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International Fund for Animal Welfare (IFAW) response to Invitation for Public Comment on Preliminary Documentation for referral 2013/6770: Bight Petroleum Pty Ltd/Exploration (mineral, oil and gas - marine)/Bight Basin/Commonwealth Marine/Lightning 3D Marine Seismic Survey (EPP-41 & EPP-42), Bight Basin, SA

Introduction

As one of the leading international animal welfare and conservation organisations, the International Fund for Animal Welfare (IFAW) works to save animals in crisis around the world. IFAW focuses its work on improving the welfare of wild and domestic animals by reducing the commercial exploitation of animals, protecting wildlife habitats and assisting animals in distress. IFAW seeks to promote animal welfare and conservation policies that advance the well-being of both animals and people.

IFAW has a particular focus on the protection of marine mammals and works around the world to protect whales and dolphins from the many threats they face today, including commercial whaling, noise pollution, ship strikes, entanglement and bycatch.

IFAW also conducts non-invasive research through our purpose built whale research vessel, *Song of the Whale*. *Song of the Whale* uses visual observations and sound to conduct whale research, having pioneered the use of passive acoustics to survey for a range of whale and dolphin species. In Australia, IFAW's work has focused on whaling by Japan in the Southern Ocean, promoting responsible whale watching and protecting whale habitat in Australian waters from threats related to offshore petroleum exploration and production, such as ocean noise pollution (from seismic surveys, construction, shipping noise), ship strikes and oil spills.

Summary

IFAW welcomes the opportunity to provide comment on the preliminary documentation provided by Bight Petroleum to assess the potential impacts of the 'Lightning' 3D marine seismic survey in lease areas EPP41 and EPP42. Comments previously submitted by IFAW to the Department regarding EPBC referral 2013/6770 are attached (Appendix 1) and this original response to the referral still stands.

IFAW would like to reiterate our concerns about this referral. Namely:

- Kangaroo Island and the surrounding marine environment are iconic and major tourist attractions in South Australia, include habitat for 28 cetacean species including sperm whales, fin and sei whales, a worldwide hotspot for beaked whales and one of only three recognised feeding areas for the endangered blue whale in Australian waters. Nonetheless, the referral and further documentation limit discussion almost exclusively to blue, southern right and sperm whales, despite the risk to other whale species vulnerable to impacts from noise pollution, and non-cetacean threatened species such as Australian sea lions that could also be affected.

- There is a severe lack of baseline data for all marine mammal species in the proposed seismic survey area. Nonetheless, from what is known, IFAW does not believe that it is possible to select a timeframe when vulnerable species are unlikely to be present in this area.

- Bight Petroleum refuses to accept the risk to marine life from seismic testing using airguns and has given no consideration to the use of alternative technology for the proposed action.

- The new measures proposed by Bight Petroleum are unlikely to substantially reduce risks to whales compared to their original proposal which was assessed as a controlled action. Minimal detail on the actual proposed mitigation measures has been provided and insufficient information for these to be quantitatively assessed in terms of risk reduction.

Having reviewed in detail the additional information provided by Bight Petroleum, IFAW remains unconvinced that the concerns raised by the Department of Environment which led to both previous referrals being deemed controlled actions have been adequately addressed.

Furthermore, as a proponent requesting EPBC approval to conduct seismic surveying, it is entirely inappropriate for Bight Petroleum to attempt to redefine Government documentation as part of this process. This is evident on several occasions within the additional information provided and ranges from Bight Petroleum proposing an SEL value to be used as a behavioural disturbance threshold for feeding blue whales, the areas *they* consider to be biologically important for certain whale species and the peak periods for these species, to continual comparisons between the Australian Government's seismic guidelines and those in other countries, despite the current application being for activities in Australian waters.

The majority of the document just repeats the personal opinions of the author which in many cases are so far out of line with international scientific thinking that they do not deserve to be taken seriously. IFAW is disappointed that the document accuses IFAW and other groups of '*blatant lies*' without giving any details to substantiate this potentially defamatory claim. We feel that the EPBC referral process is a highly inappropriate platform to make defamatory statements about concerned stakeholders. The fact that Bight Petroleum believes that describing a whale as pregnant is '*a rather emotional anthropomorphic term (probably coined by the likes of IFAW?)*' or that it is valid to compare the static pressure changes a whale experiences during a dive with sound pressure levels, are further examples of Bight Petroleum's lack of understanding of its scientific knowledge and environmental responsibilities.

Detailed comments from IFAW on the additional documentation provided by Bight Petroleum can be found below. These comments are in addition to, but in many cases reiterate, those made to the original referral, which are attached in Appendix 1.

Baseline data

IFAW firmly believes that adequate and scientifically valid baseline data should be collected ahead of any proposed industrial activity commencing in an area. The eastern Great Australian Bight (GAB) upwelling area off the coast of South Australia is severely data deficient in terms of understanding both cetacean biodiversity and oceanographic fluctuations between years. There is a severe lack of baseline data for all marine mammal species in the proposed seismic survey area and IFAW's serious concerns around the "*extensive baseline aerial monitoring programme"* conducted by Bight Petroleum are described in detail in our original referral response (see Appendix 1).

Given these concerns, IFAW was compelled to conduct the first boat-based visual and acoustic cetacean survey of the leased area, in order to gather initial baseline data on the presence, diversity and distribution of cetaceans in this poorly studied area. Despite the short length of this survey, 20 visual sightings and 60 acoustic detections of marine mammals were recorded and 1099 km (220 hours) of research effort was achieved.

Overall, the results of this survey suggest that the proposed seismic survey will be both spatially and temporally proximate to aggregations of whales including sperm whales, pilot whales and Shepherd's beaked whales, a species that may have only been previously seen alive at sea on fewer than ten occasions worldwide. Given the variable nature of the regional upwelling, both within and between seasons, the recommendation from this survey was that visual and acoustic surveys for cetaceans be conducted over multiple years. This would provide a better understanding of cetacean presence, diversity and distribution, which could then better inform future decisions around industrial development and conservation in this area.

IFAW shared a comprehensive survey report (Appendix 2) with Bight Petroleum in August 2013, yet the additional documentation provided by Bight Petroleum makes very little reference to the survey results, despite the report containing the most comprehensive information for the area during April/May. As noted in the research report, the IFAW survey provides some insight into the distribution and diversity of cetaceans found in this area but a need remains for several years of scientific data to be collected in the proposed seismic survey area. However, Bight Petroleum states that "*After consideration of the alternatives, the surveys conducted much closer to shore, the data already available and the modelling completed, it was concluded that deploying additional resources towards logging is not consistent with the project objectives outlined in section 2, nor will monitoring data provide any benefit to matters of National Environmental Significance during the Survey.*" IFAW categorically disagrees with this statement. Gathering scientific baseline data will greatly increase knowledge of the species inhabiting the area and deploying noise loggers at this stage would allow acoustic data to be collected in 2014 during the same time period of the proposed seismic survey, the year before it commences, now that it has been delayed until 2015.

In place of scientific baseline data gathered over repeated years, as would be common scientific practice, the documents instead make repeated reference to previous sightings from Marine Mammal Observers (MMOs) working on previous seismic surveys in the GAB region. This is despite the documents making clear that the Department has already informed Bight Petroleum that these are not viewed as reliable data. IFAW shares the Department's concerns about these data. They should be viewed with extreme caution. This information will be highly biased, as sightings are likely to be low due to noise input from the active seismic vessel leading to both behavioural changes and habitat displacement. Bight Petroleum cannot rely, on the one hand, on whales avoiding seismic surveys as a mitigation method, and on the other hand, try and present MMO sightings from seismic vessels as a reliable indicator of whale presence/absence in an area.

Whale distribution

According to the EPBC Act Policy Statement 2.1 (DEWHA, 2008), one of "*the most important aspects of assessing the likelihood of potential impacts on whales, is determining whether the proposed survey will have a low likelihood or a moderate to high likelihood of encountering whales*".

A moderate to high likelihood is described as "*spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important*

habitat" for whales. The proposed seismic survey area is both spatially and temporally proximate to biologically important habitat for blue whales and sperm whales (SEWPaC, 2012a), to migratory pathways for southern right whales and to likely aggregation areas for fin, sei, pygmy right, killer and beaked whales.

IFAW was surprised to find that Bight Petroleum has formulated their own table to describe expected whale presence in the seismic survey area throughout the year (Figure 4, Attachment 1). This table is completely unreferenced, with no supporting information to describe how Bight Petroleum came to their conclusions of peak occupancy months for blue, southern right and sperm whales. Therefore, IFAW does not believe the Department should take the detail in table into consideration as part of the documentation assessment.

Additionally, it is not for Bight Petroleum, as an oil and gas corporation, to determine where biologically important areas for sperm and blue whales *should* be mapped in Government documents such as the National Conservation Values Atlas and Southwest Marine Bioregional Plan. These documents are based on the best available scientific advice for the region and IFAW finds it disappointing that Bight Petroleum attempts to disagree with the key information presented by the Department.

Blue whales

Gill *et al* (2011) describe the presence of complex cross-shelf canyons in the proposed survey area as being similar to those linked to upwelling on the Bonney Coast, and propose that the nutrient-rich waters of the Kangaroo island pool influence both blue whale and krill distribution in this area. During aerial surveys conducted in 2003, blue whales were observed feeding along the outer shelf to the south and west of Kangaroo Island, confirming that the blue whale feeding ground in the south Australian region was larger than previously thought (Gill *et al*. 2011).

Blue whale presence and distribution across the upwelling system off southern Australia demonstrates high variability within and between upwelling seasons and as a result, it is highly possible that the proposed timing for seismic testing will coincide with blue whale presence in this area. Furthermore, given the lack of scientific survey effort in the proposed seismic survey area between March and May, it is not possible for Bight Petroleum to conclude that blue whales will not be feeding in significant numbers in this area. In fact, while Gill *et al.* (2011) describe a blue whale aggregation area west of Kangaroo Island in November and December, the authors stipulate that this time period "*is qualified by the fact that there was little survey coverage of this area in subsequent months*".

Furthermore, throughout Bight Petroleum's own correspondence with the Blue Whale Study (see Attachment 1), Dr Peter Gill urges caution when citing results from previous years given that so little is understood of upwelling trends and intensity, which in turn determine the seasonal presence and distribution of blue whales in the region. Despite this qualifying information, Bight Petroleum continues to insist that the peak period for blue whales in this area is November to December.

IFAW is not aware of any other published data to verify that the peak season for blue whales in this area is restricted to November to December. Knowledge of blue whale presence in the area during the January to March period is based on a very limited number of surveys funded by Bight Petroleum (one per month February-March and none in April-May). A lack of data outside of this survey effort should not be taken to imply that the likelihood of encountering blue whales is lower at these times.

The finalised Southwest Marine Bioregional Plan confirms the eastern Great Australian Bight Upwelling / Kangaroo Island canyons as one of two important areas in the south-west marine region where the blue whale aggregates to feed and, despite peaking in December, this area is

important foraging habitat for pygmy blue whales **between November and May** (SEWPaC, 2012a). Bight Petroleum attempts to suggest that the draft blue whale conservation management plan is inconsistent with this description of important habitat. The draft plan states blue whales have known feeding grounds in the "*Bonney Upwelling and adjacent waters off Victoria and South Australia*" (SEWPaC, 2012e). IFAW sees no inconsistency here, as we would suggest the term 'adjacent waters' would clearly include the extension from the Bonney Upwelling westward to the Kangaroo Island Pool and Canyons. However, we believe that for the benefit of Bight Petroleum and other stakeholders this does need clarifying by the Department.

Additionally, the EPBC Act Policy Statement 2.1 (2008) considers there to be a medium to high likelihood of encounter in areas "*spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat*". Based on this information, IFAW believes there is a moderate to high likelihood of encountering blue whales during the proposed survey period.

Southern right whales

The Conservation Management Plan for the Southern Right Whale 2011-2021 (SEWPaC, 2012b) highlights that southern right whales occupy calving/nursery grounds in Australian coastal waters **from May to October (occasionally as early as April and as late as November)**. Both offshore distribution patterns and the migratory behaviour of southern right whales in the region are poorly understood, but it is recognised in the recovery plan that habitat connectivity between calving areas is of importance to the recovery of this endangered whale species.

During May, and possibly April, the proposed seismic survey has the potential to cause avoidance behaviour by creating an acoustic barrier to migrating whales. Seismic activity could therefore alter the path of pregnant female southern right whales travelling through the survey area on their migratory route to Sleaford Bay and other known calving grounds in waters off South Australia, which could in turn have significant population effects for this species. It is for this reason that IFAW has emphasised that pregnant whales may be present in the area. There is nothing emotional about that statement, whales are either pregnant or not. However, if Bight Petroleum would prefer, we are happy to use the term *gravid*, which is the scientific term for a pregnant whale.

It is not possible for Bight Petroleum to conclude whether or not individual whales might be present. The southern right whales found in Australian waters exhibit high site fidelity, routinely returning to the same location to calve and mate (AMMC, 2009). As a result, both *gravid* females and also males seeking mates need to migrate to these biologically important locations each year and it is likely some will have to travel through the proposed seismic survey area to access these important habitats.

In place of validated scientific data, Bight Petroleum has presented southern right whale sightings information from a number of seismic surveys between the GAB and Western Tasmania. As indicated in the documents, Bight Petroleum has already been warned by the Department that these data are not reliable. IFAW reiterates that these data should be viewed with extreme caution. This information will be highly biased, as sightings are likely to be low due to noise input from the active seismic vessel leading to both behavioural changes and habitat displacement. Furthermore, the whale watching statistics included in the referral demonstrate that whales may be sighted at coastal calving grounds in April and early May, meaning that these whales would have had to transit through the seismic survey area during the proposed seismic survey timelines.

IFAW notes that the population of southern right whales in this area are from the distinct southeast population (Port Lincoln to Queensland, AMMC 2009); the population showing little evidence of increase, which is therefore more vulnerable to the impacts of noise. That Bight

Petroleum has failed to recognise that the southern right whales in this area are part of the southeast population and has gone on to discuss population trends at the Head of Bight, which represents whales from the recovering southwest population, demonstrates a lack of research and a misinterpretation of the actual trends of this population.

Given the proximity of the Sleaford Bay calving ground to the proposed seismic survey (approximately 85km), IFAW does not believe that Bight Petroleum has addressed the potential of the proposed seismic activity to negatively impact the migratory route of these southern right whales to their calving and breeding grounds. As in their previous referral, Bight Petroleum has stated that '*it is unlikely that southern right whales will be encountered during the proposed MSS*', when there is a complete lack of independent, scientific data to substantiate such a claim.

Sperm whales

During IFAW's nine-day visual and acoustic survey of the licenced area for marine mammals in April/May 2013 (IFAW/MCR, 2013), a total of seven separate acoustic detections of sperm whales were made, accounting for the detection of at least 11 individuals. Of these, 71% were made in depths greater than 1000 m. Of the seven acoustic detections, five were made during hours of darkness. In addition to these acoustic detections, three individual sperm whales were sighted on 6 May from a concurrent aerial survey over the proposed seismic survey area.

Given that IFAW shared the comprehensive report for this cetacean survey with Bight Petroleum on 12 August 2013, it was surprising to find that Bight Petroleum makes little reference to these encounters within the additional information provided for public comment. Based on data collected in suitable sperm whale habitat (waters deeper than 200 m), IFAW was able to conclude that the acoustic density estimate for sperm whales in this area was 0.72 animals per 1000 km^2. This is comparable with acoustic density estimates for other regions recognised as important sperm whale habitats; for example, 0.34 for the Hellenic Trench (south of Crete) and 1.96 for the southwest Mediterranean (Lewis *et al.*, in prep.), and 0.52 to 2.05 for the Faroe Shetland Channel off Scotland (Hastie *et al.*, 2003). These detections support the suggestion in the Action Plan for Australian Cetaceans (Bannister *et al*., 1996) that the waters to the south-west of Kangaroo Island may contain a 'concentration' of sperm whales and IFAW's study provides novel data on the distribution of this species. It is therefore concerning to find Bight Petroleum has omitted this information from the documents provided.

Additionally, Bight Petroleum states that *'Given the preferred habitats of sperm whales are waters greater than 600m deep, the sperm whale BIA [biologically important habitat] should not extend onto the shelf*'. Again, IFAW stresses that it is not the role of the proponent to try and inform the Department of where biologically important habitat should be mapped. Optimal sperm whale habitat is actually considered to be waters greater than *200 metres* deep (e.g. Amano and Yoshioka, 2003; Papastavrou *et al*., 1989; Thode *et al*., 2002; Wahlberg, 2002; Watwood *et al*., 2006; Whitehead, 2003). While the Department of Environment's SPRAT profile for sperm whales notes that these whales '*…tend to inhabit offshore areas with a water depth of 600 m or more',* this is qualified by noting that '*The habitat of the Sperm Whale is difficult to categorise due to the cosmopolitan nature of this species and its ability to inhabit all oceans'* (SEWPaC, 2012c).

The updated final version of the south-west marine bioregional plan (SEWPaC, 2012a) clearly states that sperm whales are in the area year round with the only period identified with any difference in abundance to be a peak in August-September. This is not to suggest a low likelihood of encounter at other times of year, or that a period of "medium" likelihood of encounter could be predicted. The bioregional plan also makes clear the area is defined as biologically important habitat for sperm whales (SEWPaC, 2012a).

Beaked whales

The proposed survey is within a key area for beaked whales worldwide (SEWPaC, 2012d). The Department's cetacean report card for the south west marine bioregion (SEWPaC, 2012d) further describes the occurrence of beaked whales: "*Information is limited on the ecology of beaked whales, and most information about the species group has been gleaned from stranded specimens (MacLeod & Mitchell 2006). Beaked whales are generally found in deep water offshore around seamounts and canyons. They dive for long periods and are rarely observed. South-west Australia has been listed as one of the key areas for beaked whales worldwide, particularly Hector's, Andrew's and Cuvier's beaked whales (MacLeod & Mitchell 2006), while the most common beaked whale to strand in South Australia is the strap-toothed beaked whale (Kemper 2008).*"

Furthermore, given that 6 rare Shepherd's beaked whales were sighted in the proposed seismic area during Bight Petroleum's limited aerial surveying (Figure 4 of the EPBC referral), IFAW would have expected Bight Petroleum to discuss this sighting in the referral and assess the likelihood of encountering this and other beaked whale species in the proposed seismic survey area. The sighting of this rarely-seen species in the area corresponds with the encounter of a group of Shepherd's beaked whales by IFAW during our April-May cetacean survey (IFAW/MCR, 2013) and that of Miller *et al*. (2012) further east in the Bonney Upwelling during January and March.

In fact, a protected matters search reveals that 8 species of beaked whale may occur in the proposed survey area, and there have been a number of historic sightings in and around the survey area during the months of February and March of groups of Arnoux's beaked whales (Kemper, pers. comm.). These collective sightings suggest that this area may include habitat of particular importance to a number of beaked whale species. Therefore, beaked whales should have been given greater consideration in the referral and the likelihood of impact on them assessed, particularly given the knowledge of how susceptible this group of cetaceans is to acoustic disturbance (Taylor *et al*., 2004).

Scientific understanding of seismic impacts on cetaceans

Bight Petroleum continues to dismiss the body of evidence surrounding the effects of underwater noise on marine life. In terms of input of noise energy into the marine environment, seismic surveys dominate all anthropogenic inputs. In many countries, underwater noise is now being included as a pollutant that needs to be regulated within environmental legislation e.g. within the European Union Marine Strategy Framework Directive. The report of the technical sub-group on noise addressing this for the EU notes that "*Organisms that are exposed to sound can be adversely affected both on a short timescale (acute effect) and on a long timescale (permanent or chronic effects). These adverse effects can be widespread and the European Commission decided in September 2010 that the two indicators for underwater noise be used in describing Good Environmental Status*" (Van der Graaf, 2012).

Bight Petroleum also makes the unreferenced claim that "*There are no known impacts to matters of National Environmental Significance from over 40 years of surveying with compressed air.*" This statement is false; there are a large number of studies that demonstrate sub-lethal effects of noise and so impacts can occur without reported deaths. Numerous variables may affect the nature and extent of impact, but it is clear from the literature that there are a wide range of potential impacts on cetaceans from the sounds from seismic airguns, ranging from physical trauma and injury (and suspected death) (Gray and Waerebeek, 2011), to avoidance and displacement (Richardson *et al*., 1999), reduced foraging activity (Jochens *et al.*, 2008; Tyack, 2009), reduced resting or socialising, changes in vocalisation (Blackwell *et al*., 2013), masking of vocalisations (Nieukirk *et al*., 2012), and changes in surfacing, respiration and diving cycles

(Richardson *et al.*, 1986) with resulting energetic cost, resulting in lower reproductive success or survival.

Notwithstanding these observations, observable reactions of cetaceans in response to noise are but one indication of potential impact. Even this measure may be difficult to interpret with confidence as different species will react in different ways when exposed to elevated anthropogenic underwater noise. Other effects, such as repeated interruption of feeding, habitat displacement and masking of communication are less easy to measure and assess, but may be highly detrimental to endangered and vulnerable populations (Nowacek *et al*., 2007). These should nevertheless be considered when assessing risk to marine fauna.

The research into the impacts of seismic airgun noise on marine mammals is focused on a comparatively few species which, due to their conspicuous surface and acoustic behaviour, are relatively easy to study. There are many species, however, which are more difficult to observe and detect visually and/or acoustically and therefore research on the impacts of seismic noise on these species is sparse or absent. The lack of published findings does not imply that impacts are not occurring, just that they are more difficult to observe and therefore document.

Bight Petroleum also claims that *"There are longitudinal studies in Australia showing that baleen whale populations such as humpbacks and southern right whales are increasing at close to biological maximum for the species…. This is despite, for example, seismic surveys continuing on the North West Shelf and Great Australian Bight over the same period of time. Even though blue whale populations have not been as closely studied there is no evidence that the population is under threat from acoustic disturbance".*

Firstly, as mentioned above, the southeast population of Australian southern right whales is the population that is *not* showing signs of recovery (and perhaps not coincidentally, the population that has been the most exposed to seismic activities in the last 40 years).

Secondly, for humpback whales, the Australian populations do appear to be recovering from the massive impact of whaling, but many other whale populations have not demonstrated similar recovery. The reasons for these differences are largely unknown. It is not possible to draw conclusions on the effects of noise or disturbance just based on recovery of one or two populations.

Thirdly, blue whales are listed as endangered and the draft Conservation Management Plan for the Blue Whale (SEWPaC, 2012e), lists noise interference (including seismic surveys) as one of the main threats to blue whales, and includes "*assessing and addressing anthropogenic noise*" as a "*very high priority*" action area for the pygmy blue whale. The plan also includes within its objectives, the aims to "*demonstrably minimise recognised anthropogenic threats to blue whales*" and "*maintain and improve current levels of legal and management protection*". Therefore, it is very clear, that based on the best available scientific evidence, the Department considers the blue whale population to be under threat from acoustic disturbance. Allowing this survey to proceed is completely counter to the noise-related objectives in the draft blue whale conservation management plan.

In the place of validated scientific data, Bight Petroleum has provided paragraph after paragraph of sightings information from MMOs on board active seismic vessels in an attempt to demonstrate that blue whales exhibit no behavioural disturbance as a result of seismic air gun exposure. As noted by IFAW on page 26 of our referral response (Appendix 1), Morrice *et al*. (2004, as quoted in Origin Energy Resources Limited, 2012) stress that the proximity of whales to seismic vessels must be interpreted in the context of their pressing need to consume tonnes of food per day and that these whales may need to feed in their zone of acoustic discomfort if the only krill available are in the proximity of an active seismic vessel. Similarly, the recent draft

Conservation Management Plan for the Blue Whale (SEWPaC, 2012e) states, "*a blue whale individual may continue feeding despite anthropogenic disturbance in the area if other suitable feeding areas are limited. This can give the appearance of a low effect of the threat, when in reality the threat is severely decreasing the quality of the population's habitat by introducing stressors which may affect immune system function and overall health.*"

MMO data provide a very limited set of information, which is highly biased given that sightings are likely to be skewed due to noise input from the active seismic vessel, leading to both behavioural changes and habitat displacement. Conversely, a peer-reviewed research paper found that blue whales clearly change their calling behaviour in response to noise from seismic activity and the study concluded that "*reducing an individual's ability to detect socially relevant signals could therefore affect biologically important processes. This study suggests careful reconsideration of the potential behavioural impacts of even low source level seismic survey sounds on large whales*." (Di Iorio and Clark, 2010).

Displacement from habitat as a result of noise is also likely, particularly in remote areas with historically low levels of anthropogenic noise. This is of particular concern when the impacted species is listed as endangered.

Elsewhere in the documentation Bight Petroleum makes a number of comparisons between seismic air gun noise and the sound of calving, cracking and colliding icebergs. This again demonstrates a lack of understanding and knowledge of differing underwater noise sources. Whilst it is true that whale species found in Antarctica have evolved in a high energy environment, Antarctic waters are well documented in experiencing low levels of anthropogenic noise and the acoustic environment is dominated by noise from natural sources (SCAR, 2012). It is not reasonable to compare this noise from natural sources to the sudden input of high intensity acoustic pulses every 10 seconds, 24 hours a day, for a period of months into the marine environment.

Determination of noise thresholds

The additional information includes Bight Petroleum's approach to determining a sound level threshold. Two thresholds were analysed: 120 – 140 dB re 1 µPa2.s and 160 dB re 1 µPa2s. It is not clear why the range of 140 – 160 re 1 µPa2.s has not been included, especially given that there are a number of scientific studies demonstrating behavioural change from cetaceans due to received sound levels in this rage (see, for example, Southall et al. 2007; Richardson et al. 1995; McCauley et al. 2000).

The discussion of thresholds in Bight Petroleum's document focuses on blue whales and uses western grey whale observations as a proxy. However, there is no discussion of whether this appropriate for southern right whales or sperm whales. IFAW notes that in the Statement of Reasons following the Department's controlled action decision, the Department uses bowhead whales as a proxy for southern right whale thresholds, and bowhead whales have been seen to display significant behavioural change at much lower thresholds than those of grey whales (see Richardson et al. cited by Southall et al. 2007). Bight Petroleum also acknowledges in its documentation that sperm whales have been observed to reduce foraging rates at SPL of 135-146 dB re 1uPa rms (118-131 dB SEL). In IFAW's view, these changes are neither "*very subtle*" nor "*very unlikely to have relevance to matters of National Environmental Significance such as negative impacts on individuals or populations of whales*", as suggested by Bight Petroleum.

Mitigation measures

IFAW does not believe that the new measures proposed by Bight Petroleum are likely to substantially reduce risks to whales compared to their original proposal which was assessed as a controlled action. Unfortunately, despite the lengthy new documents, there is minimal detail on the actual proposed mitigation measures and insufficient information for these to be quantitatively assessed in terms of risk reduction. Although Bight Petroleum states that '*The high standard of mitigation proposed in this survey is adequate to mitigate potential physical or behavioural impacts, and therefore the Survey is acceptable*' it is not adequate to just state this, there needs to be sufficient detail so that these claims can be properly assessed.

Specifically, while IFAW appreciates that the planned timing of the survey is chosen to avoid the highest *known* densities of blue and southern right whales, in this area it is not possible to choose a time period when vulnerable species are unlikely to be present. This is well demonstrated by IFAW's research in the area, which demonstrates at a minimum, the presence of sperm whales, beaked whales and pilot whales during April/May. Also, the proposal acknowledges (Figure 8, p.15) that if the threshold for sound exposure levels for whales at which the source would be powered down was set at less than 160dB re 1 µPa2.s then there would be a '*risk of being unable to complete the survey in the proposed operational window*'. This clearly illustrates the difficulty of safely conducting a seismic survey in this area. If sound exposure criteria used for whales in other areas were to be applied for this survey then the operator would consider it impracticable to complete. In addition, if the survey was completed but with frequent power-downs then the overall noise input would be greatly increased.

The use of four MMOs, aerial surveys, scouting vessels and PAM does *potentially* have the ability to detect a greater proportion of the whales coming within the power-down zone compared to just using MMOs from the seismic vessel. However, effective use of these data streams will be complex and much more detail needs to be provided by Bight Petroleum as to how this would be achieved (including the planned level of aerial survey effort).

Bight Petroleum also appears to rely on the assumption that all whales in the vicinity of the active seismic vessel will be sighted by the MMOs on board. This is concerning, as it demonstrates a clear lack of understanding around the limitations of employing visual observations alone when attempting to detect marine mammals. As cited by Bight Petroleum on page 7 of the referral document, 15% of all MMO sightings in the GAB and Carnarvon Basin were within 500 m. This demonstrates well the limitations of visual observations in detecting cetaceans in a timely manner, as they are frequently sighted within the zone of the highest level of sound intensity and are therefore at risk of hearing damage.

Furthermore, Bight Petroleum suggests that blue whales feeding at depth will be sighted by the MMOs on board the scout/support vessel travelling ahead of the seismic vessel well before any enter the proposed 3km power down zone. Firstly, it is not clear to IFAW how MMOs will be able to sight an animal that is feeding at depth below the surface. Secondly, Bight Petroleum is not proposing enough MMOs on board the scout/support vessel to ensure continuous 360 degree observations in daylight hours from these vessels, so the effectiveness of this mitigation method will be further reduced.

The detail on proposed mitigation methods for night-time surveying is also inadequate to enable a proper assessment of its likelihood to reduce risk to whales, both with regards to pre-night-time searching proposals and passive acoustic monitoring (PAM).

Bight Petroleum states that one of the two support vessels will "*during the last few hours of daylight each day, search the travers(s) that the survey vessel will be acquiring overnight, to ensure that there are no whales in the area*". However, no further detail is provided about the

search methods. For example, it is not clear how the support vessel will be conducting the search – there is no detail on the search design i.e. proposed area to be searched either side of the night-time traverse, the line-transects required to adequately cover the area, the ability of MMOs or other staff on the vessel to conduct such a search etc., especially if, as suggested, they will also be scouting for possible fishing equipment.

Furthermore, Bight Petroleum states that should whales (how many? Which species?) be sighted in the areas scheduled to be traversed overnight either no acquisition will commence that night or the vessel will operate in an alternative area "known to be free of whales". No information is supplied of quite how another area will be determined to be "free of whales", especially if the scout vessel is being employed to search elsewhere. Elsewhere in the documentation Bight Petroleum refers to this proposed mitigation as meaning the vessel will "*record on the less sensitive part of the survey (i.e. the deep water section)*". No evidence is provided as to why these waters are deemed to be less sensitive. In fact, and as noted by Bight Petroleum in the information, IFAW's cetacean research survey in the area found the majority of sperm whale detections were in deep waters (IFAW/MCR, 2013).

Bight Petroleum also proposes to 'trial' passive acoustic monitoring (PAM) to help detect sperm whales. Bight Petroleum claims that "*towed PAM has not been shown to be fully effective in operational mode*", and that the detection rate is inferior to visual observations, yet the use of PAM to detect sperm whales and other cetaceans is well-established in the scientific community (Gillespie, 1997; Leaper et al., 2000; Barlow and Taylor, 2005;). IFAW's own cetacean research (IFAW / MCR, 2013) in the proposed seismic area showed far superior detection rates with PAM versus visual observations. PAM is also used elsewhere in the world as a mitigation measure for seismic surveys. Therefore, IFAW cannot understand why its use should be considered a 'trial' by Bight Petroleum.

PAM relies on good reliable equipment and experienced operators. If it has not proven effective for the seismic industry, this may be due to insufficient attention to the equipment and operator training. Therefore, the additional information supplied by Bight Petroleum should have focused on what steps will be taken to ensure it is effective. Instead, there is an extremely sparse and generic description of PAM systems and no further detail about their proposed use. This gives little confidence in the likelihood of Bight Petroleum conducting a trial that is anything other than designed to fail. Much greater detail of proposed PAM use, the methodology, the equipment and training of operators is required to give confidence that this so-called 'trial' of PAM is a serious proposition.

As a further demonstration of the misunderstanding of the use of acoustics by Bight Petroleum, the additional documentation contains a discussion of Miller *et al*.'s (2012) paper about the use of sonobuoys to track blue whales, where Bight Petroleum attempts to compare visual and acoustic sightings in that paper. The use of acoustics in this instance was to locate whales in order to track and therefore increase the chances of visual sightings, therefore it is disingenuous to attempt to present a comparison between the two detection rates; one is a direct corollary of the other.

The negative comments about PAM in the proposal are symptomatic of a wider problem that effective detection of whales by either MMOs or PAM require a responsible operator to make strenuous efforts to ensure that these systems are working effectively and yet it is against the operator's commercial interests to do this. The new documentation does not provide any reassurance that Bight Petroleum is intending to make the necessary effort.

