Humpback Whale Aerial Surveys in Western Australian Petroleum Permit Areas During October/November 2002

Report to ROC Oil and Environment Australia

April 09, 2003

Prepared by:

Curt and Micheline Jenner
Centre for Whale Research (WA) Inc.
PO Box 1622
Fremantle WA 6959

Summary

Twenty aerial surveys were flown between October 28 and November 21, 2002. A total of 443 whales in 361 pods, including 20 cow/calf pods, were sighted in the vicinity of an operating seismic vessel. Strong seasonal winds hampered data collection and interpretation. It was not possible to make recommendations to government for future seismic operations based on this data set alone.

1. Scope of Work

The Centre for Whale Research (CWR) was commissioned on 16/10/02 by ROC Oil Company Limited to:

1) Provide aerial based whale observing services daily while the Jean, Rita and Cheryl seismic surveys were being conducted from 28/10/02 to 21/11/02.
2) Report daily to the seismic vessel on whales in the vicinity of the vessel so that the vessel may plan to avoid contact with whales
3) Record and report all whales observed in accordance with Environment Australia requirements
4) Maintain a progressive log of whales observed, their location and behaviour in relation to the seismic vessel
5) Provide a completion report (with appropriate recommendations) on the effectiveness of the measures adopted to protect whales from the impacts of the seismic operation.

2. Background

There are many marine mammals that use the valuable habitats that occur along the Western Australian coast. Among these marine mammals are the humpback whales, which are found in great numbers along the coast during their annual migration to and from calving grounds between June and November.

Previous studies by collated by Jenner *et al.* (2001) have found that in general, humpback whales on the Western Australian coast appear to be found within the 200m depth contour between the months of June and November (Jenner *et al.* 2001). However, this simplistic description of the whales' migratory paths is not sufficient for planning or conducting the potentially disruptive exploratory seismic surveys for the oil and gas industry. In the case of the Cheryl, Rita and Jean areas near Geraldton, Western Australia (28.7° S), no detailed knowledge of the migratory timing or patterns was available. Jenner et al. (2001) had suggested (based on extrapolated data) that the southern migration at this latitude would peak during late September.

Accepted knowledge (Chittleborough,1953, 1965) regarding the 4 week delay in the arrival of cow/calf pairs at a given location after the southbound peak has passed, forecast that the timing for the seismic operation and the arrival of cow/calf pairs in the Geraldton area would coincide. Pressure from the commercial rock lobster fishery, which began operations in mid-November, meant that delaying the seismic operations to allow cow/calf pairs to pass by the region was not acceptable. Environment Australia (EA) granted ROC Oil a Cetacean Interference Permit (#E2002/0054) with 8 special conditions designed to mitigate the potential impacts of the seismic exploration activities on migrating humpback whales.

This report describes the aerial survey component required by EBPC permit #E2002/0054 and furthermore advises as to the programmes effectiveness in determining whether any negative impact to humpback whales could be attributed to seismic survey operations.

3. Methods

3.1 Aerial Survey Techniques

Aerial surveys were chosen as the primary study methodology due to the size of the study area, the distance from shore of the study area and the immediate need for useful data. Transects were flown in passing mode (plane does not deviate from the flight path) at an altitude of 1000 feet and a speed of 120 knots. A twin-engine over-head wing Cessna 337 aircraft was used for all surveys. Flights were conducted in wind speeds up to 20 knots (wind speed exceeded 20 kts on some transects). The decision to fly in conditions above 15 knots, which is the standard cut off for cetacean surveys, was made in order to allow for basic monitoring of the whales' positions about the seismic vessel to continue on an almost daily basis. However, we accept that data collected on these windy days are not completely comparable to data collected on less windy (>15kts) days.

