Use of lateral body pigmentation patterns for photographic identification of East Australian (Area V) humpback whales

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Gregory D. Kaufman, Mari Ann Smultea, and Paul Forestell

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USE OF LATERAL BODY PIGMENTATION PATTERNS FOR PHOTOGRAPHIC IDENTIFICATION OF EAST AUSTRALIAN (AREA V) HUMPBACK WHALES

ABSTRACT

Humpback whales (Megaptera novaeangliae) were photographically identified during their northward and southward migration along east Australia (Area V) in 1984-85. The primary area of data collection off the east coast was North Stradbroke Island (27 S, 153 E), Queensland, with additional photographs collected in the nearshore waters northward to Townsville (19 S, 147 E). Humpbacks of the Area V group exhibit wide variation in lateral body pigmentation which may be used to identify individuals in addition to fluke patterns. Using photographs of fluke and lateral body pigmentation patterns, 210 east coast humpback whales have been individually identified. Twenty-five percent of these animals were identified on the basis of lateral body pigmentation alone. Eighteen (8.6%) animals have been resighted at least once, and two of these resighted twice, for a total of 20 resights. Because some whales, especially cows, calves, and subadults, do not present the ventral portion of their flukes as often as other whales when diving, the use of lateral body pigmentation patterns should increase the frequency of resights in Area V of the Southern Ocean.

The use of photographs has now become an accepted technique for identifying individuals within a number of cetacean species. Adult humpback fluke patterns in the North Atlantic appear to remain virtually unchanged over time for at least 15 years, persisting even after death (Katona et al. 1979, Perkins et al. 1985). Photographic identification techniques have since been instrumental in the analysis of population estimates and distribution, stock identification, migration patterns, social dynamics, and other ecological parameters important for effective species management of North Atlantic and North Pacific humpback whales (Whitehead 1982, Whitehead et al. 1983, Mayo et al. 1985, Darling & Jurasz 1983, Baker & Herman 1984, Darling & McSweeney 1985, Mobley & Herman 1985, Baker et al. 1986, Darling & Morowitz 1986).

One of the major difficulties in using fluke photographs to identify individual whales is that not all ages and classes of animals show their flukes with equal probability. Cows, calves, and subadults appear to present their flukes less often than other animals (Perkins et al. 1985, Reid 1985). Consequently, conclusions regarding the population dynamics or distribution patterns of humpback whales based exclusively on animals identified by fluke photographs might be biased. Identification techniques utilizing pigmentation features appearing with equal probability across all classes of animals should prove useful in alleviating these biases. To date the use of dorsal fin markings (Jurasz & Jurasz 1977, Mayo et al. 1985) and lip grooves (Glockner & Venus 1983) have provided alternatives to flukes as a means of identification. Each of these methods unfortunately has its own limitations. With the exception of damaged or highly anomalous dorsal fins, differences in dorsal fin shapes are extremely difficult to discriminate. The identification of animals using lip grooves requires, for the most part, close-up underwater photography.

Humpback whales which migrate along the west and east coasts of Australia are thought to comprise the Area IV (70 E-130 E) and Area V (130 E- 170 E) feeding stocks, respectively. While the Area IV whales frequent one main area off the west Australian coast during the winter breeding season, the Area V stock is known to fragment into apparent substocks to the east Australian coast and islands of the southwest Pacific (Dawbin 1956, 1959;

