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# Seismic Surveys and Offshore Exploration in Highly Sensitive Marine Areas: Regulatory Guidelines and Best Practices for Contractors and Operators Working in the Indonesian Seas.

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Introduction: Indonesia's Oil and Gas Industry

Indonesia has a major challenge to produce more oil from current fields, and has difficulty to meet increased target set by the Ministry of Energy of 960,000 barrels/day. In 2008, Indonesia withdrew from the Organization of Petroleum Exporting Countries (OPEC) due to declining production and increased imports of oil. It is the prime objective of the Government to increase the overall production of hydrocarbons, especially the more abundant gas fields, and deep-sea extraction will become a crucial part to achieve this goal.

As such there has been, and will continue to be, a clear focus on deep-sea exploration and production, often referred to as Indonesia's "New Frontier'. The increased interest and upcoming offshore activities for the Indonesian Seas can be sampled at the major regional conferences for offshore in 2010 alone such as the:

- 34th IPA Indonesia Petroleum Association Conference in (May 2010, Jakarta, Indonesia);
- 3rd DSAC Deepwater Southeast Asia Congress (October 2010, Kuala Lumpur, Malaysia).
- The OSEA Conference in Singapore in (Nov 2010, Singapore) and to a lesser extend
- 50th APPEA Australian Petroleum Production and Exploration Limited Conference (May 2010, Brisbane – with emphasis on the Timor Sea)

All these events have high-level government officials and industry leaders presenting on Indonesia's potential for oil and gas exploration and production. **It is clear that accelerated exploration is urgently pursued at both industry and government.** Exploration is the front end of future production and it is essential to encourage as much exploration activity as possible (Ashton 2010). At the IPA 2010 conference alone "14 Production Sharing Contracts (PSCs) and 8 Gas Sales Contracts were signed, as well as 18 New Work Acreages announced (Ashton, 2010).

To encourage the rapid expansion of industry activities Indonesia's Vice – President announced in May 2010 that **government policies will focus on:**

- Reviving and accelerating exploration activities by reviewing the incentives structure, streamlining regulations and eliminating implementation bottlenecks (Boediono 2010).

Current and future production sharing contracts, concessions and work acreages span throughout the Indonesian archipelago, with new bidding rounds currently underway and additional rounds expected to continue until 2015 at least. The current focus seems to be on three main regions. These are consistently highlighted as "Areas of Interest" for immediate or future exploration and extraction of hydrocarbons, predominantly gas**:**

- Makassar Strait (especially the adjoining coasts of East Kalimantan and South and Central Sulawesi
- Papua (especially the Raja Ampat and Bird's Head regions, Cendrawasi Bay)
- Northern Ceram Sea (bordering Raja Ampat)
- Halmahera
- Various scattered areas such as the Jamdena Islands

Recent accidents and spills involving deep-water wells such as the Montara / West Altas spill in the Timor Sea of the northern coast of Western Australia (which took 10 weeks to plug and caused pollution in the Kupang area, Savu Sea and Timor Leste)

and the mega Deepwater Horizon spill in Gulf of Mexico (GoM) are timely reminders that the environmental as well as socio-economic stakes are high.

If any early lessons can be learned from the recent spills in Australia and the USA, it is clear that containing and stopping a spill at depth is a technological problem which even for the most advanced and rich nations on Earth takes several months to solve, and at great expense. Investigations into the Australia spill have been finalized and a government review is scheduled to be released by the end of 2010; whereas the GoM investigations are not expected to be completed until late 2010. Nonetheless, there are clear statements by various industry experts that both spills could have been prevented if international best practices had been adhered to (i.e. International Herald Tribune 18 June 2010; Jakarta Post 21 June 2010).

For Indonesia - the world's largest archipelago - with its limited resources and limited technical capacity in case of a major oil spill in remote areas, the only practical approach seem a dual priority on:

a) Adequate Marine Spatial Planning (where, when and how these project are conducted through all stages) and

b) Prevention of Accidents (development of national best practices).

These international best practices are available for each stage of the oil and gas extraction process (adapted from Pidcock et al. 2007):

1. Preliminary Exploration Activities

Including airborne surveys and geotechnical explorations and "sniffer' surveys.

2. Exploration Activities

Including seismic surveys; exploration and appraisal drilling; well testing.

3. Construction, Commissioning and Operation Activities

Including production platforms (incl. coastal infrastructure such as jetties – pile driving being a major noise impact), under sea pipelines, development of production wells, support shipping and international transport

4. Decommissioning

The International Maritime Organization (IMO), of which Indonesia is a participating nation, has issued guidelines for the removal of abandoned offshore installations, including

> *"...on or after 1 January 1998, no installation or structure should be placed on any continental shelf or in any exclusive economic zone unless the design and construction of the installation or structure is such that entire removal upon abandonment or permanent disuse would be feasible."*
>
> These guidelines are also in effect in Australia (as quoted in APPEA (2), 1997)

## Underwater noise as a major pollutant with high risk potential for impact on protected species and habitats.

The intense underwater sounds generated during seismic surveys for oil and gas exploration can have extreme ranges of acoustic impacts, both in space and time. Marine mammals are especially sensitive to underwater noise, but turtles, fish and squid may also be affected. Behavioural changes in large baleen whales such as fin and blue whales have been documented as far as 3000 km away from the seismic source and such changes have lasted for days after the exposure occurred. Furthermore, different species have different sensitivities to the noise frequencies. In general large whales will be more impacted by low frequency noise, whereas dolphins and beaked whales are more disturbed by relatively high frequencies. Several comprehensive and reviews on best available science have recently been published as noise pollution in the ocean becomes an urgent priority for improved marine industry management.

Noise, as a form of energy, is implicitly considered a pollutant under Article 1(1) (4) of the United Nations Convention on the Law of the Sea (UNCLOS). However, to date noise is not subject to the same level of regulation as other pollutants, at national or international levels, although such efforts are increasing and currently underway in the Mediterranean and elsewhere (Agardi et al. 2007). Further in-depth background on underwater noise propagation, noise exposure at distance and depth, and species-specific sensitivities, been published recently, (Hereta 2007, Agardi et al. 2007, Parsons et al. 2009 and references therein)

Publications on best industry practices and guide lines to management agencies for noise impacts to Marine Protected Areas have also increased dramatically compared to a decade ago (Pidcock et al. 2003, MPA News 2010, Weilgart 2007, Hooker and Gerber 2004).

Both industry, marine managers and other stakeholders recognize that increased cross-sectoral planning, clear and transparent regulations and restrictions on how and where to operate and strict compliance (either voluntary and/or legally stipulated) by the oil and gas industry as a whole is a much needed step forward to ensure the sustainable development of the rapid growing and nationally important industry sector (i.e. see Hothus 2010 in NEAM 2010 for an global offshore industry association's perspective on the need for Marine Spatial Planning).

## Underwater sound generators - Airguns and arrays

Seismic surveys are conducted offshore by industries trying to find deposits of oil and gas under the seabed. Large specialized seismic survey vessels are deployed with cables that can fire airgun blasts/sound waves at the seabed to describe underwater geological formations and structures. These vessels are normally supported by "chase boats" to ensure the path of the survey vessel is not obstructed by other traffic or fishing nets.

