

PHOTO-IDENTIFICATION OF HUMPBACK WHALES, *MEGAPTERA NOVAEANGLIAE*, OFF THE ANTARCTIC PENINSULA: 1997/98 TO 1999/2000

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During three summer seasons (1997/98-1999/00), photographic sampling of humpback whales was conducted by Projeto Baleia/Brazilian Antarctic Programme in waters of the Antarctic Peninsula. Whales photographed totalled: 63 (1997/1998), 70 (1998/1999) and 21 (1999/2000). Of these, 74.6% (n = 47), 87.1% (n = 61) and 100% (n = 21), respectively, were represented by photographs categorised as quality 1 (excellent) or 2 (moderate). Inter-annual comparisons showed two matches: a whale photographed on 27 January 1998 in the Gerlache Strait was resighted on 11 January 1999 in the same region; the second on 3 February 1998 in the Gerlache Strait was resighted on 25 January 1999 at almost the same coordinates. These matches indicate that humpback whales may show fidelity to feeding grounds off the Antarctic Peninsula. Intra-annual comparisons showed two matches: a whale photographed on 22 January 1998 close to the King George Island and another on 27 January 1998 in the Bismarck Strait were resighted together on 7 March 1998 in the Gerlache Strait. Average indices of fluke colouration obtained for 1997/1998 and 1998/1999 were 2.39 (n = 44) and 2.60 (n = 53), respectively. Total average index, including photographs from the three periods, resulted in 2.54 (n = 116). All values are significantly different from those obtained by Rosenbaum et al. (1995) for western and eastern Australia (p < 0.001) and similar to that found for Colombia (p > 0.05) (non-parametric test of Kolmogorov-Smirnov). These results reinforce the view that humpback whales feeding in the western side of the Antarctic Peninsula probably originate from eastern South Pacific breeding grounds. □ *Humpback whale, photo-identification, fluke pigmentation patterns, Antarctic Peninsula.*

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Katona et al. (1979), Whitehead et al. (1980) and Katona & Whitehead (1981) pioneered photo-identification studies based on variation in ventral fluke pigmentation of humpback whales, *Megaptera novaeangliae*. Since then, photo-ID techniques have provided information on many aspects of life history, abundance, distribution, movements and migratory patterns of humpback whales worldwide (e.g. Whitehead et al., 1983; Baker et al., 1986; Clapham & Mayo, 1987; Calambokidis et al., 1990; Katona & Beard, 1990; Kaufman et al., 1990; Perry et al., 1990; Kinas & Bethlem, 1998; Smith et al., 1999; Steiger & Calambokidis, 2000).

Recent studies in molecular biology (e.g. Baker et al., 1994; Valsecchi et al., 1997) and pigmentation patterns/photo-ID (e.g. Rosenbaum et al., 1995; Stone et al., 1990) have not determined stock discreteness of Southern Hemisphere humpback whales. Catalogue comparisons from breeding and feeding grounds showed no matches between whales in the Brazilian wintering ground (n = 80) and the Antarctic Peninsula (n = 233) (Muñoz et al., 1998), although significantly more humpback whales have since been photo-identified in the Brazilian area (~475: Bethlem, 1998).

The Projeto Baleia, part of the Brazilian Antarctic Programme (PROANTAR), has carried out

