

***Ecology and behaviour of southern right whales
Head of the Bight, South Australia 2002***

Final report to Environment Australia

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1. Overview

Shore-based surveys and photo-identification studies of southern right whales were carried out at the Head of the Great Australian Bight in 2002, continuing a data set that began in 1991. Data collected included the number and distribution of right whales within the aggregation area and photographic identifications of individual whales for life history and movement studies. An intensive program of individual identification has been maintained since 1991 and to date the study has provided a catalogue of identified right whales numbering around 500 individuals.

Two field trips were made to the Head of the Bight aggregation area during the 2002 winter - spring season. Unfortunately the early season period, usually surveyed during the first two weeks of July, was not covered in 2002 as funding was not confirmed until October 2002. An equivalent of 24 survey days were completed for this consultancy, with temporal coverage expanded using complementary data collected by the southern right whale habitat assessment project. Whales were present within the aggregation area on every surveyed day between 13 August and 9 October 2002. The number of individual whales within the aggregation area ranged from a low of 23 animals on the 2 October to a high of at least 71 animals on 31 August. A large number of whales (32) were still present on the last surveyed day, 9 October. A minimum of 28 calves (including a calf found dead on the beach in the early part of the season) were born or present in the aggregation area in 2002, less than the 39 recorded in 2001. Given the modal three year calving interval of the species a more valid comparison is made with the 1999 season, in which 22 calves were recorded.

There were regular sightings of bottlenose dolphins (*Tursiops truncatus*) throughout the field season. This species was commonly sighted in medium pods of 20-50 animals and occasional interactions with whales were noted. Humpback whales were recorded on two days. Sharks were sighted on two days, but no interaction with whales was noted. The large number of sharks present in 2001 when an entangled right whale died at Head of Bight were not in evidence in 2002.

2. Introduction

The southern right whale is classified as 'vulnerable to extinction' by the IUCN and is listed as 'endangered' under the Australian *Environment Protection and Biodiversity Conservation Act 1999*. Their conservation status reflects the current low population levels, and recognises that unmitigated threats may compromise the species' recovery. Despite evidence of a sound recovery trajectory (IWC 2001), the population remains low in comparison to pre-whaling levels, and is vulnerable to human impacts, particularly due to their habit of utilising waters very close to shore and within range of land-based human activities.

Southern right whales are found along the southern coastline of Australia in winter and spring, with the majority of sightings occurring between Sydney (33°53'S, 151°13'E) on the east coast and Perth (31°55'S, 115°50'E) on the west coast, and including Tasmania. Most right whales occur between the Head of Bight, South Australia (31°28'S, 131°08'E) and Albany, Western Australia (35°00'S, 117°52'E), with smaller aggregations at several locations in southeastern Australia and increasingly regular sightings around Tasmania (Bannister 2001). The Head of the Bight represents one of the most significant and consistent aggregation and calving areas for the species in Australian waters with concentrations of right whales reliably recorded there between June and October each year (Burnell and Bryden 1997).

Since 1991 shore-based surveys of right whales within the aggregation area at the Head of the Bight have been undertaken. Information collected has included censuses of the number, class and distribution of right whales and photographic identifications of individual whales for life-history and movement studies (Burnell 2001, Burnell 1999). The long-term dataset provided by the study is an essential tool for monitoring the conservation status, recovery of and potential impacts on this long-lived species.

The photographic and census data gathered during the 2002 season were again collected in a manner allowing comparison with previous years. Data gathered to date have shown the consistent use of the Head of the Bight by a significant proportion of the identified Australian right whale population. Calving females use the site consistently, with between 18 and 42 calves born there each year since 1991. A large number of non-calving whales, including males, females and juveniles are also present at the Head of the Bight each season.

This report covers work undertaken under the consultancy agreement signed on 3 October, 2002, and follows an interim report forwarded to Environment Australia in January 2003. The results presented below refer to the reporting requirements as outlined in Section J of the Consultancy Agreement Schedule.

3. Field activities and data collection

The Head of Bight aggregation area was surveyed from 13 August to 3 September and from 24 September to 9 October, 2002. Unfortunately the early July period surveyed in previous years was missed due to funding being confirmed in early October. The entire 2002 field season was undertaken in good faith in the absence of a contract and using credit provided by the consultant. An equivalent of 24 days of survey time was achieved for this consultancy (14 days in August and 10 days in September-October) between mid August

and early October. Temporal coverage was augmented by complementary data collected during field work for the southern right whale habitat preference project.

The data collection methods employed in 2002 were consistent with those in previous years, ensuring comparability with data from earlier years of the study. The continuity of the dataset begun in 1991 was compromised somewhat by omission of the early July survey period, but mid and late season periods were covered adequately. Data collection methods involved:

- (i) a daily visual census of the aggregation area, recording the number of individual right whales by class and a plot of the approximate positions of individuals on a grid chart of the area
- (ii) the collection of photo-identification pictures to record as many individual whales as possible, with the priority being females with calves of the year
- (iii) opportunistic observations of right whale behaviour
- (iv) opportunistic records of other cetacean species and sharks

Right whales were present on each of the surveyed days during the 2002 calving season. Over the whole season, the number of whales ranged between a high of 71 on 31 August and a low of 23 on 2 October. The number of calves present during any single surveyed day peaked at 23 on 23 August, and fell to a low of 11 on 2 October. Whales were also observed west of the study area on a number of occasions during the 2002 season.