Cumulative impacts

Throughout the preliminary documentation provided, Bight Petroleum makes a number of references to the seismic survey conducted by BP in the GAB, which was approved to take place between October 2011 and May 2012. Bight Petroleum also notes that a busy shipping lane runs through the area of concern. Despite these references, Bight Petroleum has failed to recognise and assess the cumulative impacts from the noise generated by other anthropogenic activities that are spatially and/or temporally proximate to the proposed seismic survey, or of the cumulative impacts of repeated seismic surveying in biologically important habitat in repeated years.

An additional and extensive seismic survey, proposed by TGS NOPEC and covering permit blocks EPP 37, EPP 39, EPP 40, EPP 44 and EPP 45 further west in the GAB, is planned for January to June 2014 and October 2014 to the end of June 2015. This survey would therefore overlap with Bight Petroleum's proposed seismic testing in March to May 2015, yet no reference is made to the resulting cumulative impacts on whales in this region. In particular, endangered blue whales and migratory sperm whales will be subject to cumulative effects from these activities throughout much of their south Australian distribution and within biologically important habitats. Thus, the consecutive and simultaneous seismic surveys proposed for the GAB region have the potential to modify or decrease the availability and quality of the acoustic habitat for these whales. In the case of the blue whale, a recovering species that needs to feed on a regular basis, reducing the availability and quality of its acoustic habitat in one of only three foraging areas known in Australian waters could have serious consequences for the health of individuals and may result in negative population-level impacts.

So little is understood of the offshore migratory movements of southern right whales that it will be difficult to determine cumulative impacts for this species but it is reasonable to assume, given their known range and seasonal presence, that they may be vulnerable to cumulative effects from the numerous oil and gas projects inputting noise into this area. The Australian southeast population of southern right whales is a small population that is not showing signs of recovery, so may be more susceptible to the adverse effects of anthropogenic noise in important habitats and migratory routes.

Other impacts such as fisheries interactions (e.g. entanglement and bycatch), noise from shipping, exploratory drilling in the GAB (should BP's plans proceed), vessel collision risk and other anthropogenic activities within whale habitat and migratory routes in this region also need to be taken into account when considering cumulative effects.

The significance of potential cumulative impacts should not be underestimated by Bight Petroleum; indications of cumulative effects may only be evident in the long-term and this highlights the need for scientific data collection on these whale species before, during and after industrial activities. Bight Petroleum has failed to acknowledge and account for any and all of the above.

Alternative technologies

The most reliable way of reducing the scope for harm to cetaceans from seismic testing is to reduce the amount of noise input into the marine environment. This is far better than relying on uncertain or ineffective mitigation. Reducing the amount of noise can be achieved in two ways: reducing the amount of surveying or by reducing the level of noise input into the marine environment.

Not only does this referral not commit to using the minimum power of sound source needed to achieve the results i.e. '*The precise sound source and precise number of streamers to be deployed will depend on the capacity of the survey vessel (which is yet to be contracted)*.', the documentation provided does not even attempt to demonstrate that Bight Petroleum has given real consideration to the use of quieter technologies as an alternative to air guns.

New and emerging technologies, such as marine vibroseis, are non-impulsive, with lower peak pressure and a slower rise time. These features mean that marine vibroseis has the potential to reduce the environmental impacts of noise generated during marine seismic surveys. Such technologies therefore offer an alternative to air guns, which remain largely unchanged in their design since the 1960s.

Sensitive habitats, like those of the Kangaroo Island canyons and pool, provide the right kind of opportunities to trial such alternative technologies which are currently under development (see Weilgart, 2010). Bight Petroleum mentions that a letter of intent was originally issued to the seismic company PGS to conduct the proposed seismic survey. IFAW notes that PGS is one of the companies currently developing a vibroseis prototype that could be utilised in this sensitive marine environment.

The preliminary documentation provided should have included explanations of alternatives to airguns that had been considered by Bight Petroleum, so that the Department could review these.

In areas of important biological habitats for cetaceans alternative technologies should be used by companies to reduce the risk of impact. That Bight Petroleum has provided no information on plans to optimise the technology being proposed, nor the use of alternative technologies, raises doubts as to whether there is a genuine intent to mitigate impact as much as possible. In such situations IFAW believes it is appropriate for regulators to impose noise limits if necessary, or insist on the use of alternative technologies, as has been the case in the Gulf of Mexico, following settlement of litigation in the US courts (see Natural Resources Defense Council Inc., *et al*., v. S.M.R. Jewell, Sec. Dept. Interior, *et al*., United States District Court for the Eastern District of Louisiana, DC: 4861376-1).

Attachments:
Appendix 1: IFAW response EPBC Act referral 2013/6770
Appendix 2: IFAW/MCR cetacean survey report
Appendix 3: Great Australian Bight proposed petroleum activities map

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Appendix 1 – IFAW response EPBC Act referral 2013/6770

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International Fund for Animal Welfare (IFAW) response to Invitation for Public Comment on referral 2013/6770: Bight Petroleum Pty Ltd/Exploration (mineral, oil and gas - marine)/Bight Basin/Commonwealth Marine/Lightning 3D Marine Seismic Survey (EPP-41 & EPP-42), Bight Basin, SA

Introduction

As one of the leading international animal welfare and conservation organisations, the International Fund for Animal Welfare (IFAW) works to save animals in crisis around the world. IFAW focuses its work on improving the welfare of wild and domestic animals by reducing the commercial exploitation of animals, protecting wildlife habitats and assisting animals in distress. IFAW seeks to promote animal welfare and conservation policies that advance the well-being of both animals and people.

IFAW has a particular focus on the protection of marine mammals and works around the world to protect whales and dolphins from the many threats they face today, including commercial whaling, noise pollution, ship strikes, entanglement and bycatch.

IFAW also conducts non-invasive research through our purpose built whale research vessel, *Song of the Whale*. *Song of the Whale* uses visual observations and sound to conduct whale research, having pioneered the use of passive acoustics (listening for the sounds whales and dolphins make) to survey for a range of whale and dolphin species. In Australia, IFAW's work has focused on whaling by Japan in the Southern Ocean, promoting responsible whale watching and protecting whale habitat in Australian waters from threats related to offshore petroleum exploration and production, such as ocean noise pollution (from seismic surveys, construction, shipping noise), ship strikes and oil spills.

Summary

IFAW welcomes the opportunity to comment on Referral 2013/6770 from Bight Petroleum regarding their plans to conduct the 'Lightning' 3D marine seismic survey in lease areas EPP41 and EPP42.

Kangaroo Island is an iconic and major tourist attraction in South Australia. The island and the marine life in surrounding waters are a vital resource for South Australian communities on the Island and the Eyre Peninsula. The proposed seismic survey covers an upwelling area where the Kangaroo Island Pool and Canyons are located; these are highly productive and biologically important marine features, with a huge diversity of marine species. The Kangaroo Island Pool and Canyons are a key ecological feature and a conservation value of regional priority in the south-west marine bioregional plan (SEWPaC, 2012c). The area is important habitat for 28 cetacean species including sperm whales, fin and sei whales, a worldwide hotspot for beaked whales, and one of only three recognised feeding areas for the endangered blue whale in Australian waters. The area also contains huge aggregations of southern bluefin tuna and attracts Australian sea lions, New Zealand fur seals, great white sharks and seabirds to feed.

The proposed timeframe of the seismic survey overlaps with likely presence of a wide range of cetaceans including threatened and migratory species (see sections 2.3 and 3). The referral uses

inaccurate and misleading statements to suggest the likelihood of encounter is low for a number of species and an extremely sparse dataset to justify the proposed timeframe. As such, the referral has not adequately assessed the likely abundance or distribution of whale and dolphin species in the region and therefore has failed to demonstrate that the survey will not risk a significant impact on these animals.

According to the EPBC Act Policy Statement 2.1 (DEWHA, 2008), one of "*the most important aspects of assessing the likelihood of potential impacts on whales, is determining whether the proposed survey will have a low likelihood or a moderate to high likelihood of encountering whales*". A moderate to high likelihood is described as "*spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat*" for whales. The survey area is both spatially and temporally proximate to biologically important habitat for blue whales and sperm whales (SEWPaC, 2012c), to migratory pathways for southern right whales and to aggregation areas for fin, sei, pygmy right, killer and beaked whales, all of which are likely to be feeding in the area (see section 3).

The referral relies heavily on data from what Bight Petroleum claims was a five-month monitoring programme, but in fact only covered five days (one day a month in Nov, Dec and Mar, two days in Feb and none in either Apr or May) and only one day of the proposed survey period (Mar-May). The Blue Whale Study report (BWS, 2012) for this monitoring programme, since released by Bight Petroleum, actually highlights that it is impossible to predict the occurrence of blue whales each year as there is considerable variability between seasons, but that the area covered by EPP41 and EPP42 has the potential to be prime blue whale feeding grounds. The Blue Whale Study report also stresses the importance of this area to a diverse range of cetaceans, stating that in addition to blue whales, sightings of fin whales, sperm whales, Shepherd's beaked whales, pilot whales, killer whales, Risso's dolphins, common dolphins and bottlenose dolphins highlight the variety of the cetacean species assemblage of the shelf and slope ecosystems in this region.

The referral also contains factual errors (e.g. about sperm whale presence (see section 3), passive acoustic monitoring (see section 4)) and a general refusal to accept the risk of seismic testing on marine life, despite the issue of noise pollution being highlighted by key international bodies such as the International Whaling Commission, the Convention on Biological Diversity and the European Union Marine Strategy Framework Directive (see section 2.6).

Bight Petroleum gives no consideration in the referral to the use of quieter, alternative technologies to airguns. Such alternatives should have been considered in an area of high conservation value, and regulators should impose noise limits if necessary. Bight Petroleum's sound modelling shows the transmission of sound at high energy levels across considerable distance in the survey area, particularly in deeper waters (see section 2.2).

The referral cites a considerable number of concerns raised by the Kangaroo Island community during the stakeholder consultation period for the previous 'Lightning MSS' referral (2012/6583) and the Department received over 3,000 campaign letters and 632 other public submissions in response to the proponents previous referral, highlighting the high levels of public concern over this proposal. By withdrawing their original referral and resubmitting as a new referral, the proponent has avoided the 30-day public comment period that would have been required by the Department's previous decision.

The mitigation methods proposed by Bight Petroleum are inadequate to protect whales from the risk of harm (see section 4). The visual monitoring regimes proposed are inadequate to ensure continuous, 360 degree observations in an area where the likelihood of encountering a number of species is high. Only one aerial survey is proposed prior to seismic testing commencement. This is not adequate for an operation scheduled to last for 70 days. Also,

inaccurate claims are made about passive acoustic monitoring (PAM) and while the proponent has conceded to a 'trial' of PAM, they are highly dismissive of this mitigation measure. This gives little confidence in the likelihood of the proponent conducting a trial that is anything other than designed to fail. Consequently, the Department should insist that the proponent provide full details of the methodology they will employ to carry out passive acoustic monitoring of cetaceans during the proposed seismic survey to reassure the Department and stakeholders that this is a serious proposition.

The referral displays a lack of objective judgement and lacks information critical to determining the potential for impact on matters of National Environmental Significance (NES). The Department's significant impact guidelines (DEWHA, 2009) state a self-assessment should be "*as objective as possible and based on sufficient information to make an informed judgement*". This referral fails on both accounts. Its use of inaccurate, selective and misleading referencing regarding mitigation is not an objective assessment (see section 4). It lacks data to substantiate presence/absence of cetaceans (and other species) in the region during the timeframe of the proposed action (see sections 2.3 and 3). Therefore, insufficient information has been presented to allow a decision to be made on whether the proposed action is likely to have a significant impact on the matters of NES including the marine environment, cetaceans and other listed threatened species.

The information provided in the referral fails to address the serious concerns raised by the Department in the 'controlled action' decision on the previous referral submitted by Bight Petroleum (2012/6583):

- While Bight Petroleum has proposed an end date of the 17 May for seismic operations, there is still the possibility of the survey impacting upon heavily pregnant southern right whales migrating through the offshore area to their calving grounds on the coast. Bight Petroleum's attempts to use previous sightings data from seismic surveys and opportunistic coastal sightings to deny the likely presence of southern right whales are no proxy for proper scientific survey effort in the proposed seismic testing area. Bight Petroleum also confuses whales likely to be in this area as belonging to the recovering south west population, whereas they are in fact likely to be from the south east population that is not showing signs of recovery, making it far more susceptible to impacts from noise pollution.
- Bight Petroleum continues to downplay the likelihood of encountering blue whales in the survey area, both misrepresenting the conclusions of the Blue Whale Study report it commissioned and misunderstanding the recently released draft Conservation Management Plan for the Blue Whale. The South west Marine Bioregional Plan makes it abundantly clear that the area is important *feeding habitat* for blue whales from November to May. It is perturbing that Bight Petroleum, on the basis of one day of survey effort in the proposed area at the proposed time of year and on speculative and unreferenced claims about blue whale habitat use, suggests a superior knowledge than the collective efforts of the many scientists and specialists that contributed to the marine bioregional plan. Furthermore, Bight Petroleum refuses to consider further aerial surveying or acoustic detection methods to improve the chances of detecting blue whales in the area.
- Bight Petroleum repeatedly attempts to suggest sperm whales are the 'least affected species' by seismic surveys yet there is documented evidence of reduced foraging activity by sperm whales in proximity to seismic surveys, and this survey is due to take place in recognised sperm whale foraging habitat. The dismissive language of Bight Petroleum towards the use of Passive Acoustic Monitoring (PAM) to aid sperm whale detection gives little confidence that Bight Petroleum is committed to the trial of PAM it has stated it will carry out, but is rather suggesting this as a tick box exercise to get its approval.

- Most fundamentally, discussions of noise modelling and impacts throughout the referral are constantly and solely focused on received sound levels that cause hearing damage in whales. Yet, in an area of biologically important habitat for a range of species this is not the only issue that must be considered. Displacement of animals from critical habitat and the extent to which this occurs is recognised as an even greater concern than physiological impacts. The effects of biologically important habitat becoming unavailable to species are likely to be detrimental and the referral fails to address this most fundamental issue.

On the basis of the above, IFAW remains convinced that "*there is a real chance or possibility*" (significant impact guidelines, DEWHA 2009) that the proposed action would have a significant impact on threatened species, migratory species and the Commonwealth marine environment (see sections 3 and 5). The proposed action is:

- likely to "reduce the area of occupancy" and "adversely affect habitat critical to the survival of" endangered blue whales;
- may "disrupt the breeding cycle" of endangered southern right whales;
- likely to "modify an area of important habitat" and "disrupt the lifecycle (feeding)" of sperm whales;
- may "disturb an important or substantial area of habitat such that an adverse impact on the marine ecosystem functioning or integrity in a Commonwealth marine area results" and have a "substantial adverse effect on a population of cetaceans including its life cycle (feeding) and spatial distribution".

On the basis of the inadequacies identified in this referral, which are fully outlined and referenced below, and in particular, Bight Petroleum's failure to properly address the concerns outlined by the Department in response to the previous referral, IFAW believes the proposal should be rejected outright. At the very minimum, the Department should refuse any request to conduct exploration until scientific data has been collected, validated, peer reviewed and published, regarding use of the proposed survey area by a range of cetacean and other listed species at the time of year for which the action is proposed. As Minister Burke stated regarding the super trawler "environmental decisions should be based on sound science and quality information".

At the very least, the proposed action should be deemed to be a 'Controlled Action'; this way the proposal can be assessed by environmental impact statement (EIS) or public environment report (PER), whereby the proponent should be required to gather the kind of information that is lacking, and publish all relevant data in the referral for public and scientific scrutiny. This would allow residents of Kangaroo Island, Port Lincoln and other regional communities along the South Australian coast which depend on this highly productive marine environment to have a proper say.

IFAW's full comments below are organised to correspond to the respective sections of the referral document and include headings and/or page number references for larger sections.

2.2 Alternatives to taking the proposed action

As with their previously submitted referral for this seismic survey (2012/6583), Bight Petroleum states under this section: "*There are no feasible alternatives to undertaking the proposed action which enables sub-surface geological mapping to be undertaken*."

The most reliable way of reducing the scope for harm to cetaceans from seismic testing is to reduce the amount of noise input into the marine environment. This is far better than relying on

uncertain or ineffective mitigation. Reducing the amount of noise can be achieved in two ways: reducing the amount of surveying or by reducing the level of noise input into the marine environment.

The former option is limited by the work program requirements of the exploration permits which require 3D seismic surveying as part of the lease conditions. However, there is no indication given in the referral as to whether or not Bight Petroleum has given any consideration to the possibility of reducing the source noise levels for these surveys. This can be done by to reducing unnecessary acoustic energy through array, source, and receiver design optimisation. Seismic airguns produce broad-band acoustic energy (>200Hz) and in directions (both horizontal and vertical to the plane of interest) that are not of use for the purpose of sub-sea geophysical profiling. This 'waste' energy is low frequency noise and is therefore most likely to have negative impacts on baleen whales, such as displacement from critical habitat.

Sensitive habitats, like those around the Kangaroo Island canyons and pool, provide the right kind of opportunities to trial the use of alternative, quieter seismic technology to airguns on a commercial-scale. There are a number of alternatives to airguns for seismic surveying under development, such as marine vibroseis (see Weilgart, 2010). In many biologically important habitats, but especially those critical to species with mid- to high-frequency hearing (e.g. sperm whales and beaked whales), marine vibroseis offers an environmentally favourable alternative to air guns. As marine vibroseis suppresses high frequency signals and uses signals of low peak pressure, negative biological impacts to odontocetes would be greatly reduced by using this technology. A recent workshop held by the Bureau of Ocean and Energy Management highlighted a lack of willingness from industry to trial alternative technologies and the need for regulators to incentivise the use of quieter technologies in order to reduce the environmental impact of seismic surveying (BOEM, 2013). The referral should have included explanations of alternatives to airguns that had been considered by the proponent so that the Department could review these options.

In areas of important biological habitats for cetaceans alternative technologies should be used by companies to reduce the risk of impact. That Bight Petroleum has provided no information on plans to optimise the technology being proposed nor the use of alternative technologies, in this section or section 4, raises doubts as to whether there is a genuine intent to mitigate impact as much as possible.

Therefore, IFAW encourages the government and regulators to impose noise limits and conditions requiring the use of quieter technologies in sensitive areas, to give the necessary impetus to further commercial development of alternative technologies to airguns that would introduce less noise into the marine environment.

2.3 Alternative locations, time frames or activities that form part of the referred action

IFAW recognises that the most effective way to mitigate the effects of seismic surveys on vulnerable species is to conduct the surveys when the species are not present in the area. However, in this instance such an approach is impossible due to the varying presence throughout the year of a range of cetacean species. It is therefore inevitable that the timeframe proposed by Bight Petroleum overlaps with significant EPBC listed species presence.

Bight Petroleum incorrectly asserts starting the survey "at sometime [*sic*] after 1st March 2014" will avoid the presence of sperm whales in the area. As the Department's South-west Marine Bioregional Plan states (SEWPaC, 2012c), sperm whales are "*known to occur in waters along the shelf break of the eastern Great Australian Bight and waters to the south of Kangaroo Island and*

are presumed to be foraging in these areas. ***They are not seasonal: they can be encountered at any time during the year****."* [Emphasis added].[1]

Bight Petroleum also asserts that the timing of the survey will avoid "*peak periods when the blue whale may be present*", referencing non-peer reviewed work by the Blue Whale Study Inc. IFAW is concerned that the whale sighting survey data on which this timing assertion has been made is based on a very limited number of aerial surveys at this time of year funded by Bight Petroleum (one day in March and none in April or May).

The lack of data outside of this survey effort should not be taken to imply that blue whales do not occur in this area at these times. As noted by The Blue Whale Study in their report to Bight Petroleum, the proposed seismic survey area has "*the potential to be prime blue whale feeding grounds"* and that the intensity of the upwelling which determine these feeding seasons is not entirely predictable and it is very possible that the survey timing will coincide with blue whale presence in the area (BWS, 2012). It is significant that Bight Petroleum have failed to include these conclusions in their referral documentation.

It is well understood that blue whale migration paths and aggregation patterns are dynamic and shift according to prey availability. As there has been such limited scientific survey effort conducted in the area in the months of March to May, IFAW does not believe it is accurate to conclude that the seismic survey timing would avoid "peak periods" of blue whale presence in the area.

IFAW also does not believe it is accurate for Bight Petroleum to assert definitively that the timing will avoid southern right whale presence in the area, as the survey is scheduled to extend until possibly the 17th May. As no published scientific data exists for surveys conducted for southern right whales in the proposed seismic survey area, it is not possible to conclude whether or not individuals might be present. During May (and possibly April), the proposed seismic survey has the potential to alter the path of heavily pregnant female southern right whales travelling through the survey area on their migratory route to Sleaford Bay and other known calving grounds in waters off South Australia.

Further discussion of whale presence in the area is detailed in section 3 below.

Given the relative lack of scientific certainty about temporal and spatial distribution of a number of whale and dolphin species for which the area is biologically important, IFAW believes, at a minimum, Bight Petroleum should be required to fund sufficient, independent and publicly available scientific survey effort in the region at that time of year, over repeated years, to confirm the likely presence/absence of blue whales and other cetaceans in the region before any seismic surveying is allowed to proceed.

2.6 Public consultation

IFAW has not been consulted with by Bight Petroleum in reference to the new proposed dates, detail and information in the current referral.

In the original referral submitted by Bight Petroleum (2012/6583), which was declared a controlled action, IFAW exchanged correspondence with Bight Petroleum on their survey plans on two occasions and met with the consultant employed by Bight Petroleum on one occasion. In those communications IFAW has stressed that we would prefer not to see the area explored given its importance to a variety of cetacean species. However, given the proponent's intention to proceed, IFAW also stressed the difficulty of avoiding cetacean presence throughout the year,

[1] Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) (2012), Marine bioregional plan for the South-west Marine Region. Australian Government: Canberra, p.173

reducing noise input and suggested enhanced mitigation measures such as aerial and vessel based surveys for whales and krill. Mitigation measures are discussed further in section 4 below.

IFAW also asked to see the data relating to what Bight Petroleum claimed was a five-month survey in the region. This information was not forthcoming during the original consultation period, but has since been obtained by IFAW under Freedom of Information law and latterly posted on the proponent's website. This report (BWS, 2012) reveals that in fact only one day of survey effort has taken place during March, with no effort at all in April or May and is not in any way "*an extensive baseline aerial monitoring programme*" as suggested by Bight Petroleum in its correspondence with IFAW.

IFAW also requested to remain consulted and see a draft of the sections relevant to measures to reduce risk to cetacean of Bight Petroleum's Environment Plan to be submitted to NOPSEMA under oil and gas legislation requirements. IFAW has yet to have any further consultation with Bight Petroleum or see any parts of a draft Environment Plan.

Therefore, IFAW does not feel that Bight Petroleum has "*consulted extensively with stakeholders*" as they claim in their referral. Section 2.6 also dismisses comments from environmental NGO's and the Greens political party in a single sentence claiming they are associated with the comments received from the Kangaroo Island community. While some of the points were similar, those covered in the referral do not cover all the points IFAW raised, and IFAW sees no reason why our comments or those of other environmental NGOs should be so readily dismissed when concerns of Kangaroo Island residents and local fishing communities are given more detailed acknowledgement (if still inadequate consideration) in the referral. Likewise, Bight Petroleum clearly has no intention of continuing consultation leading up to, during and after the MSS period with IFAW in the same way it intends to continue consultation with the fishing industry.

IFAW is also concerned by a number of inadequate or misleading responses in this section by Bight Petroleum to concerns raised by stakeholders during the consultation process.

On page 6 Bight Petroleum claims "*there is no significant evidence of lethal and sub-lethal impacts" of seismic exploration carried out in the natural environment with acoustic pulses generated from compressed air, especially when key mitigation procedures such as survey timing, soft starts (ramp-ups) and the "stand-off" factor of the source itself are in place*."

This statement shows a lack of understanding of the body of evidence of the effects of underwater noise on marine life. In terms of input of noise energy into the marine environment, seismic surveys dominate all anthropogenic inputs. In many countries, underwater noise is now being included as a pollutant that needs to be regulated within environmental legislation. For example, within the European Union Marine Strategy Framework Directive. The report of the technical sub-group on noise addressing this for the EU notes that "*Organisms that are exposed to sound can be adversely affected both on a short timescale (acute effect) and on a long timescale (permanent or chronic effects). These adverse effects can be widespread and the European Commission decided in September 2010 that the two indicators for underwater noise be used in describing Good Environmental Status*" (Van der Graaf, 2012).

Concerns over effects of seismic surveys have also been expressed by the Convention of Migratory Species (CMS), the United Nations (U.N. General Assembly (UNGA) and U.N. Convention on the Law of the Sea (UNCLOS)), the International Union for Conservation of Nature (IUCN), the International Maritime organization (IMO), the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic and the Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM) and by the International

Whaling Commission (IWC) (CBD, 2012). In 2004 the IWC Scientific Committee noted that it "*views with great **concern** the impacts on large whales in critical habitats from exposures to seismic sounds impulses*". In addition the Committee also "***agreed** that evidence of increased sounds from other sources, including ships and seismic activities, were cause for serious concern*" (JCRM Suppl. 2005, Report of the Scientific Committee).

In contrast to these conclusions by key international organisations, it is of concern that Bight Petroleum continues to deny the potential for seismic surveys to impact the marine environment. For example, on p.39 it is argued that it is "*implausible*" that the energy level arriving at a deep diving sperm whale from a seismic source "*will have any impact on the animal*". This suggests the need for the regulatory authorities to update the operator on the potential for environmental impacts before any actions take place so that a more realistic assessment of the impacts can be provided.

Also on page7, Bight Petroleum claims: "*Towed PAM has not been shown to be fully effective in operational mode*".

Towed PAM has been demonstrated to be effective in detecting some species and especially for sperm whales (Gillespie, 1997; Leaper *et al*., 2000; Barlow and Taylor, 2005). However PAM relies on good reliable equipment and experienced operators. If it has not proven effective for the seismic industry, this may be due to insufficient attention to the equipment and operator training. More effective use of PAM could be promoted with the establishment of a workshop of experts to discuss ways in which this can be implemented effectively and reliably during seismic surveys. There is currently no incentive for the seismic operator to ensure that PAM gear is properly functional because acoustic detections may cause delays and additional expense.

Bight Petroleum goes on to claim: "*sperm whales have been shown to be the least impacted by seismic (Stone 2003)*".

The report by Stone (2003) is referred to several times within the document and this seems to form much of the basis for the arguments put forward by Bight Petroleum. This is an unpublished report from observations by observers working on seismic surveys in the UK between 1998 and 2000. The key weaknesses with these data are that they are only an indication of whale behaviour at the surface and reveal nothing of other effects. This point is noted by Stone: "*Other potential effects of seismic activity remain largely unknown, for example long-term effects, effects on vocalisations, social behaviour and physiology, consequences of auditory masking and the potential for damage to hearing. It is essential, therefore, that the precautionary guidelines to minimise disturbance continue to be applied*" (Stone, 2003).

Subsequent studies have concluded that seismic surveys may affect sperm whales (Jochens, 2008) through reduced foraging rather than horizontal displacement. Currently there is insufficient understanding of the effects of seismic on sperm whales to conclude that this species is the least impacted. The potential for noise pollution to cause stress in whales is especially difficult to determine but has been demonstrated in a recent study of North Atlantic right whales (Rolland *et al*., 2012).

In this paragraph, Bight Petroleum also claims "*there is a low likelihood of encountering more than a very small number of beaked whales*". However, the sightings of beaked whales made in the survey area during Bight Petroleum's commissioned work by the Blue Whale Study were highly exceptional, as they were of a group of 6 extremely rarely sighted Shepherd's beaked whales. This information is highly significant as "*fewer than 10 sightings of this species have been authenticated worldwide*" (BWS, 2012) and it is well documented that beaked whales are highly susceptible to noise pollution (e.g. Cox *et al*., 2006; Pirotta *et al*., 2012). That Bight Petroleum omitted the inclusion of these details in the referral and did not share this information with

stakeholders is significant and raises further questions as to the transparency of their stakeholder engagement process.

In the response in paragraph 5, page 7 regarding the detection of marine mammals, Bight Petroleum refers to "*a recent (unpublished) study of MMO sighting reports from the GAB and Carnarvon Basin*." This is an unpublished document (in this instance written by the referral's author) which has not been made publicly available or attached to the referral in order to allow peer review or independent analysis.

Furthermore, the one paragraph summary given of the study in this section appears to confuse the first time of sighting of a marine mammal with conclusions on the direction in which the mammal was heading. Without seeing the paper concerned it is impossible to say whether this is a misinterpretation of the data (for example, did the sightings data record direction of travel of the mammals sighted versus direction of travel of the seismic vessel) or simply a confusing presentation of the data.

The only conclusion that can be made from the figures presented here is the extent to which visual observations are limited as a means of mitigation, given that 15% of whales were not sighted until they were within the shut-down zone (within 500m of the source).

IFAW also notes that "*Bight is currently following up on the opportunity to become a sponsor of the project "Impacts of Modern Seismic Sources on Temperate Marine Species - Rock Lobster (Family: Palinuridae)" being planned by IMAS (Institute for Marine and Antarctic Studies, Fisheries, Aquaculture & Coasts Centre, University of Tasmania) with potential funding from FRDC and the petroleum industry*" (page 8). It is disappointing that Bight Petroleum is not offering to sponsor any research related to the impacts of the proposed survey on cetacean species in the region, particularly given the region's importance to such a wide range of cetacean species (at least 28 according to a search of the protected matters database).

3 Description of the environment
3.1 (d) Listed threatened species and ecological communities
Mammals
Blue whale
Gill *et al* (2011) describe the presence of complex cross-shelf canyons in the proposed survey area as being similar to those linked to upwelling on the Bonney Coast, and propose that the nutrient-rich waters of the Kangaroo island pool influence both blue whale and krill distribution in this area. During aerial surveys conducted in 2003, blue whales were observed feeding along the outer shelf to the south and west of Kangaroo Island, confirming that the blue whale feeding ground in this region was larger than previously thought (Gill *et al*. 2011).

Bight Petroleum repeatedly states that the months of November to December are the key months for blue whale presence in the proposed survey area. However, the upwelling system that determines blue whale feeding seasons is not entirely predictable and it is very possible that the survey timing in 2014 will coincide with blue whale presence in the area. There has been very little scientific survey effort conducted in the area in the months of March to May to conclude that blue whales will not be present in significant numbers. The vast majority of survey effort in the region for blue whales has been conducted by Peter Gill and Margie Morrice of the Blue Whale Study Inc. and while the work by Gill *et al.* (2011) indicates a blue whale aggregation area west of Kangaroo Island in November and December, the authors point out that this time period "*is qualified by the fact that there was little survey coverage of this area in subsequent months*".

Bight Petroleum suggested in a letter to IFAW dated 4 May 2012 that they had carried out "*an extensive baseline aerial monitoring programme in conjunction with experienced researchers and*

observers over a 5 month period to gain a better understanding of cetacean activity, and blue whales in particular, along the entire coast between Portland and the head of the Great Australian Bight near Ceduna". On review of this non peer-reviewed study, IFAW found that this "monitoring programme" was in fact only one day a month of survey effort in the proposed seismic area over the five month period, with no survey effort at all for the months of January, April or May. IFAW does not consider this to be "extensive" nor sufficient to provide a baseline from which Bight Petroleum or the Department can make judgements about cetacean presence and abundance in the region. Furthermore, it is not possible for this 'snapshot' to measure any temporal or spatial variability in cetacean activity and this is particularly true for the blue whale, given the variable nature of habitat use by this species.

On page 11, Bight Petroleum refers to a map depicting cetacean sightings for the surveys completed on their behalf by the Blue Whale Study (Figure 4). This map actually highlights the importance of this whole region to a diverse range of cetacean species. Blue whales were sighted across a large proportion of the study area, despite the very limited hours of survey effort in this program.

Additionally, the November and December encounter rates in the eastern GAB and south of Kangaroo Island to which Bight Petroleum eludes (Gill & Morrice, 2011) come from a skewed dataset, as a large majority of the survey effort in this region actually took place in the month of December, with very little during the other months mentioned.

As in the original referral, Bight Petroleum state on page 12 that "*…the January-March period …has a lower likelihood of encounter in the eastern GAB upwelling area due to the fact it appears to have an earlier season (November-December)*". Given the proposed seismic survey dates of March to May, it would appear that Bight Petroleum have not given full consideration to the new survey dates proposed in this referral, as no mention is made of April and May. Furthermore, IFAW contests this statement, as there is no published data to verify that the peak season for blue whales in this area is restricted only to November-December. As mentioned above, knowledge of blue whale presence in the area during the January to March period is based on a very limited number of surveys funded by Bight Petroleum (one per month February-March and none in April-May), and the lack of data outside of this survey effort should not be taken to imply that the likelihood of encountering blue whales is lower at these times.