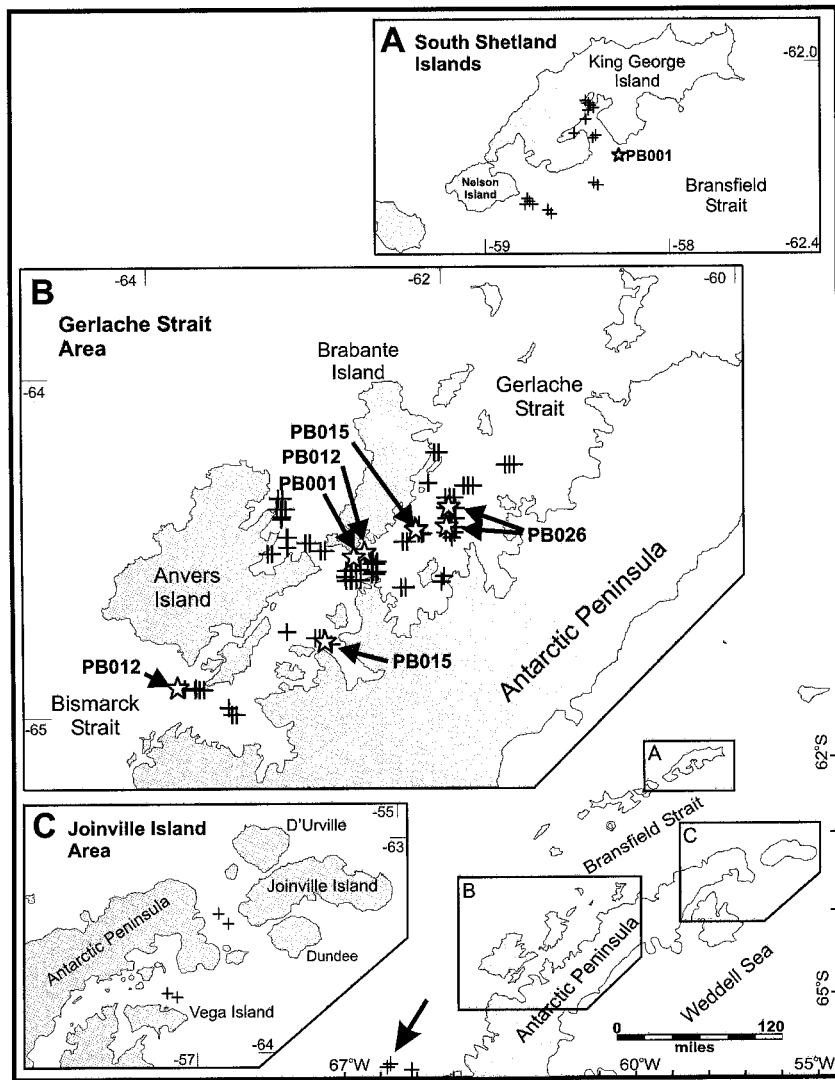


FIG. 1. Study area off the Antarctic Peninsula. The points indicate sighting positions of humpback whales photo-identified from 1997/1998 to 1999/2000.

photo-ID recording and genetic biopsy sampling of humpback whales for genetic and pollution analyses, and cetacean density estimates in the Antarctic Peninsula region to improve knowledge of Southern Hemisphere cetacean stocks.

In this preliminary study, we make inter- and intra-annual comparisons and calculate average colouration indices of humpback whales photo-identified in the Antarctic Peninsula region.

MATERIAL AND METHODS

FIELD WORK. During three summer seasons (1997/1998-1999/2000), ship surveys for biopsy and photo-ID of humpback whales and for cetacean density estimates were conducted from the 75m Oceanographic and Supply Ship (NApOc) 'Ary

Rongel', in waters off the Antarctic Peninsula (IWC areas I and II) (Fig. 1). The main survey sites were the Gerlache Strait and the South Shetland Islands. Data were mostly collected on a time-opportunity basis according to the PROANTAR's schedule, however dedicated surveys were performed in the Gerlache Strait, where they were divided between biopsy/ photo-ID and density estimate studies.

Searches were made from the exterior wing bridges, approximately 14m above sea level, unless weather conditions forced the observers to watch from the bridge. When time and weather conditions were favourable, a small inflatable boat was launched to approach and photo-identify humpback whales. Otherwise, photo-ID was performed from the wing bridges and the bow of the ship, when approaches were possible.