Airgun blasts can be discharged every 6–20 seconds and can proceed for up to 24 hours. The depth of the cable is controlled at 5–10m depth, and sound waves can penetrate up to 10 km below the seabed. The intensity of the sound can be 241–265 decibels at the source. Sounds at half this intensity (e.g. 125 decibels) can injure the human eardrum and cause permanent hearing loss.

The general use and function of airguns and arrays can be explained as follows (extracted from an independent review by Pidcock et al. 2003*)): "The airgun is a device that produces an impulsive signal by violently releasing compressed air into the surrounding water column. The discharge of the airgun arrays during seismic survey represents the key potential disturbance on marine fauna, specifically marine mammals, through the input of high energy, low frequency sound. The signals produced travel down through the water column, and into the seabed where some of the energy is deflected back.*

*These 'echoes' are received by strings of hydrophones (array) towed by the seismic vessel, and their travel times and character allows geophysicists to map the sub-sea strata and so locate potential petroleum traps. Air-gun signals are much more intense than continual noise from shipping or drilling associated noise. Air-gun signals are generally repeated at short intervals of 8-15 seconds within a track line, which will vary per survey. In general, air guns may produce broadband source levels approximately between 215 – 230 dB re 1µPa [or more], although the exact source level will be a function of air gun design, capacity (litres), operational air pressure and detonation depth. Most of the sound energy produced by an air gun can be considered to be in the range of 10 – 300 Hz.*

*Thus seismic surveys are a locally intense and persistent noise source active over a large region for a protracted period (McCauley and Duncan 2001)."*

## THE IMPACTS

### Indonesia's marine mammals: cetaceans and the dugong

Indonesian waters have an exceptional marine mammal diversity with over 30 species recorded thus far (Rudolph et al. 1997 Kahn 2002, 2007, 2009). More than one third of all known whales and dolphins species (collectively called cetaceans) worldwide can be found in the Indonesian Seas. This includes numerous rare and endangered species, including 8 species of so-called "great whales" such as the Blue whale *Balaenoptera musculus,* Sperm whale *(Physeter macrocephalus),* Bryde's whale *(B. brydei),* Humpback whale (*Megaptera novaeangliae*), Fin whales (*B. physalus*); at least 4 species of oceanic beaked whales (Fam. Ziphidae); and at least 17 species of oceanic, coastal and riverine dolphins (Fam. Delphinidae; including orcas or killer whales and the Irrawaddy dolphin *(Orcaella brevirostris) and the Finless porpoise (Neophocaena phocaenoides)*. The dugong *Dugong dugon* belongs to another marine mammal group, the sirenians or sea cows, and can be found in shallow seagrass areas of Indonesia.

Marine mammal habitats include major rivers, mangroves, coastal and open ocean environments. In Indonesia, these diverse habitats are often in close proximity to one another (Kahn 2002, 2009). Critical marine mammal habitats of regional conservation importance have been identified throughout the better studied parts of the archipelago. These include Indo-Pacific migratory corridors as well as foraging and mating grounds for great whales, as well as several isolated populations of dolphin species, which are recognized as strongholds throughout their SE Asia range.

Cetaceans have developed a highly sophisticated acoustic repertoire. Cetaceans have acutely sensitive hearing and use sound both actively and passively in their day-to-day lives find food and mating partners, navigate through their environment, avoid predators and to communicate over large

distances. An increasing number of studies have clearly demonstrated that seismic surveys can disrupt cetacean behaviour.

Seismic surveys use airguns incorporating highly sophisticated technology. These surveys produce extreme underwater sounds and can have an extended range of acoustic impact, in both space and time, can disrupt these animals and their natural migration and feeding patterns. This impact may even be felt across spanning ocean basins. Marine mammals can become displaced and may show avoidance or stress behavior estimated up between tens to thousands of kilometers from a large seismic source.

For example, seismic survey noise has been detected over 4000km from its source and, even at this exceptional distance, it *still obscured* natural whale vocalisations (Nieukirk et al. 2004). In another study, fin whales stopped making sounds altogether throughout an extensive whale habitats area of at least 10,000m2 in response to a nearby seismic survey (Clark and Gagnon 2006). Furthermore, long-term research has indicated that migratory cetacean species in Brazil may have been displaced by chronic seismic survey activity. During a 10-year period this study found substantial decreases in cetacean density with increasing seismic surveys. These changes where not thought to be caused by any oceanographic parameters (Parente et al. 2007).

Habitat displacement of several large baleen species such as sei and fin whales by an especially large seismic survey is also suspected in Scotland in 1998 (Macleod et al. 2006). Blue whales - the largest whale and a relatively common species in the Savu and Banda Seas at certain months – changed its behaviour in response to seismic surveys at least 10's of km away, and exhibited "probable avoidance" from such activities within 3-20km from the sound source McCauley and Duncan (2001). McCauley et al. (2000) reported that humpback whales, Megaptera novaeangliae, of West Australia, showed strong and aversive reactions at 7–12 km from seismic vessels, with mother and calf pairs being especially sensitive. Numerous dolphin species also show a variety of responses including active avoidance (Bain and Williams, 2006 Beale, 2007 and Wright et al. 2007). If seismic sound waves are particularly intense they may cause lethal injuries and subsequent whale strandings.

In Raja Ampat the greatest concentration of cetaceans occurs in Dampier Straits MPA, the deeper waters of the Sagewin Strait and in Kofiau MPA (Kahn 2007 and 2009, Muljadi 2009). Monitoring data from Kofiau and wider Raja Ampat clearly shows the MPA is an important feeding ground and migration corridor for whales and dolphins (Kahn 2007, Muljani 2009,) Many of these species are listed as Endangered or Threatened on the IUCN Red List including the extremely rare Indo-Pacific Humpback dolphin - the coastal waters of Raja Ampat are considered a regional stronghold for the species[4]. There are also residential Bryde's and sperm whales that uses these local Papuan waters for most if not all their life cycle Kahn 2007 and 2009. The potential impact to cetaceans is of great concern given the license area known as "*Block Kofiau*" is positioned directly over the area where cetaceans concentrate. Given this and adjacent areas (into Dampier Straits) are the only known areas where cetaceans concentrate and feed and migrate to in Raja Ampat, and therefore critical habitat, all measures must be taken to minimize disturbance. Similar situations of high risk to extreme sound exposure exist in numerous areas of east Indonesia where cetacean hotspots and critical habitats have been identified including Savu and Banda Seas.

Marine turtles, fish, squid and other marine life are considered less sensitive to extreme sound, yet these diverse species are also affected in different ways (see

section below). Many of these species are of importance to marine conservation, tourism, and food security (local and commercial fisheries).

**Marine turtles**

Marine turtles are deep-diving reptiles and may be at considerable risk of extreme sound exposure at depth. Marine turtles are very hard to study at sea and even more so when investigating a behavioural response to a sound source. More studies are needed to fully understand the potential impacts of seismic surveys of these animals. Although marine turtles are generally considered less sensitive to underwater sound than marine mammals, permanent hearing loss could occur, as well as various dive related injuries (baro trauma), which may be lethal or sub lethal (Eckert et al. 2000).

