EARTHWATCH FIELD REPORT

Peter B. Best

Mammal Research Institute,
University of Pretoria,
South Africa.

WHALES OF SOUTH AFRICA – *The movements and feeding behaviour of southern right whales off the West Coast of South Africa*

September 28, 2003 – January 25, 2004

St Helena Bay, West Coast of South Africa

Abstract

Between September 2003 and January 2004, four two-week Earthwatch teams were scheduled to participate in boat-based observations of the right whale feeding ground believed to exist in St Helena Bay on the West Coast of South Africa: in the event, only two volunteers participated, one in Team I and one in Team III. Results are presented here for the whole field season. In 39 days of sea-time, 214 sightings of 442 whales were made, including 170 sightings of 388 southern right whales and 16 sightings of 31 humpback whales. For 27.5% of the time while motoring at sea the team was in the company of whales! Right whales exhibiting behaviour believed to be associated with feeding were rarely recorded in September and October, but formed 30.3% of whales seen from November to January. With one exception, all feeding seemed to be taking place at depth: faeces were collected on 4 occasions. The one surface-feeding whale was tracked for 1 h 26 min, during which time it swam a total distance of 6.173 km, at an average speed of 4.31 km/hr. Surface-active groups were commonly seen in every month, despite this supposedly being the non-breeding season. A line of 5 oceanographic stations was successfully completed 7 times, including CTD casts and vertical plankton hauls at each, and such stations were also carried out opportunistically 6 times next to feeding whales. Some 1 600 frames were taken for photo-identification purposes. Biopsies were collected from 21 humpback whales.

Objectives

In the light of recent evidence that southern right whales might be re-occupying an eighteenth-century summer feeding ground on the West Coast of South Africa, we wanted to determine the distribution and seasonality of right whales in the area, how these related to oceanographic features, how many individuals might be involved and what evidence there might be of feeding (and on what prey).

Methodology

Observations were semi-continuous (with periodic gaps to relieve personnel) from September 28, 2003, to January 25, 2004, but because we only wanted Earthwatch volunteers to be present at times of high whale density (and we didn't expect much response over the Thanksgiving/Christmas period), we restricted teams to two periods.

Four research teams, each consisting of the PI, a scientific staff of 2 and up to 4 volunteers, were scheduled for the periods

Team I	September 28 – October 12, 2003	1 volunteer
Team II	October 12 – 26, 2003	0 volunteers
Team III	October 26 – November 9, 2003	1 volunteer
Team IV	January 11 – 25, 2004	0 volunteers

In the event, only two volunteers were attracted to the project, as shown above.

The project was entirely boat-based. The boat used was the Unit's 6 m inflatable *Balaena*. This boat is powered by two 50 HP four-stroke engines, carries GPS, a fish-finder and VHF radio (as well as at least one cell phone), and has two inboard tanks carrying 160 l of fuel in total. For this project it was specially fitted with a small manual cable winch in the bows. It was stationed at either the Naval Dockyard at Saldanha, or more frequently, at Sandy Point Fishing Harbour in St Helena Bay. The crew and volunteers would be ferried to the appropriate harbour in the Unit's 4x4 vehicle (affectionately known as Humphrey).

Depending on prevailing weather conditions, the boat would be launched at a suitable slipway and recovered at the same slipway later in the day. Two modes of operation were used while at sea. Most frequently the boat was in full searching mode, in which a continuous look-out for whales was maintained, and all large whale sightings were closed with. About once every two weeks, however, the boat would be dedicated to undertaking a line of oceanographic stations, and whale sightings (although still recorded) would take second priority and would not be closed with until the line had been completed.

The research area was divided into 7 roughly equal-sized blocks, and when the boat was to be in full searching mode, it was decided each day which block would be searched. This decision was based on expected weather conditions and where the boat had searched previously. All but two of the blocks contained coastline, and the usual search pattern was to do a coastwise search first and return offshore.