Personnel for each survey included one pilot and two observers. The pilot was not responsible for spotting and was separated acoustically from the two observers who could communicate with each other on a separate intercom. The pilots only role in data collection was to report the horizontal drift of the aircraft from its flight path at the end of each transect. Observers changed sides of the aircraft after each flight in order to minimise any spotting biases. A lap-top computer was used to log GPS coordinates and altitudes for every second of the flight.

The observers wrote whale sightings on separate data sheets using GPS waypoints to identify each pod sighted. Using clinometers (Suunto PM-5/360PC) and compass boards, the observers recorded the relative vertical and horizontal position of each sighting from the marked waypoint. Angle of drift for each transect was corrected for so that horizontal angles reported from the compass boards could be corrected relative to the flight path (Figure 1). The latitude and longitude of each sighted whale was later computer plotted by projecting a new GPS waypoint the calculated bearing and distance from the plane's position at the exact time of the sighting. In this manner perpendicular distances of each sighting to the transect line can be measured in order to standardise the data for future use in estimates of absolute abundance. However, opinions vary on how to deal with the problem of estimating abundance when an unknown portion of the population is unavailable for sampling, such as when a whale is below the water, and although the data has been collected in a strict and consistent manner, estimating absolute abundance is not within the scope of this study.

The sighting information that was recorded included animal species, the direction of migration and sighting cue. Migratory direction (north or south) was recorded for each pod observed, however, due to the speed of the aircraft and the distance from some of the sightings it was not always possible to determine direction of travel. These pods were classified as being of "undetermined" migratory direction, which are distinct from milling pods. Pods reported as "milling" were generally surface lying at the time of sighting with no obvious signs of swimming.