McCauley et al. (2000, 2002) showed that marine turtles are also affected by seismic sound sources, and display an "alarm" response are while being up to 2 km away from a seismic source. In captivity, 2 species, the loggerhead and Kemp-Ridley turtles exhibited a "abrupt avoidance" response when exposed to low-medium frequency sounds in their tank (Eckert et al. 1999). In the wild, such strong behavioural reactions to any seismic survey nearby could well disrupt seasonal mating behaviour or displace nesting females from prime beach areas.

As all six species in the Indonesian Seas are classified as Critically Endangered, and listed as protected species under national law, the potential impacts of seismic surveys on these animals are of concern. This is of particular importance near critical habitats such as nesting beaches, migratory corridors and foraging areas. Papuan waters include some of the most important nesting beaches of the Pacific population of leatherback turtles, the largest of all marine turtles. Leatherbacks prefer pelagic habitats and are exceptionally deep-divers which may dive as deep as 1200m. Their specialized ecology means that leatherbacks have a large number of behavioral and physiological differences when compared to other turtle species (i.e. a soft leathery carapace or shell; Eckert et al. 1999). These attributes may make leatherbacks more sensitive to seismic surveys than other marine turtles. Hence any overlap between Areas of Interest or oil and gas concessions and turtle nesting beaches with high abundance is of major concern, this includes large coastal areas of Papua Barat and the Derawan islands.

**Fish and squid**

Sound levels at or greater than 180 decibels cause damage to fish and squid (Hirst and Rodhouse 2000) and can be affected up to 2–5 km from the seismic source (McCauley et al. 2000). Impacts to fish can be divided into lethal and sub-lethal effects. If adult fish, fish larvae or fish eggs are close to the source of the seismic surveys, within 10s of meters or less, they can be killed instantly. (Hirst and Rodhouse 2000, Gausland 2003) Sub-lethal effects can include damages to fish ears, swim bladders, eyes and other internal organs, which will then affect their ability to feed and makes them more vulnerable to predators and diseases. Hirst and Rodhouse 2000, Sverdrup et al. 1994. These internal injuries can cause a delayed effect and death may occur later, after seismic activities have stopped. Coral reef would be particularly vulnerable given the specialized habitat they live in. Very little is known about the impact to other animals in the marine system (e.g. zooplankton, squid, etc.) that may play vital roles such as providing food for fish. Other invertebrates like lobsters and clams do not appear to be affected as much by seismic surveys (McCauley et al. 2000, 2002. More research is required to fully

understand the short and long term impacts to fish populations, especially the sub-lethal impacts.

**Underwater noise "sweeping" marine life away from of inter-island channels**

In Indonesia – the world's largest archipelago with over 18,000 islands - narrow yet deep channel habitats between islands are relatively common and may also function as migratory bottlenecks for large marine life such as blue and sperm whales (Kahn 2007, 2009). In certain areas, where powerful seismic arrays are towed through these deep passages, the resulting underwater propagation of extreme sound in an enclosed underwater environment may act like an amplified sound beam and "drive forward and completely displace fish and squid species from such channel habitats", as marine life tries to avoid the approaching blasts of the array (McCauley pers. comms).

This "sound beam" impact on local fish and squid would be in addition to disturbances and potential injury to the more sensitive mammals and turtles, (McCauley pers. comm. 2010). In effect the acoustic impact of a seismic survey may thus sweep these confined channel habitats. These potential impacts have not been studied thus far, but experts in sound propagation and noise exposure at depth indicate this may be of serious concern for archipelagic nations such as Indonesia. As such, it is recommended that all air gun arrays are turned off when seismic vessels pass through confined inter-island passages and straits.

**Impact to local communities**

Fish is a vital source of food and livelihoods for local communities in Raja Ampat. Any impact to local fisheries will have a follow-on impact to local communities. Surveys from other parts of the world have found that fish harvests can decrease in areas where seismic activity has been conducted Skalski et al. 1992. Fish catches may be reduced in areas where seismic activity occurs due to mortality (immediately or delayed) or changes in their behavior as they move away from the stress – see also above on risks of acoustic sweeping for inter-island channels.

Given the high value communities have placed on their resources and their role in establishing MPAs within their areas, it is important that all unnecessary impacts to the MPAs and local fishing grounds are prevented. Seismic surveys within or in proximity to MPAs is contrary to the commitment communities and the Raja Ampat government have made to protecting biodiversity, fisheries resources and long-term community well being.

While Raja Ampat is often noted as a case study in this report, there are numerous MPA initiatives throughout the archipelago, which would benefit from this approach.

As noted in this report, the public's perception of the long-term risks of a spill or deep- sea well blow out have radically changed after the mega disasters in the Gulf of Mexico (as well as the Montara blow-out in the Timor Sea).

To control a deep sea well head may well be beyond the technological capabilities and contingency plans for Indonesia. While such large scale spills will literally affect 1000's coastal communities and their livelihoods as well as the Coral Triangle's regional food security.

Dive tourism industry

Throughout east Indonesia, this rapidly growing marine industry is providing much needed local job opportunities and economic diversification in remote areas. Often the development of nature-based tourism such as diving has been highlighted as a priority by provincial and local governments – as is the case for the Raja Ampat government.

The seismic surveys and offshore industry can have a major disruptive effect on the quality and reputation of Indonesia's world-class dive destinations. Live-aboard dive operators often book clients with fixed itineraries years in advance, and cannot easily change schedules when a seismic survey is planned for their area of operation, without disappointing clients. Land-based resort operators do not have options to move their diving guests and would be severely limited if seismic surveys are conducted within or close to MPAs and key dive sites.

As the events of January 2010 illustrate (see Appendix 2), to conduct a seismic surveys in proximity to key sites in Raja Ampat, especially popular dive sites in MPAs such as Dampier Straits and SE Misool will have a devastating negative impact on the tourism industry. For example, the TGS seismic activities within and adjacent to the SE Misool MPA has clearly impacted upon the dive operators, who have been asked to forgo access to the prime dive sites and move to different locations – all during their prime dive season. According to the warnings made by the vessel at the time, divers within a radius of 18 kilometer if the seismic surveys ran a high risk of being injured. This meant a substantial part of the area was declared off limits to diving, and clients were increasingly concerned about their safety. Wilderness values – so important for client satisfaction in nature based tourism – were degraded as well. Any single injury is likely to result in negative local, national and international press, which would be damaging to Raja Ampat's reputation as a world-class dive location. For Raja Ampat, high end establishments such as Misool Eco Resort and Papua Diving have no where else to go if a seismic survey is conducted in the same waters – and may experience negative economic consequences of such offshore activities for a long period after the vessels have left.

To mitigate these risks, seismic surveys need to be prohibited inside Marine Protected Areas and restricted near areas of marine tourism, with the vessel staying outside an acoustic buffer zone of 10 nautical miles or 18 kilometers (see below; Table 1).

**Local and International Calls for better management of offshore industries.**

Following the catastrophic Deepwater Horizon oil spill in the Gulf of Mexico, the intergovernmental organization IUCN (International Union for Conservation of Nature) called for a global moratorium on oil and gas exploitation in ecologically sensitive areas, including deepwater ocean sites and polar areas. (see http://www.iucn.org/?5420/Stop-oil-and-gas-exploration-now-says-IUCN)

These concerns of a major spill in Indonesian waters are not alarmist, as the recent Montana blow-out in the Timor Sea illustrates. It took more than 10 weeks to stop the leak from that sub-sea well. Situated on the continental shelf, at relatively moderate depth, this well was by no means in an extreme position to fix.