In full searching mode, an observer would keep watch from an elevated position about 3 m above sea level, and the helmsman and at least one other observer would maintain a look-out from deck level. After making contact with a sighting, the time, species, position, sea surface temperature and water depth would be recorded, and sketching and photo-identification would begin. Photography was carried out using a Nikon F301 or Minolta X300 equipped with a 100-300 mm lens and loaded with either colour (for right whales) or black-and-white film (for humpback whales). After photography was completed, the film and frame numbers would be entered, the final estimate of group size (and an decision on whether it was reliable or not) recorded, and the presence of calves or juveniles noted. The prevailing behaviour of the group would also be recorded: the categories used were logging, milling, playing, travelling, evasive, long-diving, feeding(?) and SAG (surface active group).If the sighting was a humpback whale, photo-identification would be followed by attempts to obtain a skin biopsy for genetic analysis, using a Paxarms biopsy gun. The gun fired a polycarbonate dart with a terminal punch: after striking the whale, the dart rebounded and floated at the surface, with a tiny piece of skin retained in the punch. The sample would be preserved in a saturated salt solution

(with DMSO) for genetic analysis. Volunteers assisted in all these tasks apart from firing the biopsy gun or using the photo-identification cameras.

About once every two weeks, the boat undertook a line of 5 oceanographic stations 5 n. miles apart, and extending along what was thought (from the movements of a satellite-tagged whale in 2001/2) to be the principal axis of the feeding ground. The intention of these stations was to monitor the distribution and availability of right whale prey (specifically the larger copepods) throughout the season. At each station a CTD (an instrument that measures Conductivity, Temperature and Depth) was dropped on the end of a cable from the surface to the sea floor and retrieved, and the data downloaded to an onboard laptop computer. This enabled us to look at the vertical temperature profile and so decide how to deploy the plankton net. We mainly used an N50 plankton net with 300 micron mesh, intended to sample zooplankton of a size likely to be interesting to right whales. The net was fitted with a digital flowmeter and a manual closing mechanism, and the plankton bucket was weighted at the bottom: the normal protocol was to make two integrated vertical hauls, one from the seafloor to the thermocline (using the closing mechanism), and one from the thermocline to the surface. All plankton collected was concentrated (latterly through a 300 micron filter) and fixed onboard with 70% alcohol. If the boat was drifting substantially, it would be repositioned just before each plankton haul.

Apart from these routine stations, some opportunistic stations were carried out next to feeding whales, with the intention of determining qualitatively what prey they were likely to be feeding on, and hopefully its density. Because in all but one case the whales were feeding at depth, the protocol used was identical to that at routine stations. On the one occasion when a whale was found feeding at the surface, the net was stripped of all weights and deployed from a small davit over the port side of the boat, from where it was towed behind but adjacent to the wake of the feeding whale.

Additionally, if the whales were seen to defecate, or faeces were seen floating at the surface, a sample would be retrieved with a poop-scoop and fixed onboard in 70% alcohol.

Results

The basic results in terms of monthly effort expended and sightings made, etc are given in Tables 1 and 2. The boat went to sea on 39 days, or 51.3% of available field days: only in December was there a noticeable decline in this figure (to 41.7%), owing to a period of particularly strong wind. Perhaps a more interesting statistic is that of the 241 hours for which the engines were running, 27.5% was spent in the company of whales! On only 8 of the days were no right whales seen, 4 of which occurred in the last 10 field days. In total, 170 groups of 388 right whales were seen (Fig. 1), which is very similar to the total seen from the boat at North Head, Saldanha, between May 2002 and February 2003, on our previous Earthwatch project . We will only know the number of individuals involved after we have sorted through the 1600 odd photographs taken, but at least one whale was recognized on more than one occasion, being a male that was satellite-tagged off Saldanha in September 2001, and in which the tag can still be clearly seen two years later (although missing its aerial).