Additionally, Bight Petroleum references the *draft* marine bioregional plan for the south-west marine region, stating that "*there is a low likelihood of encounter during the months January-March and May-October*". In fact, the finalised Southwest Marine Bioregional Plan confirms the Eastern Great Australian Bight Upwelling / Kangaroo Island canyons as one of two important areas in the south-west marine region where the blue whale aggregates to feed and, despite peaking in December, this area is important foraging habitat for pygmy blue whales **between November and May** (SEWPaC, 2012e). Additionally, the EPBC Act Policy Statement 2.1 (2008) considers there to be a medium to high likelihood of encounter in areas "*spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat*". Based on this information, IFAW believes there is actually a moderate to high likelihood of encountering blue whales during the proposed survey period of March to May.

Bight Petroleum states "*it should be noted that they are more likely to be migrating through the area than feeding in the area during the April timeframe*". This statement is completely unsubstantiated and such unsupported statements about blue whale habitat use in the area during different months are highly misleading. Again, given the highly mobile nature of blue whales and the annual variability of the both the upwelling systems and krill distribution, it is not possible to predict blue whale occurrence during 2014 and for this reason, blue whales may be found feeding anywhere in the region during these months.

Southern right whale
The Draft Southern Right Whale Recovery Plan 2011-2016 (SEWPaC, 2012a) highlights that southern right whales occupy the calving/nursery grounds in Australian coastal waters **May to October**, despite Bight Petroleum misleadingly 'quoting' that they are present between mid-May and mid-November.

As no published scientific data exists for surveys conducted for southern right whales in the proposed seismic survey area, it is not possible to conclude whether or not individuals might be present. During the latter part of the proposed survey period (late April and May), the proposed seismic survey has the potential to alter the path of heavily pregnant female southern right whales travelling through the survey area on their migratory route to Sleaford Bay and other known calving grounds in waters off South Australia.

In place of validated scientific data, Bight Petroleum has presented southern right whale sighting information from a number of seismic surveys between the Great Australian Bight and Western Tasmania. IFAW urges the Department to review these data with extreme caution. This information will be highly biased, as sightings are likely to be low due to noise input from the active seismic vessel leading to both behavioural changes and habitat displacement. Furthermore, the whale watching statistics included in the referral demonstrate that cow-calf pairs may be sighted at coastal calving grounds in April and early May, meaning that these whales would have had to transit through the seismic survey area during the proposed seismic survey timelines.

Although no research has been conducted to verify the migratory patterns of southern right whales through the survey area, it is recognised in the Southern Right Whale Recovery Plan 2005-2010 (DEH, 2005a) and the draft Conservation Management Plan for the Southern Right Whale 2011-2016 (SEWPaC, 2012a) that habitat connectivity between calving areas is of importance to the recovery of this endangered whale species. If seismic activity causes avoidance behaviour during migration, it is possible that such activity will create an acoustic barrier to migrating pregnant females, which could in turn have significant population effects for this species.

Furthermore, the population of southern right whales in this area are from the distinct southeast population (Port Lincoln to Queensland, AMMC 2009); the population showing little evidence of increase, which is therefore more vulnerable to the impacts of noise. That Bight Petroleum have failed to recognise that the southern right whales in this area are part of the southeast population and have gone on to discuss population trends at the Head of Bight, which represents whales from the recovering southwest population, demonstrates a lack of research and a misinterpretation of the actual trends of this population.

Given the close proximity of the Sleaford Bay calving ground to the proposed seismic survey (approximately 85km), IFAW does not believe that Bight Petroleum have addressed the potential of the proposed seismic activity to negatively impact the migratory route of these southern right whales to their calving and breeding grounds. As in their previous referral, the proponent has stated that '*it is unlikely that southern right whales will be encountered during the proposed MSS*', when there is a complete lack of data to substantiate such a claim.

Fin whale
While fin whales, listed as vulnerable, have been sighted in the survey area on previous occasions, documented distribution, abundance and habitat use for fin whales is lacking due to lack of scientific surveying in this area. This should not be taken to imply that these whales do not occur in the survey area, or whether or not this area is biologically important habitat. IFAW does not consider it sufficient for Bight Petroleum to assume the peak encounter period for fin

whales in the proposed survey area is outside of the timing of the seismic survey without any evidence to the contrary. Likewise, assuming that the likelihood of encounter with this species is low is a statement based on no research or baseline data for the area.

Sei whale
Bight Petroleum recognises that sei whales, listed as vulnerable, have been sighted feeding in the Bonney Upwelling between December and April and that the movement and distribution of the species is unpredictable and not well documented (DEH, 2009). Again, without any scientific survey effort in the proposed seismic survey area to assess sei whale activity, it is impossible for the proponent to predict the likelihood of an encounter with this species as being 'low'.

Australian sea lion (Pinniped)
Two of the main Australian sea lion breeding colonies are located on Kangaroo Island (Seal Bay and Seal Slide) and the Seal Bay population are known to be in decline (Goldsworthy *et al*. 2008). Bight Petroleum acknowledges that the seismic survey is likely to encounter male Australian sea lions in the survey area, but makes no mention of the nursing female Australian sea lions that will also be foraging in the area. Nursing females need to feed at sea and subsequently return to nurse their pups. Seismic activity has the potential to cause interruptions to these foraging trips and thus delay females returning to land to feed pups. Therefore, in addition to foraging male sea lions, it is also likely that the proposed seismic survey will encounter nursing female sea lions carrying out essential foraging trips to provide sustenance to newborn pups.

Nature and extent of likely impact - cetaceans
Under the EPBC Act Policy Statement 2.1 (2008) it is stated that one of "*the most important aspects of assessing the likelihood of potential impacts on whales, is determining whether the proposed survey will have a low likelihood or a moderate to high likelihood of encountering whales*". The likelihood of encountering a whale is defined as follows:

Low likelihood: Spatially and temporally outside aggregation areas, migratory pathways and areas considered to provide biologically important habitat;
Moderate to high likelihood: Spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat".

Given that no extensive and systematic scientific surveying has taken place in this area (IFAW does not consider one day of aerial surveying to be extensive) at the proposed time of year for the seismic activity, it is not possible to fully assess the likelihood of potential impacts on listed threatened whales (blue, fin and sei) in the proposed survey area.

Nonetheless, for the endangered blue whale, those scientific surveys that have taken place in the region have revealed the area to be biologically important (foraging). The proposed survey area is both spatially and temporally proximate to (in fact, directly overlapping) this biologically important area. Therefore, according to the definition above, IFAW considers the likelihood of encounter with this species to be moderate to high.

High Intensity Sound Discharges
The acoustic modelling of sound transmission provided by the proponent actually demonstrates that considerable areas of the survey area will receive high intensity sound energy levels (SELs) following propagation from the source. This is particularly true in the scenario in Figure 7 from the 2000m water depth point (P3), where SELs greater than 140dB *re* 1μPa^{2}s (above which level displacement of cetaceans has been recorded) are predicted to propagate out into a significant area from the shelf. Overall, the sound transmission modelling provided by Bight Petroleum demonstrates the potential for the seismic survey to substantially modify the acoustic habitat of cetaceans likely to be encountered in the survey area.

The significant impact guidelines (DEWHA, 2009) state that an action is likely to have a significant impact on an endangered species *"if there is a real chance or **possibility** it will: … reduce the area of occupancy of the species; … adversely affect habitat critical to the survival of the species; … modify … or decrease the availability or quality of habitat to the extent that the species is likely to decline"* [emphasis added].

There is a very real possibility of all of these occurring for blue whales. Bight Petroleum's own modelling of sound transmission demonstrates that considerable amounts of the survey area will receive SELs at or above thresholds recognised to cause avoidance and displacement for baleen whales. This will likely reduce the area of occupancy of blue whales as well as modify or decrease the availability and quality of their acoustic habitat. In the case of a recovering species, which needs to feed on a regular basis, reducing the availability and quality of its acoustic habitat in one of only three foraging areas known in Australian waters could have serious consequences for the health of individuals within that population and as a result cause the species to decline.

The significant impact guidelines define habitat critical to the survival of a species as areas that are necessary for activities such as foraging. The Kangaroo Island Pool and Canyons fit this description – they are recognised in the blue, fin and sei whale recovery plan (DEH, 2005b, as the Duntroon Basin) as one of only three recognised foraging areas in Australian waters and listed as a foraging area in the Southwest Marine Bioregional Plan (DSEWPAC, 2012c). The guidelines are clear that habitats critical to the survival of a species **are not limited to** the Register of Critical Habitat under the EPBC Act.

Bight Petroleum also makes the unreferenced claim that "*During the 40 years of MSS using compressed air as the source, no verified impacts other than avoidance of the source or vessel have been recorded*". This statement is false as published work by Gray and Van Waerebeek (2011) documents the death of a healthy dolphin in close range of an active seismic vessel, following highly erratic and striking behaviour. Jochens (2008) also recorded reduced foraging behaviour by sperm whales in the vicinity of seismic surveys. Notwithstanding, observable reactions of cetaceans in response to noise are but one indication of potential impact. Even this measure may be difficult to interpret with confidence as different species will react in different ways when exposed to elevated anthropogenic underwater noise. Other effects, such as repeated interruption of feeding, habitat displacement and masking of communication are less easy to measure and assess but may be highly detrimental to endangered and vulnerable populations (Nowacek *et al*., 2007). These should nevertheless be considered when assessing risk to marine fauna.

Nature and extent of likely impact – Cetaceans

Bight Petroleum concedes that baleen whales "*are considered to be the most sensitive of the marine mammals to seismic arrays due to their use of low-frequency signals for communication. Their low frequency hearing capability is believed to overlap the energy output of a seismic signal and the potential for disturbance in baleen species is considered higher than that for toothed whales*". While it is true that baleen whales use low frequency signals for communication, it should be noted that low frequency sounds are also essential for hearing, predator avoidance and localising mates. Bight Petroleum then goes on to explain that blue, southern right and humpback whales spend the summer season in the Antarctic "…*a substantial noise environment*". Antarctic waters are well documented as experiencing low levels of anthropogenic noise and the acoustic environment is dominated by noise from natural sources (SCAR, 2012). It is not reasonable to compare this to the sudden input of high intensity acoustic pulses every 11 seconds for a period of many months into the marine environment.

The proponent recognises that behavioural avoidance by cetaceans has been observed at 140dB *re* 1μPa²s and this is of particular concern when examining both Figure 6 and 7, provided by Bight Petroleum. These modelled maps demonstrate that whales would be excluded from a large proportion of the waters within the 100m to 200m depth range surrounding the seismic airgun array (Figure 6) and almost the entirety of the deep water section of the survey area (Figure 7). Also, the information provided by Bight Petroleum alongside these maps does not make it clear that, due to the logarithmic scale on which decibels are measured, an SEL of 140dB *re* 1μPa²s is actually **10 times more intense** than an SEL of 130dB *re* 1μPa²s and **100 times more intense** than an SEL of 120dB *re* 1μPa²s and so on. This is significant when assessing the acoustic modelling maps, as the proponent has not cited the exact modelled figures but rather has given an interpretation from the maps, graphs and figures provided in the CMST report (CMST, 2012). Therefore, the text provided by Bight Petroleum is actually a subjective interpretation of the modelled received levels rather than exact figures provided by CMST. Furthermore, when presenting the CMST acoustic modelling, Bight Petroleum has not made it clear that the seismic array to be used is 3250in³ in volume and that the modelled sound attenuation and decay provided is based on a 3090in³ array. The proponent has not provided modelling for the more powerful array that is to be used and consequently the values provided cannot be considered as accurate predictions.

Furthermore, Bight Petroleum hypothesises that the modelled SELs at various distances from the source will not lead to Temporary Threshold Shifts (TTS) in hearing in whale species. However, data that exists around seismic noise-induced TTS in cetaceans is limited to only two toothed whales, and onset levels for such hearing impairment in baleen whales are currently unknown. In fact, recent research results obtained by modelling indicate "*a reasonable likelihood that (baleen) whales at a kilometre or more from seismic surveys could potentially be susceptible to TTS*" (Gedamke *et al*., 2011). The proponent then describes the risk of collision with cetaceans in relation to the risk of TTS as being exceptionally low. Although IFAW finds it difficult to understand how TTS and collision risk are linked, Bight Petroleum does concede in an earlier statement that in one unpublished study, the distance of first sighting in 15% of all sightings were within 500m. This indicates that cetaceans are sighted within the zone of the highest level of sound intensity and are therefore at risk of hearing damage.

Bight Petroleum has made no consideration of the more recent and emerging evidence around marine mammal responses to increased underwater noise. A recent study by Rolland *et al*. (2012) provides evidence of the negative effects of low-frequency anthropogenic noise on North Atlantic right whales and discusses the negative consequences for population viability. This research provided a unique opportunity to examine the effects of a lull in shipping noise, and therefore decreased underwater low frequency background noise, on levels of stress-related faecal hormone metabolites (faecal glucocorticoid, fGC) in these whales. Here, a highly significant decrease in fGC concentrations was found to correlate with a 6dB decrease in underwater background noise and a significant reduction of noise below 150 Hz. This is noteworthy as chronic elevations of glucocorticoids secondary to repeated or continuous stressors become maladaptive, suppressing growth, immune system function and reproduction, with implications for individual and population fitness (Rolland *et al*., 2012).

In the case of blue whales, Di Iorio & Clark (2010) found that these whales clearly change their calling behaviour in response to noise from seismic activity. This study concluded that "*reducing an individual's ability to detect socially relevant signals could therefore affect biologically important processes. This study suggests careful reconsideration of the potential behavioural impacts of even low source level seismic survey sounds on large whales*."

Pygmy blue whales reach maximum lengths of ~30m, with a mass that well exceeds 100,000kg (Mackintosh and Wheeler, 1929). Blue whales require copious amounts of krill to sustain their high energetic requirements. Recent studies on the energetic demands of blue whale lunging

and foraging have found that the energetic cost of a single lunge ranges from 3226 to 8071kJ (Goldbogen et al, 2011). Based on feeding rates of seals and whales (Innes et al. 1987), a mammal weighting 150 tonnes requires ~3,000 Kg of food per day. Large baleen whales need to feed in areas with high concentrations of krill, such as the Kangaroo Island Pool and Canyons. Morrice *et al*. (2004 as quoted in Origin Energy Resources Limited, 2012) stress that the proximity of whales to seismic vessels must be interpreted in the context of their pressing need to consume tonnes of food per day and that these whales may need to feed in their zone of acoustic discomfort if the only krill available are in the proximity of an active seismic vessel.

The blue, fin and sei whale recovery plan (DEH, 2005b) states, "*A range of anthropogenic activities have the potential to degrade habitat important to the survival of blue, fin and sei whales. These activities may degrade habitat by operating at times that coincide with the presence of whales … These activities may include … acoustic pollution (e.g. commercial and recreational vessel noise, and seismic survey activity…*". The plan then proposes the action to "*protect habitat important to the survival of the species*".

The updated draft Conservation Management Plan for the Blue Whale (SEWPaC, 2012f), lists noise interference (including seismic surveys) as one of the main threats to blue whales, and includes "assessing and addressing anthropogenic noise" as a "very high priority" action area for the pygmy blue whale. The plan also includes within its objectives, the aims to "demonstrably minimise recognised anthropogenic threats to blue whales" and "maintain and improve current levels of legal and management protection". Allowing this survey to proceed is completely counter to these objectives.

Nature and extent of likely impact – Pinnipeds

It is well recognised that seismic exploration represents a potential threat to pinnipeds (Shaughnessy, 1999) and the Australian government has acknowledged that very little is known about the nature of such threat. Species-specific data is lacking for Australian sea lions in terms of avoidance and disturbance behaviour, but as noted above, seismic activity may interrupt the foraging activities of both male and female sea lions in the area.

Bight Petroleum claims that "*given their poor hearing below 100Hz*" sea lions encountered during the seismic survey are unlikely to be "*significantly disturbed*" by the seismic activity. However, this does not take into account the considerable seismic energy input into the marine environment that is over 100Hz. Bight Petroleum quotes several studies that have investigated hearing sensitivities in a number of other pinnipeds, but do not consider the fact that sea lions are likely to detect seismic vibrations via their vibrissae (whiskers). The vibrissae of pinnipeds are well supplied with nerves, blood vessels and muscles. They have been shown (for example, in harbour seals, *Phoca vitulina*) to be sufficiently sensitive to low frequency waterborne vibrations that they may function to detect even the subtle movements of fish and other aquatic organisms (Lavigne and Kovacs, 1988). In evaluating the ability of endangered sea lions to detect and react to seismic vibrations, the referral fails to consider the one sensory modality that might be expected to be most relevant.

Nonetheless, it has been recognized for years that seismic exploration represents a potential threat to pinnipeds (Shaughnessy, 1999). And the Australian government has acknowledged that very little is known about the nature of such threat.

In addition to the potential impacts of low frequency sounds on the pinnipeds themselves, IUCN has also expressed concern about the effects of seismic exploration on their prey species (See http://www.iucnredlist.org/details/14549/0). If such disturbance in their feeding environment reduces food availability, the seals will eventually show signs of reduced condition and may have difficulty feeding their pups, which could result in reduced reproductive success through higher levels of neonatal mortality. It is also known that disturbances in marine and terrestrial

environments can cause pinnipeds to abandon colonies entirely, which could have serious implications, especially for a species like the Australian seal lion that is already endangered.

Valid concerns expressed previously by the international scientific and conservation communities, and the government of Australia about potential impacts on pinnipeds have frequently been rejected by the petroleum industry. The appropriate response would be for the industry to evaluate each potential threat and provide data and analyses that would dispel such concerns. When it comes to pinnipeds, however, IFAW cannot find any cases where specific threats have been examined and evaluated sufficiently, let alone found to be inconsequential.

Bight Petroleum's referral simply concludes that the proposed action "will not" or "is not likely" to result in significant impacts but evidence to support such conclusions are lacking. The lack of impact conclusion is said to be based on "*the observed species avoidance characteristics in proximity to operating marine seismic sources*". Yet no data or references are provided on observations of a species most likely to be affected in this instance - the Australian sea lion.

"Absence of evidence" arguments are weak arguments, and this is certainly the case when it comes to pinnipeds in the referral. If there is a lack of scientific study on the potential threats of seismic exploration on pinnipeds, and particularly on endangered species, it is hardly surprising that there is no "*significant evidence of lethal and sub-lethal impacts*". If no one has actually looked into the possibilities, where would such evidence even come from?

When dealing with the problems of uncertainty in the environmental field, it has become commonplace to defer to the precautionary principle. Australia is no exception. In Australia, the precautionary principle is a central feature of the EPBC Act. Section 391 of the Act makes it clear the Minister must take account of the precautionary principle in making a decision as to whether an action is a controlled action.

Application of the precautionary approach would seem to dictate that no seismic exploration be undertaken in waters inhabited by pinnipeds, especially near islands where important breeding colonies currently exist, until such time as the potential threats and the risk of serious or irreversible harm are better understood. Without such information one cannot even begin to describe and implement appropriate mitigation measures.

The physical presence of the vessel

While IFAW accepts that the likelihood of a fatal vessel strike is low, due to the slow speeds at which seismic vessels travel when collecting data, this section of the referral features further inaccurate statements from Bight Petroleum.

Bight Petroleum states that *"…marine species (particularly cetaceans), if present, will also practice avoidance behaviour due to vessel noise (NOO, 2001)".* The expectation for cetaceans to avoid the seismic vessel does not take into account varying behaviour of the different species found in this area. As an example, it is well documented that delphinids such as dusky and common dolphins show strong attraction behaviours towards approaching vessels (e.g. Neumann & Orams, 2006).

Increased vessel presence in cetacean habitat will inevitably result in increased risk of ship strike. Such collisions are thought to be more common than previously suspected and are not without significant conservation implications (Laist *et al*., 2001). Bight Petroleum dismissively states that "*In the unlikely situation of marine fauna impact from vessel collision, individuals may be affected however it will not affect species at a population level*". However, for endangered populations the loss of even one individual can be significant and so ship collisions can actually be a major recovery obstacle (Laist *et al*., 2001).

3.1(e) Listed migratory species

Mammals

Antarctic minke whales

As no scientific research has been conducted to assess Antarctic minke whale distribution and abundance in the proposed survey area, it is impossible to assess the likelihood of encounter with this species as low. Likewise, there is no basis on which to make the assumption that "… *the species would, at most, transit the area during the proposed MSS activities*".

Bryde's whales

As with the Antarctic minke whale, there has been no scientific survey dedicated to assessing Bryde's whale activity in the proposed seismic survey area, and it is therefore not possible for Bight Petroleum to predict the likelihood of encounter or habitat use for this species.

Pygmy right whales

Bight Petroleum recognises that Kangaroo Island and the southern Eyre Peninsula are key locations for the pygmy right whale and that these whales are present year-round. In fact, the SPRAT profile for pygmy right whales states that "*These areas are all close to habitats rich in marine life and the zooplankton upon which the Pygmy Right Whale feeds"* (SEWPaC, 2012b). It should also be noted that the discreet surfacing behaviour of this whale species makes detection at sea relatively difficult (SEWPaC, 2012b), which will have implications for encounter rates. Given the known importance of this habitat to the pygmy right whale, likelihood of encounter should be predicted to be higher and considering the information above, it is more likely that these whales will be found foraging in rather than "*transiting within*" the proposed seismic area.

Killer whales

Killer whales were observed during November to March in Bight Petroleum's pre-survey aerial monitoring and yet Bight Petroleum claims that killer whales "*may be encountered in low numbers during the proposed Lightning MSS*". As no abundance estimates were calculated for killer whales in this area, it is impossible for Bight Petroleum to predict encounter rates for this species.

Bight Petroleum states that the survey is likely to encounter Australian sea lions in the area and as these pinnipeds are an important prey species to killer whales, it is also likely that these whales will be encountered feeding in the survey area.

Dusky dolphins

As with the other cetacean species in this section of the referral, there has been no scientific survey dedicated to assessing dusky dolphin activity in the proposed seismic survey area, and it is therefore not possible for Bight Petroleum to predict the likelihood of encounter for this species.

Sperm whales

IFAW is concerned that Bight Petroleum has provided information in the referral indicating peak periods for sperm whales in this region, when it is well-known that sperm whales are not seasonal and can actually be encountered at any time of the year in these waters, as detailed by SEWPaC (2012c). Bight Petroleum references the *draft* Marine Bioregional Plan for the South-west (referenced as SEWPC 2011a) as indicating a low likelihood encountering sperm whales between January and March and May to October. In the previous referral submitted by Bight Petroleum, they stated that "*there is a medium likelihood of encounter if the MSS proceeds into April or early May*". It is interesting to note that the proponent has not included this information in the most recent referral with amended timelines.

The updated final version of the bioregional plan (SEWPaC, 2012c) clearly states that sperm whales are in the area year round with the only period identified with any difference in abundance to be a peak in August-September. This is not to suggest a low likelihood of encounter at other times of year, or that a period of "medium" likelihood of encounter could be predicted. The South-west Marine Bioregional Plan also makes clear the area is defined as biologically important habitat for sperm whales (SEWPaC, 2012c).

Nature and extent of likely impact - cetaceans

The latest mapping from the Department of Sustainability, Environment, Water, Population and Communities indicates significant overlap between sperm whale foraging areas and the proposed survey area (SEWPaC, 2012d). Given that the waters in the proposed survey area are biologically important for sperm whales (foraging), there is "*High risk of significant impact … seismic surveys may still pose a threat to sperm whales, particularly in biologically important areas, where seismic noise may affect the abundance of prey species"* according to the Southwest Marine Bioregional Plan (SEWPaC, 2012c).

The acoustic modelling of sound transmission provided in the referral actually demonstrates that considerable areas of the survey area will receive high sound energy levels (SELs) following propagation from the source. This is particularly true in the scenario in Figure 7 from the 2,000m water depth point (P3), where SELs greater than 140dB *re* 1µPa^{2}s (above which level displacement of cetaceans has been recorded) are predicted to propagate out into a significant area from the shelf. Such intense SELs in deeper waters may have implications for sperm (and beaked) whales in particular, which are likely to occur in these areas. Overall, the sound transmission modelling provided by Bight Petroleum demonstrates the potential for the seismic survey to substantially modify the acoustic habitat of cetaceans likely to be encountered in the survey area.

In reviewing likely cetacean responses to seismic testing, Bight Petroleum makes several references to the review by Stone (2003). However, in correspondence with the Kangaroo Island Council (KI Council, 2012) Bight Petroleum states, *"we would point out that this was not actually a research study but was simply a compilation of MMO sightings during 1998-2000 in UK waters. … We would suggest that it is not possible to draw any significant conclusions about avoidance behaviour from a limited set of observations such as these."*

More recent and published studies have concluded that seismic surveys may affect sperm whales (Jochens, 2008) through reduced foraging and potential vertical avoidance rather than horizontal displacement. Bight Petroleum claims that "*Jochens et al (2008) found Sperm Whales reasonably tolerant of seismic activity";* however, the Jochens (2008) paper actually notes that "*Gulf sperm whales, at least in the area studied, may have some level of acclimation to seismic airgun sounds. Moreover, whales were tagged in a region with substantial human activity, so they are not naïve to human-generated sounds. Follow-on studies in regions not as affected by human activities are needed to address the issue of habituation"*.

As there is currently an insufficient understanding of the effects of seismic surveying on sperm whales, IFAW does not believe that Bight Petroleum can conclude that the proposed seismic activity will only affect these whales temporarily nor that this species is the least impacted.

As abundance, distribution and habitat use of the other migratory cetacean species in this area is poorly known, Bight Petroleum cannot make the unsupported claim that Antarctic minke whales, pygmy right whales *and* Bryde's whales will all have a 'transitory presence' in the area and will 'not be found in large numbers at one location' during the proposed seismic survey. All of these species are known to occur in this area and pygmy right and killer whales in particular are likely to be foraging. The lack of data available for these species should not be taken to imply that there is a low likelihood of encounter.

Furthermore IFAW does not believe that it is correct to portray the seismic activity as having *"only very temporary and localised potential exposure"* to species in the area. As shown by Bight Petroleum's own acoustic modelling, in deep water in particular, the sound will propagate over large amounts of the survey area.

3.2(c) Commonwealth marine area

Beaked whales

The referral form makes it clear that proponents are required to "describe the nature and extent of likely impacts (both direct & indirect) on the whole environment if the project … will be taken in a Commonwealth marine area". Furthermore, the guidelines on significant impact (DEWHA, 2009) make it clear that potential impact upon cetaceans is a key consideration when assessing the likely impact on the environment in a Commonwealth marine area. Yet Bight Petroleum's referral does not describe or discuss potential impacts on cetacean species other than those that are listed as threatened or migratory in this section or section 3.3(a) (other important features of the environment – flora and fauna).

The proposed survey is within a key area for beaked whales worldwide (SEWPaC, 2012e). The SEWPaC cetacean report card for the south west region (SEWPaC, 2012e) details the occurrence of beaked whales in the region; "*Information is limited on the ecology of beaked whales, and most information about the species group has been gleaned from stranded specimens (MacLeod & Mitchell 2006). Beaked whales are generally found in deep water offshore around seamounts and canyons. They dive for long periods and are rarely observed. South-west Australia has been listed as one of the key areas for beaked whales worldwide, particularly Hector's, Andrew's and Cuvier's beaked whales (MacLeod & Mitchell 2006), while the most common beaked whale to strand in South Australia is the strap-toothed beaked whale (Kemper 2008).*"

Furthermore, given that 6 extremely rare Shepherd's beaked whales were sighted in the proposed seismic area during Bight Petroleum's limited aerial surveying (Figure 4 of the EPBC referral), IFAW would have expected Bight Petroleum to mention this in the referral and assessed the likelihood of encountering this and other beaked whale species in the proposed seismic survey area. The sighting of a Shepherd's beaked whale in the proposed survey area corresponds with sightings of Miller *et al*. (2012) further east in the Bonney Upwelling during January and March. In fact, a protected matters search reveals that 8 species of beaked whale may occur in the proposed survey area, and there have been a number of historic sightings in and around the survey area during the months of February and March of groups of Arnoux's beaked whales (Kemper, pers. comm.). Therefore, these species should have been given greater consideration in the referral and the likelihood of impact on them assessed, particularly given the knowledge of how susceptible this group of cetaceans is to acoustic disturbance (Taylor *et al*., 2004).

Pinnipeds

Bight Petroleum also fail to include two further species of pinniped found in South Australian waters; the Australian fur seal and New Zealand fur seal. These species of fur seal are likely to be susceptible to the impacts of seismic activity in a similar way to Australian sea lions (as discussed above), and as such Bight Petroleum should have considered the impacts on these species.

3.3 Other important features of the environment

The descriptions of the marine environment given by Bight Petroleum in this section highlight in numerous places the importance of the area to a wide variety of marine life at the time of year of the proposed survey. For example:

"The canyons south of Kangaroo Island and the adjacent shelf-break appear to be important areas for biological productivity and spawning and aggregation of a large number of marine species" (p.30)

"Within this bioregion, seasonal winds and ocean currents interact with the seafloor features to produce seasonal upwellings high in biological productivity. The Lightning MSS area lies in, and adjacent to, an upwelling area, lying on the shelf to the west of Kangaroo Island, known as the Kangaroo Island Pool." (p.30)

"This Spencer Gulf Province is regarded as one of the most productive commercial fishing areas in Australia, producing sardine and anchovy (finfish fishery) and for supporting migratory Tuna" (p.30)

"Sardines account for more than half of the prey species of juvenile southern blue-fin tuna (SBT) which also aggregate in the area" (p.30)

"killer whales are possible SBT predators at different stages of the SBT lifecycle (Kailola et al, 1993)." (p.31)

"As a result of this high biological productivity, aggregations of marine life such as New Zealand Fur Seals, Australian Sea Lions, dolphins, sharks, seabirds and cetaceans are also drawn to the area (DEWHA, 2007)." (p.31)

"seasonal upwellings attract aggregations of marine life to the shelf and shelf break including small pelagic fish, squid, marine mammals, sharks, large predatory fish and seabirds. The shelf break area is of high productivity with respect to giant crab and southern rock lobster (DEWHA, 2007)." (p.32)

[In reference to why the area is proposed as a Commonwealth marine reserve]
"… ecological features including:

- *Ancient coastline (high productivity);*
- *Kangaroo Island Pool, canyons and adjacent shelf-break; and Eyre Peninsula upwelling (high productivity and feeding aggregations);*
- *Meso-scale eddies (high productivity and feeding aggregations); …*
- *Important seasonal calving habitat for the threatened Southern Right Whale;*
- *Important foraging areas for the threatened Australian Sea Lion; threatened white shark; endangered Blue Whale; Sperm Whale and migratory seabirds;"* (p.32)

The repeated references to the high productivity of the area and, in particular, aggregations of cetaceans are completely at odds with the assessments made by Bight Petroleum earlier in the referral that the likelihood of encountering various cetacean species will be low.

IFAW also notes that on page 35 Bight Petroleum outlines how it is in discussions with CSIRO and ASBTIA to help boost southern Bluefin tuna aerial surveys to achieve statistically relevant information on the movement of tuna in the vicinity of a seismic survey. As mentioned above (section 2.6) in relation to Bight Petroleum's planned contribution to rock lobster studies, it is disappointing that Bight Petroleum is not offering to sponsor any research related to the potential impacts of the proposed survey on cetacean species in the region, particularly given the region's importance to such a wide range of cetacean species (at least 28 according to a search of the protected matters database).

4. Measures to avoid or reduce impacts

Cetacean Controls

IFAW contests the statement on page 37 by Bight Petroleum that the time period selected to conduct seismic testing in the area can be considered a period of *"low occurrence"* for blue whales, sperm whales or other cetacean species. This assertion is based on an incredibly sparse dataset and selective use of the limited information available around cetacean activity in and around the Duntroon and Ceduna sub-basins.

A more comprehensive survey detailing presence/absence and how the area is used by cetaceans (and other listed species) is an obvious and critical gap in determining whether the seismic activity could be acceptable and if so how it should be conducted to avoid likely significant impacts on species and the marine environment.

The Department has outlined a standard of suitable survey measures for terrestrial mammals in the Survey guidelines for Australia's threatened mammals (SEWPaC, 2011). Similar principles should apply in the marine environment, while also taking into account the additional difficulties of mapping ephemeral characteristics of key habitats such as krill swarms.

Without implementation of standardised survey methodology, any risk assessment and associated mitigation measures will be essentially speculative, offering no credible basis on which to determine whether actions are likely to have significant impact.

In terms of what is actually proposed by the proponent, the aerial surveys described by Bight Petroleum three days prior to seismic survey commencement are in no way sufficient to inform the conduct of the survey throughout the proposed seismic period of 70 days. Should seismic testing be approved in this area, IFAW believes that as a minimum requirement aerial surveys should be undertaken throughout the duration of the seismic survey to determine whether cetaceans are present. Not only would this allow Bight Petroleum to direct survey effort away from cetaceans in the survey area, it will also allow for scientifically valid data to be obtained about cetacean activity in the area prior to and during seismic surveying.