The August-September field surveys were conducted between 13 August and 3 September 2002. Photo-identification and census work for the current consultancy was completed by a dedicated team over nine days (21/8-27/8 and 31/8-1/9), with about five days of additional census and photo-identification effort spread across the remaining field time, according to the availability of field assistants.

Whale numbers ranged from a low of 41 (17 female-calf pairs and 7 unaccompanied whales) on 2 September to a high of 71 (22 female-calf pairs, 23 unaccompanied whales and 4 unclassified whales) on 31 August. Twenty female-calf pairs were present during the first census on 15 August and fluctuated between a low of 12 on 17 August and a high of 23 on 23 August. The number of unaccompanied whales present each day varied substantially. The highest was 23 recorded on 31 August, and the lowest was seven recorded on four days (22 August and 1-3 September). The peak number of whales in each population class for the year overall occurred during the first field trip. Thirty-three films of photo-identification pictures were taken.

In general the weather during the August-September surveys was extremely good, with a majority of days offering excellent observation and photographic conditions conducive to accurate censuses of whale numbers. There were, however, several days of strong wind,

and moderate or heavy overcast with showers on three days (13 and 28 August and 2 September). On the 28 and 30th August sightability of whales was reduced by sea states of greater than Beaufort 4. Consequently, census totals for those days may under represent the actual number of whales present.

September-October field surveys were completed over 10 days between 25 September to 9 October 2002. Whale numbers had apparently dropped from winter highs, with a peak of 49 whales (18 female-calf pairs, 12 unaccompanied adults and 1 unclassified whale) recorded on 26 September. A low of 23 (11 female-calf pairs and 1 unaccompanied adult) was noted on 2 October, but 32 whales (15 cow-calf pairs and 2 unaccompanied adults) remained on the last surveyed day, 9 October. The number of unaccompanied adults had apparently fallen overall with the highest count being 12 on 26 September. At least one unaccompanied adult was seen within the study site each day except on 1 October. The number of females with calves also seemed to be generally lower than during the first field trip, but again fluctuated during the second survey period, ranging from a high of 20 pairs on 29 September to a low of 11 on 2 October.

During September-October surveys fine and clear weather prevailed for about half the days. Several days of overcast weather adversely affected identification photography opportunities, and two days of survey time were almost completely lost due to rain and storms. High winds were experienced on more than half the days, and sometimes affected sightability of whales and hampered photo-identification, even in otherwise fine weather. Beaufort sea states greater than 4 prevailed during censuses on 28 September and 2 and 7 October, and again daily totals under those conditions may under represent the actual number of whales present.

Aerial counts of whales were possible on two occasions courtesy of D.J. Needham (30 September) and R. Belcher, Great Australian Bight Marine Park (1 October). On 29 September a minimum of 29 whales (10 female-calf pairs, 3 unaccompanied whales and 6 unclassified whales) was counted within the study area, and an additional 4 (1 female-calf pair and 2 unaccompanied whales) to the west. Although weather conditions were fair (Beaufort sea state 3 and low swell), the water was very cloudy and the presence or absence of a calf could not be confirmed for 6 observations, consequently female-calf pairs were probably underestimated. On 1 October weather conditions were fair for aerial counts, but a strong offshore wind increased the sea state beyond Beaufort 4 offshore. A minimum of 24 whales (9 female-calf pairs and 6 unclassified) was present within the study area, and a further 3 (1 unaccompanied whale and 2 unclassified whales) to the west. Again, cloudy water prevented confirmation of the presence or absence of a calf for some observations, but a concurrent shore-based count indicated that all unclassified animals within the study area were probably female-calf pairs.

The peak number of whales present on any single day in 2002 (71 overall and 23 females with calves) was lower than recorded during 2001 (92 overall and 39 females with calves) (Pirzl and Burnell 2002). The difference between years is consistent with expectations based on a three year calving interval, where very high numbers of whales were present in 1998 and again in 2001, followed by lower numbers in the intervening two years. A better comparison is therefore made with numbers recorded in 1999, when the highest number of whales recorded was 79 overall and 22 females with calves (Burnell 2000), slightly lower than the 2002 figures.

Matching of identification photographs within the 2002 season has been completed, with resights within and between trips matched. Twenty-five calving females and thirty unaccompanied adults were identified at the Head of the Bight in 2002 and have been compared against the catalogue.

4. Outcomes

The outcomes from the project are detailed below against each scope item of the consultancy agreement.

- (a) *From shore-based positions undertake surveys of the spatial and temporal distribution of southern right whales at the Head of the Bight aggregation area, including but not limited to surveys of individual whale numbers and positions.*

Shore based surveys of southern right whales were carried out daily. The number and position of individual whales was recorded on a grid chart of the area and environmental data including wind direction and strength, Beaufort sea state, cloud cover and swell height were recorded. Data collected under this consultancy were combined with several days of complementary data collected under the southern right whale habitat preference project to improve the temporal coverage of the season.

Whale numbers at the Head of the Bight in 2002 generally reflected expectations based on previous years. With a three year modal calving interval, comparisons are best made with the years 1996 and 1999 in which maximum daily counts reached 49 and 79 respectively. The 28 calves recorded in 2002 is higher than the 22 recorded in 1999, but as expected is lower than the 39 recorded in 2001.

