

***Ecology and behaviour of southern right whales  
Head of the Bight, South Australia 2003***

**Final report to Department of Environment and Heritage**

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## 1. Overview

Southern right whales aggregate at the Head of the Great Australian Bight, South Australia, to breed during the austral winter. Whales are reliably present within the aggregation area from June to October, and are frequently recorded as early as May and as late as November. The area is one of the most important calving locations for the species on the Australian coast.

The long-term study of the behaviour and ecology of whales has been ongoing at the Head of Bight since 1991. Shore-based surveys and photo-identification studies carried out in 2003 continued this long-term dataset. Data collected included the number and distribution of right whales within the aggregation area, and photographic identifications of individual whales. The intensive program of individual identification has been maintained for thirteen years and to date the study has provided a catalogue of identified right whales numbering around 550 individuals.

Three field trips were made to the Head of the Bight aggregation area during the 2003 winter - spring season, totalling forty survey days. Whales were present within the aggregation area on every surveyed day between 1 July and 7 October 2003. The number of individual whales within the aggregation area ranged from a low of 12 animals on 28 September to a high of at least 74 animals on 16 August. A minimum of 30 calves was born or present in the aggregation area in 2003, roughly equivalent to the 28 recorded in 2002. Given the modal three-year calving interval of the species a more valid comparison is made with the 2000 season, in which 27 calves were recorded. The number of unaccompanied whales present (adults without a calf of the year and sub-adults) was lower than expected, particularly during the early and middle parts of the season (July and August field trips).

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 relatively frequent interactions with right whales were noted. Common dolphins (*Delphinus delphis*) were recorded on two occasions and a single humpback whale (*Megaptera novaeangliae*) was observed on one day. Large great white sharks (*Carcharodon carcharias*) were sighted three times, but no interaction with right whales was noted. Australian sea lions (*Neophoca cinerea*) were seen and heard within the study area on a number of occasions throughout the season.

## 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 (Bannister et al., 1996).

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 (Burnell and McCulloch, 2002). 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 south-eastern 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).

Shore-based surveys of right whales within the aggregation area at the Head of the Bight since 1991 have censused the number, class and distribution of right whales, and collected photographic identifications of individual whales for life history and movement studies (Burnell, 1999; Burnell, 2001). 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, and has been used for several management applications including the designation of boundaries for the Great Australian Bight Marine Park (GABMP) and the development of the Draft Recovery Plan for Southern Right Whales.

The photographic and census data gathered during the 2003 season were again collected in a manner allowing comparison with previous years. Data gathered to date have shown 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.

Annual research reports have been submitted to the Commonwealth Department of Environment and Heritage and its predecessors the Australian Nature Conservation Agency and Environment Australia since 1996. This report covers work undertaken under the consultancy agreement signed April 2003, and follows an interim report forwarded to Environment Australia in November 2003.

### **3. Field activities**

#### *Data collection methods*

The Head of Bight aggregation area was surveyed from 1-14 July, 15-28 August and 26 September to 7 October 2003, totalling forty days at the study site. The data collection methods employed in 2003 were consistent with those in previous years, ensuring comparability with data from earlier years of the study. Field methodology included:

- (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

#### *Field trip summary*

Right whales were present on each of the surveyed days during the 2003 calving season. The number of whales ranged between a high of 74 on 16 August and a low of 12 on 28 September. The number of calves present during any single surveyed day peaked at 30 on 21 August, with lows of 6 recorded in both the early (1 July) and late (28 September) season.

The early season field surveys were conducted 1-14 July 2003. Excellent sighting and photographic conditions prevailed on the majority of days, with only one day lost due to poor weather. Twelve films of identification photographs were taken and censuses of the survey area were completed on 13 days. Photo-identifications of 22 individuals comprising seven females with calves and 15 unaccompanied whales were obtained.

The mid-season period was surveyed over 14 days (15-28 August). The weather for the second field trip was generally poor, with good survey conditions experienced on only five of the 14 days. Rain showers, overcast conditions and/or strong wind affected sightability of whales and hampered photo-identification efforts on other days, with an equivalent of about three survey days lost completely due to adverse weather conditions. Fourteen films of identification photographs were taken, and censuses were completed on 12 days. Photo-identifications of 38 individuals comprising 20 females with calves and 18 unaccompanied whales were obtained during the midseason field trip. All seven females with calves identified in July were resighted, and identifications of 14 new cows for the season were obtained. Only two of the unaccompanied whales identified in July were resighted, and identifications of 16 new unaccompanied whales for the season were obtained.