For Indonesia and the Coral Triangle Region, several recent scientific conferences and business summits have recognized the need to initiate a dialogue with offshore

industries on perceived conflicts. Experts during a recent Indian Ocean Cetacean Symposium in 2009 officially stated their concerns and "

> *"Urge organizations using seismic surveys for oil and gas and mineral exploitation and production (and the governments of the countries in which they operate) to adopt international best practice to minimize impacts on cetaceans" (whales and dolphins) (Maldives Declaration 2009)*

Similar calls to action were put forward during the inaugural Coral Triangle Business Summit (CTI Business Summit 2010). The Summit's Energy, Transport and Tourism Sector Communiqué include recommendations to:

- *Urge organizations involved in offshore oil, gas to adopt international best practice to minimize impacts on marine ecosystems*
- *Ensure early* engagement by the offshore industries with all stakeholders affected by their activities *[ to provide for adequate lead up time during the projects planning stages to mitigate any potential impacts]*

Several regional and global oil and gas Industry Associations have also recognized the need for better ocean management – and acknowledgement of sensitive marine areas - , recently the World Ocean Council (WOC) has taken the lead to mobilize "ocean industries" into a push for better communication with other marine stakeholders and a call for improved responsible care and better self-regulation of offshore activities. WOC states that an important step forward is industry-wide voluntary compliance to international best practices. The companies with are members of the IUCN Business and Biodiversity Initiative have stated similar commitments to environmental stewardship – also in remote, unregulated locations. Table further details temporal and spatial restrictions for seismic surveys.

Collaborations with industry leaders with a commitment to the environment will be vital to progress in these areas of concern. To ensure these requirements can be fully understood by future concession holders, restrictions and special operating requirements can be incorporated in a clear and transparent lease process (as is the case in Australia, Brazil, Norway).

**Compliance to national laws of "home governments" while conducting projects overseas.**

The seismic survey industry is an international business sector with numerous multi-national companies. It is important to note that various governments whose nations have regulated significant offshore industry in their national waters have stated that "home governments have a responsibility to put and enforce their national laws to hold international companies accountable" and *"home governments [in this case Canada] expects her companies to comply with both international and national practices and laws"* (pers. comms Dickens, AFIEGO). Transparency and adherence to these legal commitments by companies conducting overseas operations is expected by the governments of Norway, Canada, USA and Australia.

## The best mitigation measures available.

The need for additional mitigation of noise impacts for seismic surveys worldwide are increasingly obvious and a consensus on priorities and next steps has emerged (and published) from marine scientists, whale ecologists and other specialists. Recent expert workshops held by regulators (i.e. the IWC) and others have endorsed the

numerous recommendations in the scientific review literature:

*"There is an urgent need to strengthen and standardise mitigation measures... We should work towards* ***regional guidelines*** *and* ***coverage throughout the world****, wherever surveys take place".* (International whaling Commission Workshop on the Impacts of Seismic Survey Activities on Whales and Other Marine Biota, proceedings by Herata 2007) .

There is broad agreement by marine scientists and conservationists on which mitigation procedures should be incorporated **at a very minimum** to reduce severe impacts to marine mammals and other biota, as well as improve ocean management in general (Weir et al. 2007 – has more detail on these points, Herata 2007, International whaling Commission Workshop on the Impacts of Seismic Survey Activities on Whales and Other Marine Biota 2007, Parsons et al. 2009).

Very basic, yet essential, strategies and mitigation measures to reduce noise impacts of seismic surveys on marine life include have been put forward as minimal *worldwide regulatory guidelines* (MPA 2009 as per Weir et al. 2007):

- **Avoid surveying in areas with sensitive species:** gather data on how animals use an area prior to conducting seismic surveys there
- **Safety zone around the survey:** make this zone large enough to ensure that received sound levels outside of it are below a maximum limit
- **Visual observers:** look for marine mammals and other species of concern inside the safety zone during the survey, and power-down the seismic activity if marine mammals are sighted
- **Passive acoustic monitoring:** listen for vocalizing marine mammals
- **Pre-shoot watch:** look for marine mammals and other species of concern inside the safety zone prior to starting the airguns
- **Soft-start or ramp-up:** gradually build up the airgun sound level to allow marine mammals to depart the area before sound levels peak
- **Minimize airgun sound propagation:** use the lowest practicable volume throughout the survey
- **Restrict airgun use during nighttime hours:** conduct surveys only when there is sufficient light for observing and detecting marine mammals and other species of concern within the safety zone.

Recommended guidelines for managing and reducing impacts from seismic surveys in the Indonesian Seas.

For Indonesia a comprehensive system on such mitigation measures has been incorporated and is recommended for adoption by the Indonesian government (below, Table 1). The guidelines on mitigation for Indonesia have been based on joint outcomes of international workshops and independent scientific reviews (in particular Herata 2007, Pidcock et al 2007, Parsons et al. 2009, Weir et al. 2006, Agardi et al. 2007) as well as numerous peer-reviewed scientific publications as listed in the reference section.

The guidelines have been aligned with, and are in accordance with, current best practices as already implemented in various regions and countries (such as Australia, Brazil, Canada, Gulf of Mexico, New Zealand, Russia, Spain, West Africa, USA. See also Table 1 in Weir et al. 2007 for a summary):

**A. Avoid surveying in sensitive marine areas and important habitats for vulnerable species.**

The overarching and critical guideline of most, if not all, these publications is that the most effective mitigation occurs at the planning stages: the distribution and abundance of Species of Concern may vary substantially in different seasons, monsoons, moon phases or other cycles for a given area. To limit exposure to extreme underwater noise, it is crucial NOT to conduct surveys in those areas at times where Species of Concern diversity and densities of animals is high.

Sensitive areas may already been designated a Marine Protected Area, but these make up a minute fraction of the ocean's area, thus oil and gas companies need to incorporate ecological data of habitat use and known "hotspots" for species of special concern such as marine mammals, turtles and whale sharks at the early planning stages of the survey in order to asses the best time and route to minimize unnecessary adverse effects. Better communication between industry and marine specialists is essential for effective avoidance of sensitive marine areas during seismic surveys and this has been widely recognized by all reviews listed and major oil and gas industry associations as well (i.e. World Ocean Council 2009, APPEA, see Marine Spatial Planning section below).

This is especially relevant for Indonesia, which is a central part of the Coral Triangle – a region of global marine conservation importance. The Coral Triangle includes the coasts, reefs and seas of the six countries of Indonesia, the Philippines, Malaysia, Papua New Guinea, the Solomon Islands and Timor Leste. These waters are regarded by experts as the world's richest marine environment and account for 30 percent of the world's reefs, 76 percent of global reef building coral species and more than 35 percent of coral reef fish. Megafauna includes 6 species of marine turtles and over 30 species of marine mammals as well as whale sharks. It is because of this extra-ordinary bio-diversity and abundance of marine wildlife (and the livelihoods and food security derived from them to over 120 million people throughout the Coral Triangle) that the Indonesian Seas are widely recognized as an highly sensitive marine area and a global priority for marine conservation. Eastern Indonesia, and Raja Ampat in West Papua in particular, is considered the epi-centre of the Coral Triangle, with the highest coral reef bio-diversity recorded on our planet. This region has been identified nationally as one of the highest priorities for conservation effort and intervention (Huffard et al. 2009).