Controls for all whales (standard procedures)

Bight Petroleum states that: "the Lightning MSS will adopt … control measures… as outlined in *EPBC Act Policy Statement 2.1 - Interaction between offshore seismic exploration and whales*." IFAW has highlighted several deficiencies with Policy Statement 2.1 in its ability to adequately protect cetaceans from noise pollution from seismic surveys in the report *Australia's Last Great Whale Haven* (IFAW, 2011). These include the reliance on cetaceans avoiding sound sources as a mitigation measure; the lack of scientific certainty about risk reduction of proposed mitigation methods; lack of mandatory mitigation methods; the risk of shut-down processes leading to greater overall noise being input into the environment; and the restriction of the guidelines to 'large' whales.

In IFAW's view, it is not sufficient for companies to rely on the measures outlined in the policy statement in order for potential harm to cetaceans to be reduced to as low as reasonably practicable.

In areas of particular high conservation value and of importance to multiple cetacean species, such as the proposed survey area, IFAW believes the Department should prohibit surveying at night-time or in periods of poor visibility.

Additional EPBC Policy Statement Part B Controls

As noted by IFAW above, the aerial survey schedule proposed by Bight Petroleum should be extended throughout the entirety of the proposed seismic survey period to determine presence

of cetacean species in the survey area, which could then inform the conduct of the seismic survey.

Again, as there is very limited evidence to suggest that blue whales are any less likely to be present during the month of March than during April to May, IFAW sees no reason that Bight should not increase the number of MFOs for the entire duration of the proposed seismic survey period as a more precautionary mitigation measure. At a minimum, four MFOs (two on watch at any time) should be required on the seismic vessel to ensure the best possible 360 degree, continuous watch. This has been required recently for both the Origin seismic survey in the Otway basin (ref 2012/6421), and the WHL Energy seismic survey (ref 2012/6683), specifically to avoid impacts on blue whales. Therefore, IFAW sees no reason why the same requirement should not be in place in this instance. Additionally, IFAW recommends that two MFOs (always one on continuous watch) should be required on the support and scout vessels to increase the likelihood of detecting cetaceans.

IFAW believes that the adaptive management controls proposed by Bight Petroleum are not sufficient. It is inconsequential whether blue whales and sperm whales observed in the seismic survey area are suspected to be travelling or feeding. The observed behaviour of whales is highly subjective, as a whale considered to be 'migrating' could easily be travelling between food sources (e.g. a krill swarm or squid aggregation) within the survey area as part of a wider foraging strategy. In this respect, the very presence of these whales should be cause enough to prompt additional observation surveys and to halt seismic operations during the hours of darkness.

Bight Petroleum states that the "*additional measures will ensure that diving feeding whales are detected well before the seismic vessel arrives near any feeding aggregation area*". IFAW contests this statement. The limitations of employing visual observations alone in the detection of marine mammals are well-recognised and this singular method is in no way sufficient to detect deep diving whales, such as sperm and beaked whales. As the proponent outlines on page 25, sperm whales are prolonged and deep divers, often diving for over 60 minutes. IFAW believes that the use of acoustic methods to assist in detecting whales would provide a valuable addition to the proposed mitigation measures (discussed in further detail below).

IFAW further believes this survey, at a time of year and in a location where there is an increased likelihood of encountering a range of cetacean species, presents a good opportunity for regulators to insist on proponents trialling technology such as thermal imaging, which can assist visual observations of cetaceans at the surface at night time and in periods of low visibility. Experiences of MMOs (Paton, pers. comm.) in trials of thermal imaging equipment have shown it can be successfully applied over relevant distances for shut-down and low power zones.

Passive Acoustic Monitoring (PAM)

The descriptions and observations of PAM provided by Bight Petroleum are misleading, as they do not make it clear that PAM would be used as a **complimentary** measure alongside visual monitoring. As sperm whales are deep diving cetaceans that spend less time surfacing during foraging, visual observers are only likely to detect a small proportion of whales and combined acoustic monitoring will greatly increase the likelihood of detecting sperm whales within proximity of the seismic source. This is increasingly being recognised by regulatory regimes across the world. As Bight Petroleum points out, PAM has been adopted in guidelines in the USA, UK and New Zealand. Bight Petroleum's dismissive commentary on PAM runs counter to regulatory best practice in many parts of the world.

Many statements in the referral by Bight Petroleum are based on a factually incorrect understanding of PAM. They state that, on the basis of PAM only working if an animal vocalising, "*the reliability of PAM as an identification tool has its limits*". IFAW would argue that it is well

recognised that all cetacean monitoring methods have limitations, but this is not a valid argument for disregarding their use.

For sperm whales, there is comprehensive evidence from combined visual and acoustic surveys that PAM using towed hydrophones is much more effective, usually by at least an order of magnitude, at detecting whales than visual methods (e.g. Gillespie, 1997; Leaper et al., 2000; Barlow and Taylor, 2005). The poor performance of visual methods is due to the whales spending long periods underwater and out of sight. It is true that there are periods when sperm whales are not vocal, but the fact that acoustic methods detect many more animals than visual ones is a clear motivation for the use of PAM. Sperm whales that are not vocalising are generally at the surface and so a combination of visual and acoustic methods offers the best chance of detection.

Methods based on towed hydrophones are well developed and although Bight Petroleum claim that '… *existing systems cannot estimate the distance, depth or abundance of the whale from the hydrophone*' this is not the case. Target motion analysis of multiple bearings to vocalising sperm whales is standard practice for acoustic surveys that have estimated whale abundance based on measurements of perpendicular distance from the hydrophone (e.g. Leaper et al., 2000; Lewis et al., 2007). There is a level of uncertainty associated with such measurements but it is not clear whether this is more or less than for visual observations which also often have large errors in distance (Leaper et al., 2011).

This misunderstanding of PAM has been pointed out by IFAW to the author of the referral and to the Department in response to a previous referral, written by this referral's author, by Arcadia Petroleum Limited (referral 2012/6476), yet no effort has been made in this referral to correct the mistake.

Towed PAM has been demonstrated to be effective for some species and especially for sperm whales (Gillespie, 1997; Leaper *et al*., 2000; Barlow and Taylor, 2005). If it has not proven effective for the seismic industry this is most likely due to insufficient attention to the equipment and operator training. PAM relies on good reliable equipment and experienced operators. This is why, for example, New Zealand's new code of practice for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations (DoC, 2012) introduced standards and required levels of training for PAM operators. It is therefore not the method that is the problem but the way this has been implemented by the industry. Bight Petroleum should establish a workshop of experts on PAM to discuss ways in which this can be implemented effectively and reliably during their surveys. There is currently no incentive for the seismic operator to ensure that PAM gear is properly functional because acoustic detections may cause delays and additional expense.

Bight Petroleum quotes extensively but also selectively from Bingham *et al*. (2011) to attempt to justify why PAM should not be used. However, a closer examination of the paper demonstrates a number of favourable conclusions on PAM. For example, Bingham states *"Towed PAM systems have been used with some success to supplement visual monitoring of exclusion zones in the North Sea, the Gulf of Mexico, and elsewhere"*, and *"In some circumstances, the effectiveness of marine mammal monitoring and mitigation could be increased by using a combination of approaches".*

Bight Petroleum also quotes figures from *The Leading Edge*, a monthly magazine which publishes articles before areas of work have undergone enough field testing for rigorous peer review. Nevertheless, the article in question by Barousse and colleagues (2012) also states that utilising PAM can lead to fewer delays and increased efficiency of seismic surveys. Additionally, this article outlines the importance of industry increasing the use of this technology in the field, to allow the full capabilities and limitations of PAM to be better understood.

IFAW is deeply concerned that the proponent makes the statement that "…*the above management procedures, excluding PAM, are considered as an effective control measure for this MSS. However, Bight Petroleum commits to incorporating a PAM system to assess how it compares to the visual measures outlined and, potentially, as a complementary measure".* The dismissive tone of this statement is highly concerning and gives the impression that the proponent is less than committed to the agreed 'trialling' of PAM as a complimentary measure during the proposed seismic survey. Given the dismissive nature of the language in the referral, IFAW has very little confidence that the proponent will conduct a trial that is anything other than designed to fail. Therefore, we believe the Department should insist that the proponent provide full details of the methodology they will employ to carry out passive acoustic monitoring of cetaceans during the proposed seismic survey to reassure the Department and stakeholders that this is a serious proposition, and also insist on some kind of independent oversight of the trial methods to be employed by Bight Petroleum to ensure the use of PAM is actually meaningful.

For all of the proposed mitigation, visual, acoustic or otherwise, estimates of the risk reduction that is likely to be achieved should be provided to enable a proper evaluation by regulators and other stakeholders. For example, if shutdowns are considered an appropriate measure then the proportion of whales that enter the shutdown zone that are likely to be detected should be estimated. This is all the more important when comparing whether to employ different methods of detection such as visual observations and passive acoustic monitoring.

A shutdown strategy based on detecting whales will reduce the risk of an individual whale being exposed to noise levels likely to cause injury. However the mitigation actions outlined by Bight Petroleum do nothing to reduce the effects of lower levels of exposure, such as displacement from critical habitat, behavioural changes, stress or reduced feeding activity, which still remain a concern. For example, Miller *et al*. (2009) noted from the Gulf of Mexico studies that sperm whales '*are affected at ranges well beyond those currently regulated due to more subtle effects on their foraging behavior*'. If shutdowns lead to more airgun blasts overall then the overall noise input needs to be considered.

5 Conclusions on the likelihood of significant impacts

IFAW disagrees with Bight Petroleum's conclusion that the proposed action is not a controlled action. The Department's concerns with the proponent's original referral are still applicable to the current referral. Bight Petroleum has not adequately addressed these issues and the responses given by Bight Petroleum demonstrate a lack of acknowledgement as to the unique and highly biodiverse characteristics of the environment in which they propose to carry out seismic testing.

In fact, given the relatively substantial data gaps in knowledge of cetacean presence and abundance in the region at the time of year of the proposed action, IFAW believes the Minister and the Department have good grounds to reject the proposal outright and insist, at a minimum, that Bight Petroleum fund sufficient, independent and publicly available scientific survey effort in the region at that time of year, over repeated years, to confirm the likely presence/absence of a variety of cetaceans in the region before any seismic surveying is allowed to proceed during March to May.

As the Department's significant impact guidelines (DEWHA, 2009) state, a self-assessment should be "*as objective as possible and based on sufficient information to make an informed judgement*". IFAW believes Bight Petroleum's referral fails on both counts. As shown above, the inaccurate, selective and misleading referencing regarding mitigation methods is not an objective assessment, and there is a lack of data presented to substantiate presence/absence of cetaceans in the region at the time of year of the proposed action.

Such information should be sought before any application is allowed to proceed, as has been the case with the super trawler. As Minister Burke said regarding the super trawler, "*environmental decisions should be based on sound science and quality information*"[2] and more recently: "*When faced with this sort of uncertainty you can either be cautious and wait for the scientific work to be done or roll the dice and run the risks. Australia chose to be cautious when it came to protecting the ocean. It was the right thing to do. The Gillard Government makes no apology for not taking risks when it comes to protecting our precious oceans*"[3]. The significant impact guidelines (DEWHA, 2009) are very clear that "*a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact*". On the basis of such statements, IFAW expects the Department to apply a similar level of caution in its decision on this referral.

Bight Petroleum has provided responses to the large number of concerns presented by the Department in its Statement of Reasons, when the previous referral for this seismic survey was declared a controlled action (ref 2012/6583). IFAW's responses to these concerns and the responses from Bight Petroleum are included below:

1) **Department's concern: Southern right whales**
   Biologically important calving/nursing areas for the endangered and migratory Southern Right Whale (SRW) are located along the coast of South Australia and around Kangaroo Island.

Proponent's response: *This concern is addressed by the fact that the nearest calving area to the northern edge of the survey is at Sleaford Bay, 85km away, and sound levels from the MSS will be below ambient well before it can reach the SRWs preferred calving/nursing habitat in water depths less than 10m and within 2km of shore. Any areas around Kangaroo Island are at an even greater distance.*

IFAW's response: The Draft Southern Right Whale Recovery Plan 2011-2016 (SEWPaC, 2012a) highlights that southern right whales occupy the calving/nursery grounds in Australian coastal waters **from May to October**. Although no research has been conducted to verify the migratory patterns of these whales through the survey area, it is recognised in the recovery plan that habitat connectivity between calving areas is of importance to the recovery of this endangered whale species. During May (and possibly April), the proposed seismic survey has the potential to cause avoidance behaviour by creating an acoustic barrier to migrating whales. Seismic activity could therefore alter the path of heavily pregnant female southern right whales travelling through the survey area on their migratory route to Sleaford Bay and other known calving grounds in waters off South Australia, which could in turn have significant population effects for this species.

It is not possible for the proponent to conclude whether or not individual whales might be present and the southern right whales found in Australian waters exhibit high site fidelity, routinely returning to the same location to calve and mate (AMMC, 2009). As a result, both heavily pregnant females and males looking for mates need to migrate to these biologically important locations each year and it is likely they will have to travel through the proposed seismic survey area to access these habitats.

[2] The Hon Tony Burke MP, Minister for Sustainability, Environment, Water, Population and Communities, Keynote address at Coast to Coast Conference in Brisbane, 18 September 2012, available at: http://www.environment.gov.au/minister/burke/2012/tr20120918.html [accessed 19 October 2012]

[3] The Hon Tony Burke MP, Minister for Sustainability, Environment, Water, Population and Communities, Statement on the Super Trawler 6 March 2013, available at: http://www.environment.gov.au/minister/burke/2013/tr20130306.html

2) **Department's concern:** The proposed action will coincide with pregnant female SRWs migrating to the adjacent coastal calving and nursing areas during the period they are known to occupy coastal calving/nursery areas (May to October). As a result there is potential for the proposed action to impact pregnant SRWs migrating to the coastal calving areas. Both physical and behavioural impacts are possible.

Proponent's response: *This concern is primarily addressed by bringing forward the MSS completion date from 30th June to 17th May and, of course, the proposed mitigation measures to be applied during the MSS. In any case, 16 seismic surveys have been approved under the EPBC Act since the year 2000 to be acquired wholly or partially during April>July in the waters between Western Tasmania and the Great Australian Bight. As shown in Table 3, the likelihood of encounter is very low during this period, no impacts have been recorded and, as shown in Fig 8, the SRW population at the Head of Bight has grown at close to biological maximum for this species (7%) throughout this period.*

IFAW's response: While moving the completion date of the proposed seismic survey forward by one month may reduce the overall number of impacted pregnant female southern right whales, the proposed seismic survey still has the potential to alter the path of heavily pregnant female southern right whales travelling through the survey area on their migratory route to Sleaford Bay and other known calving grounds in waters off South Australia.

As outlined by IFAW on pages 9 & 10, the population of southern right whales in this area are from the distinct southeast population (Port Lincoln to Queensland, AMMC 2009); the population showing little evidence of increase, which is therefore more vulnerable to the impacts of noise pollution. Negative impacts on even a small number of pregnant females have potential to impact on a larger population scale in a species with low numbers that is not recovering. That Bight Petroleum have failed to recognise the southern right whales in this area are part of the southeast population and have gone on to discuss population trends at the Head of Bight, which represents whales from the recovering southwest population, demonstrates a lack of research and a misinterpretation of the actual trends of this population. Additionally, the information provided by the proponent will be highly biased, as sightings recorded during seismic surveys are likely to be low due to noise input from the active seismic vessel leading to both behavioural changes and habitat displacement.

Given the close proximity of the Sleaford Bay calving ground, IFAW does not believe that Bight Petroleum have addressed the potential of the proposed seismic activity to negatively impact the migratory route of these southern right whales to their calving and breeding grounds.

3) **Department's concern:** The South West Marine Bioregional Plan states that noise may cause whales to detour away from migration routes or from breeding or feeding areas. Other potential behaviour impacts include disruption to calving behaviour and stress.

Proponent's response: *As observed with humpback whales on the NW Shelf it is unlikely that whales will make anything more than small course corrections on migration routes. Such minor corrections are insignificant in terms of the overall distance travelled by whales and their energy budget for the migration. In fact, one of the key mitigation measures enshrined in EPBC Act Policy Statement 2.1 is the ramp-up or soft-start, which relies on whales moving away from the source to a safe "stand-off" distance. As stated Bight Petroleum Limited – Lightning 3D Marine Seismic Survey (Bight Basin) above, sound levels at the breeding areas of SRWs will be below ambient.*

IFAW's response: It is not valid to compare (unreferenced) behavioural observations in a species showing signs of recovery in one area, extrapolate this information and broadly apply it to completely different and endangered species in a different area. That Bight Petroleum makes such sweeping statements about energy budgets and changes in migratory routes without any scientific evidence is highly concerning.

IFAW strongly agrees with the statement in the Southwest Marine Bioregional Plan that noise may cause whales to detour away from migration routes or from breeding or feeding grounds. This statement refers not only to the endangered southern right whale, but to all species of whale including endangered blue whales which are known to feed in the area.

Furthermore, Bight acknowledges that seismic activities rely on whales moving away from an areas as a mitigation method to prevent hearing damage. However, they do not address the non-physical implications of displacing animals from biologically important habitat, here nor anywhere else in their referral, and this is a critical issue when considering whether or not seismic activities should take place in such habitats.

4) **Department's concern:** Noise modelling reports provided by the proponent do not make sufficiently clear what noise levels would be received at the coastal calving areas 70km away. Calving and nursing SRWs may be subject to noise during the 70-day survey that could result in adverse behavioural reactions.

Proponent's response: *The acoustic modeling report stated "The maximum received SEL's at the 50m contour just off the coast of Kangaroo Island (KI) are predicted to be less than 120 dB re 1 µPa2s, with the smaller array producing received levels approximately 5 dB lower than the larger array". Although the Referral clearly stated "less than 120 dB re 1 µPa2s" it is true that perhaps it did not state actual predicted levels, as the proponent believed that any levels below 120 dB re 1 µPa2s were acceptable. As the smaller array has been specified for this MSS the sound levels at 50m would be "less than 115 dB re 1µPa2s" and, as can be seen in Fig 5, sound levels near Sleaford Bay at 50m would be less than 115 dB re 1 µPa2s. Furthermore, due to the "sound shadow" in the top 18m of water and further attenuation in shallow water, sound levels at the calving/nursing areas would be below ambient.*

IFAW's response: IFAW agrees that the acoustic modelling commissioned by Bight Petroleum does predicate levels less than 120dB *re* 1µ Pa^2s at coastal calving areas. However, acoustic modelling predictions and results should be considered with caution, as calculated received levels are *representative* and strongly dependent on water depth, salinity, seabed slope and direction relative to the array (CMST, 2012). As outlined in CMST's report to Bight Petroleum; the rate of decay inshore is affected by array directivity, which results in higher source levels in the inshore direction. The proponent has failed to include this cautionary note in both their referral and their response to the Department.

5) **Department's concern:** The proponent suggested that there is a very low likelihood of encountering SRWs, based on observations from previous seismic surveys. However, these observations provide only a limited set of information, given their sporadic timing, and may be biased, not accounting for whales that may have altered their behavior to actively avoid seismic surveys.

Proponent's response: *This was an analysis that specifically focused on SRWs in the vicinity of seismic surveys. As shown in table 3 16 surveys have now been assessed. These EPBC approved surveys covered 31867km of seismic acquisition traverse conducted over a cumulative period of 475 days. The findings would appear to be representative of the avoidance behavior or low natural presence of SRWs in the vicinity of seismic surveys conducted at a similar time and on similar SRW migration routes to the proposed Lightning MSS. Furthermore, altering behavior to ensure avoidance of close encounters with the seismic source is one of the key mitigation measures enshrined in EPBC Act Policy Statement 2.1 (and other cetacean interaction guidelines around the world). It must therefore be concluded that, on the basis of these 16 EPBC approved surveys conducted during the April>July timeframe, the mitigation measures are working and the surveys have not had a significant impact on SRWs.*

IFAW's response: IFAW strongly supports the concerns of the Department. In place of validated scientific data, Bight Petroleum has presented southern right whale sighting

information from a number of seismic surveys between the Great Australian Bight and Western Tasmania. IFAW urges the Department to review these data with extreme caution. This information will be highly biased, as sightings are likely to be low due to noise input from the active seismic vessel leading to both behavioural changes and habitat displacement.

6) **Department's concern: Blue Whales**
The proposed area is within a biologically important foraging area for the endangered and migratory Blue Whale and the proposed action is proposed for a time when the Blue Whale could be feeding. Feeding opportunities are of critical importance to the survival of the Blue Whale.

Proponent's response: *The recently released Blue Whale Recovery Plan does not mention this area as "biologically important". It is known that, in some years, Blue whales feed in this area in November/December on their way to the more reliable Bonney Upwelling feeding grounds. This is likely to be opportunistic feeding which does not occur every season (eg it occurred in 2003 but no evidence to indicate it occurred in 2004). However, it is not known if the area is biologically important to them when they move from the Bonney Upwelling to the Perth Canyon in the April timeframe. It is unlikely that this area is important to them in April but the mitigation measures proposed by Bight ensure that, if they are found to be feeding in the area, the same sensitivities will be applied as if the survey were being conducted in the Bonney Upwelling.*

IFAW's response: While the recently released draft Conservation Management Plan for the Blue Whale (SEWPaC, 2012f) makes no specific reference to the Kangaroo Island Pool and Canyons using the term biologically important habitat, the plan does make clear that known feeding grounds include "*the Bonney Upwelling and adjacent waters off Victoria and South Australia*" [emphasis added]. Furthermore, the plan clearly states, "*currently known Biologically Important Areas used by blue whales for essential life functions are identified in the Australian Government's Marine Bioregional Plans*". The Marine Bioregional Plan for the southwest (SEWPaC, 2012c) very clearly identifies the Eastern Great Australian Bight upwelling and Kangaroo Island canyons as important foraging habitat for pygmy blue whales between November and May under the section titled "Species distribution and biologically important areas" on page 172 of the plan.

Even if the area were not defined as biologically important habitat, the proposed seismic survey area is still both spatially and temporally proximate to other biologically important habitat for blue whales (the Bonney Upwelling). The EPBC Act Policy Statement 2.1 (DEWHA, 2008) considers there to be a medium to high likelihood of encounter in areas "*spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat*". Therefore, based on this definition, there is a moderate to high likelihood of encountering blue whales during the proposed survey period of March to May.

7) **Department's concern:** The South West Marine Bioregional Plan indicates that the abundance of Blue whales in the area of the proposed survey peaks in December, although this cannot be determined with full certainty, given the ephermeral nature of krill upwellings on which they feed from year to year. The South West Bioregional Plan states that Blue whales may remain feeding in the area until the end of May.

Proponent's response: *Based on ongoing study of blue whale movements in the Perth Canyon, Geographe Bay, Bonney Upwelling and opportunistically in the MSS area (including aerial surveys during the 2011-2012 season), it is very unlikely that Blue whales will be present in this area in the same numbers as in November/December in this area or during November>May in the Bonney Upwelling.*

IFAW's response: The Southwest Marine Bioregional Plan confirms the Eastern Great Australian Bight Upwelling / Kangaroo Island canyons as one of two important areas in the

south-west marine region where the blue whale aggregates to feed and, despite peaking in December, this area is important foraging habitat for pygmy blue whales **between November and May** (SEWPaC, 2012e). The Bioregional Plan is based on the best available scientific advice for this area. IFAW finds it disappointing that the proponent attempts to disagree with the information presented by the Department.

8) **Department's concern:** Potential concerns for Blue whales in the presence of seismic surveys are:
    a. Whales continuing to feed whilst being exposed to high sound levels that may cause physiological damage or stress;
    b. Whales moving away from the area and not feeding; and
    c. Whales may feed at depth in this area, making visual observations an inadequate measure

Proponent's response: *The observations made during the 2003 seismic survey in this area and subsequent surveys along the Southern Margins (submitted to SEWPaC as part of 'manner specified" conditions), the intensity of blue whale vocalisations and the proposed mitigation measures in this Referral that are in excess of those approved for surveys in the Bonney Upwelling, addresses the above three concerns. Sound levels will be less than 160 dB re 1µPa2.s at 1.7km from the source meaning that the 3km proposed power-down distance in this Referral is very precautionary. Additionally, even though Blue whales may feed at depth, they will need to surface after about 10 minutes. This is the time the seismic vessel takes to travel about 1.5km (ie 9km/hr). Thus, any aggregations of Blue whales feeding at depth will be sighted by the MFO's on board the scout/support vessel travelling 5-10km ahead of the seismic vessel well before any Blue whales enter the proposed 3km power down zone.*

IFAW's response: As referenced by IFAW on page 26, Morrice *et al*. (2004 as quoted in Origin Energy Resources Limited, 2012) stress that the proximity of whales to seismic vessels must be interpreted in the context of their pressing need to consume tonnes of food per day and that these whales may need to feed in their zone of acoustic discomfort if the only krill available are in the proximity of an active seismic vessel. Similarly, the recent draft Conservation Management Plan for the Blue Whale (SEWPaC, 2012f) states, "*a blue whale individual may continue feeding despite anthropogenic disturbance in the area if other suitable feeding areas are limited. This can give the appearance of a low effect of the threat, when in reality the threat is severely decreasing the quality of the population's habitat by introducing stressors which may affect immune system function and overall health.*"

Alternatively, displacement from habitat as a result of noise is also likely, particularly in remote areas with historically low levels of anthropogenic noise.

In addition, the response provided by Bight Petroleum to this concern appears to rely on the assumption all blue whales in the vicinity of the active seismic vessel will be sighted by the MFOs on board. This is concerning, as it demonstrates a clear lack of understanding around the limitations of employing visual observations alone when attempting to detect marine mammals. As cited by Bight Petroleum on page 7 of the referral, 15% of all MMO sightings in the GAB and Carnarvon Basin were within 500m. This indicates the limitations of visual observations in detecting cetaceans, as cetaceans are frequently sighted within the zone of the highest level of sound intensity and are therefore at risk of hearing damage. Furthermore, Bight Petroleum suggests that blue whales feeding at depth will be sighted by the MFOs on board the scout/support vessel travelling ahead of the seismic vessel well before any enter the proposed 3km power down zone, yet they are not proposing enough MFOs on board the scout/support vessel to ensure continuous observations from these vessels.

9) **Department's concern:** The proponent proposed visual observations from vessels and an aerial survey three days prior to the activity commencing, the frequency of further

aerial surveys dependent on the frequency of sightings. However, as Blue whales may feed at depth in this area, it is not evident that feeding whales would effectively be observed through the proponent's proposed visual observation measures.

Proponent's response: *As mentioned above, Bight Petroleum considers that the scout or support vessel travelling 5-10km ahead of the seismic vessel will give adequate time for any blue whales feeding at depth to be detected by the MFO's well before they enter the proposed 3 km power-down zone.*

IFAW's response: The aerial surveys proposed by Bight Petroleum three days prior to seismic survey commencement are in no way sufficient to inform the conduct of the survey throughout the proposed seismic period of 70 days. Should seismic testing be approved in this area, IFAW believes that as a minimum requirement aerial surveys should be undertaken throughout the duration of the seismic survey to determine whether cetaceans are present. This would better enable the proponent to direct survey effort away from cetaceans in the survey area.

Furthermore, Bight Petroleum suggests that blue whales feeding at depth will be sighted by the MFOs on board the scout/support vessel travelling ahead of the seismic vessel well before any enter the proposed 3km power down zone, yet they are not proposing enough MFOs on board the scout/support vessel to ensure continuous observations from these vessels.

10) **Department's concern:** The use of sonobuoys and/or other acoustic tools to assist in identifying the presence of Blue whales in the area present viable measures to detect whales, including feeding Blue whales at depth. The proponent did not propose the use of any complementary acoustic tools and was of the view acoustic tools would not be fully effective.

Proponent's response: *As far as Bight Petroleum is aware, real-time towed PAM or sonobuoys have not been successfully used for the detection of Blue whales in conjunction with seismic surveys. It is considered that the very low frequency nature (peak frequency 20Hz) and the length (120 seconds) of the vocalisations would make accurate triangulation of blue whale calls in "real-time" very problematic. However, as Bight is willing to commit to a commercially available PAM system as a mitigation measure in this new Referral, any input regarding specifications for an optimized system that SEWPaC can provide would be appreciated. At this stage, Bight considers that PAM technology may be able to provide complementary sightings for Sperm whales only but any commercial systems would have to be significantly modified to provide complementary sightings for Blue whales, SRWs and Sperm whales using the same system.*

IFAW's response: IFAW agrees that towed PAM would not be suitable in the use of blue whale detection during a seismic survey. However, the Antarctic Blue Whale Project has successfully trialled the use of sonobuoys as part of an acoustic tracking system to actively locate blue whales in the Bonney Upwelling. In this recent study, Miller *et al*. (2012) found this method to be highly effective. By deploying sonobuoys they were able to track blue whales in real-time and locate these whales with a 91% success rate. As this method has great potential for the real-time detection of blue whales, IFAW believes that the proponent should fully consider and investigate the use of sonobuoys as part of the methods to detect blue whales proposed for the scout or support vessel travelling 5-10km ahead of the seismic vessel. By consulting with the Australian Antarctic Division on the specifics of this methodology, the proponent would have the opportunity to trial the acoustic detection of vocalising blue whales in combination with visual observations, resulting in a far more effective suite of measures to identify the presence of blue whales in the area.

11) **Department's concern:** Given the critical importance of feeding opportunities to the survival of Blue whales, as well as conclusions regarding the adequacy of the proposed

mitigation measures, SEWPaC formed the view that there is a real chance or possibility that the proposed action will substantially impact feeding Blue whales within important habitat for the species.

Proponent's response: *Given the timing of the proposed survey (Mar>May) Blue whales will most probably be migrating from their more reliable feeding grounds in the Bonney Upwelling to the Perth Canyon feeding grounds prior to their migration to tropical waters. Even though it is unlikely that Blue whales will stop to feed in this area, Bight Petroleum in this new Referral is proposing mitigation measures in excess of those approved for more established Blue whale feeding grounds such as the Bonney Upwelling.*

IFAW's response: IFAW agrees with the Department and reiterates that the importance of this habitat to both feeding blue whales and a large number of other marine species sensitive to the impacts of anthropogenic noise cannot be underestimated. The comments made by Bight Petroleum here regarding blue whale habitat use during Mar to May are both speculative and unreferenced.

The Blue Whale Study report commissioned by Bight Petroleum highlights that the intensity of the upwelling which determines these feeding seasons is not entirely predictable and it is very possible that the survey timing will coincide with blue whale presence in the area. It also states that the area covered by EPP41 and EPP42 has the potential to be prime blue whale feeding grounds. It is significant that Bight Petroleum have failed to include these conclusions in their referral documentation.

The Southwest Marine Bioregional Plan confirms the Eastern Great Australian Bight Upwelling/ Kangaroo Island canyons as one of two important areas in the south-west marine region where the blue whale aggregates to feed and, despite peaking in December, this area is important foraging habitat for pygmy blue whales **between November and May** (SEWPaC, 2012e). Additionally, the EPBC Act Policy Statement 2.1 (2008) considers there to be a medium to high likelihood of encounter in areas "*spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat*". Based on this information, IFAW believes there is actually a moderate to high likelihood of encountering blue whales during the proposed survey period of March to May.

12) **Department's concern: Sperm whales**

The South West Marine Bioregional Plan states that the migratory Sperm whale can be found in southern waters at any time of the year. They are also believed to spend a large proportion of their time at depth. Thus, concerns resulting from the proposed activity include: a) Sperm whales continuing to feed whilst being exposed to high sound levels, potentially leading to physical damage; and/or b) That whales will move away from the area and not feed. Although there is recognition by SEWPaC that the implications for this species is not known.

Proponent's response: *There is general acceptance from various published studies (Stone 2003, SWSS report) and observations during seismic surveys around Australian waters, that sperm whales are the least affected by seismic. Numerous observations have occurred under "manner specified" seismic surveys of sperm whales continuing to feed while the seismic vessel approaches the feeding area and then powers-down at 2km (previously 3km). It is noted that any sound levels received by Sperm whales at these distances are well below 160 dB re 1 µPa2s and well below the intensity of their own vocalisations or the changes in pressure they experience during their deep dives.*

IFAW's response: IFAW notes that the Department's Southwest Marine Bioregional Plan states that sperm whales are "*known to occur in waters along the shelf break of the eastern Great Australian Bight and waters to the south of Kangaroo Island and are presumed to be foraging in these areas.* ***They are not seasonal: they can be encountered at any time during the year***"

(SEWPaC, 2012c; emphasis added). The latest mapping from the Department of Sustainability, Environment, Water, Population and Communities indicates significant overlap between sperm whale foraging areas and the proposed survey area (SEWPaC, 2012d). Given that the waters in the proposed survey area are biologically important for sperm whales (foraging), there is "*High risk of significant impact … seismic surveys may still pose a threat to sperm whales, particularly in biologically important areas, where seismic noise may affect the abundance of prey species*" according to the Southwest Marine Bioregional Plan (SEWPaC, 2012c).

