

# Preliminary results of photographic matching of humpback whales *Megaptera novaeangliae* between Breeding Stock B - Antarctic Feeding Areas II/III, and sub-stocks B1 (Gabon) - B2 (West South Africa)

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## INTRODUCTION

At the 61st meeting held in Madeira, Portugal in 2009, the IWC Scientific Committee (SC) identified as high priority the need to review all extant information on Breeding Stock B (BSB) of humpback whales *Megaptera novaeangliae*, in order to aid the completion of the Comprehensive Assessment of this stock (IWC 2009). The available data should be used to analyse levels of interchange and mixing, and to identify possible migratory links between BSB and Southern Ocean feeding grounds. Furthermore, it should help to clarify whether the distinction between the sub-stocks B2 (West South Africa) and B1 (Gabon) carries any weight. Priority items identified to achieve these objectives included: 1) a photographic match between B1/2 - Antarctic Areas II (60°W-0°) and III (0°-70°E); and 2) between B2 - B1. No such comparisons had been made previously; however, microsatellite matches have been recorded between the B1 and B2 sub-stocks (Carvalho et al. 2009), as well as between B1/B2 and the Antarctic (IWC 2009, Loo et al. 2009). The results from photographic matching between B1-B2, and B1/2-Antarctic Areas II and III are reported here.

## METHODS

### Photographic databases

#### West South Africa

A Microsoft Access 2003 database was compiled for West South Africa (SA), linked to electronic images of each individually photographed whale. The database incorporated all known sightings where photographs of tail flukes (TF) and/or left and right dorsal fins (LDF/RDF) were taken from 1983 to 2008, in the area west of Cape Agulhas between about 29° - 34° S. The structure of the database was based on a template developed by P.J. Ersts, S. Cerchio, T. Collins and others, as part of an ongoing regional Atlantic/Indian Ocean collaboration effort. The original images ('raw') were scanned from film at a resolution of 600 dpi, and dimensions 9.843 cm (w) by 6.35 cm (h) and cropped to maximise the coverage of the area of interest (i.e. tail fluke or dorsal fin). Scanned images were saved as files with a TIF-extension. A similar protocol was applied to high resolution digital photographs, though the raw image format (.jpg) was retained. The database displays a thumbnail (.jpg) of the raw image at reduced resolution (100dpi) however; a medium resolution (200dpi) copy or the raw image may be viewed if required, by clicking a link in the database. Each image was individually assessed for photo quality, orientation of subject, and individual distinctiveness and a score based on a 5-point scale assigned to each category (1 = not useable, 2 = poor, 3 = fair, 4 = good, and 5 = excellent). Images of which the photo quality or orientation were classified as 'not useable' were excluded from the matching procedure.

Each TF image was further classified according to its ventral pigmentation pattern (or type), on a scale from 1-5, where 1 is all white (with no central bar) and 5 is all black. (see Rosenbaum et al. 1995). Flukes were further rated for the part visible above water, viz. whole, left fluke only, right fluke only, and trailing/leading edge. An additional classification type "0" was introduced for TF where it was impossible to assign types 1-5, either due to the unfavourable orientation or partial obscuration of the subject (i.e. partial flukes, dorsal flukes or

trailing/leading edges), or where the tail flukes were severely scarred or mutilated due to injury (e.g. killer whale bites).

Within and between-year matching was carried out for each feature separately and a unique individual identification number (Catalogue ID) assigned to each identified individual. Although the best photographs were tagged as ‘representative’ for each Catalogue ID, some individuals may have multiple images of different features available in the database.

### *Gabon*

The Gabon database was based on the same template as for West SA. For a full description of the database, the area of collection, and matching procedures used see Collins *et al.* SC/62/SH11.

### *Antarctica*

The Antarctic Humpback Whale Catalogue (AHWC) is a compilation of photographs (TF, LDF and RDF), taken by miscellaneous contributors, both by scientists and non-scientists. The images originate from regions throughout the southern hemisphere, and the overall aim of the AHWC is to investigating movements of humpback whales between the Southern Ocean and lower latitude waters through an internationally collaborative project (Allen *et al.* 2008). It is currently maintained by the College of the Atlantic. The images are organised by pigment type, ranging from type 1 (primarily white) through type 5 (primarily black). The catalogue has recently been uploaded into the web-based photo-sharing platform *Flickr*<sup>®</sup> (<http://www.flickr.com/ahwc>). The photostream can be viewed as a whole, as subsets, or by using the search tool to select any combination of tags or text, such as TF types or locality of picture (e.g. Area II). The type 0 is not used in the AHWC.