A shift in the cohort structure of calving females apparently occurred in 1998, causing the very high calf production (42 calves born) that was recorded in that year. Following such a reproductive peak somewhat lower levels of births could be expected in the following year (1999). The 1999 calving figures support this conclusion, with only 22 calves born at the site in that year, and are again reflected in the 2002 calving figures, with 28 calves recorded.

The range of number of whales in each population class recorded during the 2002 season, and a comparison of the peak counts for each population class with previous years are provided in Tables 1 and 2 respectively. While a maximum of 23 calves was counted on any one daily census, 27 female-calf pairs have been confirmed from identification photography, and an additional calf found dead on the beach prior to photo-identification surveys beginning raises the total to a minimum of 28 calves present within the aggregation area in 2002.

Table 1: Range of daily counts of females with calves, unaccompanied adults and whales of unknown status within the Head of Bight aggregation area during each of the two field trips in 2002. * whales were assigned as 'unknown status' when they were too distant or visibility was too poor to confirm or refute the presence of a calf.

	13 Aug – 3 Sept	24 Sept – 3 Oct
Female-calf pairs	14-23	11-20
Unaccompanied adults	7-23	0-12
Unknown status*	0-5	0-5
Range of daily totals	41-71	23-49

Table 2: Comparison of the maximum daily counts made at the Head of the Bight since 1991. *1991 data not comparable as the number of pods were counted rather than the number of individual whales.

Whale class	Number of whales by year											
	'91*	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02
Female-calf pairs	?	18	26	23	22	21	24	42	22	27	39	23
Unaccompanied adults	?	7	21	24	16	21	28	20	32	29	34	23
Unknown status	18*	5	6	7	4	3	7	5	4	9	10	5
Maximum daily count	?	43	56	65	57	49	72	103	79	67	92	71

Temporal variation in use of the site consistent with the migratory nature of southern right whales, where numbers of whales build up gradually at the beginning of the season, and decline toward the end, was again noted in 2002. The aggregation area was more heavily used during the middle of the calving season than toward the end of the calving season, with the median number of whales present on 17 days during the middle of the season (mid August to early September) significantly greater than the median number of whales present on 10 days in the late season (late September to early October), for the days surveyed ($U=11$; $P<0.05$, Mann-Whitney U-test).

A highly significant association was found between population class and seasonal presence within the aggregation ($\chi^2_1 = 27.92$, $P < 0.01$, Yates' correction factor for continuity applied) when female-calf pairs were considered separately from unaccompanied adults. The individual test statistics indicated that the association between female-calf pair numbers present and time of year was less strong ($\chi^2 = 3.89$ and 5.78 for winter and spring respectively) than the association between unaccompanied whale presence and time of year ($\chi^2 = 7.34$ and 10.91 for winter and spring respectively). For both classes fewer whales were present late season than mid season.

Broader scale processes may have affected movements of whales into and out of the study area and in the surrounding waters in 2002. Bannister, 2003, noted unusual aggregations of right whales at several locations on the southern coastline during aerial surveys in the 2002 season, including 25 unaccompanied whales just east of Head of Bight on 11 September. Higher than usual numbers of right whales, including females with calves were observed at Fowlers Bay, east of Head of Bight, and more right whales than usual were also recorded at other dispersed locations on the southern Western Australian coast. These observations of the coast in general may indicate broader scale factors influencing right whale distribution and movements on the southern Australian coast in 2002.

Spatial variation in use of the aggregation area was examined by dividing the site into two broad sectors, cliff and bay. The cliff sector comprised the western part of the site, where the coastline is composed of cliffs between about 15 and 50 metres high. The bay sector comprised a wide, shallow bay area bounded by a sandy beach at the eastern end of the site. There was no significant difference in the use of two habitat sectors when all population classes were pooled ($\chi^2_1 = 0.45$). However, a statistically highly significant association was found between certain habitat sectors and class of whale ($\chi^2_1 = 109.89$, $P < 0.01$, Yates' correction factor for continuity). Female-calf pairs exhibited a strong preference for the bay sector of the study site, while unaccompanied whales showed a strong preference for the cliff habitat sector. This is consistent with patterns of use previously described for the site (Burnell 1999). The size of individual test statistics indicates that the preference of unaccompanied adults for cliff areas was stronger than the preference of female-calf pairs for the bay area.

(b) *Provide maps showing the broad patterns of use and differentiation of use by mother-calf pairs and other adults*

Maps showing the positions of whales within the aggregation area over each of the two survey periods are presented in Appendix 1. Separate maps showing the distribution of female-calf pairs and unaccompanied right whales during the winter and spring survey periods in 2002 are included.

(c) *Report on abundance estimations and population increase from mark-recapture data*

Mark-recapture population growth estimates are reliant on the final matching of all photo-identified individuals against the catalogue. Given final matching of unaccompanied adults will not be available prior to January 2004 and the need to fully incorporate sightings made since 2000, mark-recapture estimates are premature at this time. It is envisaged that updated mark-recapture population estimates for the sub-population of whales using the Head of Bight will be available following the 2003 season surveys. This is due to the availability of some funds to enable catalogue analyses to take place being made available for the first time in the current season.

