EGS Survey Pty Ltd
Unit 2 / 85 Abernethy Road,
Belmont WA 6104
Australia

Impact of High-Resolution Survey Equipment on Marine Mammals

This report briefly summarises the effects of hydrographic survey equipment on marine mammals. The received sound energy density levels at ½km are listed, for comparison with the requirements of the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Marine Mammal Auditory Range

Marine mammals have two types of acoustic systems (Au 1993):

- All marine mammals have auditory systems recognisably similar to terrestrial mammals, including humans. Hearing sensitivity at different frequencies varies widely among species of marine mammals, but the range of greatest sensitivity is typically within 0.5 - 20 kHz.
- In addition, odontocetes (toothed whales, including porpoises & dolphins) use echolocation to avoid predators and to locate prey. The sound is focused forwards through the bulbous mellon, making the sensitivity highly directional. The frequency of the echolocation clicks also varies between species, typically within the range 30 - 150 kHz.

Threshold of Disturbance to Marine Mammals

Acoustic signals generated by marine survey systems within these frequency ranges will be heard by marine mammals. The received sound energy density level of the signal is among the factors controlling the impact the signal has on the mammal. The Australian EPBC Act Policy Statement 2.1, "Interaction Between Offshore Seismic Exploration and Whales (2008)", defines a threshold of disturbance to marine mammals as the received sound energy density level of 160 dB re 1µPa^2 in one second.

Stand-Off Distances

Stand-off distances are used to mitigate the potential adverse affects that sonar may have on marine mammals. A stand-off distance is the distance that needs to be maintained between a piece of surveying equipment and a marine mammal, so that the sound wave will have dropped in pressure enough to be below the harassment or disturbance threshold. A Marine Mammal Officer is sometimes used on survey vessels to help survey crew identify marine mammals in the survey area, and ensure that appropriate stand-off distances are maintained.

Australian EPBC Act's Policy Statement defines a stand-off distance of 500m. Provided that the sound energy density level is less than 160 dB re 1µPa^2 in one second (160 dB re 1µPa^2-s).

The following table lists the source characteristics of hydrographic and geophysical survey instruments for the forthcoming survey: dominant frequency (kHz); acoustic pulse length (ms); the number of pulses per second (Hz); and the source level (dB re 1µPa-m). These values are from a combination of academic publications (e.g. Richardson et al, 1995), manufacturers' specifications and EGS estimates based on experience of operating the systems. The sound pressure levels and sound energy density levels at a distance of 500m were calculated by applying seawater absorption (National Physical Laboratory, 2014; Ainslie & McColm, 1998) and geometrical spreading to the source characteristics.

EGS Survey Pty Ltd
Unit 2 / 85 Abernethy Road,
Belmont WA 6104
Australia

Survey Equipment	Operating Frequency (kHz)	Source Level (dB re 1µPa-m)	Pulse Length (ms)	Pulses per Second (Hz)	Sound Levels Received at 500m from Source	
					Sound Pressure Level (dB re 1µPa)	Sound Energy Density Levels (dB re 10^{-6} µPa^2-s)
Single Beam Echosounder						
Kongsberg EA400 Dual Frequency	38	213	0.2	5	178.5	124.3
	200	213	0.1	5	141.6	91.8
Multi-Beam Echosounder						
Reson 7150-F	12	229	0.15	1	198.4	138.0
	24	230	0.15	2	198.0	140.5
Reson 8125	455	224	0.05	10	123.0	73.6
Side-Scan Sonar						
Edgetech FS4200 Dual Frequency (incl. in TVD combined system)	100	235	0.1	10	186.7	133.7
	450	235	0.05	10	134.7	85.2
Ultra-Short Baseline (USBL) Beacons						
Kongsberg HiPAP USBL	25	202	8	4	175.0	112.0
Pinger & Boomer Profilers						
GeoAcoustics 2x2 (incl. in TVD combined system)	2	205	1	4	176.9	116.9
4x4 Pinger array	2	214	1	3	183.9	123.9
C-Products LVB C-Boom	0.8	220	1	4	190.0	127.0

Note that all of the acoustic instruments proposed for this project have sound energy density levels well below the threshold (sound energy density levels of 160 dB re 1µPa^2-s) requiring additional management procedures.

References

Ainslie M. A. and McColm J. G., 1998, "A simplified formula for viscous and chemical absorption in sea water", Journal of the Acoustical Society of America, 103(3), 1671-1672.

Au W. L., 1993, “The Sonar of Dolphins”, Springer Verlag, 277p.

National Physical Laboratory, “Calculation of Absorption of Sound in Seawater”, http://resource.npl.co.uk/acoustics/techguides/seaabsorption/ (Accessed: 30th July 2014)

Richardson W. L., Greene C. R., Malme C. I. and Thomson D. H., 1995, “Marine Mammals and Noise”, Academic Press, 576p.