The Stone (2003) report cited by the proponent is an unpublished report from observations by MMOs working on seismic surveys in the UK between 1998 and 2000. The key weaknesses with these data are that they are only an indication of whale behaviour at the surface and reveal nothing of other effects. This point is noted by Stone: "*Other potential effects of seismic activity remain largely unknown, for example long-term effects, effects on vocalisations, social behaviour and physiology, consequences of auditory masking and the potential for damage to hearing. It is essential, therefore, that the precautionary guidelines to minimise disturbance continue to be applied*" (Stone, 2003). Subsequent studies have concluded that seismic surveys may impact sperm whales (Jochens, 2008) through reduced foraging rather than horizontal displacement. Currently there is insufficient understanding of the effects of seismic on sperm whales to conclude that this species is the least impacted.

The proponent also refers to visual observations from active seismic vessels to argue that sperm whales continue to feed during seismic testing. Given that it is well-documented that sperm whales feed at depth, it is difficult to understand how "numerous observations" of this behaviour have been recorded from a distance of 2-3km away.

13) **Department's concern:** While it is recognized that the proposed activity is not planned to coincide with the possible peak in August/September, Sperm whales may be present in the proposed area at the time of the proposed action.

Proponent's response: *Agreed, they may be present all year round, as they undoubtedly are in other areas along the continental slope of Australia's Southern Margins.*

IFAW's response: IFAW agrees with the Department that sperm whales may be present in the proposed area and the time of the proposed action. It is interesting to note that the proponent also agrees with this concern, as elsewhere in the referral they claim there is a low likelihood encountering sperm whales between January and March and May to October (page 25 of the referral).

14) **Department's concern:** The proponent discounted the use of Passive Acoustic Monitoring (PAM) to support identification of Sperm whales in the proposed survey area in the referral documentation and additional information provided on 17 December 2012 and did not propose the use of any alternative mechanisms to detect whales at depth. Adaptive management measures have been proposed, but rely on visual observations.

Proponent's response: *Bight's concern about the effectiveness of PAM is based on the latest BOEM workshop and report (Bingham 2011) together with operational articles and reports on the use of PAM during seismic surveys. As a result, Bight considered that visual observations from the scout/support vessels deployed 5 to 10km ahead of the main vessel was a more effective way of detecting the presence of diving sperm whales. Based on their average dive time of 35 minutes, there would be sufficient time to detect sperm whales visually, especially given the highly localized location of their dive areas (above canyons) before they entered the proposed 3km power-down zone. Nevertheless, Bight is committing to deploying a PAM system in this new referral on the basis that its effectiveness will be closely monitored relative to visual sightings.*

IFAW's response: IFAW reiterates that towed PAM has been demonstrated to be effective in detecting many cetacean species and especially for sperm whales (Gillespie, 1997; Leaper *et al*.,

2000; Barlow and Taylor, 2005). However PAM relies on good reliable equipment and experienced operators. If it has not proven effective for the seismic industry, this may be due to insufficient attention to the equipment and operator training. There is currently no incentive for the seismic operator to ensure that PAM gear is properly functional because acoustic detections may cause delays and additional expense.

The descriptions and observations of PAM provided by Bight Petroleum are misleading, as they do not make it clear that PAM would be used as a **complimentary** measure alongside visual monitoring. As recognised by the proponent, sperm whales are deep diving cetaceans that spend less time surfacing. Visual observers are only likely to detect a small proportion of whales and combined acoustic monitoring will greatly increase the likelihood of detecting sperm whales that enter either the low-power zone or 500m shutdown zone. This is increasingly being recognised by regulatory regimes across the world and PAM has been adopted in guidelines in the USA, UK and New Zealand.

In the proposed seismic survey area, the continental slope is highly irregular and is intersected by numerous deep canyons, creating the varied habitat likely to attract prey such as squid and deep-sea fish, providing feeding habitat for deep-diving sperm whales (BWS, 2012). These factors make the surfacing and diving sites of sperm whales anything but "*highly localized locations*" and a moving scout vessel is still highly unlikely to detect a submerged sperm whale diving for 35 minutes using visual methods alone.

15) **Department's concern:** SEWPaC considers that the use of PAM to assist in identifying Sperm whales in the area, presents a viable management measure. SEWPaC also concluded that feeding sperm whales would not be effectively observed using the proponent's proposed visual observation measures.

Proponent's response: *The BOEM workshop and report concluded that much work was still needed to make PAM an effective management measure. Recent reports of the use of PAM in, for example, the Gulf of Mexico, discussed in the original referral and in this new referral, demonstrated that visual observations were more effective in detecting sperm whales than PAM. Despite this, as indicated in this new referral, Bight Petroleum is willing to commit to the deployment of a PAM system during the Lightning MSS.*

IFAW's response: Bight Petroleum quotes extensively but also selectively from Bingham *et al*. (2011) to attempt to justify why PAM should not be used. However, a closer examination of the paper demonstrates a number of favourable conclusions on PAM. For example, Bingham states *"Towed PAM systems have been used with some success to supplement visual monitoring of exclusion zones in the North Sea, the Gulf of Mexico, and elsewhere"*, and *"In some circumstances, the effectiveness of marine mammal monitoring and mitigation could be increased by using a combination of approaches".*

Again, IFAW notes that for sperm whales, there is comprehensive evidence from combined visual and acoustic surveys that PAM using towed hydrophones is much more effective, usually by at least an order of magnitude, at detecting whales than visual methods (e.g. Gillespie, 1997; Leaper et al., 2000; Barlow and Taylor, 2005). The poor performance of visual methods is due to the whales spending long periods underwater and out of sight. PAM relies on good reliable equipment and experienced operators. If it has not proven effective for the seismic industry, this may be due to insufficient attention to the equipment and operator training. There is currently no incentive for the seismic operator to ensure that PAM gear is properly functional because acoustic detections may cause delays and additional expense.

IFAW is concerned at the number of inaccurate claims made by the proponent about PAM and while Bight Petroleum has conceded to a 'trial' of PAM, they are highly dismissive of this mitigation measure. This gives little confidence in the likelihood of the proponent conducting a trial that is anything other than designed to fail. Should the proposed seismic survey be

approved, the Department should insist that the proponent provide full details of the methodology they will employ to carry out passive acoustic monitoring of cetaceans during the proposed seismic survey to reassure the Department and stakeholders that this is a serious proposition, and also insist on some kind of independent oversight of the trial methods to be employed by Bight Petroleum to ensure the use of PAM is actually meaningful.

16) **Department's concern:** On the basis of the above points related to Sperm whales, SEWPaC concluded that, without effective detection measures, there is a real chance or possibility that the proposed action will substantially impact feeding Sperm whales within important habitat for the species, hence the proposed action is likely to have a significant impact on the migratory Sperm whale.

Proponent's response: *Although Bight does not consider that the addition of PAM as proposed in this referral will be fully effective, when added to the visual detection measures already proposed which are in excess of most surveys conducted along the Southern Margins of Australia, the proposed management measures in this new referral should address SEWPaC's concerns.*

The proposed Lightning MSS will be run in accordance with comprehensive cetacean interaction procedures (DEWHA, 2008) which will ensure no significant impact to cetacean species at an individual or a population level, for those species which may be present during the MSS period.

IFAW's response: Given the numerous negative remarks included by the proponent about the use of PAM to assist in detecting sperm whales in the area, IFAW is less than convinced that the proponent is willing to fully embrace the use of PAM during the entirety of the proposed marine seismic survey and urges the Department to consider this as a substantial issue when reviewing this proposal. As stated above, should the proposed seismic survey be approved, the Department should insist that the proponent provide full details of the methodology they will employ to carry out passive acoustic monitoring of cetaceans during the proposed seismic survey to reassure the Department and stakeholders that this is a serious proposition, and also insist on some kind of independent oversight of the trial methods to be employed by Bight Petroleum to ensure the use of PAM is actually meaningful.

Given the vast number of serious concerns the Department had previously about the proposed seismic survey proceeding, and given the failure of the proponent to adequately address these issues as highlighted above, IFAW believes the proposed action should be refused outright. At the very least, it should be deemed a controlled action for the following reasons:

1. If deemed a controlled action the proposal could be assessed by environmental impact statement (EIS) or public environment report (PER), whereby the proponent should be required to gather the kind of information that is lacking as highlighted above.

2. The significant impact guidelines (DEWHA, 2009) state that an action is likely to have a significant impact on an endangered species *"if there is a real chance or **possibility** it will: … reduce the area of occupancy of the species; … adversely affect habitat critical to the survival of the species; … modify … or decrease the availability or quality of habitat to the extent that the species is likely to decline"* [emphasis added].

   There is a possibility of all of these occurring for blue whales. Bight Petroleum's own modelling of sound transmission demonstrates that considerable amounts of the survey area will receive SELs at or above thresholds recognised to cause avoidance and displacement for baleen whales. This will likely reduce the area of occupancy of blue whales as well as modify or decrease the availability and quality of their acoustic

habitat. In the case of a recovering species, which needs to feed on a regular basis, reducing the availability and quality of its acoustic habitat in one of only three foraging areas known in Australian waters could have serious consequences for the health of individuals within that population and as a result cause the species to decline. The significant impact guidelines define habitat critical to the survival of a species as areas that are necessary for activities such as foraging. The Kangaroo Island Pool and Canyons fit this description – they are recognised in the blue, fin and sei whale recovery plan (DEH, 2005b, as the Duntroon Basin) as one of only three recognised foraging areas in Australian waters and listed as a foraging area in the South-west Marine Bioregional Plan (DSEWPAC, 2012c). The guidelines are clear that habitats critical to the survival of a species **are not limited to** the Register of Critical Habitat under the EPBC Act.

3. The significant impact guidelines (DEWHA, 2009) state that an action is likely to have a significant impact on an endangered species if there is a *"**possibility** it will … disrupt the breeding cycle of a population"* [emphasis added]. As the survey will continue into May, there is the possibility it will disrupt the breeding cycle of endangered southern right whales as heavily pregnant southern right whales migrate through the survey area to calving grounds in South Australia. These are likely to be whales from the southeast population, which is not recovering. The latest draft of the southern right whale conservation management plan identifies seismic activities as being one of the key threats to both the southeast and southwest population and specifically as a risk with **major consequences** to the southeast population.

4. The significant impact guidelines (DEWHA, 2009) state that an action is likely to have a significant impact on a migratory species if there is a *"**possibility** it will: substantially modify … an area of important habitat; … seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population"* [emphasis added].

   Given that Bight Petroleum's own modelling of sound transmission demonstrates that considerable amounts of the survey area will receive high sound energy levels, particularly in deeper waters, there is a possibility that this will substantially modify the acoustic habitat of sperm whales, and other migratory species (e.g. pygmy right whales) which are likely to be encountered in the survey area at that time of year. The area is presumed to be a foraging area for sperm whales (SEWPaC, 2012e) and likely feeding area for pygmy right whales; therefore, there is also the possibility that the survey would seriously disrupt the lifecycle (feeding) of these animals. The Southwest Marine Bioregional Plan (SEWPaC, 2012c) clearly states: *"[f]or the purpose of determining the significance of impacts of proposed actions on sperm whale, a migratory listed species, it should be assumed that an ecologically significant proportion of the population occurs in the South-west Marine Region"*.

5. The significant impact guidelines (DEWHA, 2009) state that an action is likely to have a significant impact on the Commonwealth marine environment if there is a *"**possibility** that the action will: … disturb an important or substantial area of habitat such that an adverse impact on the marine ecosystem functioning or integrity in a Commonwealth marine area results; have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour life expectancy) and spatial distribution"*.

   As well as listed threatened and migratory species, the region is home to a wide range of other cetacean species, which are top predators in the marine ecosystem in this area. This includes a number of beaked whale species, which are likely present in the area to feed and are highly susceptible to acoustic disturbance (Taylor *et al.*, 2004). The South-

west species report card for cetaceans highlights how the South-west region is one of the key areas worldwide for beaked whales (SEWPaC, 2012e). There is a possibility that introducing intense sound into this acoustic habitat will have adverse effects on cetaceans feeding in the area (and possibly some of their prey species) and may disturb an important or substantial area of habitat for top predators in the marine ecosystem such that an adverse impact on the its functioning or integrity results.

The guidelines also note, *"Actions in or near marine protected areas, or other areas with high conservation value, have a greater likelihood of significant impacts on the Commonwealth marine environment".* A significant proportion of the survey area, particularly over deep water (where beaked whales are more likely to be concentrated), is included in the Commonwealth marine reserves network; a clear indicator that this is an area of high conservation value.

6. The significant impact guidelines (DEWHA, 2009) also note that proponents *"should not conclude that a significant impact is not likely to occur because of management or mitigation measures unless the effectiveness of those measures is well-established … and there is a high degree of certainty about the avoidance of impacts or the extent to which impacts will be reduced"*. As noted in section 4 above, the effectiveness of mitigation measures for seismic surveys are not well-established. There is a high degree of uncertainty about the extent to which impacts will be reduced, particularly by the measures proposed by Bight Petroleum.

7. The revised referral still relies on unpublished and non-scientifically peer reviewed sources to substantiate its claims. If deemed a controlled action the proposal could be assessed by environmental impact statement (EIS) or public environment report (PER), whereby the proponent should be required to publish the data concerned so it is open for public and scientific scrutiny.

7.2 Reliability and date of information

Bight Petroleum states: *"The information provided in this Referral has been sourced from a wide range of scientific papers and published reports. The information is the most current information available and has been the subject of technical, scientific and peer review."*

This statement is inaccurate. Many of the reports Bight Petroleum most heavily relies on (Blue Whale Study Inc., 2012; CMST, 2012; unpublished study of MMO sightings in the GAB; Barousse *et al.*, 2012) to make conclusions about timings of the proposed survey, likelihood of impact (sounds transmission modelling) and effectiveness of mitigation methods have either not been published or have not been subjected to scientific peer review (and in some cases neither).

7.3 Attachments

Bight Petroleum have not attached "copies of any flora and fauna investigations and surveys", nor "technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral".

As mentioned above, Bight Petroleum relies heavily on the information in Blue Whale Study Inc. (2012) to determine the timing of this survey, but has not attached this report to the referral, although this and other documents have been published now on Bight Petroleum's website. IFAW has studied this report closely, allowing us to identify the amount of survey effort dedicated to finding cetaceans, the month each sighting was made, group size and behaviour. Many of the cetaceans found in these waters are elusive i.e. low in number and travel fast across large distances (e.g. blue whales) or deep diving (e.g. sperm and beaked whales) and detections are unlikely to be made of these animals without adequate dedicated survey effort. In fact, the survey comprised of only five days of survey effort in the proposed area (one day a month in

Nov, Dec and Mar, two days in Feb and none in either Apr or May) and **only one day of surveying during the proposed seismic testing period**. This is quite clearly not "*an extensive baseline aerial monitoring programme*" as Bight Petroleum has sought to present it. IFAW concludes that the data collected were insufficient to truly reflect species presence and distribution within the survey area.

Nor has Bight Petroleum attached the CMST, 2012 report that models sound transmission in the survey area, although as with the report above this has been published on the proponent's website.

Bight Petroleum has not attached the unpublished study of MMO sightings in the GAB.

All of these reports are important documents relied upon by Bight Petroleum in its referral. The referral template clearly envisages such documents being submitted. Attaching such documents should be a prerequisite for referral submissions in order that those being given the opportunity to comment during the public comment period have all relevant information to hand.

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Appendix 2 – IFAW/MCR cetacean survey report

Final report for a survey of cetaceans in the eastern Great Australian Bight 26th April – 8th May 2013

by

The International Fund for Animal Welfare

and

Marine Conservation Research Limited

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SUMMARY

The eastern Great Australian Bight (GAB) upwelling area off the coast of South Australia is severely data deficient in terms of both understanding cetacean biodiversity and oceanographic fluctuations between years. The Australian Government opened two lease areas for oil and gas exploration in 2010 and in response to this, International Fund for Animal Welfare (IFAW) Oceania undertook a visual/acoustic survey of the licenced area for marine mammals in April/May 2013. The objective of the work was to provide initial baseline data on the presence, diversity and distribution of cetaceans in this poorly studied area and this is the first systematic vessel-based research survey of the region conducted during this time of year. The survey site covered 15,130 km^2 and included shelf, slope and abyssal habitats. During 1100 km (220 hours) of survey effort, 20 sightings were made of four species of cetaceans (pilot whale, common dolphin, bottlenose dolphin and Shepherd's beaked whale) and one species of seal. In addition, sperm whales were also detected acoustically, usually in waters deeper than 1000 m, and although there were no sightings during vessel surveys, the aerial surveys conducted of the same area reported two sightings of three individual sperm whales (see Appendix II). Odontocete clicks, whistles and pulsed calls were detected throughout 32% of the study site and were mainly concentrated around the continental slope between depths of 200 m and 3000 m. The peak in detections was situated within the planned seismic survey area and over the slope, areas that were also found to have low ambient noise levels during the course of the study. The majority of acoustic detections were made during hours of darkness, highlighting an inherent weakness in surveys relying on visual techniques alone. Baleen whales were not seen or heard throughout the survey, nor were they encountered during consecutive aerial surveys. These results suggest the proposed seismic survey will be both spatially and temporally proximate to aggregations of whales including sperm whales, pilot whales and Shepherd's beaked whales, a species that may have only been previously seen alive at sea on fewer than ten occasions worldwide. As such, it is recommended that visual and acoustic surveys for cetaceans be conducted over multiple years to gain a better understanding of presence, diversity and distribution in this area, to better inform future decisions around industrial development and conservation.

1. INTRODUCTION

The eastern Great Australian Bight (GAB) upwelling area off South Australia is severely data deficient both in terms of understanding upwelling fluctuations from year to year and in terms of cetacean biodiversity. The Australian Government opened two lease areas for oil and gas exploration in 2010 (EPP-41 and EPP-42). Presently, one petroleum exploration company has applied for permission under the Environment Protection Biodiversity Conservation (EPBC) Act to conduct seismic testing in this area during the months of March to May. This time of year is considered a "shoulder season" between blue whale feeding aggregations in the summer months and the migration of southern right whales to calving and breeding grounds in winter months.

This area includes the Kangaroo Island pool and canyons, a key ecological feature and a conservation site of regional priority in the south-west marine bioregional plan (SEWPaC, 2012a). The Government's protected matters search tool reveals that the area represents habitat for 28 species of cetacean including sperm whales, fin and sei whales. South Australian waters also encompass a worldwide hotspot in terms of beaked whale species diversity and one of only three recognised feeding areas for the endangered blue whale in Australian waters. Survey effort is severely lacking in

this area, particularly during the months of March to May. Scientific data regarding the diversity, distribution and presence of cetacean species are urgently needed in this oil and gas development area and Australian waters more generally in order to inform conservation management and decisions on industrial activity in the area.

The field work conducted in 2013 was the first systematic vessel-based research survey of the area during these months. The objective of the work was to conduct visual and acoustic research for cetaceans in the waters of the eastern GAB upwelling area, providing initial baseline data on presence, diversity and distribution in this poorly studied area.

1.1 Baleen whales

Blue whales, thought to be pygmy blue whales (*Balaenoptera musculus brevicauda*), aggregate off southern Australia each austral summer (November to May) to feed on euphausiid (krill) swarms (*Nyctiphanes australis*) in the seasonal cold water upwelling (Gill *et al*., 2011). Gill and colleagues (2011) describe the presence of complex cross-shelf canyons in this area as being similar to those linked to the upwelling along the Bonney Coast, and propose that the nutrient-rich waters of the Kangaroo Island pool influence both blue whale and krill distribution in this area. During aerial surveys conducted in 2003, blue whales were observed feeding along the outer shelf to the south and west of Kangaroo Island, confirming that the blue whale feeding ground in this region was larger than previously thought (Morrice *et al*., 2004). The exact timing of blue whale presence in the area is highly variable, as is the upwelling which is thought to drive prey availability and distribution in the region (Gill *et al*., 2011).

Southern right whales (*Eubalaena australis*) migrate to calving and breeding grounds in southern Australian waters during the austral winter each year. These whales occupy coastal waters from May to October and female southern right whales exhibit high site fidelity during calving years (Pirzl, 2008). The exact migratory routes of southern right whales from Antarctic to Australian waters remain unknown. However, it is recognised in the Conservation Management Plan for the Southern Right Whale 2011-2016 (SEWPaC, 2012b) that habitat connectivity between calving areas is of importance to the recovery of this endangered whale species. It is likely that pregnant southern right whales migrating to nearby calving grounds at Sleaford Bay would travel through the area to the west of Kangaroo Island on their migratory path.

Although sighted on previous occasions, data regarding distribution, abundance, movement patterns and habitat use of fin whales (*Balaenoptera physalus*) and sei whales (*Balaenoptera borealis*) in this area are deficient due to a lack of survey effort. Observations have been made of both fin and sei whales feeding alongside blue whales nearby in the Bonney Upwelling (Gill, 2002).

Large whales are subject to a wide range of anthropogenic impacts. From the late 1700s to as recently as 1978, southern right, humpback, sperm and blue whales all suffered some degree of population depletion by whaling carried out in Australian waters. The extent to which pygmy blue whales were impacted by the whaling activity that pushed Antarctic blue whales (*B. m. intermedia*) to the brink of extinction (with as few as 150 individuals remaining in 1973; Branch *et al*., 2004) is still not fully understood. Since the IWC moratorium on whaling came into effect in 1986, other anthropogenic activities continue to threaten the recovery of large whales. Entanglement in fishing

gear for example is a major source of non-natural mortality (Perrin *et al*., 1994; Volgenau *et al*., 1995) and ship strike poses a threat to all species of great whales, especially from large, fast commercial vessels such as container ships (Clapham *et al*., 1999). Noise pollution is a growing issue in the waters around Australia (see Erbe, 2013, for a review). Shipping traffic is steadily increasing as are the number of seismic surveys, due to the dramatic increase in offshore oil and gas development in recent years.

Baleen whales are known to produce numerous types of low frequency signals (see for example, Cummings *et al*., 1986; Edds, 1988; McDonald *et al*., 2001; Thompson *et al.,* 1996), mostly below 50 Hz. Off Madagascar and Western Australia, regionally distinctive sounds are produced by suspected pygmy blue whales with differing frequencies and sound production patterns (Ljungblad *et al*., 1998; McCauley *et al*., 2000) and recently, the vocal repertoire of southern right whales in New Zealand waters has been described (Webster and Dawson, 2011). With limited knowledge of sei and fin whale vocalisations and increasing evidence suggesting that song patterns from blue whales can be used to distinguish between stocks (McDonald *et al*., 2006), efforts to describe the vocalisations of baleen whales are particularly important.

1.2 Beaked whales

The beaked whales are one of the least known families of cetaceans. They are particularly difficult to study, because they are deep divers with an oceanic distribution. They are also very difficult to detect visually at sea (Barlow *et al.,* 2006). In recent years, there has been increasing evidence that they are vulnerable to anthropogenic sounds, particularly seismic airguns and military mid frequency sonar (2-10 kHz) (e.g. Tyack *et al.*, 2011; DeRuiter *et al.,* 2013). In the past 40 or so years, over 40 mass strandings have been reported world-wide (probably representing a small proportion of all beaked whale strandings). Some of these were concurrent with naval exercises and the use of active sonar, and the overall pattern of strandings has led to increasing concerns that certain high intensity sounds may result in the death and injury of beaked whales (Cox *et al*., 2006).

Beaked whales are known to be difficult to observe at sea (e.g. Barlow *et al.,* 2006), so improved systems for detecting beaked whales, for example using passive acoustic techniques, have intrinsic value. Beaked whales have been found to use relatively high frequency echolocation (up to 50 kHz or more) and non–echolocation sounds in the region of up to at least 16 kHz. Some of these vocalisations appear to be quite distinctive from those of other cetaceans (Johnson *et al*., 2004; Zimmer *et al*., 2005); a very positive finding in terms of the viability of identification of beaked whales by acoustics.

The SEWPaC cetacean report card for the south-west region (SEWPaC, 2012c) details the occurrence of beaked whales in the region; "*Information is limited on the ecology of beaked whales, and most information about the species group has been gleaned from stranded specimens (MacLeod & Mitchell 2006). Beaked whales are generally found in deep water offshore around seamounts and canyons. They dive for long periods and are rarely observed. South-west Australia has been listed as one of the key areas for beaked whales worldwide, particularly Hector's, Andrew's and Cuvier's beaked whales (MacLeod & Mitchell 2006), while the most common beaked whale to strand in South Australia is the strap-toothed beaked whale (Kemper 2008)*." In 2012, six rarely-seen Shepherd's beaked whales (*Tasmacetus shepherdi*) were sighted in this area (BWS, 2012) and a sighting of this

species was also documented further east in the Bonney Upwelling (Miller *et al*., 2012). Based on historical data, eight species of beaked whale may occur in the area and a number of sightings of groups of Arnoux's beaked whales (*Berardius arnuxii*) have been reported in the past (Kemper, *pers. comm*.).

Current information on beaked whale distribution is sparse, but they "seem to be most common in slope waters and around offshore volcanic islands" (Kaschner, 2007). Certainly, many of the recent strandings have been in areas with abrupt undersea topography (e.g. Hellenic Trench, Greece, the Canary Islands and Galápagos Islands; Frantzis, 1998; Podestà *et al*., 2006; D'Amico *et al*., 2009). The physical basis for the association probably lies in the effects of topography on the water column and the way it concentrates nutrients and prey. A better understanding of the preferred habitats of these whales will support measures to protect them.

1.3 Sperm whales

Sperm whales (*Physeter macrocephalus*) are the largest of the toothed whales and have been recorded off all Australian states (Bannister *et al*., 1996). Sperm whales are deep diving cetaceans that forage for oceanic cephalopods for prolonged periods and are usually found in deep waters (>200 m) in pelagic habitats. In Australia, key locations for sperm whales include the area between Cape Leeuwin and Esperance, Western Australia, close to edge of continental shelf; southwest of Kangaroo Island, South Australia; off the Tasmanian west and south coasts; off New South Wales, including Wollongong; and off Stradbroke Island, Queensland (Bannister *et al*., 1996). Sperm whales were hunted commercially in Australia until 1978 and the only systematic survey for these whales was conducted in the late 1960s; as a result the current population status is not known (SEWPaC, 2012d).

Sperm whales produce very distinctive, loud and regular characteristic broadband clicks at a rate of about one per second during most of their deep dives. Between dives they may spend only short periods (about 10 minutes) at the surface. These characteristics make sperm whales well-suited to acoustic surveying, but more difficult to survey visually. Sperm whale clicks can easily be detected and analysed with available software allowing the location of the whale to be determined (Gillespie and Leaper, 1997).

1.4 Other odontocetes

Pilot whales

Both short-finned (*Globicephala macrorhynchus*) and long-finned pilot whales (*Globicephala melas*) are found in Australian waters, although the latter appears to occur exclusively south of 27°S (Ross, 2006). These gregarious delphinids are highly social animals and are typically observed in smaller groups of 10 to 50 although they are also seen in large pods from hundreds to thousands (Bannister *et al*., 1996). Pilot whales have been widely recorded in the waters off Australia and the short-finned species is found in tropical (22-32°C) to temperate (10-22°C) oceanic waters and the long-finned in temperate (10-20°C) and deep, sub-Antarctic (1-8°C) waters. Long-finned pilot whales also appear to favour areas of higher productivity along continental slope waters, apparently moving into shallower shelf waters (<200 m) to hunt for prey (Ross, 2006). Neither short-finned nor long-finned pilot whales have been systematically surveyed in Australian waters despite the numerous sightings.

Bottlenose dolphin

Historically, all bottlenose dolphins in Australia were recognised as *Tursiops truncatus*. More recently, *Tursiops aduncus* have been confirmed off eastern and western Australia (see Möller & Beheregaray, 2001 and Krützen *et al*., 2004) and *Tursiops australis* off south eastern and southern Australia (Charlton-Robb *et al*., 2011). Molecular and morphological differences are well described, but biological and habitat preference information is limited for bottlenose dolphins inhabiting Australian waters, although they are known to be abundant and widely distributed in both coastal and offshore waters (Ross, 2006).

Common dolphin

Short-beaked common dolphins (*Delphinus delphis*) are poorly studied in Australian waters and so information about their ecology, distribution and abundance is currently lacking (Ross, 2006). In South Australia, Gulf St. Vincent is recognised as a key locality for this dolphin species; it is suspected that this is due to high prey availability or because the shallow, sheltered waters provide protection from the many deep-water predators in this area (Filby *et al*., 2010). Bycatch of common dolphins in purse-seine fisheries, such as the South Australian Sardine Fishery, has been identified as a serious cause of mortality likely to be impacting these dolphins at a population level (Bilgmann *et al*., 2008).

1.5 Aims

The primary purposes of this survey were to:

- Collect baseline visual and acoustic data for cetaceans in the eastern GAB upwelling area during April and May (a season with little previous survey effort).
- Collect photographic identification data on priority species (see Appendix I) in order to support local photo-ID catalogues and to further understanding of which populations utilise this upwelling area.
- Investigate the importance of slope waters for all species.

2. METHODOLOGY

The research was conducted in the eastern Great Australian Bight from the 26th April to the 8th May 2013 in a 15,130 km^2 offshore area located to the south of Spencer Gulf and limited by the most western tip of Kangaroo Island (Figure 1). The survey was carried out from the 19 m sailing catamaran *SV Pelican* with a team of 13 personnel; seven scientific staff, five crew and one cinematographer. When sailing was not possible, twin 50 HP diesel sail drive engines provided auxiliary power.

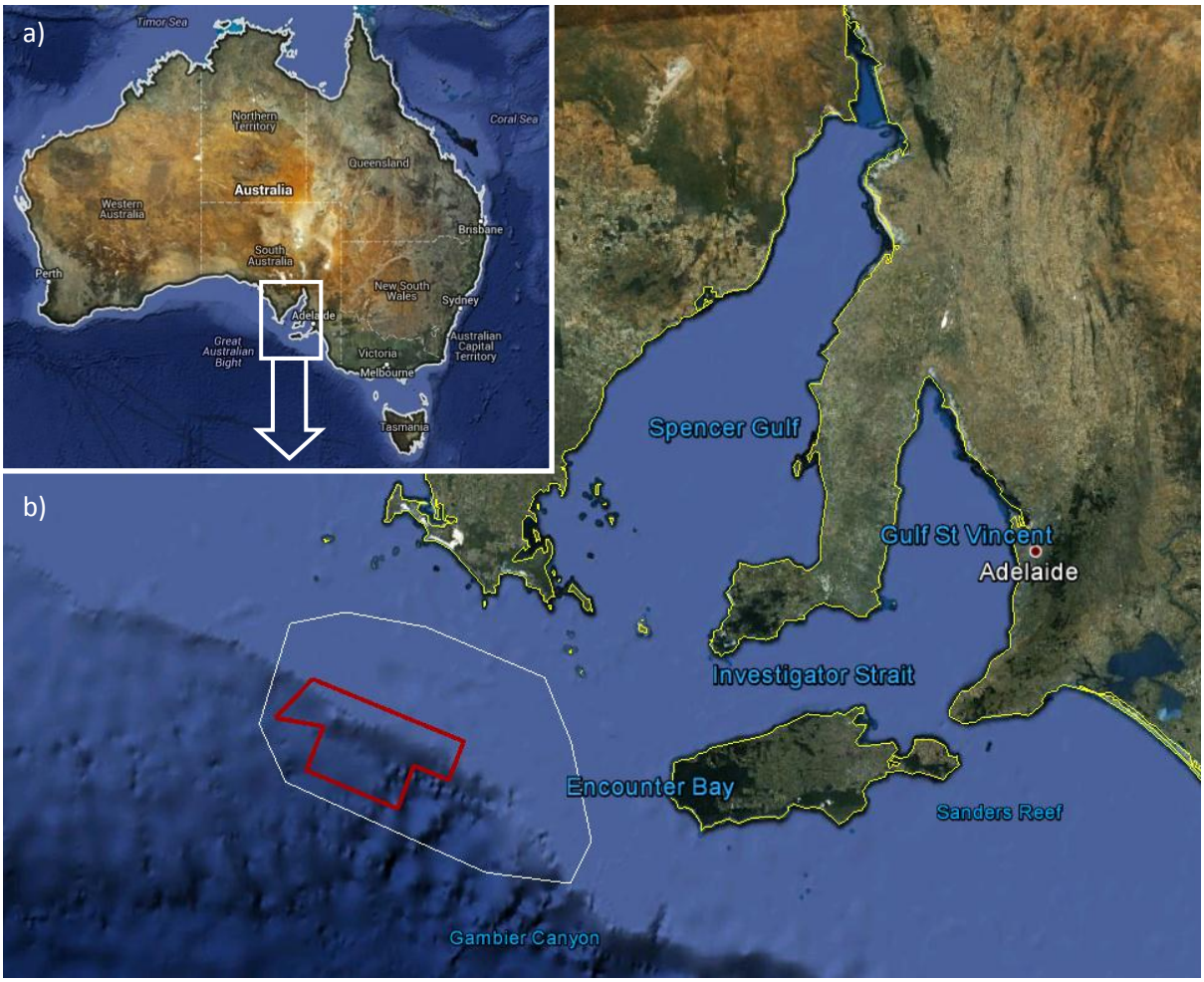


Figure 1. a) Map showing the location of the survey area. b) Detailed view of survey area (white polygon) and the planned seismic area (red polygon). Bathymetry from Google Earth.