Usually three scientists manned the inflatable; one responsible for photographing, another for biopsy sampling or photographing, and the third for recording data and assisting with films and biopsy samples. Each whale was photographed recording the

underside of the fluke and both sides of the dorsal fin, wherever possible. Photographs were taken with 35mm SLR cameras equipped with 75-300mm zoom or 300mm telephoto lenses. Preference was given to colour print films ISO 200 and 400, usually the latter for its performance under most light conditions. Slide films ISO 100-400, black-and-white T-Max 400 (pushed or not) and colour print films ISO 100 were occasionally used.

Data recorded during photo-ID included: sighting date, time, coordinates (recorded on the ship's GPS), pod size, calf presence, photographer, films, frames taken, corresponding biopsy numbers when available, and any additional relevant observations. Conspicuous

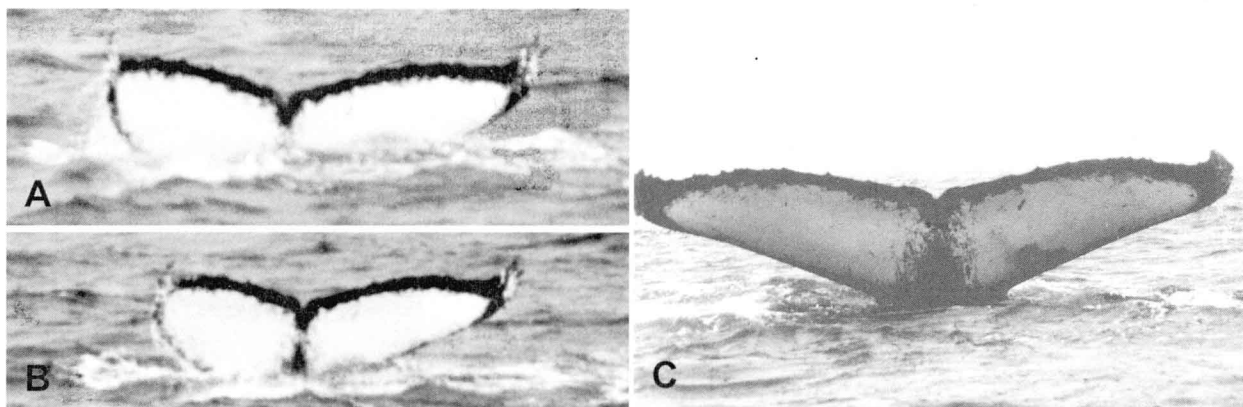


FIG. 2. Ventral fluke photographs of whale PB015 taken on 27 January 1998 (A & B) and 11 January 1999 (C) in the Gerlache Strait, Antarctic Peninsula.

natural markings, especially on the flukes and dorsal fins, were drawn on a datasheet for field reference.

ANALYSIS OF FLUKE PHOTOGRAPHS. Each photographed whale received a reference code based on the order of observation in a season (e.g. OA16/PB01). The best available fluke photograph of each individual on each observation was analysed and rated from 1 to 3 according to photo quality and recognition quality, following Mizroch et al. (1990): 1 (excellent), 2 (moderate), 3 (poor). Complementary photographs were considered for fluke information when necessary. Whales identified by photographs rated 1 or 2 in photo quality were included in the main catalogue and received an overall identification code (e.g. PB001).

Photographs (10 × 15 cm print size) were organised by summer season according to decreasing amounts of white pigmentation on the underside of the flukes and compared serially with the entire data set. Inter-annual comparisons examined evidence of site fidelity to the feeding grounds around the Antarctic Peninsula, while intra-annual comparisons examined time of residency and movements of humpback whales in the area during feeding seasons.

To examine the identity of the humpback whales stock using the area, average indices of fluke colouration were calculated according to Rosenbaum et al. (1995) and compared to indices available from Southern Hemisphere breeding grounds, using the non-parametric test of Kolmogorov-Smirnov (Zar, 1996). Photographs of quality 1 and 2 from whales photographed on the western side of the Antarctic Peninsula were assigned rank values on a scale of 1 (white) to 5 (black) based on the proportion of pigmentation

present on the underside of the flukes (see also Carlson et al., 1990). These scores were multiplied by the frequency of animals in each class to obtain the average index.