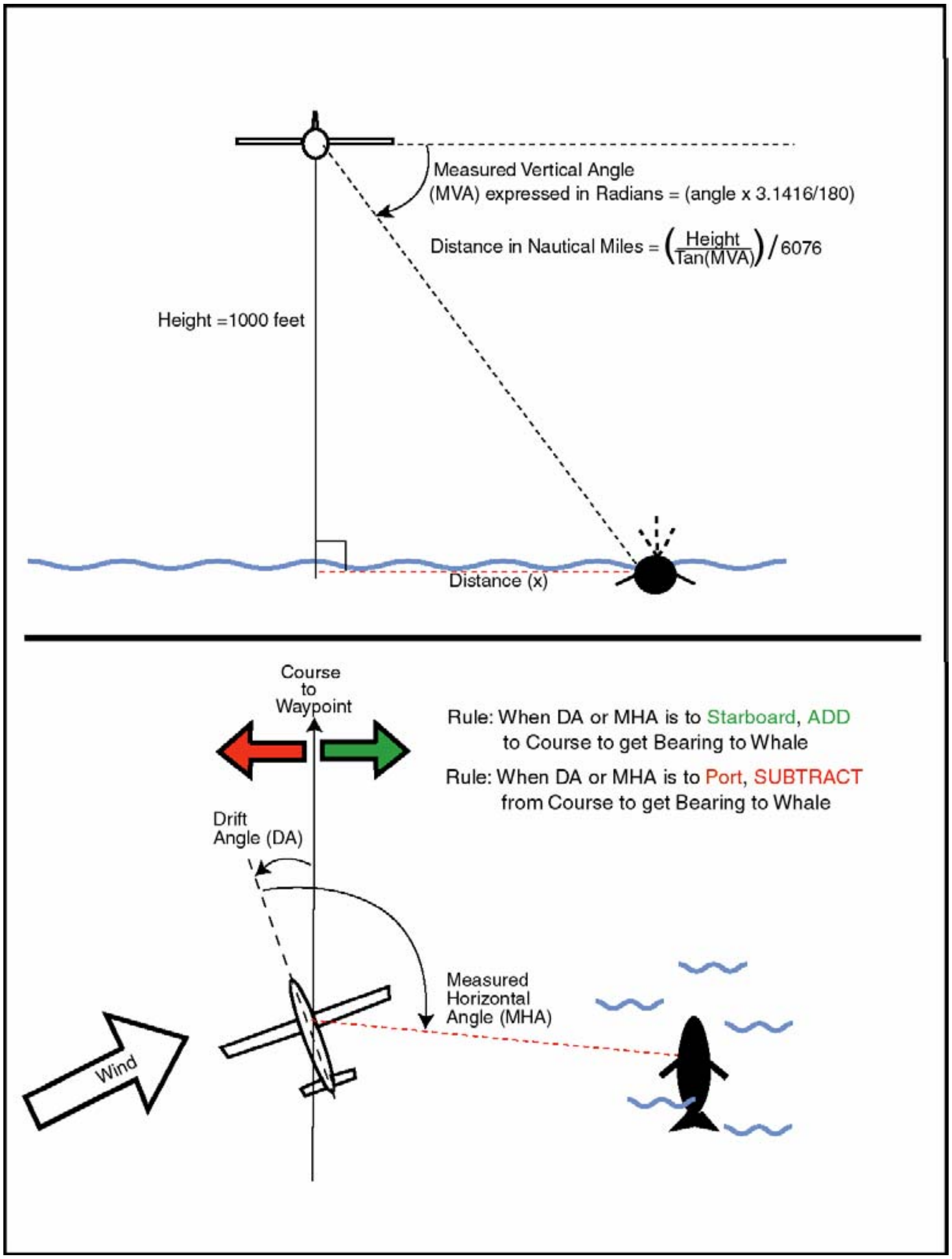

Figure 1. Trigonometric theory for determining the precise position of a sighted whale or pod of whales. At the instant in time the whale is sighted, the latitude and longitude from a GPS waypoint is used as a reference point from which to project the distance and corrected horizontal angle to the whales' actual position.

3.2 Flight Path Design

Design of the flight paths to suit the stated objective "determining whether any negative impact to humpback whales could be attributed to seismic survey operations" was undertaken by EA and initially interpreted for execution by aviation specialists under contract to ROC Oil. This arrangement proved unsatisfactory and the power to modify the flight paths as the study progressed was given to the Centre for Whale Research following an approval process by EA.

The conceptual goal of the aerial surveys was two fold;

1) The surveys would provide advance warning to the seismic vessel in regards to numbers of whales swimming toward its area of operation.

2) The surveys would detect whether any gross avoidance patterns, presumably due to the vessel, were evident in the progression of the migration.

Given the fuel constraints (4 hrs) of the aircraft, two separate flight plans were needed and designed to address the conceptual needs to the project. Strong afternoon sea breezes (SSW) meant that only one type of flight could be flown each day. The flight path to provide advance warning to the seismic vessel of numbers of migrating whales involved a pair of transects flown parallel to the coast up to 100 nautical miles (nm) (approximately 1 days travel for a migrating humpback whale) to the northwest of the vessel and a pair of transects flown perpendicular to the coast, one north and one south of the vessel to try to establish the position(s) of the main migratory body (Figure 2). This flight plan was alternated with a saw toothed survey design with 10nm end point spacings, flown between the coast and the continental shelf (200m bathymetry), that overlapped the area being sampled by the seismic survey (Figure 2).