In such a sensitive marine region, it is crucial that the environmental component of the spatial/temporal planning activities should be conducted well before the survey commences (i.e. 1-2 years prior) and must become a core requirement for all seismic surveys in Indonesian waters. Table 1 includes additional information on spatial and temporal closed zones in other countries and includes operational guidelines for surveys operating in the vicinity of Indonesia's Marine Protected Areas, seamounts and persistent pelagic habitats. These habitats are extremely sensitive and highly productive and of major importance to other marine industry sectors and thus warrant an acoustic buffer radius of 18 km.

**B. On-board actions to reduce noise impacts from the exploratory seismic survey vessel.**

Once the survey has been planned, routed and timed appropriately, the following *on-board* mitigation measures would include (bold as by Herata 2007; full listing and further operational details as per Table 1):

1. Marine mammal mitigation **guidelines should be adopted by *all* oil and gas companies.**
2. Mitigation measures should apply to ***all marine mammal species*** and marine turtles.
3. **MMOs** (Marine Mammal Observers) must be qualified, dedicated and experienced.
4. MMOs should ***report directly to the regulating body*** throughout and on completion of each survey to ensure that reports are received without other involvement. Standardised reporting should also be a requirement.
5. Every seismic operator should implement a ***soft start procedure*** for every use of airguns.
6. The use of the ***lowest practicable airgun volume*** should be defined and enforced.
7. There should be a scientific basis for the ***Exclusion Zone (for Indonesian deep sea waters the EZ is recommended at 3000m***))
8. There should be a dedicated ***pre-shoot watch*** of 30 minutes (<200m depth) or 60 minutes (200m depth) for deep-diving species.
9. There should be a ***delay to commencement of soft start*** for all marine mammal species and marine turtles observed within the EZ.
10. Soft start may not begin until 30 minutes after the animals depart the EZ ***or*** 30 minutes after they are last seen.
11. There should be an immediate ***shut-down*** of the airguns whenever a marine mammal or marine turtle is seen to enter the EZ.
12. Following a shut-down, a full soft start is mandatory.
13. Extra mitigation measures should be applied in deep water areas for ***sperm and beaked whales*** seen diving on the vessel track line, soft start delays and shut-down procedures are applied to animals seen diving within 2 km ahead of the source, even if outside of the EZ at the time of last visual confirmation
14. Airgun use should be restricted during ***adverse weather conditions*** (Beaufort sea state ≥ 4, swell ≥ 3 m, thick fog, heavy monsoonal rainfall)
15. **The use of Passive Acoustic Monitoring (PAM)** is to become a compulsory aid to visual detection during daytime hours and a stand-alone detection technique during low visibility (incl. nighttime).
16. Disturbance from ***other vessels*** associated with the seismic operation (e.g. guard vessels, supply boats, work boats, undershoot vessels etc) should be minimized.
17. Ideally, airgun use should be ***prohibited at night, (***unless adequate nighttime detection methods are in place, such as PAM or monitoring systems that use maritime night vision systems with the use of infra red cameras. Depending on sea state, these Infra Red (IR) systems can reliably detect surfacing whales within a limited range).
18. The 18 km acoustic buffer zone[2] around any designated sensitive marine areas must be adhered to (Table 1). **A**
19. **All air gun arrays are turned off when seismic vessels pass through confined inter-island passages and straits (to avoid acoustically 'sweeping' marine life out of such channels).**
20. Restrictions and special operating requirements can be incorporated in the lease process (as is the case in Brazil, Norway) to ensure a clear and transparent process for future concession holders.

[2] A spatio-temporal noise-threat buffer zone is a marine zone set up around an MPA to provide adequate or precautionary distance between noise sources and known or suspected cetacean habitat (e.g. the Abrolhos Bank, Brazil – Engel 2007 in Agardi et al. 2007).

21. Alternative seismic technology should be encouraged when further developed (there are several methodologies in development which may yield comparable geophysical data without extreme underwater noise generation).

A full listing of mitigation measures including further operational details and countries where such measures have been implemented already is included in Table 1.

**C. Policy and Management recommendations**

**Broader policy measures for reducing noise impacts on marine mammals.**

For policy makers and managers, access to information on industry activities is vital. To ensure this data is forthcoming Agardi et al. suggest the following:

- Managers and the public should have timely access to data on noise source characteristics, spatio-temporal distribution of use and mitigation protocols for noise- producing activities. Noise producers need to provide sufficient lead-time and notice (e.g. at least a year for significant projects) for planned timing of activities, to allow appropriate mitigation and scientific assessment of impacts ('before, during and after' studies; IWC, 2006).

- Expert bodies and extramural scientists should have a role in discussions surrounding site determination for intense anthropogenic sound-producing activities. For Indonesia this may be an IUCN-led panel.

- Expert reports should be required from independent sources, such as local research bodies, conservation organisations and federal environmental agencies.

- Complete information on past noise events, such as naval manoeuvres involving sonar, should be released in a timely and transparent manner by noise producers to allow for the independent analysis of potential correlations between biological and noise events, such as strandings with active sonar.

The core recommendations from the IWC SC included further measures to better manage the following issues. Further details on each of these can be found in Herrera 2007:

1. The future of the seismic industry
2. Acoustic exposure and stranding events
3. Long term effects of noise impacts
4. Critical species and habitats – the role of MPAs as effective noise impact mitigation tools.

- In some areas (e.g. many parts of Asia and Africa), empirical data on the distribution, abundance and structure of cetacean populations exists but has not been compiled. Compilation of such data is essential for spatio-temporal mitigation of anthropogenic noise in these areas and increased emphasis on researching cetaceans in areas where such data do not exist, but where noise-producing activities are expected to occur [such as Indonesia] should be a priority for management funding. However, management should not be delayed during this process: the opinion of recognised experts can be used to supplement the limited data that is available.

- Long-term visual and acoustic monitoring of species and acoustic monitoring of noise levels should be undertaken in existing cetacean-related MPAs and sanctuaries.

- Identification of gaps between existing MPAs and areas subject to extensive noise-producing activities is required.

- The environmental component of the spatial/temporal planning activities should be conducted well before the seismic survey commences (i.e. 1-2 years prior) and must become a core requirement for all seismic surveys in Indonesian waters.

- The establishment of an interdisciplinary **Advisory Panel on Best Practices for Offshore and Extractive Industries (AP-BPOEI).** This Panel can be established as per IUCN guidelines, and includes key government agencies, international and local experts, industry association representatives, local community leaders, NGOs and other maritime industry stakeholders. The Advisory Panel will play a vital in the effective implementation of agreed-upon best practices for offshore industries in the Indonesian Seas. The commitment of several offshore industry associations to best practices has been clearly stated (i.e. APPEA, IPA, WOC – see Holthus 2010). Such a long-term commitment by all companies will be of prime importance to the effectiveness of the Advisory Panel and the sustainability of the oil and gas projects in the Indonesian Seas.