(d) *Obtain photographs for individual identification of southern right whales utilising the Head of Bight aggregation area and nearby coastline in the 2002 season. Report on individual female calving intervals, male visitation frequency and other pertinent biological factors or management objectives from available data.*

The equivalent of twenty four days of dedicated photo-identification effort was achieved in 2002. Over 1000 individual identification photographs (33 rolls of 36 exposure Kodak Ektachrome 400 transparency film) were taken using a Nikon F4 SLR camera with 1000mm telephoto lens. All films were processed, cut and sleeved, matched for resights within the 2002 season, and the best frames were mounted for addition to the catalogue.

Identifications were obtained of a total of 80 individual whales, comprising 53 unaccompanied adults and 27 calving females. Many of the calves born at Head of Bight in 2002 were also provisionally identified. The number of individual whales photo-identified on each trip is summarised in Table 3.

Table 3: The approximate number of photo-identifications achieved on each of the two field trips made to the Head of the Bight in 2002. The number of individuals identified in one or more previous years of this study (between year resights) are unavailable to date and will be determined when final matching is complete.

	Number of whales identified	
	Calving females	Unaccompanied adults
Trip 1 – 2002	15	36
Trip 2 – 2002	18 (incl. 6 from Trip 1)	17
Total individuals identified 2002	27	53

Matching of all identification photographs against each other to establish resights of individual whales within the 2002 season has been completed. All 27 females with calves have been matched against the Head of Bight catalogue. Of the 27 females with calves

identified in 2002, six were photographically recorded on each of the two trips. The total number of calving females photo-identified exceeds the peak daily count of female-calf pairs (23) within the aggregation area. This probably indicates that some females with calves identified during the first field trip, had left by the second field trip, and new calves had been born between the two trips. Of the calving females identified in 2002, 21 have been identified in one or more previous years.

Appendix 2 contains the resighting histories of 126 female right whales which have calved at least once at the Head of Bight between 1991 and 2000. An analysis of the 96 confirmed inter-calf intervals shows the great majority (85%) of intervals are three or four years; 68% at three years and 17% at four years. Burnell, 2001, suggests explanations for anomalous inter-birth intervals of two years and five years and states that intervals exceeding five years are likely to involve an intervening calving event being that was not recorded.

Matching of the 53 unaccompanied adults photo-identified in 2002 has yet to be completed. To date, 14 matches have been made with whales identified in previous years at the Head of Bight. A number of calves of the year have been provisionally identified but, as has been the practice in the past, this age class is not included in the catalogue until resighted in a subsequent year. Final matching will occur prior to the photo-identification workshop planned for Adelaide in January 2004.

(e) *Compile and catalogue identification photographs obtained and include in the current Head of Bight photo-identification catalogue. Include representative photographs in the digital archive. Make all photographs available for comparison with other Australian southern right whale identification catalogues.*

The best frame of each whale identified in 2002 has been mounted. Images of the callosity patterns, ventral surface showing the ventral blaze and or genital slit, and other images showing distinctive markings or scars will be digitised for inclusion in the catalogue. The digitised photographs are held securely on hard disk. Work continues on scanning the most recent identifications and on formulating a custom database that will incorporate sighting and photographic data. To this end, in May 2003, Burnell met with Dr. Desray Reeb from South Africa and Peter Ersts of the American Museum of Natural History in New York to review a relational database built for humpback whales and discuss requirements for comparing and data basing southern hemisphere right whales.

The catalogue of identified individuals generated during this study at the Head of the Bight currently numbers around 500 non-calf right whales, of which around two thirds have had their gender determined. All photographs collected under this consultancy are available for comparison against the other large catalogues currently held.

The size of the current identification catalogues makes the task of matching identification photographs extremely time consuming and laborious. Inadequate funding for the matching and comparison of photographic data for a number of years has meant that comprehensive inter-catalogue matching has not been completed. At a workshop designed to facilitate such inter-catalogue comparisons in Adelaide in 2002 the only significant matches made involved individuals from the Head of the Bight catalogue involving movements between the Head of the Bight and the Antarctic and the Head of the Bight and sub-Antarctic New Zealand (Anon 2002). A photo-identification workshop in collaboration with other catalogue holders has been funded for late 2003/early 2004, and matching of the Head of Bight catalogue against other Australian catalogues will again be undertaken at the workshop. Once again, it is expected that full inter-catalogue comparisons will not be feasible at such an event until all catalogues are fully internally matched and digitised and the use of computer-assisted matching is used.

- (f) *Undertake opportunistic behavioural studies of right whales within the aggregation area and at other locations when possible.*

No dedicated behavioural studies of southern right whales were undertaken within the Head of Bight aggregation area or at other locations under this consultancy in 2002. Several opportunistic observations of right whale behaviours, including interactions with other cetacean species, were noted.

Incidents of tactile, surface-active behaviour involving large groups of right whales were observed during the August-September field trip. Visible penises and intromission were observed on a number of occasions, indicating that mating is occurring in coastal waters as reported in numerous other studies (Payne 1986, Donnelly 1967, Burnell and Bryden 1997). No intromission was observed during the September-October trip, indicating that the majority of mating within this population is occurring earlier in the season, as noted in Burnell and Bryden (1997).