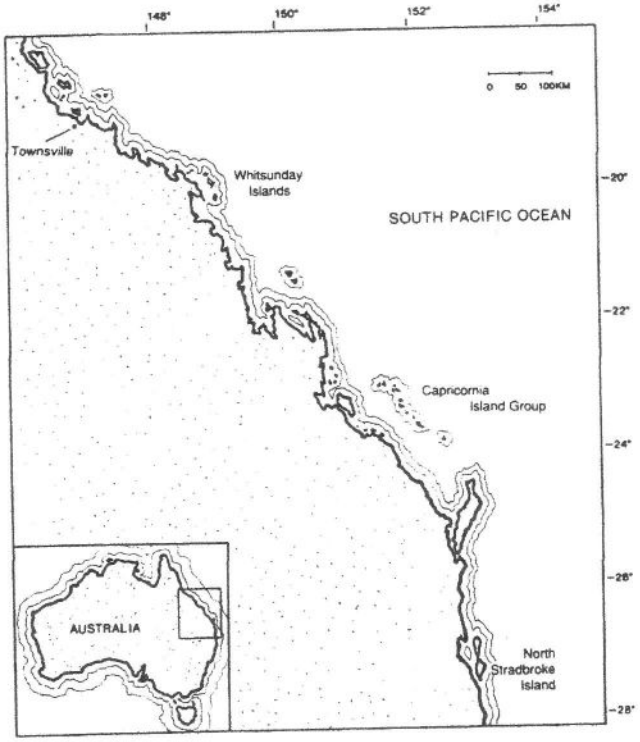
The authors are with the Pacific Whale Foundation, Kihei, Hawaii 96753.

Chittleborough 1959, 1960, 1965).

Attempts have been made in the past to verify the separation of feeding stocks by demonstrating differences in coloration pattern associated with specific groups. Upon examination of Southern Hemisphere humpback carcasses, Lillie (1915) divided ventral body pigmentation patterns into seven categories (four main and three intermediate), ranging from a high degree of white on the abdomen and sides to a predominantly black body. Similar pigmentation classifications were later applied to dead humpbacks in both the North and South Pacific (Matthews 1937, Omura 1953, Pike 1953, Nishiwaki 1959, Chittleborough 1965). Southern Hemisphere humpbacks were found to exhibit a greater degree of white coloration than those in the Northern Hemisphere.

In the Southern Hemisphere, however, there has been little attempt to identify live humpback whales using individual pigmentation pattern characteristics. There have been no attempts to obtain clear, close-up photographs of the flukes, dorsal fins, body scars, or other distinguishing characteristics of whales offshore of Australia. Bryden (1982) noted that migrating whales in the Area V subgroup off east Australia exposed minimal body area and rarely presented flukes. Additionally, most of the flukes seen were uniformly white and non-distinguishable. These observations led Bryden to conclude that Area V flukes were non-distinguishable and therefore individual whales not identifiable.

Figure 1. Study areas on the East Australian coast.



Research has been carried out by the Pacific Whale Foundation since 1984 to determine migratory characteristics of the Area V humpback whale stock, with shore- and water-based observations made primarily from Point Lookout on North Stradbroke Island (27 S, 153 E), Queensland. Additional data have been collected from the waters northward to Townsville (19 S, 147 E). This research represents the first effort to photographically identify individual humpback whales in Australia using body pigmentation characteristics. It also introduces a new method for identifying and verifying resights of individual humpback whales of all age and sex classes by photographing unique lateral body pigmentation patterns visible during surfacing behavior. Within two seasons of study, 210 individual animals, including adults, subadults, cows, and newborn calves, have been identified.

METHODS

Since 1984, research periods have been selected to coincide with the peak period of migration of Area V humpback whales past North Stradbroke Island, as well as in the vicinity of Townsville, the Whitsunday Islands, and Capricornia (Figure 1) (Townsend 1935, Chittleborough 1965). From North Stradbroke Island, shore- and water-based research was conducted from 13 June-29 July 1984 and 14 June-29 July 1985 during the northward migration; southward migration studies were undertaken from 21 September-18 October 1984 and 21 September-3 November 1985. Identification photographs were also collected near Tangalooma on Moreton Island, 36 km north of North Stradbroke Island, from 3-10 October 1985. Off the Great Barrier Reef, identification photographs were opportunistically collected in the waters of Capricornia (27 July-24 August 1984 and 15 July-9 September 1985), the Whitsunday Islands (8-18 August 1985), and the Townsville area (10-16 August 1985).

Shore-based observations were conducted eight hours daily from a 28 m headland at Point Lookout on North Stradbroke Island. As the second easternmost point on the Australian coast, the Point Lookout land station offers optimum conditions for sighting migrating humpback whales passing within 10 km of the headland (Paterson & Paterson 1984, Bryden 1985, Kaufman et al. 1985). The land station was operated during sea states less than five on the Beaufort scale and the research vessel launched during sea states less than four.