RESULTS AND DISCUSSION

Season totals of humpback whales photographed were: 63 (1997/1998), 70 (1998/1999) and 21 (1999/2000), of which 74.6% ($n = 47$), 87.1% ($n = 61$) and 100% ($n = 21$), respectively, were represented by photographs categorised as quality 1 or 2. From this set of photographs ($n = 127$ whales, considering $n = 2$ resights), 81.1% of the identified whales were classified as being of recognition quality 1 or 2, based on pigmentation patterns. Of these, 73.2% ($n = 93$) were photographed in the Gerlache Strait and surrounding areas. Most poor quality photographs ($n = 25$) were taken from the ship (76%) and were usually related to low definition due to distance, however, some showed enough information to be included in the comparisons.

Sighting positions of photo-identified humpback whales are plotted in Fig. 1, excluding one animal photographed southeast of the South Orkney Islands.

INTER-ANNUAL COMPARISONS. Two identified humpback whales were sighted in more than one season. One (PB015) was first sighted on 27 January 1998 in the Gerlache Strait ($64^{\circ}27'S$, $62^{\circ}10'W$) and again on 11 January 1999 in the same region ($64^{\circ}47'S$, $62^{\circ}45'W$) (Fig. 2A-C); the second (PB026) on 3 February 1998 in the Gerlache Strait (ca. $64^{\circ}23'S$, $61^{\circ}56'W$) and again on 25 January 1999, almost at the same coordinates ($64^{\circ}26.4'S$, $61^{\circ}55.8'W$) (Fig. 3A-B). These matches indicate that animals may show temporal fidelity to particular feeding

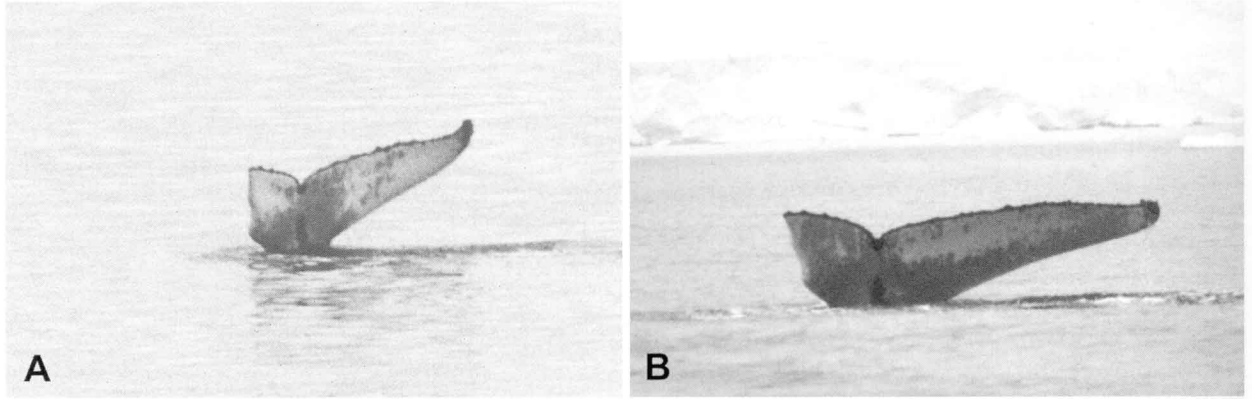


FIG. 3. Ventral fluke photographs of whale PB026 taken on 3 February 1998 (A) and 25 January 1999 (B) in the Gerlache Strait, Antarctic Peninsula.

grounds of the Antarctic Peninsula region, however a continued effort is required for verification. Five to six distinct feeding areas have been suggested for Antarctic waters (Mackintosh, 1942; Dawbin, 1966), although tag recoveries indicate some interchange among them (Dawbin, 1966).