Instances of southern right whale contact with bottlenose dolphins are not uncommon at Head of Bight. Generally, dolphins approach whale(s) and may swim with or around them for a brief period before moving off. A number of such instances were noted in 2002, most lasting only seconds or several minutes. One extended interaction between a right whale female-calf pair and a pod of approximately 50 bottlenose dolphins was recorded. Whale-dolphin contact (dolphins within about 5 metres of the whales) continued for approximately 45 minutes. During this time the female right whale was observed to engage in a number of active behaviours including repeated rapid changes in direction, circling tightly, swimming rapidly after the dolphins, and making loud audible blows. The calf also interacted with the dolphins, although not as vigorously as the female.

Right whales were recorded in the company of humpback whales on two occasions in 2002 (reported under scope item (g)). On both occasions a single humpback whale approached right whales, but no active approach by right whales to humpbacks was noted. During contact with humpback whales, right whales were not observed to react overtly. On the first occasion a dispersed group of seven socialising right whales was approached. The right whales continued to exhibit surface active behaviours, a continuation of their earlier activity, and the behaviours persisted after the departure of the humpback. On the second occasion a small humpback whale (possibly a yearling) accompanied a right whale for about 75 minutes, during which time the right whale continued to travel directionally toward the west, apparently unresponsive to the presence of the humpback.

One right whale calf mortality was confirmed during the 2002 season. A calf was found washed up dead on the beach about 1km east of Twin Rocks in the early part of the season. No autopsy was conducted, but several tissue samples were collected for the South Australian Museum by Yalata Land Management staff. When the carcass was examined by the survey team in mid-August, no evidence of scarring or external trauma indicating shark attack or entanglement was apparent. It was not possible to confirm which female had lost the calf, as no photo-identification work had been conducted prior to the death.

Two large (estimated at 15 feet) sharks were seen during the August-September field trip. One was observed on 14 August swimming east to west about 50m from shore, and a second shark was seen on 31 August again swimming east to west, about 100m from shore. On the second occasion the shark followed the cliff line, approaching but skirting around a female-calf pair, with no reaction noted from the whales. It is possible that the female did not detect the shark as vigorous reactions to shark approaches have been observed in the past.

(g) *Comment on incidental sightings of other cetacean species during the survey, and on current and potential impacts and remedial measures.*

Incidental sightings of other cetaceans

Pods of bottlenose dolphins (*Tursiops truncatus*) were sighted regularly within the aggregation area in 2002, as in other years. Dolphins were commonly sighted in pod sizes ranging from 20-50 animals, but single animals and groups of about 100 were also seen. One group of 6 dolphins, each with a calf, but unaccompanied by any other dolphins was recorded.

The only other large cetacean species observed during the survey were humpback whales, seen on two occasions. An adult humpback whale was observed approaching a dispersed and surface active group of seven right whales about 1km from shore at 17:25 on 15 August. The humpback swam past the outer edge of the group and exhibited a series of

surface active behaviours. At 17:45 the humpback was interacting with three right whales about 600m from shore, before swimming fast to the west fluke up diving. A second humpback whale, very small and probably a yearling, was seen in the study area on 17 August. First observed at about 15:45, the humpback remained in contact with a single right whale for about 75 minutes, before breaking contact at about 17:45.

Current and potential impacts

The entanglement of an adult whale in monofilament line and its subsequent death at Head of Bight in 2001 is the most obvious evidence of anthropogenic impact on whales using the aggregation area to date. Southern right whales are also clearly at risk from collisions, with a right whale killed by collision with a ship in coastal waters off South Australia (not Head of Bight) during the 2001 winter season. These incidents highlight the need to effectively monitor the occurrence of such events in Australian waters. Information on the frequency of such interactions is essential to assess any impacts on the southern right whale population and to instigate early management action where necessary to ensure the recovery of the population is not compromised.

In recent years whales have been present in the aggregation area as early as May, and have regularly remained until into November. It is possible that the seasonal closure of waters around the Head of Bight calving aggregation area may need to be reviewed if temporal patterns of site use alter from those on which the seasonal closures were originally based.

It is clear that the main anthropogenic impact on right whales within the Head of the Bight aggregation area itself continues to be in the form of light aircraft overflying the area. Light aircraft traffic occurs multiple times per day, occasionally well below guideline height. Helicopters are also occasionally present. The commercial whale watch operation based at Nullarbor roadhouse was again active in 2002. It is our belief that the potential cumulative and long-term impacts of aerial overflights of a primary breeding aggregation should be investigated. We believe that a directed study should be undertaken to quantify any impacts on the whales, and to assess the efficacy of the current guidelines for aircraft operating heights over right whale breeding areas.

All right whale research undertaken under this contract was conducted from land-based positions avoiding potential impacts of aircraft and vessel approaches. In addition, photo-identification studies of right whales utilise the natural markings of the animals, meaning tags are not required, and no detectable impacts on right whales as a result of the research have been observed.

- (h) *Assess the benefits of continuation of the study in future seasons, including an assessment of the appropriate duration and frequency of future surveys.*

This scope item is addressed below in Section 5. *Appropriateness* and Section 6. *Effectiveness*.