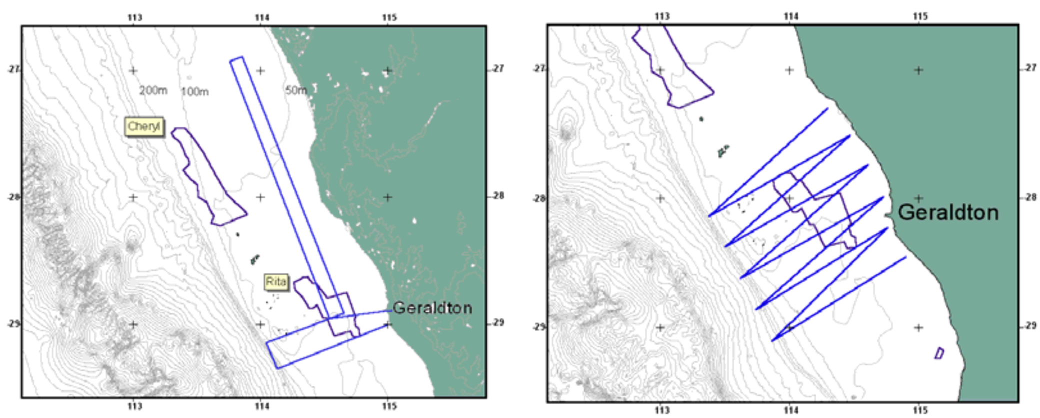

Figure 2. The study area and flight plans. The Parallel flights (left hand figure) were positioned so that the seismic vessel was at the base of the NW/SE transects. The saw toothed surveys were positioned centrally over the area sampled by seismic survey, whether in the Rita or Cheryl areas.

3.3 Spatial Anaylsis

Spatial analysis was conducted on the Rita MSS region only. Data used was for good weather days (winds <15kts) sampled by either saw toothed surveys or the perpendicular transects when the surveys parallel to the coast were flown (Table 1). The positions of the resulting 77 pods of whales sighted were analysed, using Arcview GIS 3.2a and its extensions Spatial Analyst and Animal Movement, to establish whether any definable spatial trends existed during the period of the seismic surveys. The degree of clustering or dispersion of pods within the specified search area was initially tested using Nearest Neighbour analysis. A resulting "Z" value of less than 1 (Z= -22.3917, r=8.65995e -006) indicated that the distribution was clumped therefore the data was able to be further analysed using probabilistic home range techniques (Arcview GIS 3.2a, 2000).

The Kernel home range technique (Hooge et al., 1999) was used to plot the utilization distribution of humpback whale pods within the main aerial survey search area. Three contour outputs were chosen, 95%, 75% and 50%, where the 95% area can be considered the total area that the whales actually use, and the 50% contour is considered the core area of whale migration.

4. Results

A total of 443 whales in 361 pods were sighted during 22 days of aerial surveys (Table 1). Cow/calf pods accounted for 20 of these sightings. Nine surveys parallel to the coast and 13 saw toothed surveys were flown (Figure 3). On 3 days, winds in excess of 25 knots prevented any surveying, although a flight was made on one of these days (01/11/02) to video record sea conditions.

Days with wind speeds of 15 knots (12/22) or higher made sighting difficult, particularly for cow/calf pods which are less likely, in our experience, to be surface active (Figure 4). The average wind speed for days with winds less than 15 knots averaged 13.0 knots $\pm$ 0.4 SE. A significant proportion (66%, 237/361) of all sightings were surface active pods (breaching, fluke slapping, head slapping) while pods sighted by blows or underwater accounted for 34% (124/361) of sightings.

Table 1. Effort and numbers of whales observed for the Jean, Rita and Cheryl surveys. Survey type "P" are parallel to the coast and "S" are saw toothed.

Date	Survey Hours	No. Whales	No. Pods	Survey Area	Survey Type
28/10/02	2.77	16	15	Jean	P
29/10/02	2.98	38	28	Jean	P
30/10/02	2.98	46	39	Jean	P
31/10/02	2.63	47	32	Rita/South	P
1/11/02	-	-	-	Rita/South	Video
2/11/02	2.72	49	37	Rita/South	P
3/11/02	3.47	27	20	Rita	S
4/11/02	-	-	-	-	-
5/11/02	3.43	19	17	Rita	S
6/11/02	2.65	20	17	Rita/South	P
7/11/02	3.47	27	26	Rita	S
8/11/02	2.80	7	7	Rita/South	P
9/11/02	3.47	18	18	Rita	S
10/11/02	2.67	13	11	Rita/North	P
11/11/02	3.30	30	30	Rita/North	S
12/11/02	2.70	6	6	Rita/North	P
13/11/02	1.82	3	3	Rita/North	S
14/11/02	3.22	20	15	Rita/Cheryl	S
15/11/02	3.45	6	4	Cheryl	S
16/11/02	3.57	16	14	Cheryl	S
17/11/02	2.67	2	2	Cheryl	S
18/11/02	-	-	-	-	-
19/11/02	2.05	2	2	Cheryl	S
20/11/02	3.52	11	5	Cheryl	S
21/11/02	3.68	20	13	Cheryl	S
22 Days	**66.00**	**443.00**	**361.00**		

