A Statement by Geoff Prideaux for OceanCare:
Ocean Noise Impact on Fisheries and Wildlife in the Great Australian Bight

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With particular reference to the regulation of seismic testing in both Commonwealth and state waters

As the lead author of the *Convention on Migratory Species (CMS) Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities* (CMS Noise EIA Guidelines) I present information I believe is pertinent to the inquiry, with particular reference to *the regulation of seismic testing in both Commonwealth and state waters.*

It is widely acknowledged that noise generated by offshore petroleum exploration and production activities is a destructive pressure on ocean ecosystems, from seismic surveys through to production rig being decommissioned. The impacts of this form of pollution is now discussed at the highest levels of the United Nations. Organisms from the smallest phytoplankton and their grazers—zooplankton—that underpin ocean productivity all the way to be largest animals on Earth—blue whales, are seriously harmed by the noise pollution generated by this industry. These impacts become particularly acute in fragile and important ecological regions such as the Kangaroo Island Pool, Kangaroo Island Canyons and Eyre Peninsula.

In Australia, offshore petroleum activities are assessed by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). Australia is also a Party to CMS, and has not submitted a reservation against the Guidelines. They were endorsed 2 years ago, and should now be mainstream within NOPSEMA's processes.

While claiming all their decisions are 'evidence based', and that process is informed by the CMS Noise EIA Guidelines, as the author of those Guidelines I am aware that NOPSEMA has been slow to apply them, is avoiding specific elements the Guidelines call for including thorough assessment of the impact on fish species, independent, scientific modelling, and styles itself as an independent reviewer of all Environmental Impact Assessment (EIAs). This clearly not the case, as NOPSEMA is reliant on industry funding. Fatally, the NOPSEMA process also relies on representation of concern from stakeholders before it acts to limit activities.

Noise Pollution Generated by Exploration

Seismic surveys

- The frequencies generated and used by seismic surveys are between 10-200Hz, and down to 4-5Hz for the larger air guns, but with high frequency components up to 150kHz, with a very high discharge at the onset of the pulse
- 260-262 dB in water at 1m, peak to peak value, (260-262 dB re 1µPa @ 1m p-p)
- Duration can be up to two months of continuous use

Drilling

- Frequencies generated by exploration drilling are between 30-40Hz as a constant drone
- 150 dB in water at 1m, rms value, (150 dB re 1µPa $_{rms}$ @ 1m)
- Duration depends on the proposal

Vertical seismic profiling

- The frequencies generated and used by vertical seismic profiling are between 10-200Hz, and down to 4-5Hz for the larger air guns, but with high frequency components up to 150kHz, with a very high discharge at the onset of the pulse
- 238 dB in water at 1m, peak to peak value, (260-262 dB re 1µPa @ 1m p-p)
- Duration is typically for a three to four hours

Noise Pollution Generated by Production

- Frequencies generated by production drilling are between 30-40Hz as a constant drone. Frequencies generated by positioning transponders 20kHz to 35kHz, as pulsive noise
- Production drilling generates 150 dB in water at 1m, rms value, (150 dB re 1µPa $_{rms}$ @ 1m). Position transponders generate 197 dB in water at 1m, (197 dB re 1µPa @ 1m)
- Duration is for the lifespan of the drill rig

Impacts of Noise Pollution

- Zooplankton are killed, within 1.2 km of seismic surveys
- Fish species, such as southern bluefin tuna and their prey, including pilchards, have critical life function sounds (detection of prey, detection of predators) masked by all noise components of exploration and production
- Lethal damage is caused to invertebrates, including rock lobster and abalone, by seismic surveys
- Marine mammals (Australian sealions, whales and dolphins) also have crucial life functions (feeding, detection of predators, communication, and migration by heavily pregnant females, or mother calf pairs) disrupted by all noise components of exploration and production.