5. Appropriateness

Field data collection methods were equivalent to previous years, with the exception that no survey was carried out during the early part of the season. Apart from this, the approach to the field work again proved to be appropriate for meeting the aims and objectives of the project. A large amount of useful data on right whales within the Head of Bight coastal aggregation area was again obtained by the intensive field survey work. The project maintained a strong data set that is now in its thirteenth consecutive year, although continuity was compromised somewhat by missing the early July sampling period.

The duration and timing of the two field trips possible in 2002 was effective in sampling the mid and late season periods. It provided good coverage of these periods that was directly comparable with previous years. The absence of the sampling in the early part of the breeding season, when most unaccompanied whales are present within the aggregation, resulted in fewer photo-identifications of this class of whale than would normally be expected. It also reduces the ability to examine residency periods of pregnant and calving females and unaccompanied adults, and reduces the ability to determine peak calving periods. Likewise it substantially reduces observation of mating behaviours and given the very short residence periods of females in their expected conception year (Burnell 1999) it reduces the chance those females will be sighted at all.

Sampling over three 10-14 day periods in early, mid and late season is an appropriate duration for field surveys. This sampling regime covers three distinct parts of the breeding season:

- (i) Early July when unaccompanied whale numbers peak. The aggregation is comprised principally of unaccompanied whales (males, non-calving females and juveniles), pregnant females and some new calves.
- (ii) Late August, when peak numbers of whales overall are usually present (most calves have been born and large numbers of unaccompanied whales remain at the site)
- (iii) Late September-early October when mostly females with older calves are present and identifications of calves are possible as their callosity patterns have matured sufficiently

Annual surveys need to be maintained due to the three year modal calving interval of right whales. It would not be possible to comprehensively monitor the population with a lower than annual survey frequency, and aspects such as shifts in cohort structure would not be detectable.

The project continues to provide information on aspects of the population ecology and reproductive biology of southern right whales only available from such long-term studies. It is an important part of collaborative projects which contribute to understanding of the wider Australian right whale population, and has strong linkages with projects examining the coastal habitat preference of right whales and the genetic structure of the population.

Data collected at the Head of the Bight represents the only long-term monitoring data available with which to assess threats from anthropogenic factors. A comparable data set on a time scale appropriate to the life history of the species (decadal) is essential to detect impacts on the population early enough to implement effective conservation strategies. As such, the importance of the dataset in allowing threats such as those that face right whales in the North Atlantic (vessel traffic, loss of habitat etc.) to be detected and addressed cannot be underestimated.

The curation, maintenance and quality of the Head of Bight photo-identification catalogue has provided an invaluable resource for international collaboration as was evidenced by the results from the 2002 matching workshop in Adelaide. Funding levels in 2002 were again insufficient to complete comprehensive matching and archiving of photo-identification data at the end of the field season, and analysis of multi-year datasets. The ability to detect impacts on the species has been compromised due to the lack of funds so far available to complete comprehensive data analyses. With more appropriate levels of funding available in 2003, however, it is anticipated that some of these issues can be addressed.

6. Effectiveness

The project successfully met its stated objectives in 2002, but as mentioned above was limited by funding availability not being confirmed until October, after all of the field work had been completed. Given this limitation, the temporal coverage achieved by the field trips was good. Data collection continued in a manner that will allow comparison with previous years. A large number of individual adult right whales (80) were photo-identified. In addition, many calves of the season were provisionally identified, continuing to provide identifications of animals of known age within the population.

7. Transferability

The current study represents the only long-term shore-based study of right whales in Australia, and as such potentially has a lot to offer similar studies proposed in the future and for other areas. Techniques used at the Head of the Bight are being extensively incorporated into a multi-year study of the habitat preference of right whales on the Australian coastline currently underway through Deakin University with the support of Environment Australia, Woodside Energy and other collaborators.

Further, the project has provided information critical to the proclamation and designation of the area as the Great Australian Bight Marine Park and will continue to provide the management of that park with biological and resource information relevant to right whales and other marine mammals. Data from the project may also be used for performance assessment of the Great Australian Bight Marine Park in relation to right whale protection.

It is important that complementary photo-identification studies of right whales continue around the Australian coastline and that adequate comparisons between these catalogues is achieved. The comparisons of photographic data between these areas continue to provide a great deal of information on the movements and structure of the Australian right whale population. It will also be necessary to continue the development of the computer assisted matching systems to allow analyses of the large amount of photographic data within reasonable time frames and ensure that meaningful inter-catalogue comparisons are made.