### **Matching protocol**

Only tail flukes were used for matching between catalogues. All matching was done on 15-19” TFT computer screens. Thumbnail images were viewed for the initial comparison, but when required medium format and raw images were examined to aid in the final decision making. All matches were checked and confirmed by a second person.

For the West SA/Gabon comparison, the two regional databases were merged into an inter-regional catalogue format used previously (e.g. Minton *et al.* 2009). Matching efforts were reciprocal, with two matchers (Barendse and Collins) conducting independent matches between catalogues. Starting with TF of type 1, all images belonging to this type from one catalogue were compared to all type 1’s from the other. Furthermore, where applicable and in keeping with matching protocols elsewhere, TF were also compared to all images from the preceding and following types; For example, type 2 TF from West SA were compared to types 1, 2, and 3 from Gabon. Type 0 flukes were compared to all available images from all other types.

The comparison if West SA and Gabon with the AHWC followed more or less the same procedure, except that the latter was viewed on the AHWC’s *Flickr*<sup>®</sup> page. Using the search function, images were selected by fluke type and area (only area II and III were compared); for example, ‘T1 area III’ would display all images of type 1 from Area III. Images on the webpage were viewed at ‘medium’ size, and compared to thumbnail images in the West SA and Gabon databases. Larger versions of images were viewed were necessary. Again, the comparison of different types was bracketed as above, to avoid mismatches due to the variable assignment of TF types.

## **RESULTS**

### **Collection effort**

Months where pictures were taken by region (Table 2).

### **Photographic databases**

The final West SA catalogue contained a total of 1, 820 images: 510 pictures of TF, 616 of LDF, and 694 of RDF. After within and between-year matching had been completed, and excluding ‘not useable’ images, a total of 154 individuals were identified by TF. The Gabon catalogue contained a total of 9, 776 TF images, belonging to 1,297 individuals. In the AHWC there were 186 TF images from Areas II and III, representing 130 individual humpback whales out of a total of over 3,400 (Table 1).

A breakdown of TF types per catalogue (Figure 1) shows type 1 (predominantly white) to be the most, and type 5 the least commonly pigmentation pattern encountered. For West SA and Gabon type 3 was the second most encountered, while types 2 and 4 were more or less equally common. In the AHWC (Areas II/III) tail flukes

were distributed almost equally among types 2, 3, 4. It should be noted that there may be slight variations in the assignment of fluke types between different catalogues, especially the AHC. In this catalogue, the type 1 TF have been divided into six subtypes, viz. T1s, T1a, T1u, T1m, T1w and T1other. This classification scheme was not used for the West SA and Gabon catalogues. There is considerable overlap in the classification of types 1 and 2.

### Matching

The comparison between B1 and B2 catalogues yielded three matches, while two matches were found between the B2 catalogue and the AHC (Table 3). Three of the West SA animals (ZAW-096, ZAW-213 and ZAW-292) were also resighted in different years in the region (Table 4).

## DISCUSSION AND CONCLUSIONS

Matches were made between the catalogues of West SA and the AHC (n=2) and West SA and Gabon (n=3) based on ID-photos of tail flukes.

Unfortunately, an examination of the date and position of the ‘Antarctic’ matches showed that both these sightings took place on the first day of the SOWER cruise that departed on 22 December 2005 from Cape Town, and were accidentally tagged as being from Area III. Both were males (determined from biopsies collected off West SA), and the one animal ZAW-290 was seen less than a month before in St Helena Bay, some 150km north of the ‘Antarctic’ sighting. The second resighted animal was first seen in December 2004, escorting a cow-calf pair, and was identified as a possible yearling calf. On the second occasion on 22 November 2006 it was seen with a different female, and several defecations were observed. The re-sighting off Cape Town confirms that it returned to the area in December 2005. No matches were made between Gabon and Antarctic Areas II and III. This may reflect the smaller size of the AHC and the variable quality of images in both catalogues. It may also be indicative of a recognised problem with whales sighted in all of these areas, namely a low fluking rate. This is a known concern for current estimates of abundance and may factor in low rates of matching here. This is also highlighted by the higher matching rate for genotypic data (SC/62/SH8).