Given the difficulties of comparing seasonal whale densities when search effort is not necessarily being allocated at random, the best indication of trends in availability probably come from observations made during the line of oceanographic stations. The numbers of groups and whales seen on each occasion are shown in Fig. 2, as well as polynomial regression lines fitted to the data. Both sets of data suggest that there might have been a peak in right whale abundance around early to mid November, but that there was a decline in numbers in late January – given the variability in the counts, however (and especially the relatively small searching effort in December), these conclusions should be taken with a hefty pinch of salt. Nevertheless, other observations (particularly the lack of whales in the last 10 days of fieldwork) would seem to confirm at least the fall-off in abundance in late January. Such a trend would also be in agreement with the observations from North Head, Saldanha, reported on last year, where the numbers of right whale sighted per hour of watch peaked in December and then declined to very low numbers in February.

Were these animals using the ground for feeding, as expected? Well, it was not always easy to determine exactly what the whales were doing, as so much of their behaviour took place at depth. True surface feeding was only seen once, so we had to look for other, indirect clues to decide when animals were (or had just been) feeding. One particular behavioural pattern (which we had seen only infrequently before) involved a rapid series of successive blows followed by a pronounced fluke-up and a prolonged dive: the location of the subsequent surfacing was unpredictable. Such animals were classified as “long-diving”, but we believe (from analogy with North Atlantic right whales) they were probably feeding at depth. Several such individuals were seen to rapidly open and close their mouth while at the surface between dives, an activity termed “baleen flushing”, or repeatedly raise and lower their head (“head-nodding”), both of which we took (from earlier work in the North Atlantic) as an indication of recent feeding: such behaviour was rarely if ever shown by animals in a SAG, for instance. Defecation occurred when animals were involved in a SAG, or milling, as well as in a possible feeding situation, so although the production of faeces must be a good indication that feeding has taken place in the recent past, we did not include it here as an indication of active feeding.

Overall, 23.5% of whales seen were categorized as feeding (Table 3), the second most frequent activity after being a member of a SAG (46.1%). The recorded incidence of feeding animals in September/October was much lower than later in the season, and no instances of baleen flushing, nodding or defecation were recorded before 4 November and 6 November respectively. In 2002/03, the first defecation in southern right whales off North Head, Saldanha Bay, was also only recorded on 11 November. It may be that right whales enter the ground somewhat in anticipation of prey availability, or that feeding initially is at a lower intensity (or possibly that we were still on a learning curve in being able to interpret their behaviour). If the data for September/October are omitted, the incidence of feeding animals rises to 30.3%, compared to 48.9% in SAGs. The validity of these proportions depends on how representative the sampling was, and it may well be that SAGs were inadvertently selected in preference to feeding groups, because of the greater ease of obtaining photo-identification data for them. Nevertheless, it is obvious that feeding is still a very important activity in the St Helena Bay region.

The one skim-feeding animal provided us with an excellent opportunity to study the movements of a right whale while feeding. By staying behind the whale and taking periodic GPS locations we were able to approximate its track (Fig. 3). For most of the

time it swam up and down a conspicuous brown slick, presumably corresponding to a patch of zooplankton. During the 1 h 26 min of tracking, the animal swam a total distance of 6.173 km, at an average speed of 4.31 km/hr (or about 2.3 knots). This distance is probably an underestimate, because when the whale turned we often cut corners to save time: this means the average speed may be too low. On the other hand we do not know if the presence of the boat was affecting the animal's behaviour in any way. The whale was feeding when first located (at 12h11), and continued feeding during the time we were attempting photoidentification and plankton sampling and before we started tracking. Feeding probably ceased around 14h18, when the animal partially exposed its flukes before submerging; over the next 17 mins it breached three times, defecated and undertook conspicuous baleen flushing. This means that the feeding bout lasted at least 2 h 07 min, and at its average speed the animal probably covered 9.12 km in the process.

The occurrence of SAGs in the area was not unexpected, given their year-round incidence in the North Atlantic (although they are rarely encountered in the Antarctic in summer). SAGs ranged in size from 2 to 13, with a mean of 4.7 animals, or almost identical to the average number seen in mid-winter. Such groups seemed to be indulging in courtship behaviour, and full intromission was graphically seen above the water surface in one such group! As this behaviour is taking place at quite the wrong season to achieve conception (at least according to the conventional wisdom about the process of gestation in right whales), its function remains obscure. One is tempted to speculate that it is largely recreational (as proposed for some of the higher primates, including man), and it certainly seemed to be entertaining for the large numbers of seals that often put in an appearance!