8. Acknowledgments

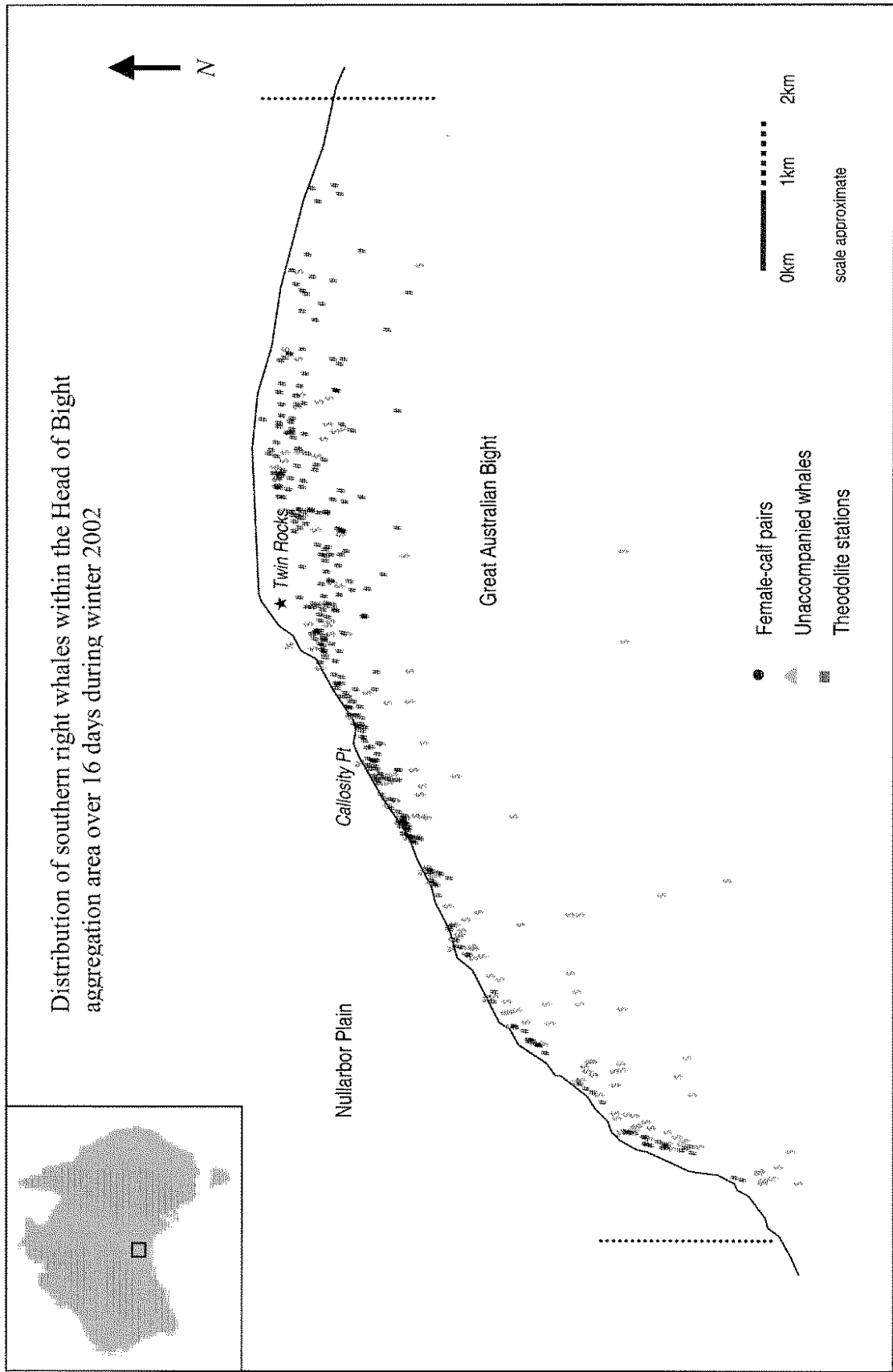
Several assistants and volunteers provided generous support for the project, which would not have been possible without their contributions. We would like to thank Leanne Sherriff, Simon Clark and Jenny Silver for providing assistance in the field - their individual efforts were invaluable. We are grateful to John Bannister for his ongoing collaboration on many aspects of the right whale work and to the Land Management staff of the Yalata Community, particularly Anton Newchurch, Shane Brown and Alan Crisp, who were again generous in their support of our project and provided assistance with the field work. Sincere thanks to Ross Belcher, Great Australian Bight Marine Park for his support of the project and supplementary funding, and to Pin Needham for the opportunity to conduct an aerial survey of the aggregation area. Thanks also to staff of the Marine Wildlife Section, Environment Australia for their efforts in support of this work, and to Environment Australia for assisting with funding.

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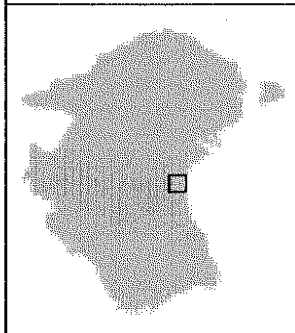
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APPENDIX 1 – 2002 Distribution Maps from theodolite position plots



Distribution of southern right whales within the Head of Bight aggregation area over 13 days during spring 2002



APPENDIX 2 - Individual female calving events.

Only females that have calved at least once at the Head of the Bight between 1991 – 2000 are included (n = 126). Bolded entries represent confirmed sightings made at other locations on the Australian coastline. (CO – female with calf of the year; CA – calf of the year; CY – female sighted with known yearling calf; A – unaccompanied adult; A# - adult of known age)