The three matches between B1 and B2 independently confirm what has been previously shown by genotypic matches (SC/62/SH8), that there is movement of individual whales between sub-stocks B1 and B2. Of particular interest is that all resighted whales were seen off West South Africa during late spring (November) and summer months (December, January, February). There is evidence that some humpback whales make use of this area as a feeding ground during these months (Barendse *et al.* in press). Of further interest is the timing of resightings of ZAW-096 (a male) during 2002/2003. It was seen on 6 August 2002 off Gabon, then 94 days later (on 2 November) off Saldanha Bay, where it apparently remained for a period of over two months to be resighted on 14 January 2003. On 16 December 2001 the same individual was seen in a group that defecated, and on 7 November 2006 it approached the research boat during a plankton haul in St Helena Bay.

It is clear that in the light of more recent information, particularly the match of an individual between A and C3 (SC/62/27) there should be more routine and wider consideration of images within the AHC, including those from areas currently deemed unlikely to yield matches.

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**TABLES****Table 1. Number of tail fluke (TF) images and number of individually identified whales per regional catalogue**

Catalogue and region	Total no. of TF images	Total no. of individual whales
West South Africa	510	149
Gabon	9,776	1,297
AHWC Area II	23	19
AHWC Area III	163	111

**Table 2. Data availability/photographic effort by region and year (Key: WZA = West South Africa, Gab = Gabon all sites, x indicates boat working but no photographs available) (see Barendse et al. SC-62-SH2 for full details of WZA effort)**

Region and year	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
1983-1997	WZA	WZA	WZA	WZA	WZA			WZA	WZA	WZA	WZA	
1999		WZA	WZA								WZA	
2000	x	WZA	WZA	X			Gab	Gab				
2001	x	x	WZA	WZA			Gab/ WZA	Gab/ WZA	Gab/ WZA	WZA	WZA	WZA
2002					WZA	WZA	Gab/ WZA	Gab/ WZA	Gab/ WZA	WZA	WZA	WZA
2003	WZA	WZA					Gab	Gab	Gab/ WZA	Gab/ WZA	Gab/ WZA	x
2004	WZA							Gab	Gab/ WZA	Gab/ WZA	WZA	WZA
2005	WZA	WZA					Gab	Gab	Gab/ WZA	Gab/ WZA	WZA	
2006							Gab	Gab	Gab/ x	Gab/ WZA	WZA	WZA
2007	x	x									WZA	WZA
2008		WZA										

**Table 3. Photographic matches between West SA and Gabon, and West SA and Antarctic Area III**

West SA Catalogue ID	Date/s photographed in region	Photo Copyright	Other Catalogue ID	Date of photograph in region	Photo Copyright
Gabon					
ZAW-213	2003/01/13; 2003/01/14; 2008/02/05	MRI Whale Unit	TF-Gab-03-124	2003/09/04	WCS/AMNH
ZAW-253	2004/11/08	MRI Whale Unit	TF-Gab-04-045	2004/09/26	WCS/AMNH
ZAW-096	2001/12/16; 2002/11/02; 2003/01/14; 2006/11/07	MRI Whale Unit	TF-Gab-02-299	2002/08/06	WCS/AMNH
AHWC					
ZAW-290	2005/11/24	MRI Whale Unit	ahwc3054	2005/12/22	IWC
ZAW-292	2004/12/01; 2006/11/22	MRI Whale Unit	ahwc3055	2005/12/22	IWC

**Table 4. Sighting histories and spatial distribution of whales from West SA matched to Gabon and Antarctic Area III (\* = resightings on the same day, \*\* = duplicate samples of same individual)**

Catalogue ID	Date*	Lat (W)	Long (S)	Group size	Biopsy collected	Sex determined**
ZAW-096	2001/12/16	33.02067	17.86033	2		
ZAW-096	2002/11/02	33.00483	17.8485	2	MNW99	M
ZAW-096	2003/01/14*	33.03133	17.82533	3		
ZAW-096	2003/01/14*	33.03067	17.87683	2		
ZAW-096	2006/11/07	32.674	17.93467	1		
ZAW-213	2003/01/13*	33.01283	17.77417	2	MNW117	F
ZAW-213	2003/01/13*	33.06383	17.83483	2		
ZAW-213	2003/01/14	32.70183	17.99017	3		
ZAW-213	2008/02/05	33.03017	17.8745	3		
ZAW-253	2004/11/08	32.66483	17.98767	2	MNW164	F
ZAW-290	2005/11/24	32.55117	18.02633	3	MNW204	M
ZAW-292	2004/12/01	32.703	17.88767	3	MNW172	M**
ZAW-292	2006/11/22	32.97283	17.8555	2	MNW217	M**

**Figures**

**Figure 1: Proportional contribution of different types of tail flukes to regional photo-ID catalogues based on ventral pigmentation patterns (Key: T0=indeterminate, T1=all white, T5=all black).**