One of the more important aspects of the project is to place the feeding of southern right whales in some oceanographic context, especially as regards the availability of suitable right whale prey. At the same time, carrying out oceanographic work, including sampling zooplankton, from such a small boat is especially challenging. The line of stations was just about the right number and spacing for completion within the best weather part of a single day, and its positioning seemed to include most of the high whale density areas (and so was probably sampling the main axis of the feeding ground). Unfortunately, owing to an error in entering the waypoint coordinates, station 3 was incorrectly positioned, being somewhat to the north of the intended line. This error was quickly discovered, but to maintain comparability (at least over the first field season), it was not corrected. This meant that the stations bypassed North Blinder instead of crossing it – as this feature was frequently identified as a "hot spot" for whales by local fishermen, its omission was unfortunate. Once properly installed, the hand winch proved perfectly adequate for deploying and recovering the CTD, while with some effort expenditure on the part of the operator, recovery rates of the plankton net at 0.8 m/sec could be routinely achieved; this is close to the speed recommended for minimizing escapement for larger copepods. The net closing mechanism usually worked well, but the flowmeter readings often stretched credulity. In an act of extreme stupidity on the part of the PI, the N50/300 net plus flowmeter was lost on the scheduled last line of stations, and was replaced with the standby N50/80 net, but without flowmeter. This system will have to be replaced by next season.

The value of the plankton samples collected can only be judged once they have been sorted, but qualitatively they seemed to contain substantial numbers of large copepods,

and so may be adequate for assessing the availability of prey species for right whales and their relative position in the water column.

Given the difficulties in physically identifying copepod species once they have passed through a right whale's gut, our intention is to try and use DNA residues in the faeces to produce a more accurate picture of the species composition of right whale food (as has been pioneered in Australia for blue whales). The number of faecal samples collected this year (5) was disappointingly low, but samples from earlier west coast work are available. A suitable student, preferably with a strong stomach, will have to be found for this work.

Biopsies were obtained from 21 humpback whales, or 87.5 % of the whales intercepted by boat. These (plus the 106 collected from 2001 to 2003) should provide a good indication of the gender composition of the humpback whales in the area, and should be sufficient to address questions of genetic relatedness with whales from the east coast of South Africa. Nearly 200 black-and-white frames were exposed for photo-identification, and it will be interesting to see how many of the humpback whales have been seen in the area before, as earlier sightings suggested that there may be a relatively small (sub) population that habitually visits the coastal waters of the Western Cape, possibly attracted by the local productivity. Faecal samples were collected from two of the groups in 2003/4.

Future plans

Fieldwork is planned to resume in September 2004, and to run through till January 2005. Partial funding has been received from the National Research Foundation, South Africa. The protocol for the fieldwork will remain much as in 2003/04, but it is our intention to include some telemetry studies, for which equipment is currently being purchased. The telemetry will consist of two main components. The first involves tracking distribution and movements using VHF capsule tags embedded in the blubber and monitored from shore-based receivers with automatic data-logging: the tags will probably be deployed early in the season to maximize information about bay usage. The second component involves tracking dive depth profiles of feeding animals using a multi-sensor telemetry tag that is attached to the whale by a suction cup, the data being received onboard in near real-time, so that the plankton net can be sent to the correct depth to sample the food. This tag will be deployed periodically throughout the season when a suitable opportunity presents itself. The number of these tags that can be deployed will depend largely on how much support the project can attract from Earthwatch and other funding agencies.

Acknowledgements

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I am also extremely grateful to Marine and Coastal Management for their loan of valuable oceanographic equipment, without which our plans to sample the environment would have been in vain: André du Randt's contribution here must be specifically mentioned. And lastly, an enormous debt is owed to the voluntary observers Lieve Van Mechelen, Carmen Dobberstein, Gillian Bradshaw, Heidi van der Meij, Susan Rhodes and Tamryn Manzoni, who willingly gave up a minimum of two weeks of their time to assist us with observations whenever needed.