Cohort	ID No.	Name	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
91	9101	Blaze	CO	A		CO			CO			CO
91	9102	Mrs Squiggle	CO			CO				CO		
91	9103	Whitebelly	CO						CO			CO
91	9104	Pinstripe	CO			A		CO			CO	
91	9105	Yarong	CO			CO						
91	9106	3 by 2	CO			CO	A		CO	CY		CO
91	9107	Noco	CO			CO			CO			CO
91	9108	Akiko	CO			CO				CO		
91	9109		CO			A		CO	CY		CO	
91	9110		CO				CO				CO	
91	9111	MMM	CO			CO			CO			CO
91	9112	Arrowhead	CO					CO				
91	9113		CO			CO			CO			
91	9114	Mary Poppins	CO			CO			CO			CO
91	9115	Saddles Cow	CO			CO						
91	9116	Flo	CO			CO			CO			CO
91	9117	Kate	CO			CO			CO			
91	9118		CO									
91	9119		CO									
91	91a		CO				CO				CO	
91	91b		CO				CO			CO		
92	9201	Lever Arm		CO			CO			CO		
92	9202	Ratty		CO			A		CO			CO
92	9203			CO			CO			CO		
92	9204			CO			CO					
92	9205	Mosaic		CO			CO			CO		
92	9206	Spot		CO			CO			CO		
92	9207	Headlights		CO			CO			CO		
92	9208			CO				CO				
92	9209	Madonna		CO			CO					
92	9210			CO			CO			CO		
92	9211	V Bonnet		CO								
92	9212	Roxanne		CO				A		CO		
92	9213			CO			A		CO			
92	9214	Patch's mum		CO				CO		CO		
92	9215	Butttons		CO								
92	9216	Crescent		CO		CO		CO		A		A
92	9217			CO			CO			CO		
93	9301	Box			CO			CO			A	
93	9302	Anchor			CO						CO	
93	9303	Line-A-Breast			CO					CO		
93	9304	Joan of Arc			CO					CO		
93	9305	Scarback			CO							
93	9306	Cottontail			CO							
93	9307	Brown Sugar			CO						A	
93	9308	Topsy			CO	CY	A	CO			A	
93	9309	Grace			CO					CO		
93	9310	Claire			CO			CO			CO	
93	9311	Roma			CO	CY		CO			CO	A
93	9312	Micky			CO			CO				
93	9313	Tenpin			CO			CO			CO	

93	9314	Dosh			CO	CY			CO			CO
93	9315	Baldy			CO							
93	9316	DM			CO	A						
93	9317	Steamer			CO							
93	9318	Granny Smith			CO							
93	9319	Minnie			CO							
93	9320	CLP			CO							
93	9321	Nami			CO							
93	9322	Tiffany			CO							
93	9323	Barmaid			CO							
93	9324	Bridget			CO		A					
93	9121	Bernadette	A	A	CO			CO				
93	9325	Billy			CO	A						
94	9401	Chevy				CO				CO		
94	9402	Snickers				CO				CO		
94	9403	Expo				CO			CO		CO	
94	9404	Darb				CO					A	
94	9405	Paris				CO				CO		
94	9406	Cliché				CO				CO		
94	9407	Shona				CO			CO			CO
94	9408	Agapi				CO					CO	
94	9409	Ellie				CO			CO			CO
94	9410	Maggie				CO		CO				
94	9411	L&R Bars				CO				CO		
94	9334				A	CO						
95	9501		CO					CO				
95	9502							CO				
95	9503							CO				
95	9504	Mata Hari		CO				CO		CO		
95	9505			A				CO			A	A
95	9120	SM	A					CO		?	A	
95	9349	Brown Scraggly			A			CO				
95	9356	Phantom			A			CO				
95	9436	Jay				A		CO				
96	9231			A		A		A	CO			
96	9366	Vicky	A	A					CO	A		A
96	9422	Xhosa				A			CO			
96	9446					A			CO			
96	9601								CO			
96	9602	Coral							CO			
96	9603	Chars							CO			
97	9364				A	A	A		CO			CO
97	9701								CO			
97	9702								CO			
97	9703								CO			
98	9125		CA	A1		A3				CO		
98	9229			AS	A	A			A	CO		
98	9801									CO		
98	9802									CO		
98	9803									CO		
98	9804									CO		
98	9805									CO		
98	9806									CO		
98	9807									CO		
99	97A23								A		CO	
99	9232			A		A	A				CO	
99	96A8							A			CO	
99	9901										CO	
99	9902										CO	
99	9903										CO	
99	9904										CO	

99	9905									CO	
2000	9362										CO
2000	9395			CA	A1						CO
2000	9536	Ash				A					CO
2000	96A3						A				CO
2000	98A52								A		CO
2000	0001										CO
2000	0002										CO
2000	0003										CO
2000	0004										CO
2000	0005										CO
2000	0006										CO
2000	0007										CO
		Calving Intervals	2	3	4	5	6	Total			
		total	3	65	16	9	3	96			
		%	0.03	0.68	0.17	0.09	0.03	1			

APPENDIX 3 - Expenditure Acquittal (Environment Australia and Eubalaena Pty. Ltd only)

Receipt and expenditure of funds:

<i>expenditure to date:</i>	<i>budgeted</i>	<i>spent</i>
Vehicle hire – 4WD	5,500	5,500
Fuel	2,200	2,200
Accommodation	2,200	1,800
Meal allowance	3,300	3,300
Volunteer support	550	1,000
Air travel	2,200	2,200
Other consumables	550	650
Salaries	13,200	13,350
Communications	1,100	1,100
Audit expenses	880	880
Capital items and equipment repair etc.	2,000	1,700
Total	33,680	33,680

Total for contract: \$33,680

funds received (and due):

1st instalment	\$20,208
2nd instalment	\$10,104
Final instalment	\$3,368