The *Convention on Migratory Species (CMS) Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities* (CMS Noise EIA Guidelines) and their *Technical Support Information* are available online

Assessing NOPSEMA's Guidance to Industry on Scientific Modelling of Marine-noise Propagation

I believe it is not appropriate to consider the impact of noise of key marine species, such as fish, without fully understanding the validity and efficacy of the regulator's information. I have objectively assessed NOPSEMA's application of the CMS Noise EIA Guidelines, and provide this information for the inquiry's benefit. It is my assertion that NOPSEMA accepts imperfect information, and routinely bases it's decisions on imperfect assessment.

The Australian government vigorously contributed to *CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities* (CMS Noise EIA Guidelines) through two stages of governmental review between 2015 and 2017, and during the CMS Conference of the Parties in November 2017, where the Guidelines were unanimously endorsed by all contracting Parties.

In general, the presentation of modelling direction by NOPSEMA is disjointed, unclear and ambiguous about its expectations of industry. By providing generalist guidance, often directing proponents to refer to other materials for further information, NOPSEMA portrays a poor understanding of modelling within NOSPEMA itself. Their generality, and lack of clear parameters, suggests that NOPSEMA does not objectively consider the appropriateness of the modelling presented to them within EPs. They remain consistently unclear about the need for the full frequency spectrum to be modelling, enable industry to continue to restrict modelling the frequency they will commercially use.

While claiming their decisions are 'evidence based', the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) has been slow to apply *'CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities'* (CMS Noise EIA Guidelines), and is avoiding specific elements—specifically independent, scientific modelling—that will reveal significant shortcomings within the information supplied to them by proponents.

The following table presents the modelling details called for within the *'*CMS Noise EIA Guidelines*'* (column 1) and additional details from the New Zealand *'Sound Propagation and Cumulative Exposure Models Technical Working Group'* report[1] (column 2). These two documents are used as the basis for assessing the adequacy of NOPSEMA's guidance to proponents in the information paper, '*Acoustic impact evaluation and management*' (column 3).

At all stages, the information provided in column 1 and 2 is intentionally conservative and does not embellish or add to the information from within each document.

1	2		3
CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities	**Sound Propagation and Cumulative Exposure Models Technical Working Group[2]**		**NOPSEMA's 'Acoustic impact evaluation and management' Information Paper**
1. Independent, scientific modelling of noise propagation should be impartially conducted	a) Models chosen should be peer-reviewed, scientific source models (as opposed to industry black box models) b) Modelers should have enough knowledge of, and experience with, the models they are using. Modellers should understand the physics of underwater noise propagation to ensure the correct models are used and that the results are accurate and make physical sense. c) Modelling results should be reviewed by subject matter experts, and experienced modellers with a strong theoretical understanding of underwater acoustics.		1. a) NOPSEMA does not specify the need for peer-reviewed, scientific source models 1. b) NOPSEMA does specify knowledge of, and experience are required 1. c) The NOPSEMA text is ambiguous. The need for expertise in reviewing modelling should be specified clearly.
2. Propagation models should be:	a) based on accurate input data, specifically the official calibration figures supplied by the survey vessel to be charted.	c) specific to the source, region and environmental conditions. d) based on accurate input data including seismic source data and environmental data, such as:	2. a & d) NOPSEMA is clear about the need for accurate input data but does not state the need for: - calibration figures from the survey vessel to be chartered; - including geo-acoustic properties; - including bathymetry mapping; and - including seasonally-relevant SSPs.

[1] This Technical Working Group advised the Department of Conservation for the revision of the NZ Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations (2015-2016)

[2] Reference: DOC (ed) 2016. Report of the Sound Propagation and Cumulative Exposure Models Technical Working Group. Marine Species and Threats, Department of Conservation, Wellington, NZ.