**Seismic Surveys and Marine Protected Areas, others sensitive areas.**

Even the best on-board mitigation measures (i.e. see Table 1 for Indonesia) often rely on real-time observations of marine life to trigger a response which will then reduced impact. However, both coastal and deep diving cetaceans spend most of the time below the sea surface, as do various marine turtle species. Thus the species most at risk are highly cryptic and difficult to see for any trained observer, and during sea conditions above state 3. Hence, on board mitigation is less effective than avoiding extreme noise exposure to marine mammals and marine turtles in the first place (for example feeding grounds, migration corridors, mating and nesting areas).

In addition, certain areas within Indonesia have exceptional marine bio-diversity, such as Marine Protected Areas, or UNESCO World Heritage Sites - which also warrant restrictions to seismic surveys, so that the exposure of extreme underwater noise to exceptionally bio-diverse areas can be limited.

**MPAs and noise**

A marine protected area, or MPA, is a generic term commonly used to describe a marine-based area to conserve species or habitats, backed by local, national or regional legislation. Of the more than 350 MPAs that include some cetacean habitat, only 20 MPAs with cetacean habitat are greater than 10,000 km2 and could function to provide superior mitigation of some noise sources. Agardi et al., 2007. For Indonesia, several recommendations for noise management and MPAs are listed in Table 1, in particular under the recommendations for acoustic buffer zones.

**MPAs and mining**

In 1975 Australia's GBR original legislation specified that "recovery of minerals" was prohibited inside its boundaries. This includes petroleum, oil shale, gas, sand, limestone even dissolved minerals in seawater. Then additional legislation passed from 1994 to 2008 expended such protection with the ban on mining, even outside its boundaries (Weilgart 2007, MPA News 2010). Spain, Brazil, UK, Norway and New Zealand have implemented MPAs that include noise mitigation measures (Weilgart 2007). The drafting of recommendations for best practice in order to avoid or reduce potential impacts of coastal mining to Indonesia's MPAs need to become one of the highest priorities of the Advisory Panel.

**Marine Spatial Planning.**

In lieu of the recent Gulf of Mexico oil spill, the largest spill in USA history both governments and experts have re-evalued the risks of extreme energy exploration and production

A substantial part of Indonesia's planned expansion in oil and gas production will involve deep water exploration and deep sea wells including those located at 2000-3000m meters depth. These sources of 'extreme energy' have an additional environmental and socio-economic risk as any spills are notoriously difficult to control and plug. It is important to realize that even rich, technically advanced and well-regulated countries like Australia and the USA are struggling to control such under sea spillages, as the recent Atlas spill (Timor Sea) and Deepwater Horizon (Gulf of Mexico) illustrate.

In Indonesia's relatively unsupervised operating environment such accidents may occur in the future when they do such a spill at depth would be near impossible to control and plug in any realistic time frame. To control a deep sea well head may well be beyond the technological capabilities and contingency plans for Indonesia. While such large scale spills will affect 1000's coastal communities and their livelihoods as well as regional food security and fisheries. Clearly there is an urgent need to assess these risks and manage them. . Marine Spatial Planning is put forward by both management and industry stakeholders and the best mechanism for sustainable development of ocean resources.

To date, Norway is one of a handful of nations that has specifically integrated offshore activities into their Marine Spatial Planning together with fishing, tourism, marine transport and nature conservation (i.e. Agardi 2010). In Indonesia, numerous MSP initiatives are currently underway on a national, provincial and district level. However, it seems these initiatives may benefit from

1. better consultation and communication amongst government agencies and key stakeholders and
2. a broader perspective: indeed all maritime sectors – including energy and maritime transport – and ecological functions need to be considered in the current MSP framework for its ultimate aim of a National Ocean Plan is to be achieved.

(More information of what MSP means from both a conservation and an industry perspective – and their overlapping goals - can be found in Appendix 3).

Table 1: On-board guidelines for mitigation of the impacts of noise from seismic surveys in the Indonesian Seas, as based upon statutory regulations from other countries used during surveys worldwide[3].

Note: All countries listed have strict statutory regulations and mitigation measures under *each* field, yet these may differ substantially. Hence, not all countries are listed for each measure per se.

| **Location**<br><br>All seas under Indonesian jurisdiction including national and EEZ waters. | **Description** | **Countries**<br><br>with identical statutory mitigation measures already implemented or reference(s) of review. | **Legal status**<br><br>in Indonesia | **Clarifications**<br><br>and cross-references within this report |
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| **1. Species included** | | | | |
| a) All marine mammals | Whales, dolphins, dugong (to date 30 species known to occur in this location) | United Kingdom; USA (California); Brazil; New Zealand; Russia (Sakhalin) | All protected species under national law | Including endangered/vulnerable species such as blue, sperm and beaked whales; coastal dolphins |
| b) All marine turtles | 6 species known to occur in this location | Brazil; Canada; New Zealand | All protected species under national law | All species endangered, some critically endangered – the highest international conservation status by IUCN's Red List, including the leatherback turtle |
| c) Species of Special Concern (SoC) | Whale shark | New Zealand (for other species) | | Some protected species under national law and provincial legislation |
| **2. Marine Mammal Observer (MMO) Requirements** | 2-3 MMOs on watch, must be qualified, dedicated, independent (not crew) and experienced. | USA (California); Australia (compulsory in sensitive areas); Brazil (minimal 3 MMOs as specified); Russia (Sakhalin) | Species included are protected from "harassment". This includes extreme exposure to underwater noise | Number of MMOs to be assigned depending on project specifications and duration. |
| **3. Required observation technique** | 1-2 MMOs on watch continuously during daylight hours. | Brazil and Sakhalin (both stipulate 2 MMOs on watch continuously during daylight | | See MMO section this report. |

[3] (adapted from Weir et al. 2007 and incorporating core recommendations from Agardi et al. 2007, Parsons et al. 2009 and others as indicated).

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| | | hours); Gulf of Mexico (max 4 hrs on watch/MMO) | | |
| | 2 MMOs on >30 min watch during all pre-shoot activities | UK; Australia; Canada; | | See MMO section this report. |
| **4. Soft start / ramp-up** | Compulsory | All countries listed. | | See more details in this report. |
| | 30 minutes minimal and | All countries listed (30 min as averaged 20-40 min); expect New Zealand (20-45 min); Sakhalin (20 min) and USA (time not specified as ramp up has strict incremental increase - see below) | Noise legal status as a pollutant – see UNCLOS legal status of ocean noise as a direct impact pollutant in this report. | All ramp-up, soft start and shut-down procedures need to be monitored and details recorded by the Marine Mammal Observers (1 MMO at the vessel's operational room and 1 on deck) |
| | Increase by 6 dB per min | USA (California) | | |
| **5. Airgun setting and sound propagation** | Set airgun at lowest practicable volume throughout the survey | UK; Brazil; USA (California); Sahkalin; New Zealand | | |
| | Airguns are restricted to the allocated survey prospects. | (Weir et al. 2006, 2007) | | Note: Airguns used during 2D/3D/4D surveys vary in power from several 100 cubic inches ($in^3$) to over 10,000 $in^3$. Thus additional caution and regulation is warranted for the usage of high powered arrays. |
| | Minimize high frequency sounds | UK; New Zealand Weir et al. 2007, Herata 2007 | | |
| | Minimize horizontal sound propagation. | Sahkalin,<br><br>Weir et al. 2007, Agardi et al. 2007, Parsons et al. 2009. | | |
| **6. Source Exclusion Zone (EZ)**<br><br>a) Shallow waters (<200m contour) | 1000m | Sakhalin (and >6km for gray whales in feeding habitats);<br>NZ (1500m for SoC); Brazil; | | EZ is defined by survey depth and thus includes 2 categories of noise output and risk of extreme exposure. See details of additional requirements on track line sightings for sperm and beaked whales in this report |
| b) Deep waters | | Australia (as | | |