Compiling data from long-term photo-ID studies, Katona & Beard (1990) have observed separate feeding aggregations in the western North Atlantic, and that individual whales returned annually to a particular feeding region. In the North Pacific, humpback whales also appear to form geographically isolated feeding herds (Perry et al., 1990), with little movement among feeding regions across years (Baker et al., 1986).

INTRA-ANNUAL COMPARISONS. Two identified humpback whales were resighted in a season. One (PB001) was sighted on 22 January 1998 close to the King George Island (ca. $62^{\circ}12'S$, $58^{\circ}13'W$) (Fig. 4A-B), the second (PB012) on 27

January 1998 in the Bismarck Strait (ca. $64^{\circ}53'S$, $63^{\circ}45'W$), near the southern end of Gerlache Strait (Fig. 5A-B). These two whales were resighted together on 7 March 1998 in the Gerlache Strait ($64^{\circ}31'S$, $62^{\circ}31'W$). The whale PB012 was ~45 nautical miles from the previous sighting, indicating that individuals may remain in an area for some time during a given feeding season.

In Antarctic waters weather conditions change rapidly and humpback whales may prefer sheltered waters where sea conditions are less severe than in open waters. Dolphin (1987) reported that humpback whales would usually rest at the surface on feeding grounds. Montú et al. (1994) found high concentrations of krill in the Gerlache and Bransfield Straits. The Gerlache Strait is a protected area between Brabante and Amberes Islands and the Antarctic Peninsula, which might shelter and supply abundant food (krill, *Euphausia superba*) for the species.

Food abundance might be a factor of the ecological importance of the Gerlache Strait to

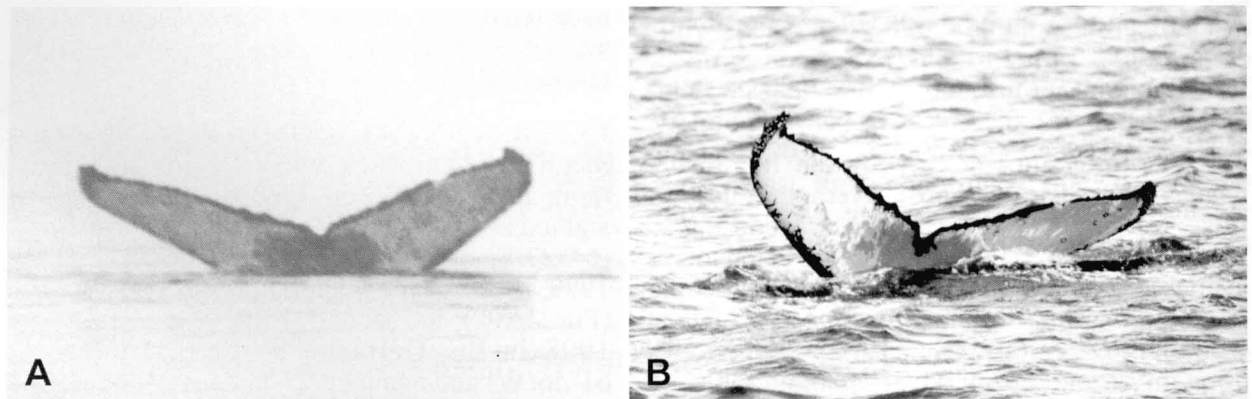


FIG. 4. Fluke photographs of animal PB001 taken on 22 January 1998 off the King George Island (A) and on 7 March 1998 in the Gerlache Strait (B), Antarctic Peninsula.