	b) able to accommodate the activity noise frequencies, the water depth, seabed topography, temperature and salinity, and spatial variations in the environment. Model methodology/s used should be stated.	- geo-acoustic properties including bottom sediment types and their layer depths for the region to be modelled, ideally down to several hundred metres into the bottom. - bathymetry mapping grid resolution greater than 450m - seasonally-relevant Sound Speed Profiles (SSPs), salinity, temperature and depth data (in tabulated form). e) chosen based on the treatment of environmental conditions, with an appropriate rationale for the modelling choice provided in the modelling report. f) given special consideration for fiords and deep-water canyons and may require high-resolution 3D models. g) biologically relevant and able to handle a wide range of frequencies, including very high and very low frequencies, regardless of	2. b, c & e) NOPSEMA indicates there are complexities with modelling, but their direction is ambiguous. NOPSEMA fails to require: - that model methodologies should be stated. 2. f) NOPSEMA implies that special consideration for fiords and deep-water canyons may be necessary but fails to direct that additional high-resolution 3D models may be required. 2. g) NOPSEMA states that modelling should be biologically relevant but does not state that modelling should be able to handle very high and very low frequencies.

		the proponent's frequency focus. The computational difficulty of modelling very high frequencies is not a reason for disregard.	
3. Propagation modelling should include:	a) the received sound levels at given distances from the noise source to determine propagation loss. b) full frequency bandwidth of a proposed anthropogenic noise source. c) the intensity/pressure/energy output within that full range. d) the principal or mean/median operating frequency of the source(s). e) the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or	f) sound propagation and cumulative exposure data that is appropriate to the full range of concurrent noise-generating activities. These should include separate modelling of each noise-generating activity (ie. shipping, support vessels, sonar, seismic surveys), as well as a cumulative model of all these activities combined. g) appropriate single shot modelling that is correctly representative of the survey region. Biologically important sub-regions may require additional focus. h) representation of cumulative exposure over time (ie 24 hours) i) acoustic ground-truthing of the chosen model (to ensure model credibility).	3. a) NOPSEMA is vague about the need to determine propagation loss. 3. b, c, d) NOPSEMA indicates that modelling should be appropriate to the task, but as with 2 (g), NOPSEMA does not state that modelling should be able to handle the full frequency range of the noise to be generated, including very high and very low frequencies. 3. e, g) NOPSEMA indicates that area/s selected for modelling should be representative of the environmental parameters to be affected (bathymetry, salinity, seabed composition, and temperature). This presumably includes appropriate single shot modelling and appropriate focus on biologically important sub-regions. They do not require the modelling to be seasonally relevant. 3. f) NOPSEMA fails to direct that cumulative exposure data, appropriate to the full range of concurrent noise-generating activities, is required. As such they fail to require separate modelling of each noise-generating activity as well as a cumulative model. 3. h) NOPSEMA does not require cumulative exposure over time (ie 24 hours).

	natural channel characteristics).		3. i) NOPSEMA suggests some validation data may be important but does not require acoustic ground-truthing of the chosen model (to ensure model credibility).
4. Propagation modelling reports should demonstrate:	a) propagation from point source out to a radius where the noise levels generated are close to natural ambient sound levels.[3] b) particle motion propagation[4] to assess the impact on invertebrates, and fish species. c) proposed exclusion zones designed for the protection of specific species and/or populations should be identified and mapped and should demonstrate how noise will not propagate into these areas, taking into consideration the local propagation features.	d) border thresholds will not be breached for exclusions zones and biologically important areas. e) that all modelling assumptions are clearly stipulated and comprehensively justified.	4. a) NOPSEMA does require modelling to a radius where the noise levels generated are close to natural ambient sound levels. 4. b) NOPSEMA refers to particle motion being more appropriate for some species, rather than sound pressure, but they do require the assessment of particle motion propagation. 4. c, d) NOPSEMA highlights that relevant fauna habitat require consideration but does not stipulate that exclusions zones and biologically important areas should be identified and mapped, and that the modelling should demonstrate how noise will not propagate into these areas. 4. e) NOPSEMA is clear that modelling assumptions should be clearly stipulated and comprehensively justified.