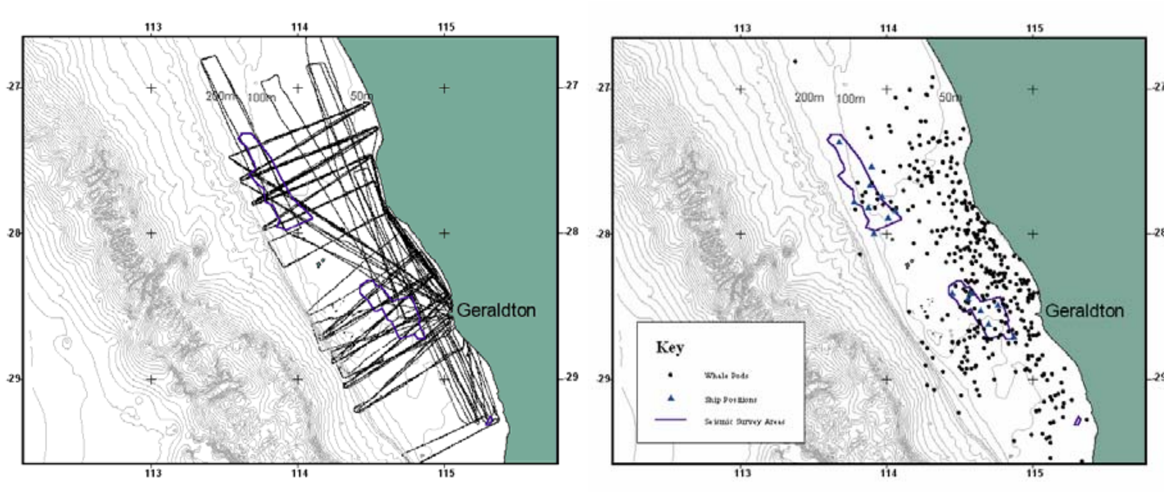

Figure 3. All aerial survey transects and resulting positions of humpback whale pods in relation to the seismic survey areas.