Survey track lines were designed using the programme Distance 6.0 (RUWPA, University of St Andrews) in order to provide an equal coverage probability within the area. Tracks were designed in an adjusted angle zigzag mode to be perpendicular to bathymetry contours and oriented towards the direction of the prevailing wind to facilitate sailing. Total length of the track was of 314 nm (see Figure 2).

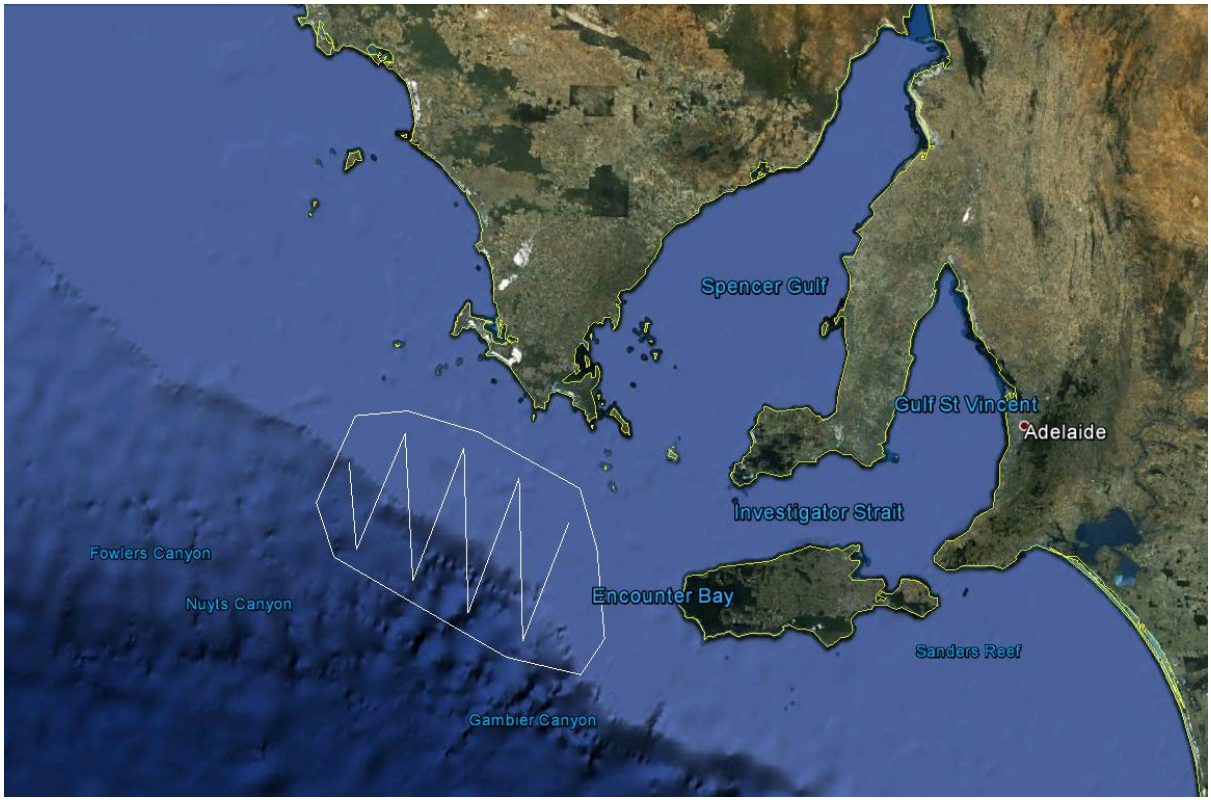


Figure 2. Planned adjusted angle zigzag track lines designed using the programme Distance. The external polygon shows the study site with a 10 km margin to allow for sail changes on the approach to any given track line.

Acoustic monitoring was carried out 24 hours a day and visual surveying conducted during daylight hours and favourable conditions. All times are reported in coordinated universal time (UTC).

2.1 Visual survey

Visual observations were conducted during daylight hours when sea conditions were appropriate (below sea state four). When on effort and weather permitting, two observers positioned on the *SV Pelican* cabin roof with an eye height of approximately 5.6 m scanned the sea surface ahead of the vessel using the naked eye and/or binoculars. One observer scanned from 0-180 degrees, and the other from 180-360 degrees; however both observers focused the majority of their effort ahead of the vessel at the trackline. In higher sea states, visual observation took place from deck.

Sighting information was logged to a database via the Logger software (IFAW) and included the angle and distance to the animal, species, group size and behaviour. Angle was determined using an angle board placed in front of observers while distance to the animals was estimated using reticulated binoculars. Environmental variables such as wind speed (knots), wind direction, sea state, wave and swell height, sea surface temperature (°C) and survey effort (numbers and positions of observers) were logged hourly or when conditions changed. GPS and AIS data were also logged automatically to the same database, including date, time and vessel position (lat-long).

Effort status was also logged and it was classified into three categories:

1) Passage: when transiting towards or away from the survey area.

2) Track: when following track lines within the survey area.
3) With animals: when normal survey effort was interrupted to approach animals.

In each category one of these options was selected: survey, visual survey, acoustic survey or visual and acoustic.

2.2 Acoustic survey

Acoustic surveys were conducted under sail, motor or motor/sail at 5-8 knots, a speed that allowed the hydrophone array to stream while reducing strum and excessive strain. A 300 m hydrophone array was towed from the *SV Pelican* at all times when water depth was sufficient. The array consisted of a tow cable and an oiled-filled tail, both containing different hydrophone elements: two low frequency elements (flat response within 1.5 dB from 10 Hz to 15 kHz) 100 meters apart and two broadband elements (2 kHz to 200 kHz) spaced 0.25 m apart (see Figure 3). The pairs of hydrophones were used in order to obtain range and bearing information to animal vocalisations. The two low frequency hydrophones were primarily used to collect data on baleen whales while the two broadband elements were used to detect beaked whales, sperm whales and dolphin clicks and whistles.

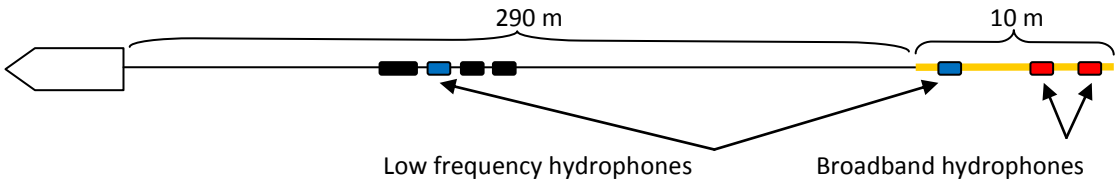


Figure 3. Details of the hydrophone and arrangements of the elements.

Continuous stereo recordings were made at sampling rates of 48 kHz (from the low frequency elements) and 192 kHz (from the broadband elements) via a bespoke Seiche buffer box passing signals to an RME Fireface sound card and an NI-6251 data acquisition card respectively. The entire system was capable of detecting signals from 10 Hz to 200 kHz. For the bandwidths of interest for baleen whale vocalisations (10 to 8000 Hz) and beaked whale clicks (25 to 50 kHz), the response of the system was approximately flat.

Recordings were made using Pamguard v1.12.05 (Passive Acoustic Monitoring Guardianship, www.pamguard.org) and Logger 2010 (IFAW), being written to disk as two-channel 16-bit wav files. Different Pamguard modules were employed in real time throughout the survey; a click detector module, which used the broadband signals to monitor and record odontocete clicks including beaked whales, and a spectrogram module, which monitored dolphin whistles. A separate click detection software, Rainbow Click (IFAW), was also run continuously to log sperm whale and dolphin click trains in the audio range (2 to 24 kHz). In addition, the hydrophone array was monitored aurally for two minutes every 15 minutes in order to detect vocalisations and check the acoustic system was operating correctly. All vocalisations heard during those listening stations were noted in a Logger database classifying them into different categories: odontocetes clicks, odontocete whistles, sperm whale clicks, sperm whale codas and baleen whale moans. Background noise, such as water flow and ship noise (from either *SV Pelican* or other vessels) was also logged. For every

vocalisation heard, a score (one to five, five being the highest) was attributed depending on the relative intensity of the sound.

Baleen whales

Analysis of the low frequency recordings sampled at 48 kHz was carried out using XBAT Extensible Bioacoustics Tool (Cornell University). Audio data were visually analysed by scanning spectrograms. For every vocalisation detected, and after aural confirmation, start and end frequencies and times were logged.

Beaked whales

A beaked whale click detector mode was run continuously in real time using Pamguard software and was checked periodically for any possible detections. Beaked whale clicks have the distinctive form of a relatively long duration (~200 µs) FM upsweep with dominant energy between 25 and 50 kHz (Johnson *et al.*, 2004; Johnson *et al.*, 2006; Gillespie *et al.*, 2009) making it possible to detect and extract potential beaked whale clicks from background noise using click detection algorithms.

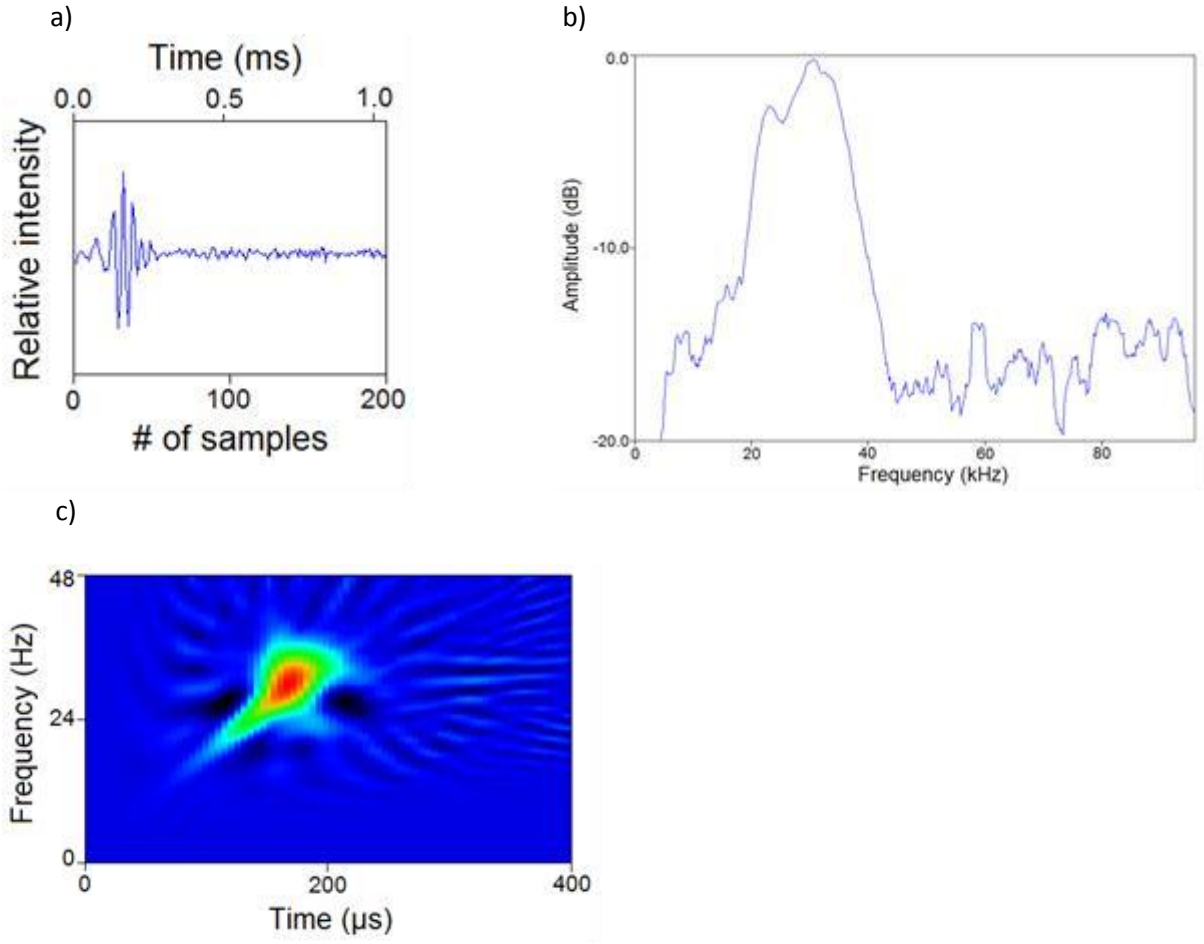


Figure 4. Typical features of a beaked whale click. Waveform (a), power spectrum (b) and time-frequency Wigner plot (c).

Post-survey, a more thorough analysis was conducted of potential beaked whale clicks using Pamguard software. Each click was manually inspected by an analyst to remove any false detections

and separate the clicks into acoustic events. Candidate beaked whale clicks were classified with a subjective measure of confidence (possible, probable or definite) according to how well they conformed to the parameters displayed in Figure 4. A second analyst independently confirmed these events.

Sperm whales

In addition to the automated detection of sperm whales using Rainbow Click, data logged from the aural listening stations were analysed post-survey to confirm sperm whale detections and separate them into different acoustic events. Recordings of every event were inspected again and sperm whale group size was estimated as one, two or three or more animals.

Background noise levels

Background noise levels were measured for all 48 kHz recordings made during the survey using the Noise Monitor module in Pamguard.

3. RESULTS

A total of 1099 km (220 hours) of research effort was undertaken in the eastern Great Australian Bight waters over nine days (Table 1). *SV Pelican* left North Haven, South Australia, on 26th April and arrived at the survey area two days later after a stop at Marion Bay (Investigator Strait) to wait for weather conditions to improve. From 28th April until 8th May, the survey was conducted continuously except for one day when weather conditions were inclement.

Table 1. Summary of research effort from 26th April to 8th May 2013.

Effort status	Nautical miles	Kilometres	Time (hh:mm)
Passage	189	350	34:37
Passage + acoustic	142	264	28:42
Passage + visual	50	93	13:46
Passage + acoustic + visual	53	99	10:10
Track + acoustic	394	730	77:57
Track + visual	17	31	2:55
Track + acoustic + visual	242	449	46:04
With animals	7	13	2:29
Other	4	7	1:02
Total track	1099	2036	220:02

Sea state and weather conditions limited the amount and type of survey effort planned pre-survey. Therefore, all tracks were designed considering short-term weather forecasts to provide maximum coverage.

The pre-designed track lines designed in Distance were completed first (Figure 5; orange track). A secondary track designed in Distance was completed (Figure 5; black track) covering the whole area with a wider adjusted-angle. Most of the acoustic detections and sightings occurred around the continental slope between 200 and 2000 m; therefore two additional sets of tracks were undertaken in this area (Figure 5; red track) in order to provide more detailed information on those species inhabiting the slope habitat. As this part of the survey was conducted during poor weather

conditions, it was not possible to design the tracks in Distance (namely with random start points and equal-coverage probability); rather these tracks were generated making the best of the prevailing winds.

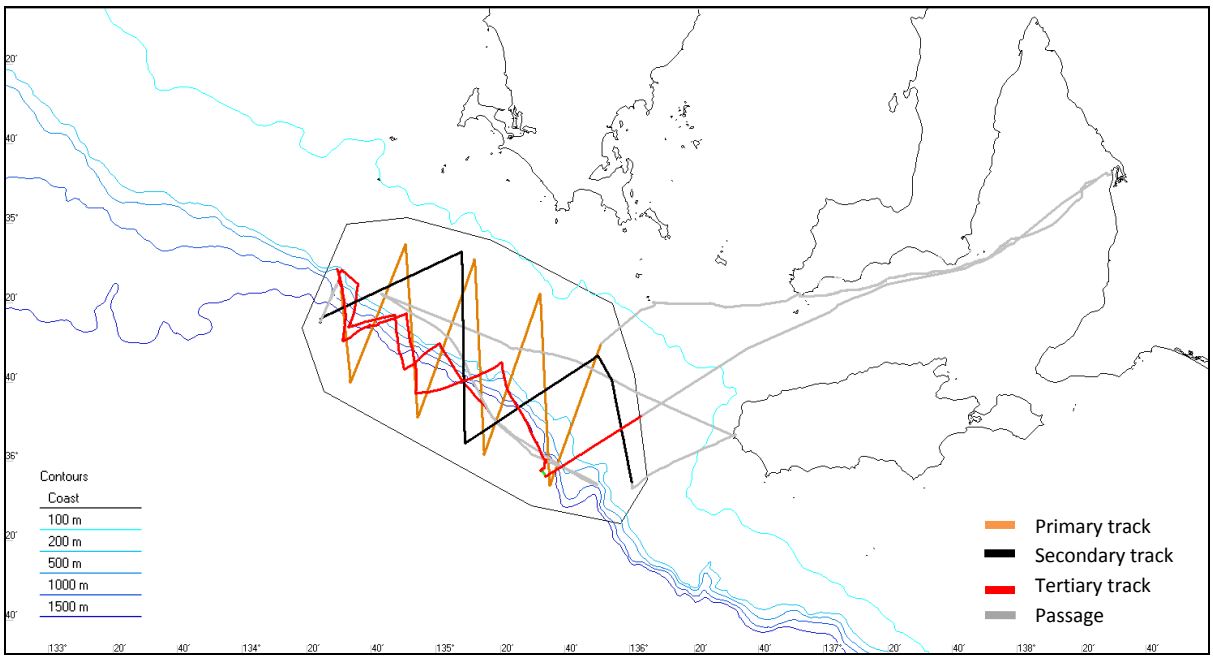


Figure 5. Track lines made by *SV Pelican* during the survey; primary track (orange), secondary track (black) and tertiary tracks (red). Grey lines are transiting tracks.

3.1 Sightings

Visual observations were strongly influenced by the sea state which was on average three (large wavelets with scattered whitecaps) with swells of one to five metres for most of the survey (Figure 6). These environmental conditions decreased the probability of detecting animals visually.

A total of 20 sightings were made of four species of cetaceans and one species of seal (Table 2); the species most often encountered during the entire survey was the short-beaked common dolphin. Three cetacean species and one seal species were sighted within the main survey block; the most commonly encountered cetacean being the pilot whale. Within the planned seismic survey area, pilot whale encounters were the most numerous followed by fur seals (Figure 7).

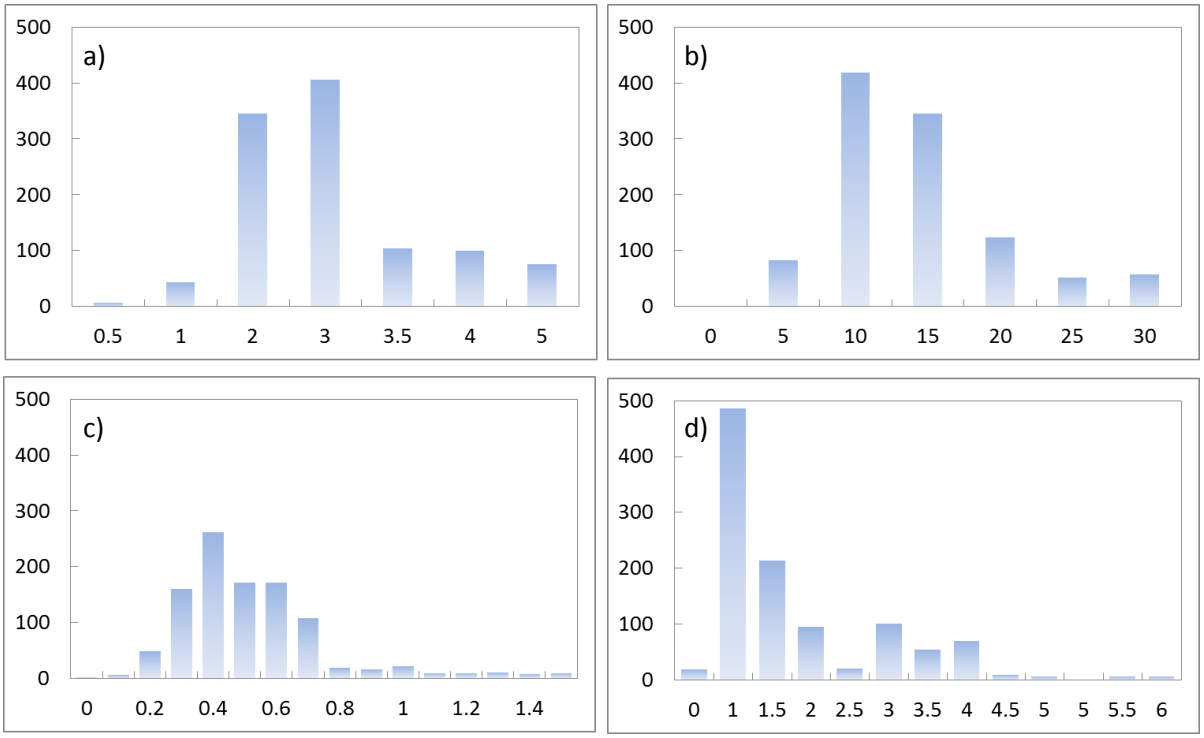


Figure 6. Interpolated frequency plots summarising environmental conditions experienced throughout the survey based on hourly logs of environmental data. a) Sea state, b) wind speed (knots), c) wave height (m) and d) swell height (m).

Table 2. Summary of marine mammals encounters during the survey.

Species	Number of encounters	Mean group size	Min. & max. group size
Pilot whale *Globicephala* sp.	3	27	4-60
Shepherd's beaked whale *Tasmacetus shepherdi*	1	3	3
Short-beaked common dolphin *Delphinus delphis*	7	30	2-30
Bottlenose-dolphin *Tursiops* sp.	2	5	3-10
Fur seal *Arctocephalus* sp.	5	2	1-2
Unidentified dolphin	2	2	1-2

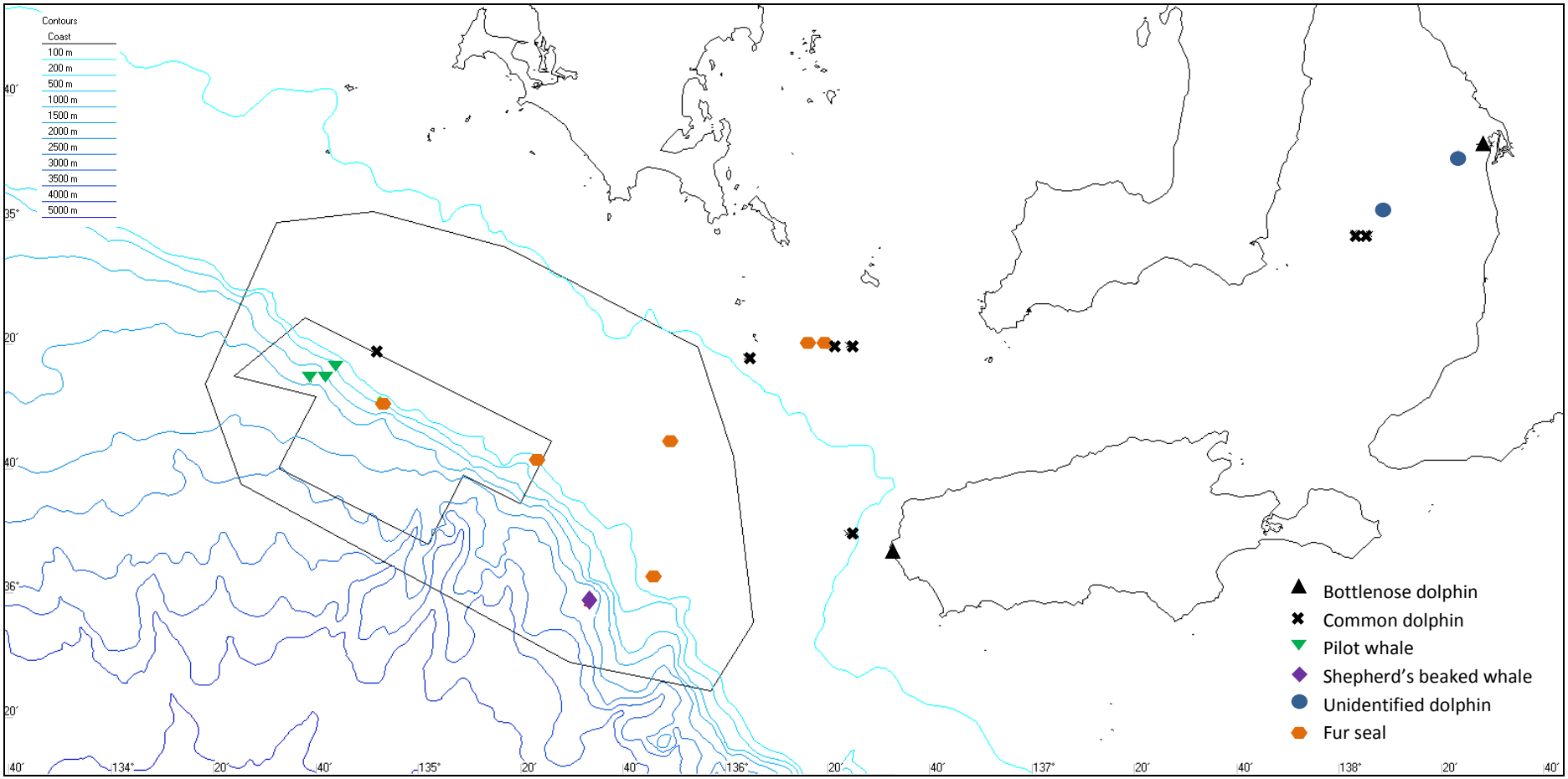


Figure 7. Map summarising marine mammals sighted during the survey. Study area (larger polygon) and planned seismic area (smaller polygon) are shown.

3.2 Acoustic detections

Odontocete acoustic detections were mainly concentrated around the continental slope between depths of 200 m and 3000 m. The hydrophone was monitored throughout the survey at 15 minute intervals. Odontocete whistles, clicks and pulsed calls were heard during 32% (*n*=201) of these 635 'listening stations'. Of these acoustic encounters, over half were reported to be probable pilot whales (*n*=104). The peak in the proportion of detections was situated within the planned seismic survey area and over the slope (Figure 8). The majority of acoustic detections (63%, *n*=127) were made during hours of darkness (specifically between 17:00 and 07:00).

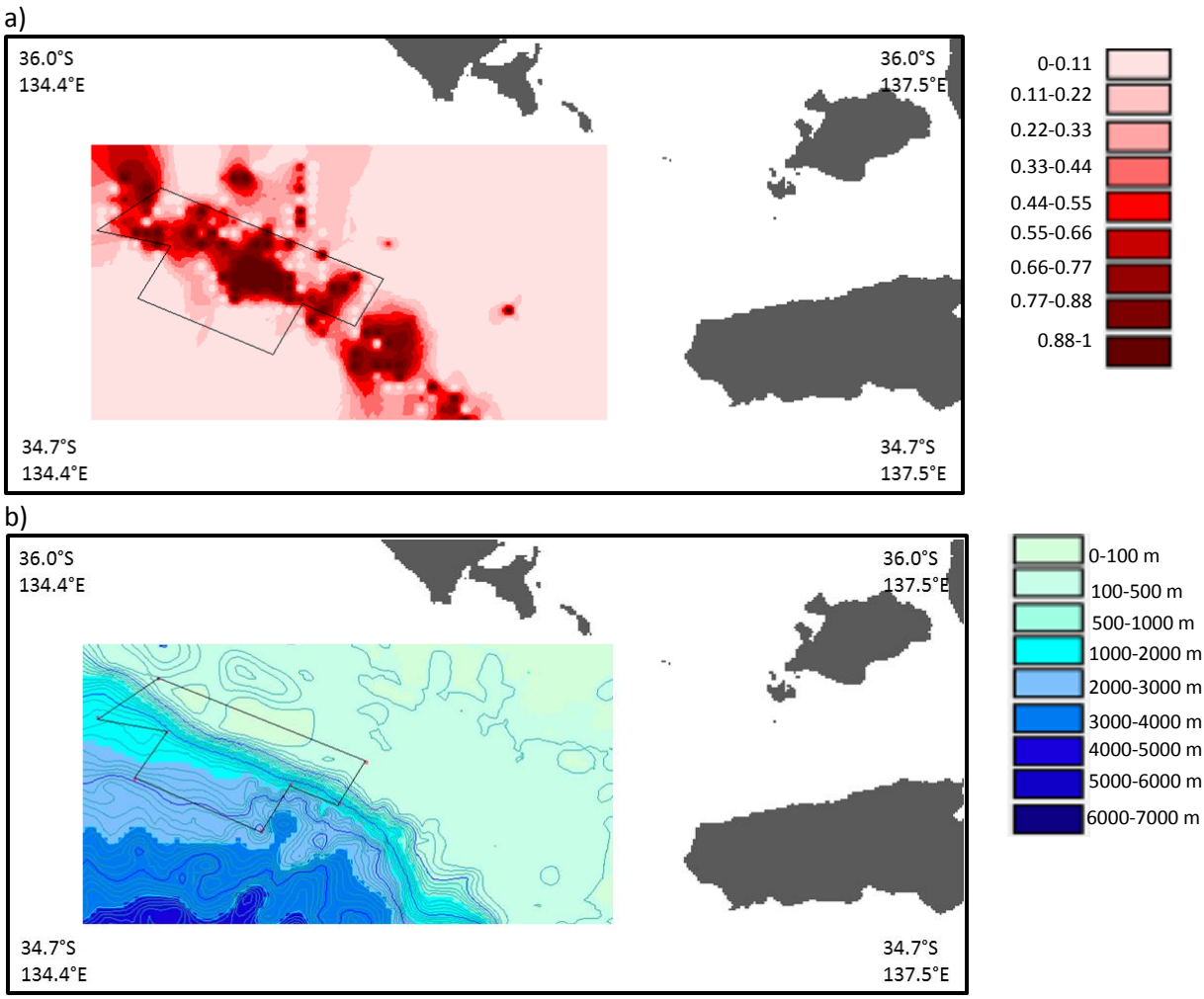


Figure 8. a) A 'heat' map showing the proportion of listening stations with acoustic detections of odontocetes (delphinids and sperm whales). The map was configured by splitting the survey area in to a 0.05 degree grid and interpolating between the points. b) Depth contours demonstrating that the peak in the proportion of detections was situated over the slope.

3.3 Sperm whales

There were a total of seven separate acoustic detections of sperm whales, accounting for the detection of at least 11 individuals. Of these, 71% were made in depths greater than 1000 m (Figure 9). Most of the detections were of relatively small groups (two individuals or fewer). Of the seven acoustic detections, five were made during hours of darkness and although two of these detections occurred in daylight hours, poor weather conditions prevented efforts to track the animals for photo-identification. In addition to the acoustic detections, three individual sperm whales were seen on 6th May from a concurrent aerial survey (see Appendix II) over the proposed seismic survey area. It is thought at least two of these animals were subsequently detected acoustically during the night of the 6th May.