[3] ISO 18405 refers to ambient sound as "*sound that would be present in the absence of a specified activity*" and "*is location-specific and time-specific*". The CMS Noise EIA Guidelines more specifically define ambient sound as the average ambient (non-anthropogenic) sound levels from biological (marine animals) and physical processes (earthquakes, wind, ice and rain etc) of a given area. It should be measured (including daily and seasonal variations of frequency bands), for each component of an activity, prior to an Environmental Impact Assessment (EIA) being developed and presented

[4] The detection of particle motion or particle displacement requires different types of sensors than those utilized by a conventional hydrophone. These sensors must specify the particle motion in terms of the particle displacement, or its time derivatives (particle velocity or particle acceleration).

There are crucial questions that must be answered by NOPSEMA, before the validity and efficacy of their assessments can be fully judged.

NOPSEMA is generally ambiguous about details surrounding modelling, yet clearly understands that knowledge of, and experience with, scientific propagation modelling is required to provide defensible information.

1. Why does NOPSEMA fail to specify the need for peer-reviewed, scientific propagation source models?
2. Does NOPSEMA have the knowledge of, and experience with, scientific propagation modelling to adequately assess the veracity of the information being presented, or does NOPSEMA rely on the goodwill of each proponent?

NOPSEMA appears to be at least partially aware that considerable scientific detail is required for propagation modelling, given the very prominent link to the *Report of the Sound Propagation and Cumulative Exposure Models Technical Working Group*, for the New Zealand Department of Conservation, within NOPSEMA's own Information Paper.

3. Focusing on the detail expected within the scientific propagation modelling, including the need for accurate input data, and the ability to accommodate the activity noise frequencies, the water depth, seabed topography, temperature and salinity, and spatial variations in the environment, and that special consideration for fiords and deep-water canyons is often necessary for accurate modelling, why does NOPSEMA fail to clearly state that:
    a. calibration figures from the survey vessel to be chartered should be required?
    b. modelling should include geo-acoustic properties?
    c. modelling should include bathymetry mapping?
    d. modelling should include seasonally-relevant Sound Speed Profiles?
4. Modelling should be able to handle very high and very low frequencies. Why is NOPSEMA consistently unclear about the need for the full frequency spectrum to be modelled, enabling industry to continue to restrict the modelling they present to the frequency they are commercially interested in?
5. Why does NOPSEMA fail to require that model methodologies should be stated?
6. Why does NOPSEMA fail to direct that high-resolution 3D models may be required in complex areas such canyons of fiords?
7. NOPSEMA appears to be at least partially aware of what propagation modelling should include. Given this, why:
    a. is NOPSEMA vague about the need to determine propagation loss?
    b. is NOPSEMA not specific that modelling should to be seasonally relevant?
    c. does NOPSEMA fail to direct that cumulative exposure data, appropriate to the full range of concurrent noise-generating activities, should be a required, including cumulative exposure over time (ie 24 hours)?
    d. does NOPSEMA suggests some validation data may be important but does not require acoustic ground-truthing of the chosen model (to ensure model credibility)?
8. If NOPSEMA's decisions are evidence-based, why does NOPSEMA fail to require:
    a. modelling to a radius where the noise levels generated are close to natural ambient sound levels?
    b. assessment of particle motion propagation when considering the cumulative impact to key species not able to be assessed by the onset of temporary or permanent threshold shift (hearing)?
9. NOPSEMA highlights that relevant fauna habitat require consideration but does not stipulate that exclusions zones and biologically important areas should be identified and mapped, and

that the modelling should demonstrate how noise will not propagate into these areas. What is NOPSEMA justification for failing to articulate this fundamental need?

10. Finally, why is NOPSEMA's guidance to proponents only presented within an Information Paper, with the disclaimer that the paper "does not provide 'how to' guidance on technical aspects of acoustic emissions EIA, monitoring and management"? Isn't defensible scientific propagation modelling a foundation of determining justifiable 'acceptable levels' of impact as defined by *Environment plan content requirements* (N04750-GN1344, Revision No 3, April 2016) and, if so, shouldn't NOPSEMA's guidance be presented with more weight and standing—as a requirement?

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