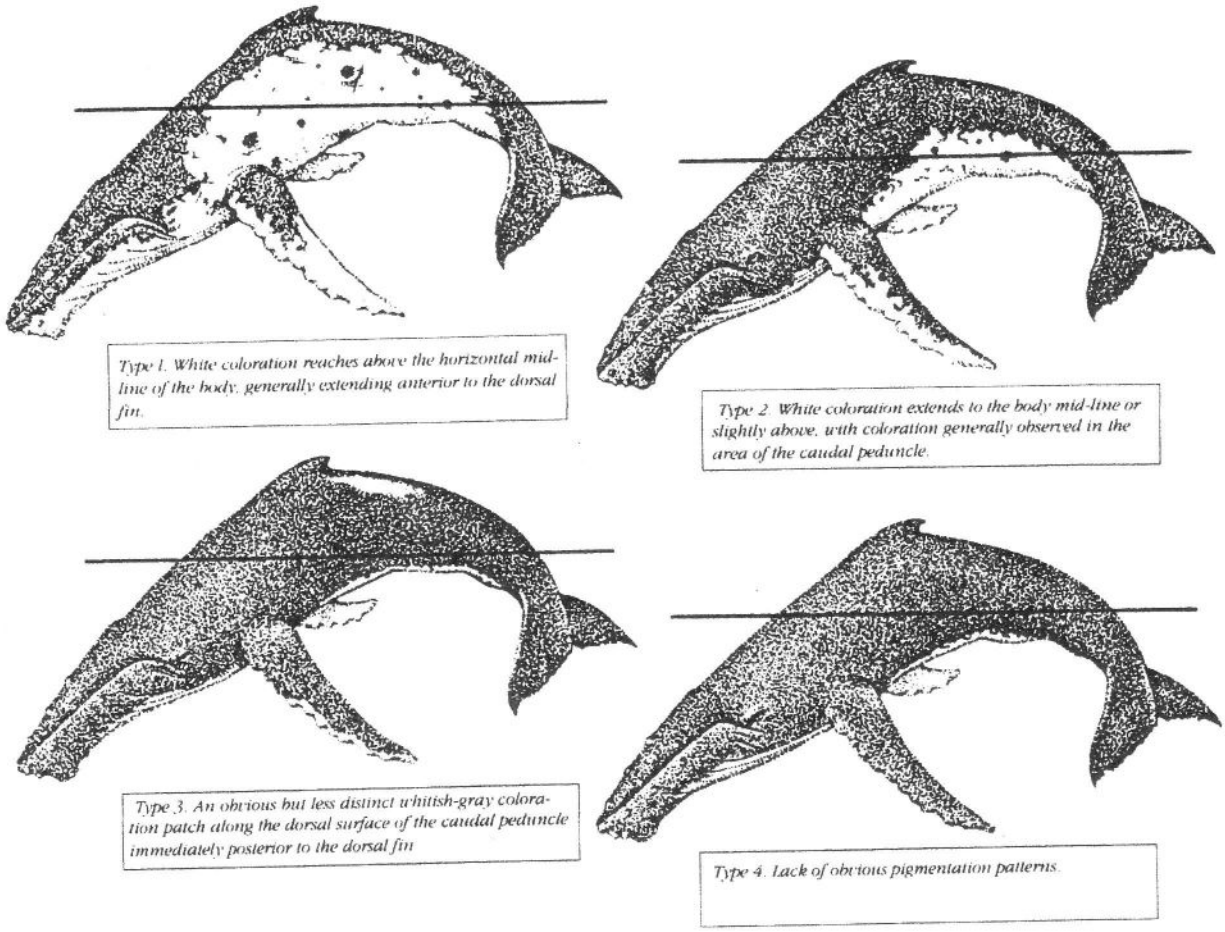


Figure 2. Description of the four lateral body pigmentation types displayed by Australian humpback whales. Illustrations by Lili Hagen

Using binoculars and a 10 sec precision theodolite (a Nikon in 1984 and a Leitz in 1985), humpback whale movements and behaviors were tracked and recorded on a Tandy M-100 microcomputer and in logbooks by a land station crew comprised of a theodolite operator, one primary observer, and two recorder-observers. Weather permitting, a 3.5 m inflatable vessel equipped with a 28 hp engine was launched from a nearby beach. A vessel team consisting of a photographer, recorder-observer, and driver, was directed to the location of whales by the land station crew by way of VHF radio-telephones. Pods were approached and photographed from the inflatable using a motor-driven Nikon F-3 35 mm camera equipped with a 300 mm telephoto lens or an 80-200 mm zoom lens. When possible, underwater photographs were collected by skindivers using a 35 mm Nikonos V camera in order to sex individual animals as described by Glockner (1983). Behavioral observations made during vessel operation were recorded in real-time on cassette recorder for later transcription.