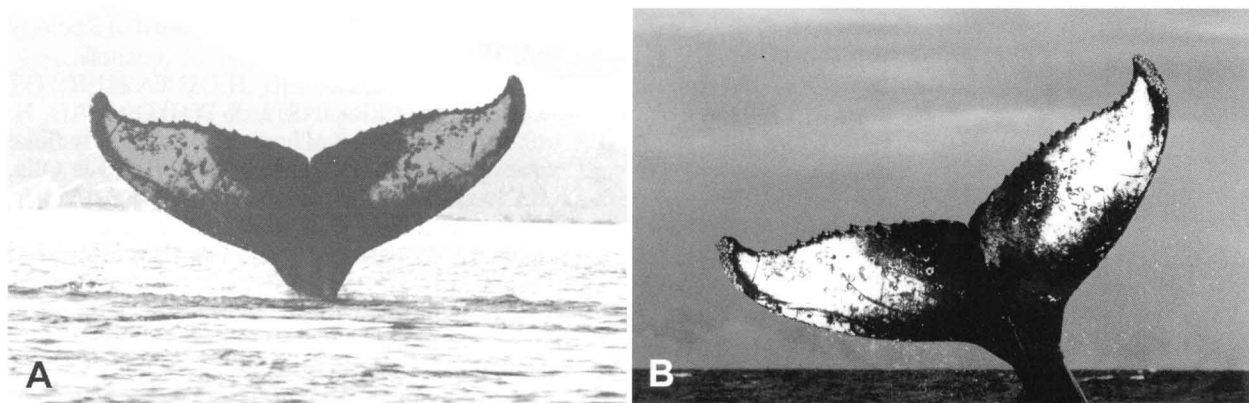


FIG. 5. Fluke photographs of animal PB012 taken on 27 January 1998 in the Bismarck Strait (A) and on 7 March 1998 in the Gerlache Strait (B), Antarctic Peninsula.

humpback whales, as evidenced by the high encounter rates (Secchi et al., 2001) and the resightings presented in this paper. Further studies are necessary to investigate local movements and seasonal residency in this area.

COLOURATION INDICES. Average indices of fluke colouration for the summers 1997/1998 and 1998/1999 were 2.39 ($n = 44$) and 2.60 ($n = 53$), respectively. Sample size for the summer 1999/2000 was considered too small to provide an individual index. Total average index of photographs over the three periods was 2.54 ($n = 116$) (Table 1). All values are significantly different from those obtained by Rosenbaum et al. (1995) for western and eastern Australia ($p < 0.001$) but similar to that for Colombia ($p > 0.05$) (Kolmogorov-Smirnov test). Although average indices of fluke colouration for the humpback whales breeding in the Abrolhos Bank, northeastern Brazil, were not available for comparison, these results support the view that humpback whales feeding in the western side of the Antarctic Peninsula probably originate from eastern South Pacific breeding grounds. Indeed, Muñoz et al. (1998) reported eight matches of individuals photo-identified off the Antarctic Peninsula and the northwest coast of South America.

Further photo-ID studies and comparison with other catalogues, especially from northeast Brazil, along with genetic studies would help to elucidate stock identity and migration patterns of humpback whales found in the study area. Considering the high cost and difficulties of working in the high latitudes of the Southern Ocean, combining the efforts of research groups is desirable to optimise results.

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TABLE 1. Average index of fluke colouration obtained in this study (1997/1998 - 1999/2000) compared to those available for Southern Hemisphere breeding grounds. * Source: Rosenbaum et al. (1995).

Area	Fluke colouration categories					Total (n)	Average Index
	1	2	3	4	5		
Western Antarctic Peninsula	32 (27.6%)	29 (25.0%)	26 (22.4%)	18 (15.5%)	11 (9.5%)	116	2.54
Eastern Australia*	186 (83.0%)	30 (13.4%)	6 (2.7%)	2 (0.9%)	0 (0%)	224	1.21
Western Australia*	167 (87.4%)	11 (5.8%)	6 (3.1%)	2 (1.1%)	5 (2.6%)	191	1.26
Colombia*	65 (36.1%)	41 (22.8%)	41 (22.8%)	19 (10.5%)	14 (7.8%)	180	2.31

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