Twelve days (26 September-7 October 2003) were spent in the field during the later part of the right whale breeding season. The weather for the third field trip was again poor. Good

survey conditions were experienced on only four of the 12 days. An equivalent of about four days were lost due to adverse weather conditions. Rain showers, overcast conditions, strong wind and/or high surge affected sightability of whales and hampered photo-identification efforts for periods of time on the other days. Ten films of identification photographs were taken and a census of the survey area was completed on 10 days. Photo-identifications of 14 individuals comprising 12 females with calves and two unaccompanied whales were obtained. Six females with calves identified on earlier 2003 field trips were resighted, and identifications of six new cows for the season were recorded. None of the unaccompanied whales identified earlier in 2003 were resighted, and identifications of two new unaccompanied whales for the season were obtained.

#### **4. Results and outcomes**

The results from the project are detailed below against each of the aims contained in the consultancy contract.

- (a) *Continue the time series collection of data on the number and distribution of southern right whales at the Head of the Great Australian Bight.*
- (b) *Continue to collect information on the population ecology and reproductive ecology of the southern right whales.*

Shore based surveys of southern right whales were carried out on 35 of 40 available survey days, continuing the 13 year time series data collection. The number and position of individual whales was recorded on a grid chart of the study site. Environmental data (wind direction and strength, Beaufort sea state, cloud cover and swell height) were recorded to assess sightability of whales. The data collection methods employed in 2003 (see Section 3) were consistent with those in previous years, ensuring comparability with data from earlier years of the study. Data were collected according to protocols that allow the population ecology and reproductive biology of southern right whales to be examined over the long time periods appropriate to the species.

The highest number of individual whales within the Head of Bight study area on a single day during 2003 was 74 (28 female-calf pairs and 16 unaccompanied whales) recorded on 16 August. A low of 12 (six female-calf pairs) was recorded on 28 September, but 22 whales (11 female-calf pairs) remained on the last surveyed day (7 October). The peak count (74) was slightly higher than recorded during 2002 (71), but lower than 2001 (92) (see Table 1). 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 more informative comparison is made with 2000 data, when the peak number of whales was 67. The 2003 figure represents an increase of 9.5% over the 2000 cohort.

Female-calf pair numbers generally reflected expectations based on previous years. Six female-calf pairs were present on July 1, the first surveyed day of the 2003 season and numbers generally increased during that trip. Up to seven calves may have been born in the aggregation area during the 14 day period, with several observations of very young calves noted. The peak count of females with calves was 30 recorded on 21 August, and had fallen by the third field trip to a low of six on 28 September. Given a three year modal calving interval, inter-year comparisons are best made with the years 1997 and 2000 in which the minimum number of female-calf pairs was 24 and 27 respectively. The 30 calves produced at the site in 2003 represents a simple 10% increase over the number produced by the cohort in 2000.

Counts of unaccompanied adults were lower than expected in 2003, particularly in the early and mid-season periods. The 2003 peak count (16) was 30% lower than 2002 (23) and 45% lower than 2000 (29). The observations at Head of Bight were consistent with broader scale aerial surveys of the south-western Australian coast, where fewer unaccompanied whales than usual were also observed (J. Bannister pers. comm.). Broader scale processes may have influenced the usage of the aggregation area resulting in lower than expected numbers of unaccompanied whales.

**Table 1:** 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	03
Female-calf pairs	?	18	26	23	22	21	24	42	22	27	39	23	30
Unaccompanied adults	?	7	21	24	16	21	28	20	32	29	34	23	16
Unknown status	18*	5	6	7	4	3	7	5	4	9	10	5	9
Maximum daily count	?	43	56	65	57	49	72	103	79	67	92	71	74

Temporal variation in site usage consistent with the migratory nature of southern right whales and patterns observed at the Head of Bight in previous years was again noted in 2003. As expected numbers of whales built up gradually at the beginning of the season and declined toward the end, with the aggregation area most heavily used during the middle of the calving season. Table 2 summarises the range of daily census totals recorded during each field trip for each population class. It also gives the mean daily number of whales recorded in each category for each of the early, mid and late season periods. The fluctuations in daily counts during the mid and late season are probably at least partly accounted for by the poor survey conditions experienced on some days.