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| (>200m contour) | 3000m | applied regardless of depth to all baleen and great sperm whales, all beaked whales, plus orcas and pilot whales) | | |
| **7. Duration of pre-shoot watch** | 60 minutes | Australia (90min); most countries listed include 30 minutes at minimum. | | An substantial period of time (60 min) is required within the Indonesian Seas due to exceptional marine mammal biodiversity and marine bio-diversity of global significance (Coral Triangle – in this report) |
| **8. Soft start delay for animal(s) within EZ** | Delay of at least 30 minutes AFTER the animals have been last seen, including outside the EZ. | Australia; Gulf of Mexico; Brazil; Sakhalin (suspend all activity until depart EZ, no further details given) | | |
| **9. Airgun shut-down for animal(s) within EZ** | 30 min delay after animal seen outside EZ, then soft start procedure as per above | Brazil; Sahkalin; Gulf of Mexico | | |
| **10. Airgun testing** | Airgun tests should be conducted in pre-determined areas. At no time may testing occur outside the licensed prospect area. | Weir et al. 2006 | | Occasionally, due to bad weather, other delays or logistical changes a vessel may be located in an unplanned, unlicensed yet highly sensitive area when tests are scheduled. This may result in unnecessary high impact risks for marine life. |
| **11. Night time airgun use** | Not permitted in the Indonesian Seas, as a highly sensitive area within the Coral Triangle), unless MMO watches use appropriate Infra-Red (IR) maritime night vision monitoring systems (MNVS). | Australia; USA (California) | | MNVS must have been independently calibrated to ensure species can be detect ed within the EZ at night. Previous detection estimates have been reported as 100m (Weir et al. 2006) but this is expected to improve rapidly. Automated, early warming features within these systems may be used once available (i.e. the m-series at www.flir.com). |
| a) An intermediate alternative to IR MNVS (due to technical | Nighttime/low visibility activities only permitted with small gun; | Gulf of Mexico (at 160 dB firing in line change); Brazil (small gun can be kept active | | Idem for all daytime weather conditions with low detection: sea state, fog, monsoonal rains; Brazil – also see this |

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| challenges this may require phase in by 2012) is: | (<120 dB re 1mPa-m, IUCN 2006) | at nighttime/low visibility | | report |
| **12. Airgun use during line changes** | Shut-down completely during daylight; soft start only with small guns running (<120 dB - see above) or again. | Brazil; Australia (no specifications on noise level small gun); Gulf of Mexico | | |
| **Airgun use in inter-island passages and migratory corridors** | All air gun arrays are to be turned off when the seismic vessels pass through confined inter-island passages and straits | Due to the unique geographical position of Indonesia and its archipelagic characteristics, this measure avoids acoustical 'sweeping' of marine life in confined environments (Mc Cauley pers.comms; Kahn 2002, 2009) | | It is to be followed by full start-up procedure once the channel is cleared. |
| **13. Use of Passive Acoustic Monitoring (PAM)** | Compulsory aid to visual detection. If vocalizing whales are heard, soft start cannot commence for 30 minutes (Canada) Use of PAM allows ramp-up at night and low visibility (Gulf of Mexico). | Parsons et al. 2009. Weir et al. 2007. | | Currently widely recommended by government regulators (incl. all listed countries in this table) and experts in sensitive areas (see below) and for certain species such as blue and other baleen whales; sperm and beaked whales. Additional regulatory requirements are expected worldwide in the next 5 years, as PAM auto-detection technology matures. |
| **14. Closed Zones /Endangered Species focus** | Seasonal or/and permanent closed areas for breeding and migrating whales, nesting turtles and dugong areas, critical habitats for SoC | Brazil (extensive closures for Humpback, right whales, turtles and manatees; IBAMA 2005b as quoted in Weir et al. 2006); Australia and Canada (both demand that surveys are planned to avoid sensitive areas and times, Dolman 2006); Sakhalin (seismic prohibited | | See significant cetacean habitats for Indonesia in this report, MPAs and Marine Spatial Planning (MSP) section this report. |

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| | | in the gray whale feeding area "protection zones"). Agardi et al. 2007, Parsons et al. 2009 | | |
| **15. Acoustic Buffer Zone: Closed Zones/Habitat focus – MPAs and Marine Spatial Planning** | In addition to above – seismic surveys are to be prohibited from critical habitats for endangered species as well as MPAs including acoustic buffer zone of 18 km. | Brazil; Australia (Marine mammal protection zone in the Great Australian Bight-Dolman 2006) and more recently the Great Barrier Reef and Coral Sea Conservation Zone.<br><br>Agardi et al. 2007, Weilgard 2007, Herata 2007. | | Known critical habitats of *global conservation* importance for sensitive species include (but are not limited to) migratory corridors for blue and sperm whales in the Savu and Banda Sea and Timor Trench, feeding and breeding areas for Bryde's whales in Triton Bay – Kaimana, and sperm whales in Raja Ampat turtle nesting sites of global importance. See MPA section of this report. |
| **16. Acoustic Buffer Zone: Seamounts and other persistent pelagic habitats (PPHs)** | Plan seismic surveys (route and timing) to avoid seamounts and PPHs. An acoustic buffer zone of 18km boundary radius perimeter is strongly recommended to minimize excessive and potentially harmful noise exposure inside these sensitive and bio-productive habitats. | Agardi et al. 2007. Parsons et al. 2009. Hyrenbach et al. 2000, Hooker and Gerber 2004, Kahn 2008, 2009. | | PPHs in the Indonesian Seas are often characterized by seasonal influences (i.e. monsoonal patterns, moon phases) and can thus be best managed with temporal restrictions to seismic activities. This measure will reduce potential conflicts with artisanal and commercial pelagic fisheries. |
| **17. Acoustic Buffer Zone: Habitats of commercial value for other marine industries: tourism and coastal and pelagic fisheries** | Minimize conflicts through survey planning and avoidance of sensitive areas or seasons (18 km acoustic buffer zone) | Norway – Marine Spatial Plan implemented throughout national and EEZ waters. | | Marine Spatial Planning is required to implement recommendations on zone boundaries for other maritime industries including (dive) tourism zones; fishing zones; shallow water nursery zones for coastal fisheries, as well as coastal villages (i.e. artisanal fishing areas) |

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**Appendix 1: Further background on recommendations.**

Marine Mammal Observers – MMOs

Marine Mammal Observers are critical for effective on-board mitigation such as shut down and soft start procedures, as these get trigged by an MMO sighting of a species of concern (Table 1) within the EZ. Hence numerous reviews (Weir et al. Parsons et al 2009, Dolman 2007) consistently recommend the following:

1. A minimum of 2 MMOs is needed per survey vessel to maintain an effective daytime watch schedule.
2. MMOs should be independent, that is NOT part of the ships crew or staff of the seismic operation.
3. MMOs should be adequately trained and have previous field experience. A 3 day intensive training course can be effectively developed for the Indonedsian Seas to increase the currently minimal marine mammal capacity.
4. MMOs must report directly to the regulatory agency and not to the vessel, concession company or any industry body.