Cooperating institutions

A permit to disturb whales and dolphins for the purposes of photography, tagging or biopsy sampling was granted to the PI by the Minister of Environment Affairs and Tourism, South Africa, in terms of the Marine Living Resources Act, 1998. Permission to occupy accommodation at Malgaskop, Saldanha, was provided by the Military Academy, University of Stellenbosch, and access to the Naval harbour at Saldanha was granted by the Officer in Charge, SAS Saldanha. Academic support at the Military Academy was provided by the Dean, Prof J. Malan. Oceanographic equipment and advice was provided by Marine and Coastal Management, Department of Environment Affairs and Tourism (see above).

Other funding sources

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Personnel

Peter B. Best	Mammal Research Institute, University of Pretoria	Principal Investigator
Meredith Thornton	" "	Research assistant
Laura Beskers		Independent student
Simon Elwen	MRI	Student
Desray Reeb	" "	Post-doctoral fellow
Jaco Barendse	" "	Student
Susannah Gordon	Earthwatch Team I	
Kim Hart	" Team III	

Table 1 – Monthly research effort, St Helena Bay, 2003/4

Month	Days in field	Days at sea	Engine hrs	Hrs with whales	No. of frames exposed	# stations	Biopsies (shots – samples
Sept	2	2	13.26	6.55	172	0	5 - 3
Oct	23	11	68.51	14.67	397	10	10 - 6
Nov	20	12	80.04	26.27	741	14	5 - 4
Dec	12	5	26.25	3.47	139	5	0
Jan	19	9	53.15	15.4	380	13	11 - 8
Total	76	39	241.21	66.36	1829	42*	31 - 21

* 6 next to feeding right whales

Table 2 – Cetaceans seen per month, St Helena Bay 2003/4

Month	Cetaceans seen (groups – individuals)					
	Right whale	Humpback whale	Bryde's/ minke whale	Unid. whale	Heaviside's dolphin	Dusky dolphin
Sept	9-26	1-3				1-5
Oct	41-81	5-10	1-1	3-4	31-91	6-30
Nov	80-187	4-6		7-7	29-82	6-57
Dec	12-32	1-2		7-9	27-54	2-9
Jan	28-62	5-10		3-3	11-24	4-45
Total	170-388	16-31	1-1	20-23	98-251	19-146

Table 3 – Right whale behaviour, St Helena Bay 2003/4

Month	No. of whales obs.	% travelling / evasive	% milling/ playing/ logging	% SAGs	% feeding/ long-diving	No. baleen flushing, nodding	No. of defecations
Sept/Oct	72	29.2	30.6	37.5	2.8	0	0
Nov	151	2.6	11.9	49.0	36.4	7	4
Dec/Jan	70	18.6	15.7	48.6	17.1	6	4
Total	293	38	51	135	69	13	8