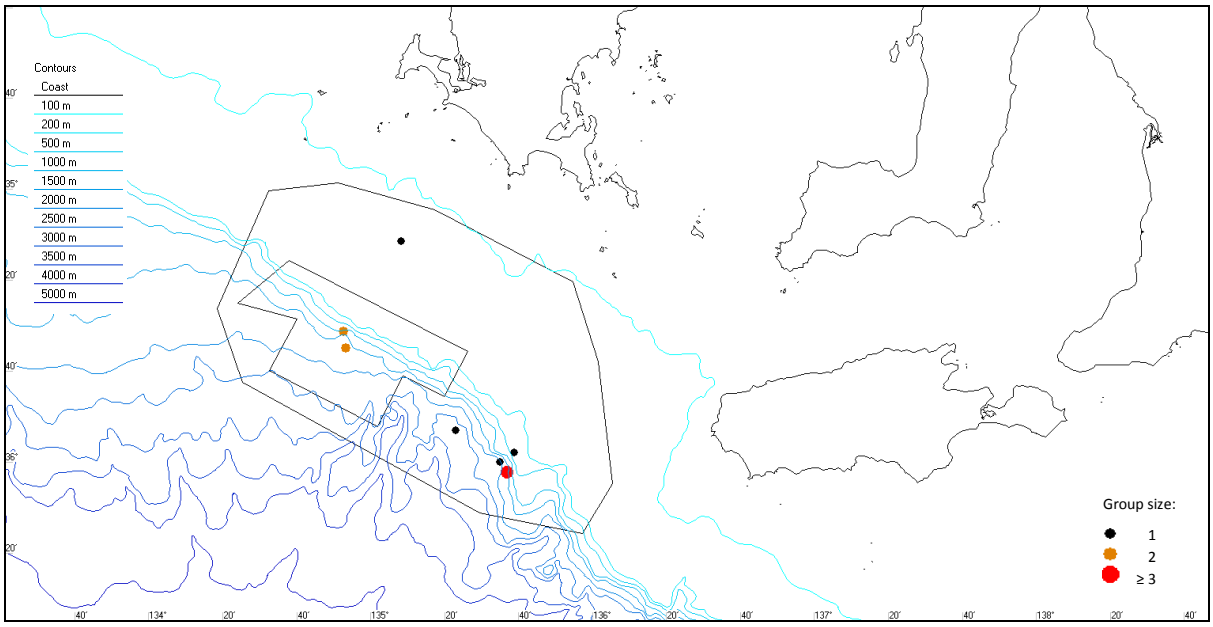


Figure 9. Map showing acoustic detections of sperm whales (and group size) within the study area.

3.4 Baleen whales

Post-survey analysis of the low frequency recordings revealed a constant flow noise (from the movement of the vessel and hydrophone through the water) from 10 – 50 Hz, limiting the ability to detect baleen whale vocalisations found within these frequencies. Although it is possible to detect vocalising baleen whales whilst underway (for example, Boisseau *et al*., 2008), it is possible that in this study flow noise reduced the ability to detect vocalising whales that may have been present. Baleen whale calls were not detected, and concurrent aerial surveys during the study period did not encounter any baleen whales.

3.5 Beaked whales

On 6th May a group of three Shepherd's beaked whale (*Tasmacetus shepherdi*) was sighted at 09:12 local time in a water depth of 2000-2500 m (Figure 7). The encounter lasted 2 hours and 6 minutes with an average dive time of 10-15 min and no apparent deep dives (as described, for example, in certain *Ziphius* and *Mesoplodon* species; Tyack *et al*., 2006), indicating that the group was not feeding and was possibly milling at the surface. Species identification was made later using

photographs taken during the encounter. Shepherd's beaked whale is the only species of ziphiid with a full set of functional teeth (17 to 27 pairs in both upper and lower jaws; Oliver, 1937). Adult males also have a pair of tusks at the tip of the lower jaw, and at least one male was among the group, identified in one of the pictures (Figure 10c) by a tooth visible in the lower jaw. Distinctive features of the species can be seen in Figure 10. No obvious beaked whale vocalisations were noted during the encounter. Detailed post-process analysis of the recordings running from one hour prior to the first sighting to one hour after the final sighting did not reveal any vocalisations that might be ascribed to these beaked whales. This may be explained by the fact that the whales did not appear to be making characteristic long deep foraging dives during which echolocation clicks have previously been described in several species of beaked whale.

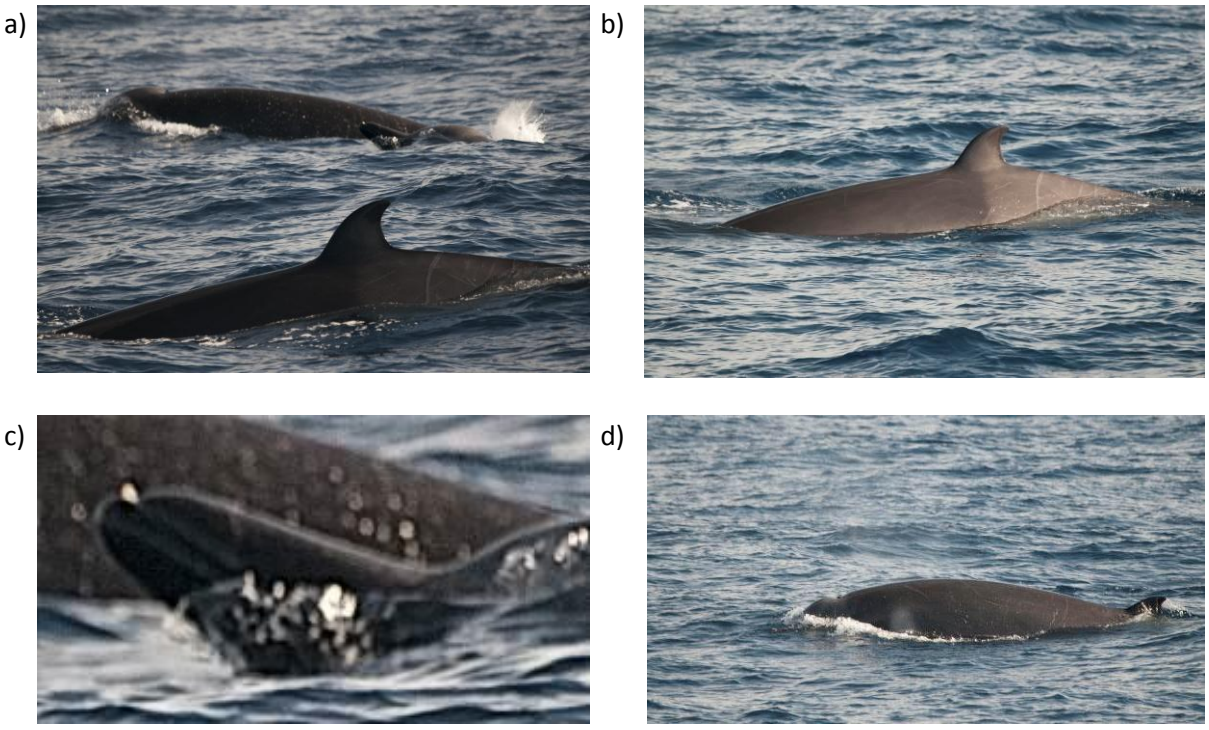


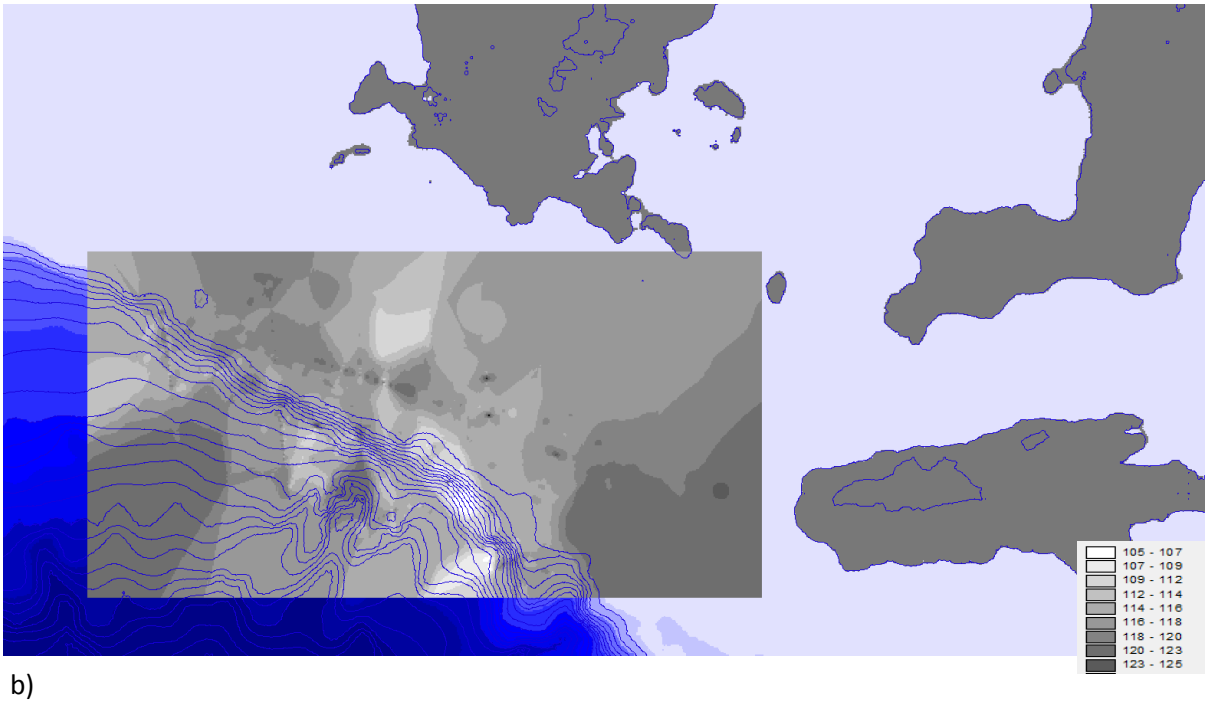
Figure 10. Photographs of the Shepherd's beaked whale group encountered on 6th May. Diagnostic features include, a) rounded melon and pale head patch; b) small falcate dorsal fin set far back and creamy-white side after dorsal fin; c) prominent beak and a pair of apical teeth protruding from the lower jaw in males; d) forward-centred pale shoulder mark above pectoral fins.

3.6 Background noise

During the course of the survey, measurements averaged over 10 minutes of relative ambient noise levels were made from the low-frequency hydrophone elements as third octave bands up to 48 kHz. The third-octave band values were averaged to generate a 'heat-map' (Figure 11). As expected, background noise levels tended to be higher in shallower waters due to 'cylindrical' spreading, a simple approximation for spreading loss in a medium with upper and lower boundaries (the sea surface and sea bed respectively). The influence of sea-bed noise, for example snapping shrimp and shifting rocks, is also likely to be more conspicuous in shallower waters. Conversely, in deeper waters sound waves are less constrained and propagate away from a source uniformly in all

directions. In general, the slope waters were relatively quiet in terms of ambient noise during the course of this study.

a)



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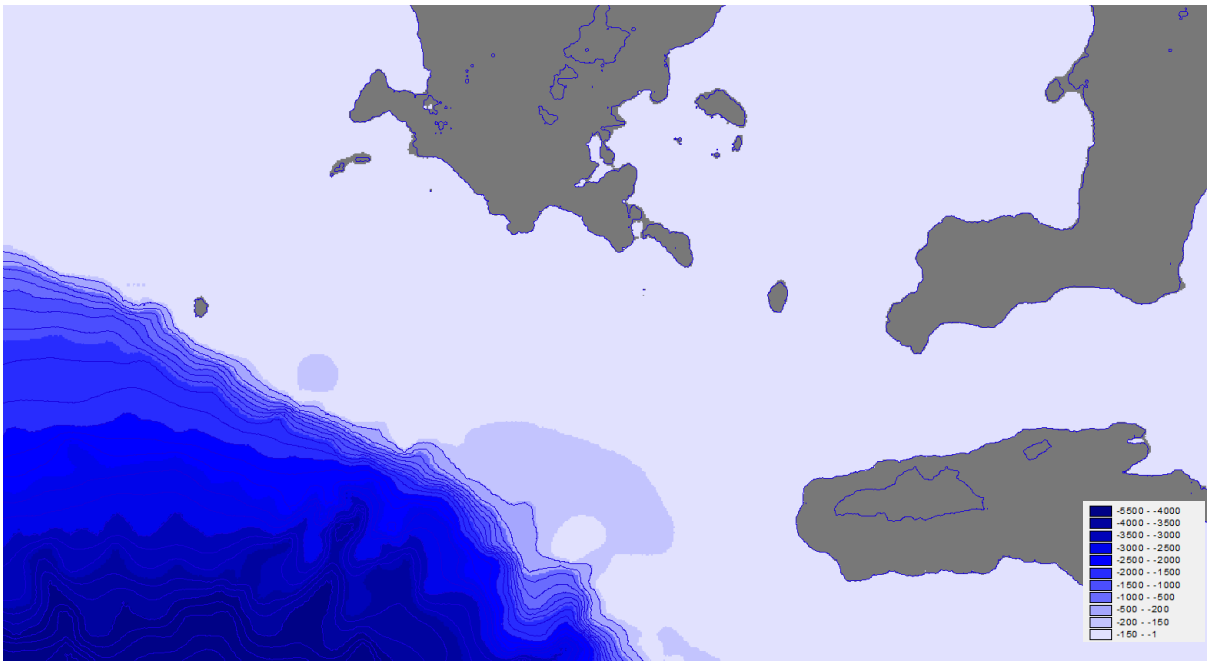

Figure 11. a) Relative ambient noise levels (dB) throughout the study area. The map was configured interpolating between 10 minute measurements and averaging all third-octave bands up to 48 kHz. b) Depth contours (m) demonstrating how the slope waters represented a relatively quiet region during the course of this study.

4. DISCUSSION

This short survey from *SV Pelican* was conducted during autumn months in latitudes of 35 degrees and higher in an area with limited previous systematic survey effort. The weather at times reduced the likelihood of observing marine mammals and this may have influenced the relatively low sighting rate. Acoustic survey techniques are less influenced by sea state, and 60 acoustic detections were made despite only 14 of these (23%) corresponding with a sighting of a cetacean. To illustrate the importance of sea state for sighting success, the only cetacean sighting that took place without a prior acoustic detection was of Shepherd's beaked whales when the sea was at its lowest level (sea state < 1 with a swell height of 0.5 m and a wave height of 0.2 m) at the end of the survey. Relying on visual techniques alone would have resulted in at least 46 groups of cetaceans passing undetected in this area, a result of some note given that currently mitigation efforts in Australian waters have focused almost solely on visual techniques (e.g. Marine Mammal Observers) and an acoustic dimension is not included (e.g. Passive Acoustic Monitoring), despite the guidelines allowing this possibility.

4.1 Baleen whales

The intensity of the annual upwelling driven by prevailing south-easterly winds in southern Australia is highly variable and difficult to predict from year to year. As discussed, these upwellings strongly influence prey abundance and corresponding pygmy blue whale aggregations in this area. As such, the presence of blue whales in this region will vary in accordance with the intensity and timing of upwelling (Gill *et al*., 2011). Reports from the Integrated Marine Observing System (IMOS) for 2013 indicate that the usual November to April upwelling for the nearby Bonney Coast was relatively weak until the first significant upwelling in March (IMOS, 2013). This could possibly provide an explanation for the lack of pygmy blue whale detections in the region this year and during this survey. Consecutive aerial surveys flown during the study period similarly did not result in any baleen whale sightings.

The paucity of data relating to migration routes for southern right whales from Antarctic feeding grounds to Australian breeding grounds makes predictions of timing or locations for southern right whale encounters in offshore waters challenging. However, coastal sightings of southern right whales are frequently made during the months of April and May in South Australia and the earliest sighting for 2013 was actually on 29 March at Boomer Beach (Pippos, *pers. comm*.), approximately 160 nautical miles east of this survey area.

Given that seismic surveying is planned for this area and the timing of this could overlap with the presence of foraging pygmy blue whales and/or migrating southern right whales, it is recommended that several years of baseline data be gathered to further elucidate endangered baleen whale habitat use in the survey area. Noise from seismic surveys utilising airguns has peak frequencies that overlap with the acoustic signals and estimated hearing ranges of baleen whales (Weir, 2008a). Seismic surveys have been documented to ensonify an area of 300,000 km^2 (IWC, 2005), raise the background noise levels by 20 dB (IWC, 2005) for months at a time and be heard up to 4,000 km from their source (Nieukirk *et al*., 2012). As blue and fin whales may communicate over vast distances of at least 400 km (Spiesberger & Fristrup, 1990) masking of biological sounds and impacts on intra species communication are likely. Furthermore, the population of southern right whales in this area are from the distinct southeast population (AMMC, 2009) which is showing little evidence

of increase, unlike the southwest population. Without evidence of recovery, this population could be more vulnerable to the impacts of anthropogenic noise.

Baleen whale acoustics

Blue whale calls recorded to date off the Antarctic Peninsula, Madagascar and Western Australia are characterised by maximum frequencies of 28 Hz (Rankin *et al*., 2005; Širovic *et al*., 2004; Ljungblad *et al*., 1998). Southern right whales produce various types of calls, some of lower frequencies from 20-60 Hz and others up to 1 kHz. From quiet research vessels, such as IFAW's Song of the Whale, it has previously been possible to detect baleen whale calls while under engine at moderate speeds averaging 6 knots (Boisseau *et al*., 2007). However, on other vessels, propeller and flow noise are often a challenge when collecting baleen whale vocalisations. With this in mind the research team planned to heave to at the end of each transect to make recordings free from or with reduced flow noise. However, operational issues made this impractical and therefore constant flow noise ranging from 10-50 Hz was present in the dataset presented here; meaning any blue or right whale calls below 50 Hz could have been masked. As the likelihood of detecting baleen whale vocalisations was limited by flow noise it cannot be assumed that blue whales were not present in the area from the results of this analysis. Southern right whale calls typically contain energy in frequencies higher than 50 Hz; however, no detections were made during this survey.

Overall, the problems associated with flow noise may impact the use of passive acoustic monitoring for baleen whales during vessel-based surveying. There are methodological adaptations which can be utilised to eliminate flow noise while using towed hydrophone arrays. For example, fairings can be attached to a hydrophone cable which would assume a streamlined shape when towed and thus reduce flow noise and cable strum; however these are often avoided due to the increased risk of entanglement with, for example, fishing gear. Even at relatively slow speeds where flow noise may be less of a hindrance, propeller noise generated by the vessel will mask detections of low frequency species unless the vessel has been specifically designed to avoid this. As an alternative, remote data loggers or DIFAR buoys can be utilised to detect baleen whales acoustically, eliminating the issues with flow and propeller noise; however careful placement of these would be needed in order to cover the entire limits of the survey area.

4.2 Beaked whales

The sighting and positive identification of a group of three Shepherd's beaked whales during this survey is very significant, as this is only the second documented sighting of this rarely-seen species of beaked whale within the survey area. There have been four other observations of this species from recent vessel-based surveys in New Zealand and southern Australia (2008 and 2012 respectively). These sightings resulted in detailed descriptions of the physical appearance and some insight into habitat preferences of this species (Donnelly *et al*. 2012). All previous sightings by Donnelly and colleagues occurred near the continental shelf break and within or adjacent to deep waters (>900 m), which is consistent with the sighting from this survey. Continental slope waters, deep canyons and seamounts are all habitats that feature the complex topography associated with beaked whale occurrence (Kaschner, 2007). It is possible that these underwater features offer ideal foraging conditions for beaked whales and that the Kangaroo Island canyons, a small group of narrow, steep-sided canyons, may provide such suitable habitat. Further surveys will be needed to confirm whether indeed this area is a key habitat for beaked whales.

Beaked whales are the group of whales thought to be most susceptible to the negative impacts of manmade noise. Strandings of beaked whales have been linked to the use of military mid-frequency sonar (e.g. Fernández *et al*., 2005; Cox *et al.,* 2006; Rommel *et al*., 2006) and a recent study demonstrated a strong behavioural response (DeRuiter *et al.*, 2013). It is thought that other noise sources such as shipping and seismic testing may affect this acoustically sensitive group of whales. The numerous reports of beaked whale strandings near naval exercises involving use of mid-frequency sonar suggest a need for caution in conducting seismic testing in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand, 2005).

Beaked whale acoustics

The lack of beaked whale detections in what seems to be a hotspot habitat for this cetacean group could be explained by the difficulties in detecting their clicks. Studies of other beaked whale species, notably Cuvier's and Blainville's beaked whales (Johnson *et al*., 2004; Johnson *et al*., 2006; Tyack *et al*., 2006) have suggested ultrasonic frequency-modulated clicks with most energy between 20 and 50 kHz are typically only produced during deeper dives (foraging clicks are often only reported when the depth of a dive exceeds 200 m). As these clicks have relatively low source levels and are mostly produced when the animal is oriented downwards, the likelihood of detecting a beaked whale acoustically is lower than for more vocally active species, such as sperm whales. However, acoustic techniques tend to be more successful than visual surveying for detecting beaked whale presence. Detection likelihood can be improved by adjusting the survey protocol (for example, slower survey speed and deeper hydrophone elements), an option not available for this survey aimed primarily at documenting and recording all marine mammal species.

During the Shepherd's beaked whale encounter, no apparent deep dives were observed; all dive times were shorter than 15 minutes. It has been suggested that vocally-active foraging deep dives (of 40 to 60 minutes) are usually interspersed with vocally-inactive shallow dives (of 9 to 15 minutes; Tyack *et al*., 2006). As such it is possible that this surface-active group was not vocalising throughout the encounter. However, it should be noted that nothing is currently known about the acoustic behaviour or the vocal repertoire of this species, and it is quite possible that the behaviour of Shepherd's beaked whales may differ from the types of behaviour documented for the better studied species such as Cuvier's and Blainville's beaked whales in the northern hemisphere.

4.3 Sperm whales

At least 11 individual sperm whales were detected acoustically during this study; in addition three individuals were observed during an aerial survey of the planned seismic survey area on 6th May (see Appendix II). As would be expected, all detections occurred in waters deeper than 200 m with most detections (71%) taking place in waters deeper than 1000 m. It is also of note that of the seven acoustic detections, five (71%) were made during hours of darkness. Within the large study area shown in Figure 1, there was a total of 1568 km of trackline undertaken. Thus, the acoustic density of sperm whales was at least 0.35 animals per 1000 km^2 (assuming an estimated strip half-width of 10 km). When considering only those sections of track representing suitable sperm whale habitat, namely waters deeper than 200 m, the acoustic density was 0.72 animals per 1000 km^2. This is comparable with acoustic density estimates for other regions recognised as important sperm whale

habitats; for example, 0.16 in the Tongue of the Ocean, Bahamas (Ward *et al.*, 2012), 0.23 for the Ionian Sea, Greece, 0.34 for the Hellenic Trench (south of Crete) and 1.96 for the southwest Mediterranean (Lewis *et al.*, in prep.), 0.52 to 2.05 for the Faroe Shetland Channel off Scotland (Hastie *et al.*, 2003), 1.26 to 2.86 for the eastern temperate North Pacific (Barlow & Taylor, 2005) and 3.6 in French and Spanish waters (Swift *et al.*, 2009).

Sperm whales are currently listed as a migratory species in Australia under the EPBC Act and globally as Vulnerable under the IUCN red list. They are listed as Endangered Migratory Species under Appendix 1 of the Bonn convention. Sperm whales have been recorded from the waters of all Australian states (Bannister *et al*., 1996) and it is possible that sperm whales in Australian waters represent severely fragmented populations. The sperm whale detections in this study are striking as despite having a status of Insufficiently Known (K) under the Australian Action Plan (Bannister *et al*., 1996), the Action Plan elaborates that sperm whales will remain, "status indeterminate until surveys conducted, particularly off south-west Australia". Our detections support the suggestion in the Action Plan document that the waters to the south-west of Kangaroo Island may contain a 'concentration' of sperm whales and this study provides novel data on the distribution of this species. Further research on sperm whale distribution is urgently needed; perhaps the most detailed report on sperm whale distribution in Australian waters is based on aerial surveys conducted almost fifty years ago, between 1963 and 1965 (Bannister, 1968).

4.4 Other odontocetes

Pilot whales were sighted on three occasions, often in large widespread groups. Although these encounters took place on separate days, they were all within 10 km of each other over the slope waters of the proposed seismic survey site. In addition to these sightings, their characteristic vocalisations were heard repeatedly during the survey, with 17% of all listening posts containing pilot whale vocalisations. A majority (61%) of all detections were made in darkness, in keeping with the suggestion that pilot whales may forage primarily at night when they would be more vocally active (Mate, 1989; Shane, 1995; Gannier, 2000). As the longest of these nocturnal acoustic encounters with pilot whales lasted over eight hours, it seems likely that some of the groups were very large and widespread. This study provides novel information on pilot whale distribution in waters of the Great Australian Bight.

Common dolphins were also encountered during the survey; all sightings were made in waters less than 200 m deep. Common dolphins have been encountered off all Australian states with apparent concentrations in the southern south-eastern Indian Ocean and in the Tasman Sea, but are rarely seen in northern Australian waters (Ross, 2006). Neither the extent of occurrence nor the area of occupancy of the common dolphin has been estimated in Australia, but due to its offshore distribution, it is unlikely that common dolphin populations are severely fragmented in Australia.

4.5 Implications for seismic surveying

The EPBC Act Policy Statement 2.1 (interaction between offshore seismic exploration and whales; DEWHA, 2008) stipulates that in situations involving biologically important habitats, explicit justification for why any proposed survey should take place should be provided. For any potential seismic survey, it will be necessary to implement more extensive measures, such as greater precaution zones and additional marine mammal observer coverage. In those areas where the

likelihood of encountering whales is “moderate to high”, the application of additional measures is necessary to ensure that impacts and interference are avoided and/or minimised. Moderate to high likelihood is defined for seismic surveys as being, “spatially and/or temporally proximate to aggregation areas, migratory pathways and/or areas considered to provide biologically important habitat”. Although the definition is vague, this study suggests Commonwealth Petroleum Exploration Permit Areas EPP-41 and EPP-42 will be both spatially and temporally proximate to aggregations of whales including sperm whales, pilot whales and Shepherd’s beaked whale, a species that may have only been seen alive at sea on fewer than ten occasions (Mead, 2009). As such, the application of additional mitigation measures will be required for any seismic survey in this area. Conducting seismic surveys during a different time of year would not only overlap with peaks in blue whale and southern right whale presence, but would also not necessarily avoid potential disturbance of odontocetes, as the deep-diving species encountered in this study are quite likely to be found in the area year round. Species, such as the beaked whales, which appear to be found in small, possibly genetically isolated, local populations and are resident year round (Wimmer & Whitehead, 2004; Balcomb & Claridge, 2001) may be particularly vulnerable to disturbance and population level impacts. Sperm whales also exhibit some evidence of year-round residency in other areas (see for example, Lettevall *et al*., 2002).

It is increasingly clear that loud underwater noise has the potential to disturb and harm marine life both directly and indirectly in the short term, with potential changes at the population level and across generations in the longer term. This appears to be the case for the cetacean species encountered in this study. For example, Jochens *et al*. (2008) demonstrated that sperm whales reduced foraging activity by between 20-60% during full array seismic activity. In the presence of operating seismic airguns, sperm whales were shown to reduce swimming effort on foraging dives, reduce buzz rates (used to home in and capture prey), and remain at the surface apparently waiting for airguns to stop before beginning foraging dives (Tyack, 2009). Other studies have shown a reduction in the number of fluke strokes and swimming effort while sperm whales were foraging, even in response to distance airgun sounds (IWC, 2007). Although there are no specific reports pertaining to the rarely-seen Shepherd’s beaked whale, other ziphiids are known to be particularly vulnerable to loud mid-frequency anthropogenic sounds, as evidenced by the growing number of mass strandings associated with military sonar (Fernandez *et al*., 2005; Cox *et al.*, 2006; Rommel *et al*., 2006). There have been reported cases of beaked whale strandings in the proximity of seismic operations, although no conclusive link has been made (Hildebrand, 2005). However, this may in part be because knowledge of beaked whale distribution and abundance is so limited that combined with the inherent problems of studying such elusive whales, data on the impacts of seismic activities on beaked whales are limited compared to some other cetaceans. For pilot whales, temporary avoidance response has been noted during seismic airgun testing (Weir, 2008b) and during the start-up of airguns (Stone & Tasker, 2006). In addition, sightings by MMOs (Marine Mammal Observers) of pilot whales in waters subject to seismic exploration around the British Isles have declined since 1998 (Stone, 2003).

The impact on cetaceans of any proposed seismic activity will depend on a number of factors including: source level and frequency; distance from the source; water depth; substrate; ambient noise environment; species concerned and their ecology and behavioural state. For example, the relative strength of seismic pulses arriving via different pathways vary with the distance from source

and depth of diving sperm whales, but absolute received levels can be as high at 12 km as they are at 2 km (Madsen *et al*., 2006). The level of risk reduction, if any, is not known for most current mitigation measures employed during seismic surveys. A common mitigation practise is to use observer MMOs to detect marine mammals visually close to the seismic operation; however, the likelihood of seeing a cetacean diminishes rapidly with degrading sea state and light conditions. As over 60% of the acoustic detections of odontocetes in this study were made during hours of darkness, it is apparent that mitigation techniques relying on visual techniques alone for detecting the presence of mammals are flawed. It seems the most effective mitigation of the effects of seismic surveys is by avoiding biologically important areas, conducting fewer surveys and/or decreasing the intensity or duration of sound during the surveys.

4.6 Future research

The data presented provide novel information on several species of marine mammal off southern Australia and highlight the intrinsic value of scientific research in those areas for which few data exist. Although only a short survey, this study improves the knowledge of cetacean distribution in the shoulder season of April and May that has received very little prior research effort. Even outside of this shoulder season, much of the publicly available information regarding cetacean distribution off southern Australia is patchy; for example, the most recent sperm whale sightings near Kangaroo Island stored on the OBIS-SEAMAP database are from 1980 (data from the National Whale and Dolphin Sightings and Strandings Database and courtesy of the Australian Antarctic Data Centre). Indeed, for sperm whales off Western Australia, an apparent decline off Albany has recently been noted despite the cessation of whaling over 30 years ago, with implications for the management of sperm whales not just in Australian waters but worldwide (Carroll *et al*., 2013).

The lack of publicly available baseline data off southern Australia is of concern, particularly in light of increasing interest in seismic surveying in this region. While this study provides some insight into cetacean presence, the highly variable seasonal upwelling and resulting prey availability fluctuations are likely to impact cetacean presence, diversity and distribution from year to year in this area. Consequently, it is recommended that systematic visual and acoustic surveys be conducted over multiple years to better determine the importance of this area to a range of cetacean species.

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APPENDIX I: Priority list of cetacean species found in southern Australia

Species	Priority	EPBC Act Listing Status
Pygmy Blue whale (*Balaenoptera musculus brevicauda*)	High	Endangered
True Blue whale (*Balaenoptera musculus intermedia*)	High	Endangered
Southern right whale (*Eubalaena australis*)	High	Endangered
Humpback whale (*Megaptera novaeangliae*)	High	Vulnerable
Fin whale (*Balaenoptera physalus*)	High	Vulnerable
Sei whale (*Balaenoptera borealis*)	High	Vulnerable
Sperm whale (*Physeter macrocephalus*)	High	Migratory
Gray's beaked whale (*Mesoplodon grayi*)	High	-
Andrew's beaked whale (*Mesoplodon bowdoini*)	High	-
True's beaked whale (*Mesoplodon mirus*)	High	-
Gingko-toothed beaked whale (*Mesoplodon ginkgodens*)	High	-
Cuvier's beaked whale (*Ziphius cavirostris*)	High	-
Hector's beaked whale (*Mesoplodon hectori*)	High	-
Shepherd's beaked whale (*Tasmacetus shepherdi*)	High	-
Arnoux's beaked whale (*Berardius arnuxii*)	High	-
Blainville's beaked whale (*Mesoplodon densirostris*)	High	-
Strap-toothed beaked whale (*Mesoplodon layardii*)	High	-
Southern bottlenose whale (*Hyperoodon planifrons*)	High	-
Long-finned Pilot whale (*Globicephala melas*)	High	-
Short-finned pilot whale (*Globicephala macrorhynchus*)	High	-
Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)	High	Migratory
Bottlenose dolphin (*Tursiops truncatus*)	High	-
Antarctic minke whale (*Balaenoptera bonaerensis*)	Medium	Migratory
Dwarf minke whale (*Balaenoptera acutorostrata*)	Medium	-
Bryde's whale (*Balaenoptera edeni*)	Medium	Migratory
Pygmy sperm whale (*Kogia breviceps*)	Medium	-
Dwarf sperm whale (*Kogia sima*)	Medium	-
Killer whale (*Orcinus orca*)	Medium	Migratory
False killer whale (*Pseudorca crassidens*)	Medium	-
Dusky dolphin (*Lagenorhynchus obscurus*)	Medium	Migratory
Risso's dolphin (*Grampus griseus*)	Medium	-
Common dolphin (*Delphinus delphis*)	Medium	-
Southern right whale dolphin *(Lissodelphis peronii*)	Medium	-

APPENDIX II: SUMMARY OF FINAL REPORT FOR 2013 IFAW AERIAL SURVEYS: SOUTH AUSTRALIA

Final Report for 2013 IFAW Aerial Surveys: South Australia

BPM-NSW-13-IFAW Aerial Surveys-Final Report-v1.1

25-06-2013

BLUE PLANET MARINE

www.blueplanetmarine.com

Executive Summary

The International Fund for Animal Welfare (IFAW) contracted Blue Planet Marine (BPM) to conduct five aerial surveys off Kangaroo Island/the Eyre Peninsula during April and May 2013. The primary purpose of the surveys was to assess the diversity and distribution of cetaceans, with a focus on great whales (e.g. baleen whales plus sperm whale), and in particular blue whales. There was no attempt, and the survey was not designed, to obtain abundance estimates of any species.
There were five survey replicates flown, all in April and May 2013. All flights left Parafield Airport, Adelaide, transited to Port Lincoln Airport to refuel, and then conducted the survey. The return flight was in the reverse order. The total flight time over the five surveys was 27 hrs 41 mins and averaged 5 hrs 32 mins per survey. Total time over the survey area was 10 hrs 34 mins and averaged 2 hrs 7 mins per survey. Three surveys were conducted while IFAW personnel were on a chartered vessel in the area. All flights were conducted in accordance with required safety procedures and there were no health or safety issues during the survey.
There were 12 confirmed sightings of cetaceans over the five surveys representing 11 different pods, with one of those sightings/pods observed outside the survey area while in transit. Of the 11 pods observed, two were identified as sperm whales, three as dolphins (species not determined), and six as unidentified small odontocetes.