**Table 2:** Range and mean daily numbers of each population class of southern right whale present within the Head of Bight aggregation area during each of three field trips in 2003.

	1-14 July		15-28 August		26 September–7 October	
	Range	Mean (n=13)	Range	Mean (n=12)	Range	Mean (n=10)
Female-calf pairs	6-13	9.5	14-30	22.4	6-13	9.9
Unaccompanied adults	1-10	5.7	4-16	8.2	0-1	0.3
Unknown status*	0-9	2.9	0-8	1.8	0-2	0.3
Daily total	18-36	27.5	44-74	54.8	12-27	20.4

\*Whales assigned as 'unknown status' when too distant or visibility too poor to confirm or refute the presence of a calf.

(c) *Continue the collection and curation of the photo-identification catalogue of southern right whales.*

The catalogue of identified individuals generated during this study at the Head of the Bight currently numbers about 550 non-calf right whales, of which around two thirds are of known gender.

About 35 days of dedicated photo-identification effort was achieved in 2003. Approximately 1200 individual identification photographs were taken on Kodak Elite 400ASA transparency film using a Nikon F3 SLR camera with 1000mm telephoto lens. All films were processed, cut and sleeved, and matched to establish resights within the 2003 season. The resultant identifications of 73 individual whales comprised 26 calving females, 14 calves of the year, and 33 unaccompanied adults (including six sub-adults) are summarised in (Table 3).

**Table 3:** The number of photo-identifications achieved on each of the field trips made to the Head of the Bight in 2003. Within season resights in parentheses.

Survey period	Number of individual whales identified		
	Calving females	Unaccompanied adults	Total
Early (Trip 1)	6	15	21
Mid (Trip 2)	20 (6)	18 (2)	38
Late (Trip 3)	12 (6)	2	14
Total individuals	26	33	59

The best photograph of adult and sub-adult callosity patterns was mounted for addition to the catalogue and comparison against whales photographed in previous years. Images of ventral or dorsal blazes, the ano-genital configuration, distinctive markings or scars, and a range of head perspectives for individuals newly identified in 2003 have been selected and will also be added to the catalogued images. Images of calves of the year will similarly be mounted and archived.

Comparison of the 2003 identifications against catalogued whales yielded 32 matches. An additional five possible resights are awaiting verification based on the examination of



additional photographs. Excluding the possible resights, 15 new unaccompanied adults, six new calving females, and a minimum of 14 calves of the year were provisionally identified in 2003. Matching has not yet been carried out against uncatalogued (not yet resighted) calves from earlier years, and may yield some additional matches, particularly from among the six sub-adults identified in 2003.

In the absence of a fully functional computer-assisted matching program, photographic comparisons continue to be made manually. The growing size of the catalogue and the large number of whales identified each season means that this is an increasingly laborious and time consuming task (for example, to match 59 whales identified in 2003 to 550 animals in the catalogue requires 32,450 comparisons, plus about 11,800 comparisons to match to non-resighted calves). A system of identification coding developed by the New England Aquarium and used for North Atlantic right whales has been adapted for this study to improve matching efficiency. The callosity pattern of each individual whale is currently being coded to enhance searching efficiency based on the presence/absence, number and shape of key features. Just over half the catalogue (around 400 adults and calves) have been coded to date. Coding protocols have been exchanged with other southern hemisphere researchers to enhance compatibility for inter-catalogue matching.

Significant advances in data and image management have been made during the period of the consultancy. The backlog of matching and curation work that has arisen as a result of low funding levels in some years is now being addressed rapidly. Major tasks included:

- The physical archive of around 2,500 images has been restructured for greater efficiency in accessing images, and to facilitate transfer to digital format.
- Around 100 non-resighted calves from the years 1995-1999 have been assigned catalogue numbers in preparation for archiving, transfer to digital format, and database image linking.
- The best images of non-resighted calves (around 174) from the years 1991-1999 inclusive have been selected in preparation for digitising and database image linking.
- Matching of identifications from all years against catalogued whales is complete with the exception of about 40 individuals from the early 2000s. Non-resighted individuals from four years remain to be matched against non-resighted calves.