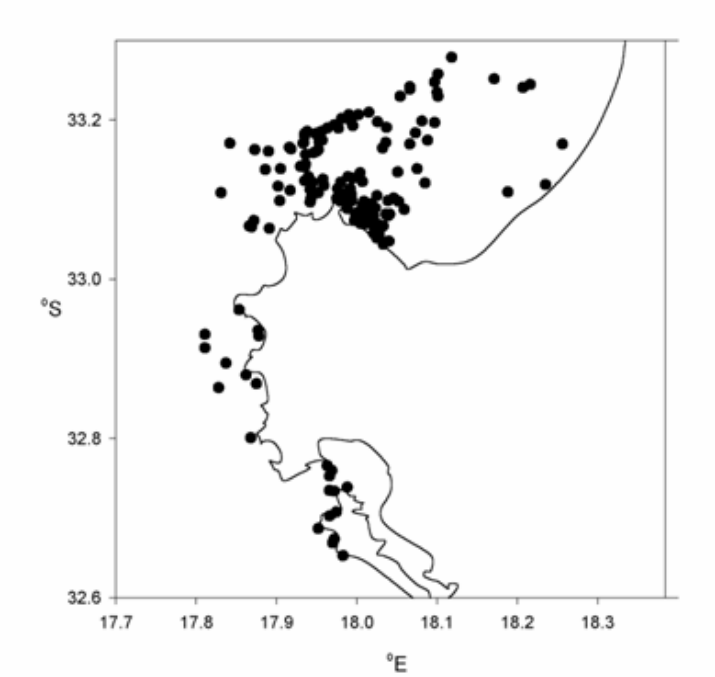

Fig. 1 – Locations of all right whale sightings, St Helena Bay, 2003/04

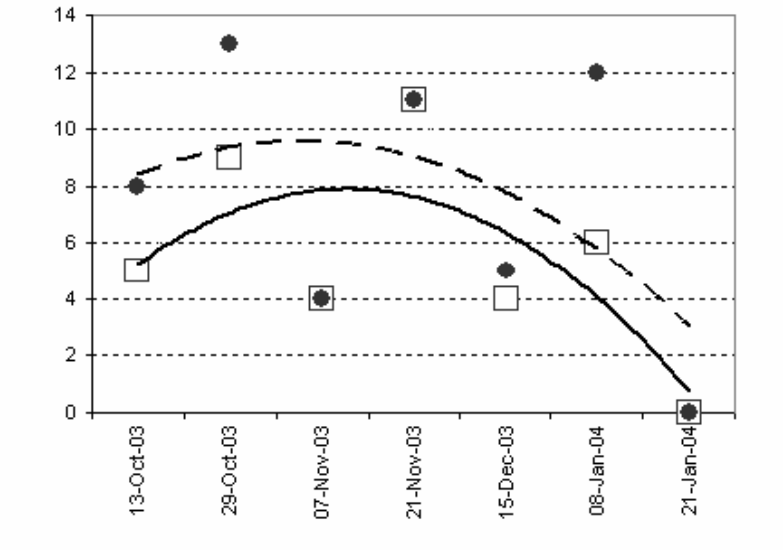

Fig. 2 – Numbers of right whale sightings made on line of oceanographic stations, St Helena Bay, 2003/04 (squares and solid line = groups, circles and broken line = whales)

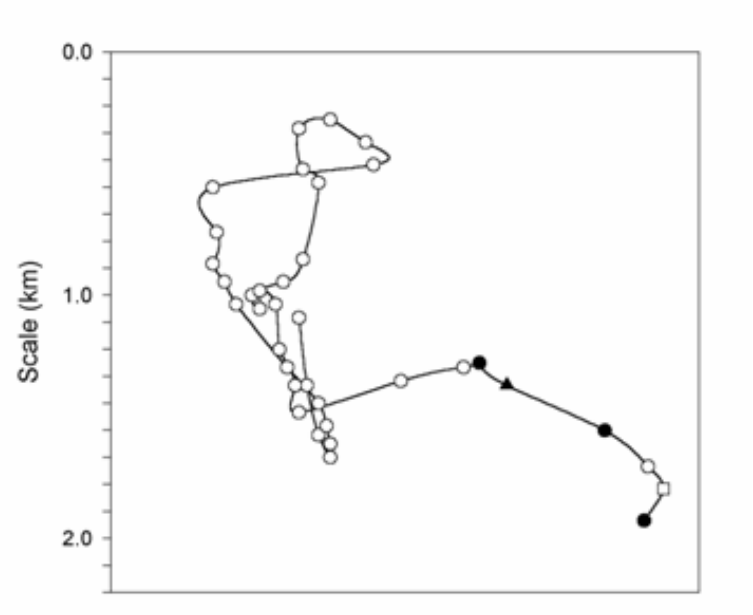

Fig. 2 – Track of boat following skim-feeding right whale, 13h09 – 14h35, 19 Jan 2004 (solid circles = breaches, triangle = defecation, square = baleen flushing)