Introduction

The International Fund for Animal Welfare (IFAW) contracted Blue Planet Marine (BPM) to conduct five aerial surveys off Kangaroo Island/the Eyre Peninsula during April and May 2013. The primary purpose of the surveys was to assess the diversity and distribution of cetaceans, with a focus on great whales (e.g. baleen whales plus sperm whale), and in particular blue whales. There was no attempt, and the survey was not designed, to obtain abundance estimates of any species.
This is the final report for the aerial surveys.

Methods

The aerial survey design and methods are detailed in Appendix A.

Results & Discussion

Flight details

There were five survey replicates flown, all in April and May 2013 (Table 1). All flights left Parafield Airport, Adelaide, transited to Port Lincoln Airport to refuel, and then conducted the survey. The return flight was in the reverse order. The transect pattern for each survey was the same except that

after the first survey transect 2 was extended to provide greater coverage of the south west corner of the survey area (see Appendix A for details and Appendix B for the trackline of each survey). The time spent over the survey area was influenced by whether the aircraft went off transect and primary effort to investigate a sighting off the trackline. The total flight time was also influenced by restricted airspace around the RAAF Base Edinburgh located near to Parafield Airport.

Table 1: Summary of flight details.

Survey	Date	Total flight time	Time over survey area	Sighting conditions	No. sightings in the survey area		No. sightings outside the survey area	
					Great whales	Other cetaceans	Great whales	Other cetaceans
1	6.4.13	05:34	02:30	Good	0	2	0	0
2	16.4.13	05:24	02:00	Good	0	5[1]	0	1
3	28.4.13	05:06	01:44	Fair	0	1	0	0
4	30.4.13	05:29	02:03	Good	0	0	0	0
5	6.5.13	06:08	02:17	Good	2	1	0	0

[1] For one pod there were two sightings as it was seen on both sides of the aircraft at the same time.

Initially, four surveys were planned and IFAW requested that two surveys were conducted while IFAW personnel were on a chartered vessel (*S/V Pelican*) in the area between the 24th April and the 9th May. The first three surveys were evenly spaced over time. The fourth survey was conducted shortly after on the 30th April as the weather conditions were not forecast to be favourable beyond then and the fifth survey had not been approved by IFAW. Surveys 3, 4 and 5 were all conducted when the *S/V Pelican* was in the area.

Sighting details of cetaceans

There were 12 confirmed sightings of cetaceans over the five surveys representing 11 different pods, with one of those sightings/pods observed outside the survey area while in transit. Of the 11 pods observed, two were identified as sperm whales (Figure 1), three as dolphins (species not determined), and six as unidentified small odontocetes (Table 2). Note that the survey protocol means that the aircraft only deviated from the transect to investigate sightings of great whales which explains why other cetaceans were not identified to a species level. The distribution of cetacean sightings is shown in Figure 2 and Figure 3. Each sighting is shown with the survey number/sighting. The details for all sightings, including other marine fauna as well as vessels, are shown in Appendix C.

Figure 1: Photograph of a Sperm whale (survey 5, sighting B).

Table 2: Summary of confirmed cetacean sightings.

Survey	Time	Sighting	Species	Composition	Position
1	14:02	F	Small odontocetes	~50	-35° 40' 17", 135° 14' 30"
1	14:13	G	Small odontocetes	100+	-35° 43' 14", 135° 20' 51"
2	11:32	A	Small odontocetes	~10	-34° 54' 01", 135° 17' 13"
2	12:26	B/C	Dolphins	80+	-35° 28' 20", 134° 47' 24"
2	12:27	D	Dolphins	~20	-35° 29' 16", 134° 46' 49"
2	13:00	E	Small odontocetes	~12	-35° 31' 30", 135° 02' 21"
2	13:35	G	Dolphins	~20	-35° 42' 10", 135° 13' 22"
3	15:09	B	Small odontocetes	5+	-35° 45' 41", 135° 19' 43"
5	13:57	A	Small odontocetes	~12	-35° 26' 21", 134° 48' 23"
5	14:44	B	Sperm whales	2	-35° 36' 36", 134° 58' 28"
5	14:45	C	Sperm whale	1	-35° 41' 21", 134° 54' 55"

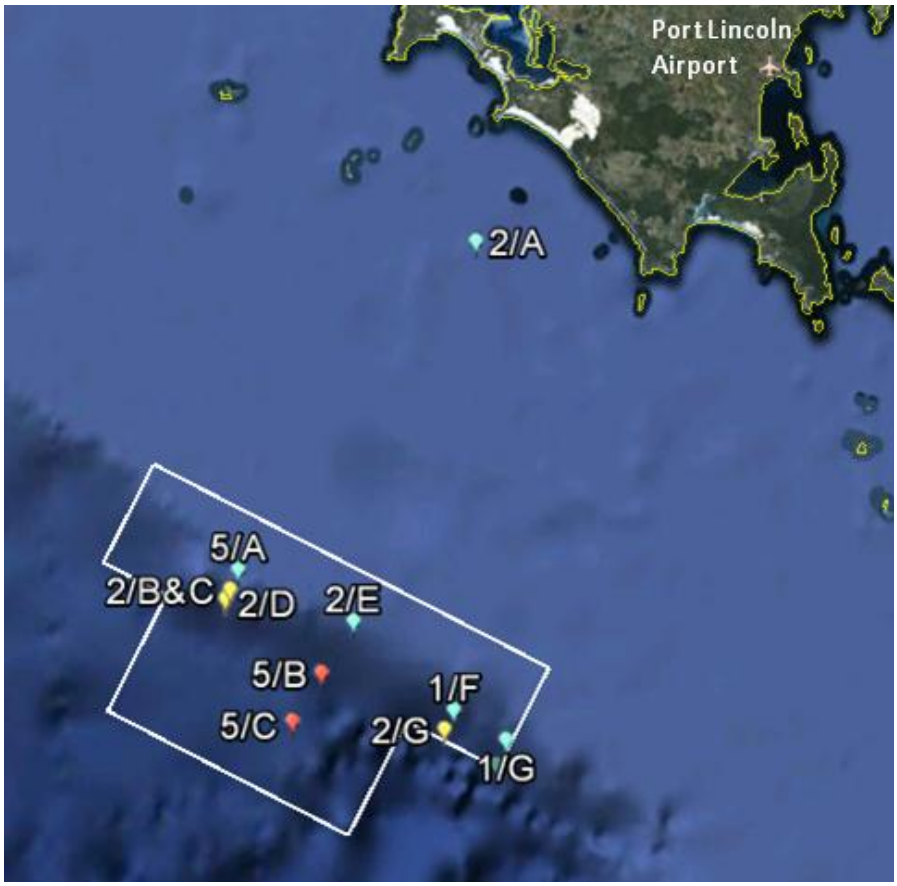

Figure 2: Google Earth image showing all cetacean sightings.

(Note: Each sighting is shown with the survey number/sighting. Light blue - small odontocetes, yellow - dolphins, red - sperm whales)

Figure 3: Google Earth image showing cetacean sightings in the survey area.

(Note: Each sighting is shown with the survey number/sighting. Light blue - small odontocetes, yellow - dolphins, red - sperm whales)

References

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Appendix A: Aerial Survey Design and Survey Area

IFAW provided BPM with the co-ordinates for the corner points of the survey area (Table 1). A map of the survey area and location relative to the mainland is shown as the white polygon in Figure 1.

Table 1: Survey area co-ordinates

Latitude	Longitude
35 15 30.45 S	134 38 14.47 E
35 35 42.46 S	135 26 03.11 E
35 45 38.01 S	135 19 50.12 E
35 40 59.07 S	135 08 43.93 E
35 52 13.82 S	135 01 37.77 E
35 39 50.27 S	134 32 25.09 E
35 28 27.39 S	134 39 41.55 E
35 25 11.65 S	134 32 03.50 E

Figure 1: Survey area location

Survey Design

The key focus of the survey was to locate and identify great whales (e.g. baleen whales plus the sperm whale) within the target area. An abundance estimate was not required and therefore the double-platform observer configuration typically used for mark-recapture based abundance estimates (as in Buckland et al. 2001) was not utilised. The survey employed a combination of line-transect methods and off-transect identification verification of sightings of great whales.

Initial design

It was considered that transects spaced approximately 12 km apart would provide good coverage. Given the area to be covered we were able to fit in eight transects with that spacing, and approximately perpendicular to the depth contours (Figure 2). Each transect extended approximately 5 km beyond each end of the target area to provide a 'buffer zone' before the line turn during which observers would go 'off-effort' to manage fatigue. For all flights, transects were flown in order from 1 to 8.

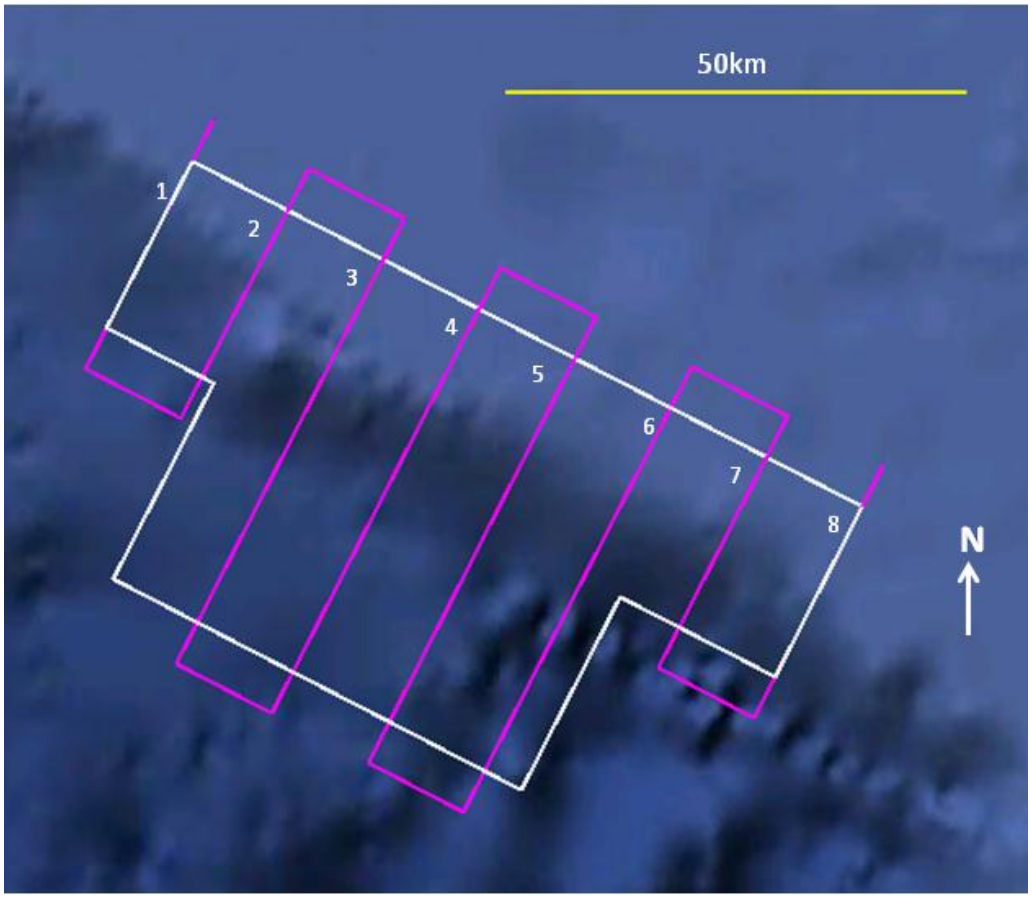


Figure 2: Initial survey design

Subsequent modifications

After the first survey flight we made two modifications to the survey design. We realised that the south-west corner of the survey area was not being covered adequately so transect 2 was extended to the south-west to match the length of transects 3-6. The 5 km buffer zone at the end of each transect was shortened to reduce the amount of time spent outside the survey area during turns. In general, the line turn to the next transect began as soon as the edge of the survey area was reached.

Thus, transects 1, 7, 8 were approximately 21 km in length, and transects 2 - 6 approximately 45 km in length (excluding line turns).

Survey Methods

Personnel

For each survey there was one pilot and two observers.

Equipment

Aerial surveys were conducted using a Cessna 337TM high-wing, twin engine aircraft. Observers wore appropriate Personal Protective Equipment (see the HSE section below). Other equipment used by the observers included:

- A handheld Garmin GPS to record the flight path and waypoints of sightings;
- A marine VHF radio to communicate with IFAW personnel on the charter vessel *S/V Pelican*;
- An inclinometer each to assist in estimating distances to sightings from the aircraft; and
- A microtrack to record flight and sighting information during the survey.

Flight plan & procedures

Flights were to take place in April and May with at least two flights requested while IFAW personnel were on a chartered vessel in the area between the 24th April and the 9th May. We attempted to spread the flights evenly through the survey period, depending on availability of personnel and weather conditions. Ideally, surveys should be conducted on days with wind speed less than 12 knots and with clear sighting conditions to maximise whale and marine megafauna detection.
During the survey period, the aircraft was housed at Parafield Airport, Adelaide. For safety reasons, the aircraft did not fly direct to the survey area from Parafield but flew via Port Lincoln Airport where it would refuel. From Port Lincoln the aircraft would fly to the north west corner of the survey area and begin observations on transect 1. The survey would finish at the end of transect 8 in the north east corner of the survey area before flying back to Port Lincoln to refuel, and then return to Parafield Airport. As we were not obtaining abundance estimates of any cetacean species, randomisation of the survey start point between flights was not necessary and therefore the most cost effective route of transects was flown.
While on transect, surveys were flown at an altitude of 457 m and at a speed of approximately 240 km per hour. These values are based on the methods of Gill *et al* (2011) for blue whale surveys off Victoria. Given the safe flying range of the aircraft and that it was over water, it was agreed with IFAW that the aircraft would deviate from the trackline only to investigate sightings of great whales (e.g. baleen whales plus sperm whale), and not other cetaceans. A waypoint will be taken prior to leaving the trackline so that the aircraft can resume the trackline at the same location.
After the first survey the question arose as to how much time should be spent off-transect to confirm a sighting of a great whale? Given that one of the primary objectives of the survey was to map the distribution of blue whales we used the following rule; that the minimum time should be 7 minutes and the maximum time 15 minutes (with the actual time spent at the discretion of the survey leader). These times are taken from a study of tagged blue whales where the average dive time was 6.6 minutes and the longest dive time was 14.7 minutes (Croll *et al*. 2001).

Observations

The two observers were seated on opposite sides of the aircraft, allowing each observer to scan from as close to the trackline as is practicable to as far as conditions will allow. In good sighting conditions, great whales can be seen up to six or more kilometres away at that survey altitude. With tracklines approximately 12 km apart there was good coverage over the survey area. There is a 'blind strip' directly beneath the aircraft of approximately 600 m width that will not be visible to observers. Both observers scanned their sector continuously when on transect. Any opportunistic sightings made when off transect were also recorded.

The following variables were recorded by the survey leader:

- Before takeoff -
    - Date and time;
    - Wind speed;
    - Wind direction;
    - Cloud cover (oktas); and
    - Visibility
- Close to survey area and whenever conditions change during transects -
    - Beaufort Sea State;
    - Glare;
    - Cloud cover; and
    - Turbidity.
- Effort -
    - Number and names of observers plus any other extra observers present;
    - Start time of transect;
    - Transect number;
    - Direction;
    - End time transect;
    - Leaving transect (e.g. to go to a sighting off the trackline);
    - Resume transect (e.g. when returning to the trackline at the same point that the transect was left); and
    - Position (where left or elsewhere).
- When a sighting of a whale is made, the observer will record the following information:
    - Side of aircraft;
    - Time;
    - Angle of inclination (or GPS waypoint number if off trackline);
    - Species;
    - Number of animals;
    - Presence of calves;
    - Behaviour (e.g. travel, feed, log, social, mill) and/or activity (e.g. dive, splash, blow);
    - Position (e.g. surface, below surface);
    - Direction of travel;
    - Presence of krill and;
    - Any other relevant information (e.g. other species present such as sea birds, etc.).

Many species of marine mammal have been recorded in South Australian waters including dolphins, whales and pinnipeds. It was recognised that at 457m altitude, species identification is unlikely for the smaller species and therefore only the presence of unidentified small cetaceans will be recorded if sighted. However, attempts were made to identify to species whenever possible. As the targets of this survey were great whales, 'off-effort' deviations from the trackline were only be made for

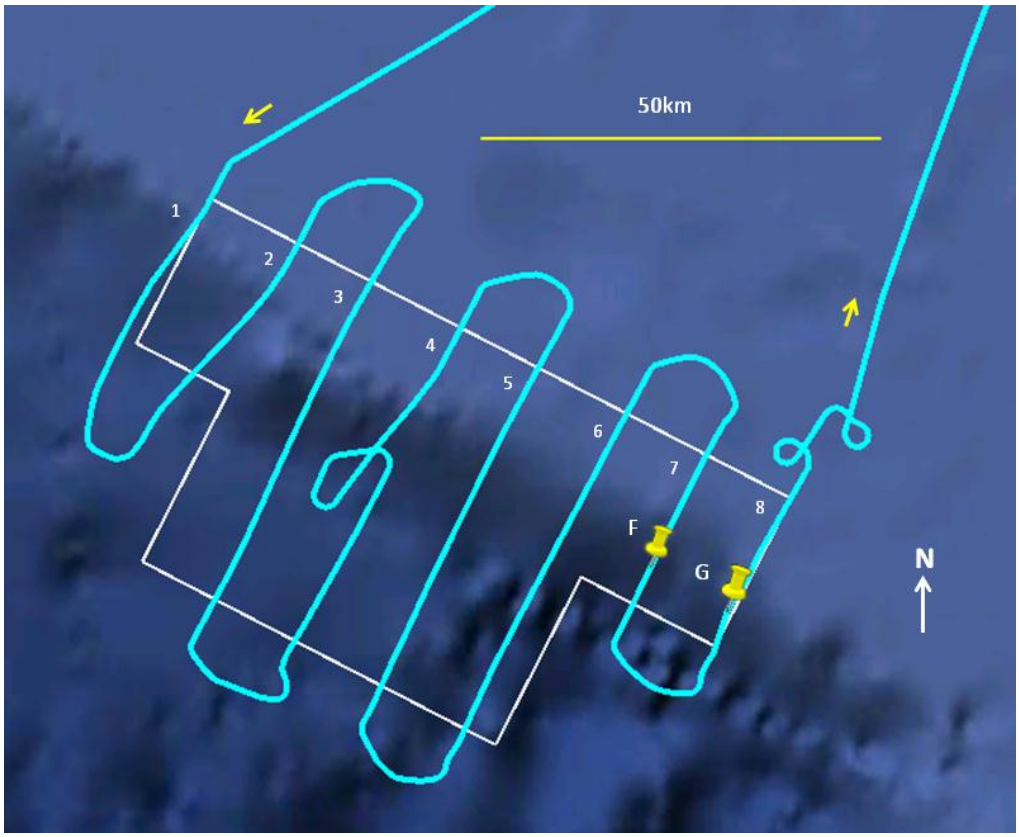
suspected sightings of large cetaceans to confirm species identification, pod composition and behaviour.

Appendix B: Survey tracklines & sightings

The images below were taken from the individual interim reports for each survey and show the trackline over the survey area and sighting locations of cetaceans. Refer to Table 2 in the body of the main report for details of sightings. For each image the direction of flight, the transect number, direction of North, and a 50 km scale are also shown.

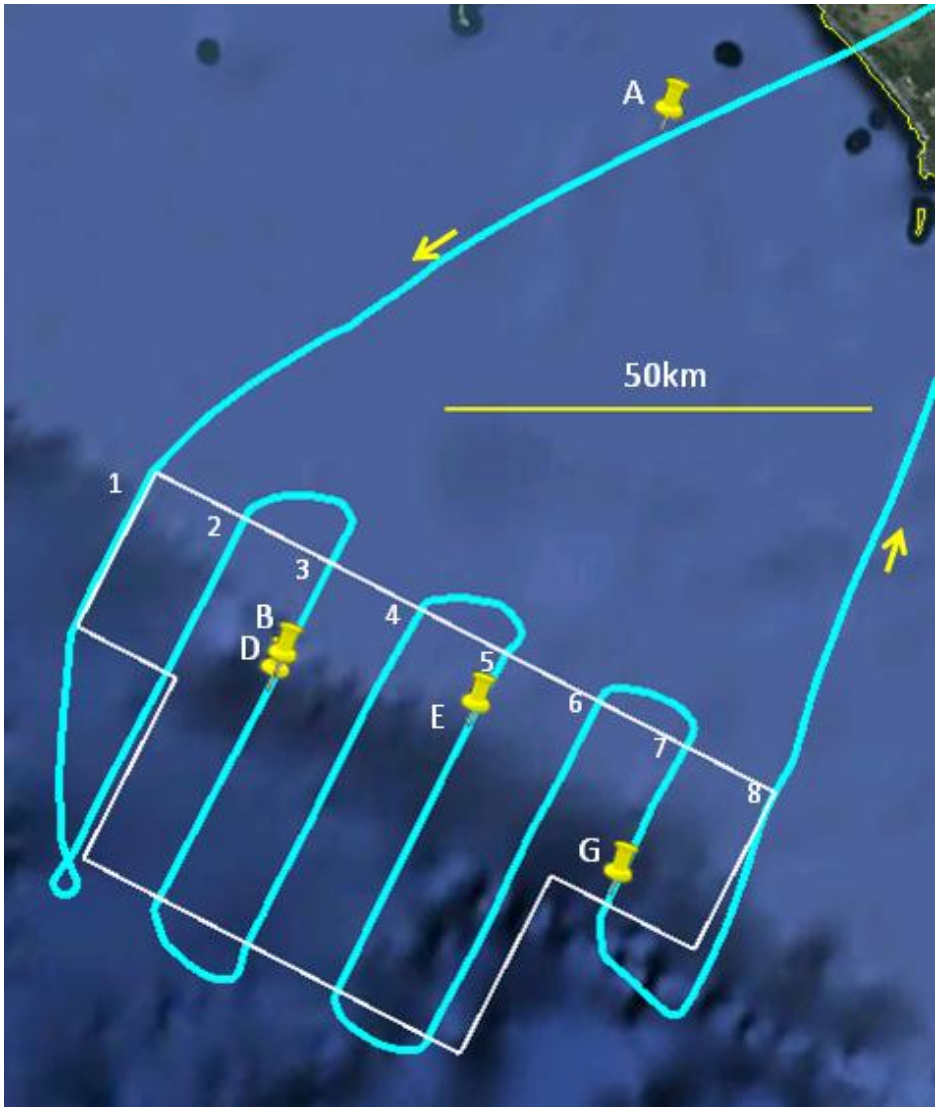
Survey 1 - 6th April 2013

During the flight, the survey leader noticed that the first two transects were flown off course. This was subsequently corrected. The deviation off the trackline in transect 4 was to investigate a possible whale sighting which was not confirmed and therefore doesn't appear on the Figure. The deviation just to the north of transect 8 was to investigate two large schools of fish as their large size and associated water disturbance indicated the possibility of a feeding whale below.

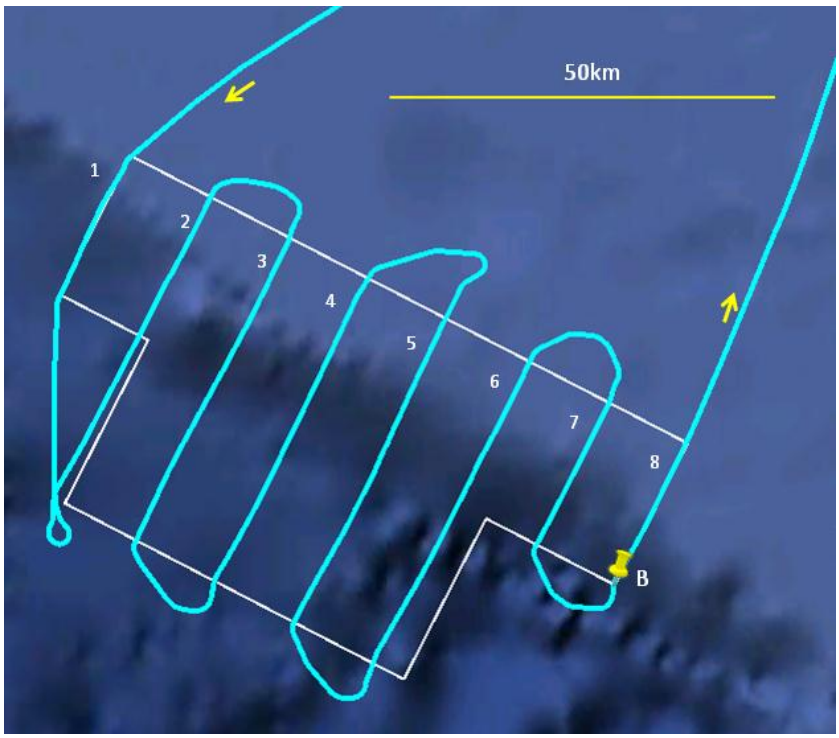


Survey 2 - 16th April 2013

Note that transect 2 has been extended to the south west for this and all subsequent flights. Transect 8 was flown slightly off course to avoid rain at the southern end.

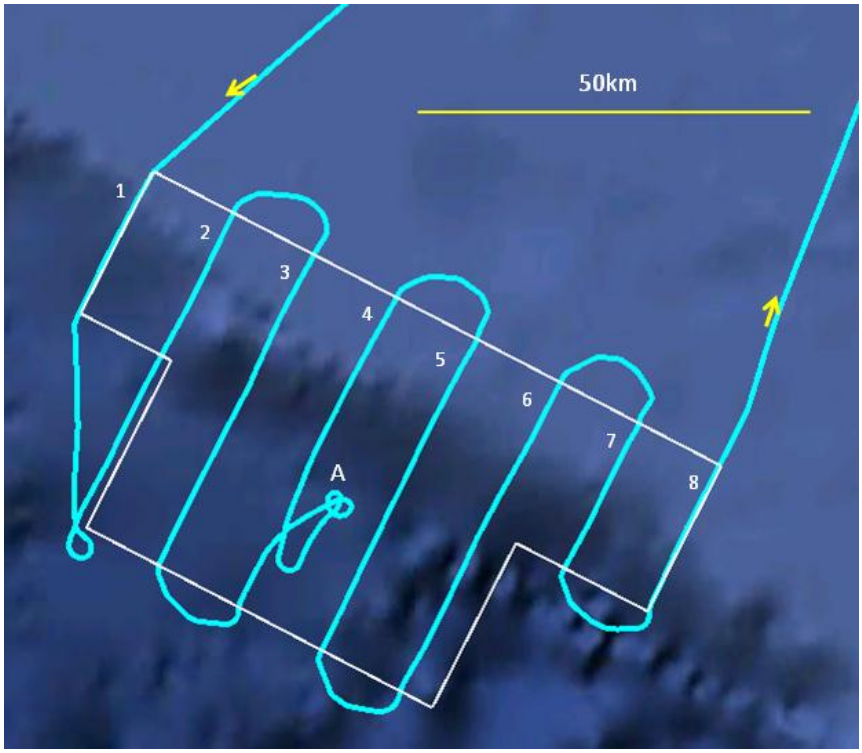


Survey 3 - 28th April 2013



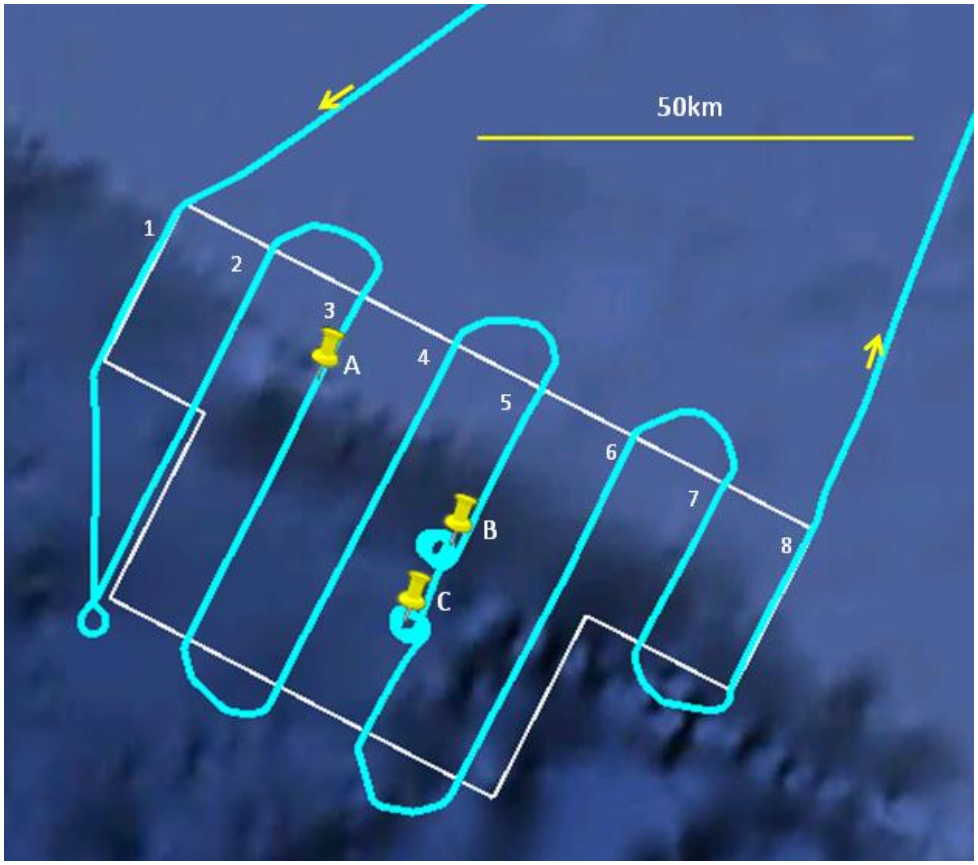
Survey 4 - 30th April 2013

Transect 4 was broken for a flyover and to communicate with the *S/V Pelican* (Sighting A).



Survey 5 - 6th May 2013

The deviations off the trackline in transect 5 were to investigate sperm whale sightings.



Appendix C: All sightings

The table contains position and description for all sightings.

Survey	Sighting	Position	Description
1	A	-35° 35' 30", 134° 42' 39"	Cargo ship
1	B	-35° 35' 39", 134° 51' 39"	Unconfirmed whale
1	C	-35° 50' 30", 134° 59' 27"	Fish school
1	D	-35° 33' 51", 135° 10' 00"	Shark
1	E	-35° 38' 00", 135° 15' 52"	Fish school
1	F	-35° 40' 17", 135° 14' 30"	Small odontocetes
1	G	-35° 43' 14", 135° 20' 51"	Small odontocetes
1	H	Not recorded	Fish school
1	I	-35° 16' 37", 135° 35' 57"	Fishing boats
2	A	-34° 54' 01", 135° 17' 13"	Small odontocetes
2	B/C	-35° 28' 20", 134° 47' 24"	Dolphins
2	D	-35° 29' 16", 134° 46' 49"	Dolphins
2	E	-35° 31' 30", 135° 02' 21"	Small odontocetes
2	F	-35° 29' 10", 135° 14' 28"	Fauna (poss seal or shark)
2	G	-35° 42' 10", 135° 13' 22"	Dolphins
2	H	-35° 16' 07", 135° 35' 32"	Fishing boat
3	A	-35° 47' 10", 135° 18' 59"	Cargo ship
3	B	-35° 45' 41", 135° 19' 43"	Small odontocetes
4	A	-35° 39' 31", 134° 48' 59"	S/V Pelican (position is where the aircraft left the trackline to fly over)
4	B	-35° 25' 32", 135° 06' 15"	Cargo ship
5	A	-35° 26' 21", 134° 48' 23"	Small odontocetes
5	B	-35° 36' 36", 134° 58' 28"	Sperm whales
5	C	-35° 41' 21", 134° 54' 55"	Sperm whale
5	D	-35° 26' 08", 135° 05' 52"	Cargo ship

Appendix 3 – Great Australian Bight proposed petroleum activities map