Improved data management systems continue to be developed. Resight information currently stored in an Excel spreadsheet with linked images will be transferred to a database application in 2004. Database structures used by other right whale researchers internationally have been examined. Reeb and Best have made available the database structure used for South African right whale photo-identification work, and it is anticipated that this will provide a useful framework for the Head of Bight database. The database is

now in the early stages of development. It will include, among other features, storage and query facilities for resight data and the calculation of associated parameters (eg. inter-calf intervals), a capacity to link and retrieve digital images, the ability to utilise coding to enhance matching efficiency, and linkages for computer assisted matching.

Photo-identification will be fully digitised from the 2004 season forward. A Nikon D100 SLR camera with Nikkor 500mm (effective length 750mm) lens has been purchased. File naming protocols have been established and a data management system will be in place prior to the 2004 season. Conversion of the catalogue to a digital format is underway to enhance retrieval and comparisons and provide a much needed back up of original images. Image management protocols have been established and scanning of around 2,500 images at 3000ppi resolution has commenced (access to equipment provided by the Australian Antarctic Division and support from the Great Australian Bight Marine Park). The images are being archived as 31MB TIFF files, with duplicate JPEG images created for routine access. A 200GB external hard drive has been purchased to store the archive quality images.

All photographs collected under this consultancy are available for comparison against the other large catalogues currently held. The size of identification catalogues and a shortage of time and funding for comparison of photographic data has meant that comprehensive inter-catalogue matching has not been completed for a number of years. A photo-identification workshop in collaboration with other catalogue holders was held in Adelaide 2004. Some matching of the Head of Bight catalogue against other Australian catalogues was undertaken at the workshop, with four matches to the Western Australian catalogue found. As has been the case for a number of years, full inter-catalogue comparisons will not be feasible until all catalogues are fully internally matched and digitised, and computer-assisted matching is used.

Some broad arrangements for international data sharing protocols were discussed at the Adelaide workshop in 2004 (Anon, 2004). Code lettering for individual catalogues were assigned, and has been adopted by this study. A number of other recommendations of the workshop including those relating to data integrity and match verification are being implemented by this project.

*(d) Continue detailed analysis of the data sets collected over the previous 13 years of the project.*

Detailed analyses of the long-term data set will not be possible until final matching is completed and data is transferred to a suitable database. The large volume of data now available and the nature of the analyses to be performed necessitate a data management system that will facilitate more sophisticated queries than are currently possible. As detailed in relevant sections of this report, work necessary to facilitate analyses of the long-term dataset is well underway and it is anticipated that this will be complete toward mid 2004. Detailed

analysis of the data set has been planned, and some aspects commenced. The results will be submitted to DEH as they become available.

During 2003, an additional 115 individuals from the Head of the Bight catalogue were sketched and included in the computer-matching database, bringing to 265 the total number of individuals available for computer assisted matching. It is planned that the remaining individuals will be sketched over the coming year. As a result of discussions held prior to, during, and subsequent to the Adelaide Workshop, progress has been made toward a single, more powerful computer-assisted matching program for right whales. The two systems currently in use (Hiby-Lovell and Burnell-Shanahan) have quite complimentary strengths and work is ongoing to combine the functionality of the two systems.

## **5. Opportunistic observations**

### *Southern right whale mortality, injury and possible impacts*

No right whale calf mortalities were observed in 2003. No entangled or injured whales were seen, and no scars consistent with human impacts were observed on any individuals. Overflights by light aircraft continue to be the most likely source of disturbance to right whales within the aggregation area.

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.

### *Seasonality of habitat use*

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. Attempts are underway to obtain coverage of the margins of the season (outside the main study period) by collaboration with the GABMP and Yalata Land Management.

### *Other cetaceans*

Bottlenose dolphins (*Tursiops truncatus*) were regularly sighted within the aggregation area throughout the season. Group size ranged from several to about 100 individuals, but was most commonly 20-50 individuals. Calves were often sighted within the groups and socialising, travelling and feeding behaviours were observed. Bottlenose dolphins frequently approached and interacted with right whales, sometimes for extended periods.