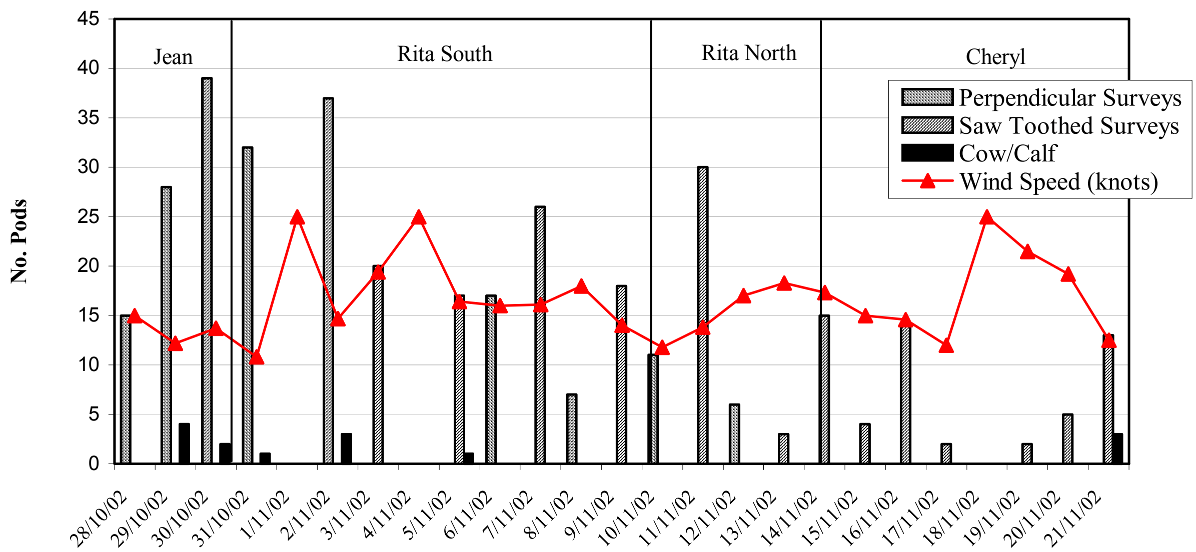

Figure 4. Graphic representation of pods sighted per day including average wind speeds during transects flown that day.

Spatial distribution patterns for the 77 pods that were sighted on the 6 survey days (Oct 31, Nov 2, 8, 9, 10, 11) that could be statistically combined in the Rita area without sighting biases are shown in Figure 5. The core migratory area (50% probability contour) directly straddles the Rita survey area. While the entire Geelvink Channel is likely to be used by migrating humpback whales as shown by the 95% probability contour.