Marine Mammal Observer Training Course

- 2 day theory on species identification at sea, introduction on the ecology for whales and other priority species, industry regulations and mitigation steps to be followed once a shut down in warranted.
- 1 day field to train MMOs in sighting clues for marine mammals and identification features and practice correct handling of equipment and recording of field data.

These training courses can be conducted in regional locales with the following criteria:

- Adequate training facilities on land
- Good travel access including domestic and international airport
- Presence of marine tourism operators (to engage in field work and monitoring, stranding recommendations – see below).
- Presence of relevant government institutions (national and provincial agencies)
- Presence of local university and environmental organizations.
- Local waters with high marine mammal diversity and abundance for maximum sighting potential during the 1-day field trip.

Recommended training centres include Bali, Ambon, Manado, Sorong and Dili (Timor Leste).

**Appendix 2:**

**Case study - Seismic surveys within a Marine Proteted Area in Raja Ampat, Papua: Local governments and communities not well informed; Recreational divers advised to stay away from survey vessel or risk serious injury.**

In January 2010, seismic surveys were being carried out by TGS Nopec on behalf of Niko Resources in Raja Ampat, West Papua, at the center of what has come to be known as the Coral Triangle. Niko Resources has licenses for 12 blocks in total for Indonesia (including Kofiau, Halmahera-Kofiau and West Papua IV), under an

agreement with the Department of Energy Resources and Minerals that was signed in May 2009.

This region has the highest recorded richness and diversity of corals and coral reef fishes in the world and is a well-known 'hotspot' for whales and dolphins (cetaceans), including some that are endangered. To help protect this area of global conservation significance, a network of seven Marine Protected Areas has been established, covering approximately a million hectares in the waters of Raja Ampat.

This network has the support of communities, local governments and the traditional leaders' council, the Dewan Adat. Also, a number of international and national non-governmental organizations, including Conservation International, the Nature Conservancy and the World Wide Fund for Nature, are actively working to support the government and local communities.

On 27 January 2010, a dive operator reported by email that that a vessel called "*Seamezen*" was laying cables for seismic survey on behalf of a company called "*TGS*" in the Efpian-Daram area in SE Misool. Upon later investigation in the field it was established the company was operating within the MPA boundary.

The staff of the live-aboard recreational dive vessel boat were advised that the seismic surveys would occur over a period of a month and they have advised divers to be at least 10 nautical miles (18.5 km), and better still 15 nautical miles (27.8 km) away from their operation. Human injury to eardrums and other serious human health concerns were mentioned as a risk when diving within this suggested exclusion zone.

The Bupati (Head of the Raja Ampat government), the Head of the Legal Bureau as well as the Traditional Leaders Council (Dewan Adat) have indicated that **no seismic surveys** should take place within any of the Raja Ampat Marine Protected Areas. This prohibition is founded on a large body of scientific evidence demonstrating that high-energy underwater sound such as that produced by seismic airguns can have very serious, in some cases lethal, effects on marine life such as , whales and dolphins and their food security (i.e kills or dislacement of local fish and squid).

Unlike some threats to marine life, such as fishing gear, high-energy sound propagates over considerable distances from the source location. This means that even though a seismic survey vessel may remain **outside the boundaries of a sensitive area, organisms inside the boundaries could be seriously harmed**. For this reason, **a substantial buffer zone** should be maintained, its width depending on the local sound propagation characteristics and the particular environmental circumstances. As suggested by the operator, the scale of such a buffer zone should be in the order of 10-15 nautical miles.

It is expected that offshore companies will follow industry 'best practices' when working in environmentally sensitive areas. Such 'best practices' include not only mitigation of impacts on natural features but also respect for the interests of local human communities and businesses and adherence to relevant national laws and regulations.

In view of this, the IUCN called the apparent lack of communication and stakeholder involvement in the planning of seismic surveys in Raja Ampat "extraordinary" (IUCN 2010). It notes that "there are numerous examples (e.g. in Australia's North West shelf region and off Sakhalin Island, Russia) where, after extensive consultations with local authorities, technical experts and non-governmental stakeholders, oil and

gas companies have found mutually acceptable precautionary approaches to this kind of industrial operation."

Early engagement with these stakeholders (well before any field activities take place), and a strong commitment to environmental care by industry are crucial for such an outcome. Such an approach is strongly recommended by at the most senior level of global marine conservation – the Director General of the IUCN - for the sensitive marine ecosystems of the Coral Triangle (IUCN 2010).

A key recommendation of this report is the establishment of an interdisciplinary **Advisory Panel on Best Practices for Offshore Industries (AP-BPOI).** This Panel can be established as per IUCN guidelines, and includes key government agencies, international and local experts, industry association representatives, local communitiy leaders, NGOs and other maritime industry stakeholders. The Advisory Panel will play an vital in the effective implementation of agreed-upon best practices for offshore industries in the Indonesian Seas.

The commitment of several offshore industry associations (speaking for numerous companies) to best practices has been clearly stated (i.e. APPEA, IPA, WOC – see Holthus 2010). Such a long-term commitment by all companies will be of prime importance to the effectiveness of the Advisory Panel and the sustainability of the oil and gas projects in the Indonesian Seas.

Appendix 3: Marine Spatial Planning: What it means from both a conservation and an industry perspective.

MSP From a marine conservation perspective:

*"From here forward, we need to think very carefully in terms of what is appropriate where, and model worst-case scenarios arising out of all intensive uses of the ocean, so we can make the best possible choices. Marine Spatial Planning (MSP) with ocean zoning may well be the best avenue for making those informed choices."*

*"Using zoning in an integrated approach to management will allow decision-makers to understand and quantify the trade-offs to be made with coastal development, environmental degradation, and resource exploitation. Zoning plans and the permitting procedures will help avoid development that is potentially environmentally devastating."* (Agardi in MEAM Vol 3, No.6 2010)

MSP from an oil and gas industry perspective (Holthus 2010 in MEAM 2010):

*"MSP is expanding in use at a variety of scales and through a variety of government-led processes, usually with significant input from scientists and NGOs. Ocean industries — oil and gas, shipping, fisheries, aquaculture, tourism, etc. — are often the principal users of marine space and resources and thus are the most critical MSP stakeholders to be involved in the process."*

*"Without business involvement in MSP there is a significant risk that ocean management plans and governance will not fully consider existing and potential economic activities, their effects, cross- sectoral interactions, and cumulative impacts. MSP implementation can be improved by bringing together the range of ocean industries into a greater partnership between industry and the scientists, managers, policy-makers, government representatives and NGOs."*

*"Successful implementation of MSP often ultimately boils down to commercial activities and operators complying with management conditions. Industry participation in MSP will increase the probability of private sector compliance with management in ocean areas that are often far from the government surveillance and enforcement capabilities."*