Common dolphins (*Delphis delphinus*) were recorded on two occasions, with one sighting of a single female with a calf and one of a single adult. Common dolphins were sighted in August and September.

The only species of large cetacean recorded within the study area (other than right whales) was a single juvenile humpback whale (*Megaptera novaeangliae*) observed in July. The animal was seen close to shore in the mid-section of the aggregation area, and moved off in a westerly direction with no observed interaction with right whales.

#### *Other marine mammals*

Australian sea lions (*Neophoca cinerea*) were seen and heard within the study area on a number of occasions throughout the season. They were observed in the water in small groups of between one and three individuals, and were also seen hauled out on the rocks at the base of cliffs.

#### *Sharks*

Great white sharks (*Carcharodon carcharias*) were observed on three occasions, twice in July and once in October. Poor water clarity for much of the mid and late field season may have prevented sightings of sharks, even had they been present. One calf of the year had scarring on its dorsal surface consistent with shark attack, but no other injuries that could be attributed to shark attack in the 2003 season were noted.

## **6. Applicability**

The project maintained a strong data set that is now in its fourteenth consecutive year, and was successful overall in meeting its stated objectives. A large amount of data on right whales within the Head of Bight coastal aggregation area was again obtained by the intensive field survey work. Substantial progress has been made on addressing the backlog of matching and curation that must be completed prior to analysis of the multi-year dataset. With more appropriate levels of funding available in 2003 these issues are rapidly being addressed.

Field data collection methods equivalent to previous years again proved to be appropriate to meet the aims and objectives of the project. Many individual adult right whales (73) were photo-identified, including 27 new animals and 14 calves of the season, the latter of which continue to provide identifications of animals of known age within the population. The duration and timing of the field work provided good coverage directly comparable with previous years (with the exception of 2002 when the early season period was missed). Sampling over three 10-14 day periods in early, mid and late season is appropriate to cover the three distinct parts of the breeding season:

- Early July when unaccompanied whale numbers peak and the aggregation is comprised principally of unaccompanied whales (males, non-calving females and juveniles), pregnant females and some new calves.
- 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)
- 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

The project continues to provide information on aspects of the population ecology and reproductive biology of southern right whales that is only available from such long-term studies. The long-term nature of the study is crucial to obtaining statistically relevant information on long-lived species with slow reproductive rates, and to tease out significant trends from natural variability. Annual surveys need to be maintained due to the three year modal calving interval of right whales. It would not be possible to effectively monitor the population on other than an annual frequency since aspects such as shifts in cohort structure would not be detectable.

The Head of the Bight long-term monitoring data is the only available dataset with which to assess threats from anthropogenic factors. A comparable dataset on a time scale appropriate to the life history of the species (decadal) is essential in order to be able to detect changes, separate trends of concern from natural variability, and implement timely 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 and entanglement) to be detected and addressed cannot be underestimated.

The Head of Bight project makes an important contribution to collaborative research that is improving the understanding of the wider Australian right whale population. It has strong linkages with projects examining the coastal habitat preference of right whales and other photo-identification and population assessment studies. The quality of the Head of Bight photo-identification catalogue has provided an invaluable resource for international collaboration as evidenced at the 2002 and 2004 matching workshops (Anon, 2002; Anon, 2004), and strong linkages between the project and other southern hemisphere researchers have been forged.

The project continues to provide the most substantial biological and management information on southern right whales available for the GABMP. Historically, data from the project was integral to establishing appropriate seasonal and geographic closures for the GABMP as well as appropriate use, and it continues to provide information relevant to management decisions within the park. The long-term data series provides a suitable basis for performance assessment of the GABMP in relation to right whale protection.

The comparison of photographic data from around the Australian coastline continues to provide a great deal of information on the movements and structure of the Australian right whale population. It is important that complementary photo-identification studies continue and that adequate comparison between catalogues is achieved. Progress has been made on the development of computer assisted matching programs, and it will be necessary for this to continue to allow analyses of the large amount of photographic data within reasonable time frames.

### Acknowledgments

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