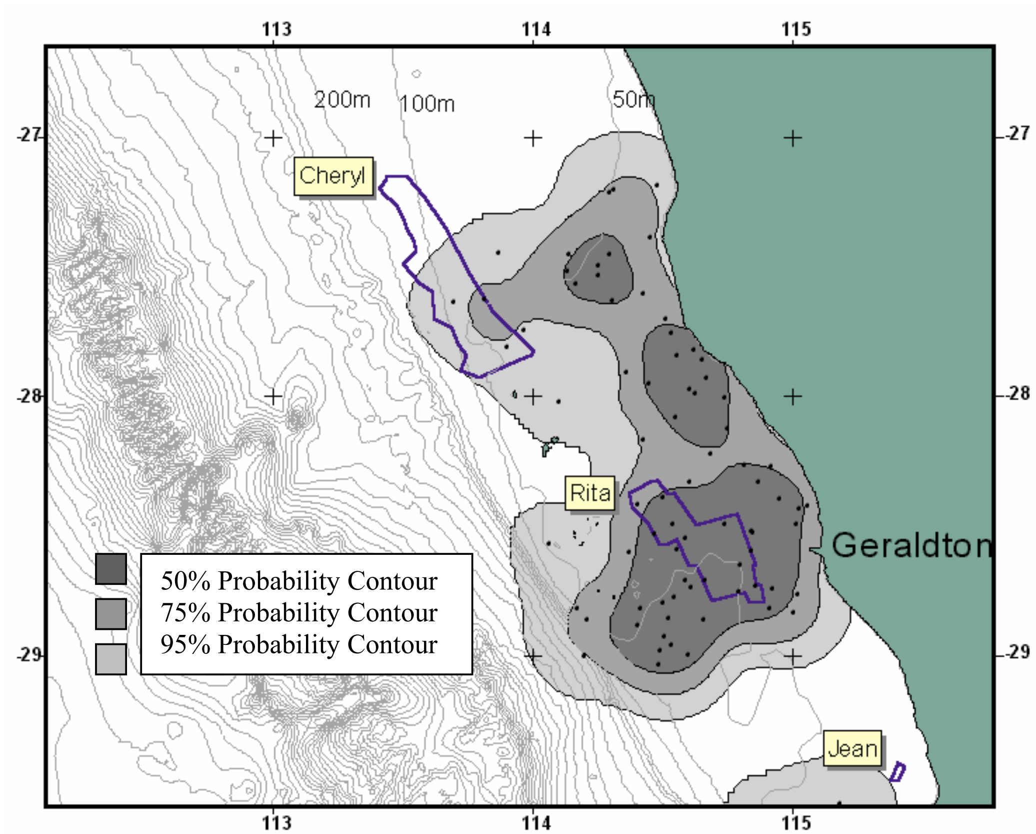

Figure 5. Probability contours of whale distribution in the vicinity of the Rita and Cheryl survey areas. The 50% contour is the core migratory area. The 95% contour is the total area likely to be used by whales.

5. Discussion

Due to persistent strong wind conditions for a major portion of the survey period our perception of humpback whale reactions to the operating seismic vessel is likely to be biased and incomplete. The prevalence of surface active individuals cannot be explained without knowing what true portion of the migratory population they represent. The low number of cow/calf pods sighted is likely to be due to the poor sighting conditions, but we cannot be certain that this is the only reason. It is not possible to conclude that the seismic operations had any effect on their migratory pattern at all. No whales were sighted in the northern portion of the Cheryl area during the surveys from mid to late November. However, we hesitate to conclude that this area is not an important area for the southern migration since weather conditions while sampling this area remained marginal to poor.

The pods that were sighted in late October/early November appeared to migrate steadily through the Rita Survey area while southbound along this part of the coast. It is not possible to assess whether these whales were disturbed from their normal migratory pattern for 2 fundamental reasons; 1) we have no prior knowledge as to where the "normal" migratory path is, and 2) we cannot attribute disturbed behaviour, by evidence of pod positions, to any source in an area that is basically a migratory bottleneck. In other words, once in the channel, the whales have little choice but to swim through the Rita survey area, whether they are being disturbed or not. Certainly there was ample evidence of whales passing through the Rita area, unfortunately we cannot determine what combination of age or sex classes this contained. We can only state that we didn't see the predicted high numbers of cow/calf pods, for whatever reasons. Unfortunately the two critical arguments, from a management perspective, as to why there were such low numbers of cow/calf pods, are not resolvable – i.e. whether the low numbers were due to seismic activity or weather conditions or both.

Therefore, due to compromised sighting conditions the effectiveness of this survey, in terms of determining the overall effect of the seismic operations on migrating whales, must be described as questionable. Without adequate baseline data to base analyses on, and without being able to observe the entire migratory body due to weather conditions, it is very difficult to determine whether any disturbance to the southern migration of humpback whales past this area has occurred. Potentially mitigating natural conditions such as strong winds creating low frequency noise, and the soft shallow sea bottom absorbing seismic shot sounds may combine with the 5km shut down range practised by the seismic vessel to create little impact on migrating whales. Unfortunately, planning more aerial surveys at this time of year, in this location, may never give us better data.

Areas such as this part of the WA coastline that present a migratory bottleneck to whales require more thorough understanding if potentially disruptive activities are to become more common. Telemetry techniques for tracking individual whales of known sex and breeding status may soon prove a more effective means of determining both the "normal" migratory paths and even the reaction of whales to anthropogenic disturbances.

References

Chittleborough, R. G. (1953). Aerial observations on the humpback whale, Megaptera nodosa (Bonnaterre), with notes on other species. Aust. J. Mar. Freshw. Res.4: 219-26.

Chittleborough, R. G. (1965). Dynamics of two populations of humpback whale, Megaptera novaeangliae (Borowski). Austr.J. Mar. Freshw. Res. 16:33-128.

Hooge P.N. Eichenlaub, W.M., Solomon, E.K. (1999). Using GIS to analyze animal movements in the marine environment. Technical paper United States Geological Survey. 20pp.

Jenner, K.C.S., Jenner, M-N., and McCabe K.A. (2001). Geographical and temporal movements of humpback whales in Western Australian waters. APPEA Journal 38 (1):692-707.