Fluke photographs were taken when a whale presented the ventral tail surface, generally when the boat was within 30 m of the animal. Left and right lateral body/dorsal fin photographs were collected during breathing sequences at a distance of one whale length or approximately 15 m. An arching peduncle offered the optimal photographic perspective of the lateral body. Efforts concentrated on photographing each animal's flukes and lateral body markings on both the left and right sides in order to minimize the possibility of counting the same animal twice. In sea states greater than three, it was not always possible to effectively photograph the lateral coloration since the body area was less exposed due to swell and wave condition.

Animals were classified by pigmentation pattern into four types according to the extent of white coloration visible on their flanks. The four body types are derived from a scheme developed by Lillie (1915), modified to permit identification of live animals. A Type 1 animal exhibits white coloration above the horizontal mid-line

of the body and generally extending anterior to the dorsal fin (Figure 2). A Type 2 animal has white coloration to the mid-line or slightly above, with coloration generally observed in the area of the caudal peduncle. A Type 3 animal has an obvious but less distinct whitish-gray patch along the dorsal surface of the caudal peduncle immediately posterior to the dorsal fin. A Type 4 animal lacks obvious white coloration. It should be noted that all categories may display extensive ventral coloration patterns. However, since these are not typically visible from the surface, they do not enter into the category scheme.

Individual whales were identified either on the basis of flukes only, lateral body pigmentation only, or both. Resight confirmation was based on independent verification of matching features as assessed by at least three observers. On the basis of in-field observations, animals were differentiated by gross size estimates relative to the vessel and other whales as either adult, subadult, or calf. Confirmation of size estimate was provided by both boat and shore observers. The adult animal that remained in closest continual proximity to the calf was designated the cow.

RESULTS

During 1984 and 1985, a total of 210 humpback whales were photographically identified off the east Australian coast. The majority (86%) of Area V whales identified were in the near-shore waters off North Stradbroke Island, with the remaining identifications (14%) collected northward in the area of the Great Barrier Reef. Table 1 presents a summary of the number of whales observed and photographically identified in each of the survey areas.

Of the 210 Area V whales identified (58%) could be identified using either fluke or lateral body pigmentation patterns, 52 (25%) were identified using only lateral body pigmentation patterns, and 36 (17%) were identified using only fluke pigmentation patterns (Table 2). Means of identification differed among population classes. Nine of the ten calf identifications depended completely upon lateral body pigmentation patterns. Approximately one-third of the subadults and cows were identified using only lateral body markings. In contrast, only 19% of the adults which were not identified as cows were identified using only lateral body markings.

Of the 174 Area V whales identifiable by lateral body markings, 164 could be classified according to one of the four body types. Ten animals, although showing distinguishable marks, did not display sufficient area of the flanks to permit pigmentation type categorization (Table 3). Fifty-seven percent of the animals categorized fell into body Types 1, 2, & 3. Figure 3 presents photographic demonstration of the categories used.

Summary of areas surveyed by research vessel

AREA V	Number of whales	
Location	**Observed**	**Photo-ID**
N. Stradbroke Is.	228	178(a)
Capricornia Group	44	38(b)
Whitsunday Is.	13	10(c)
Townsville area	10	4
Total	**295**	**230**

Resights included: (a) 16; (b) 1; (c) 3.

Table 1

Means of identification for each population class

Class	Lateral body or fluke		Lateral body only		Fluke only		Total
	N	%	N	%	N	%	N
Adult	103	61	33	19	34	20	170
Cow	7	64	4	36	0	0	11
Subadult	11	58	6	32	2	10	19
Calf	1	10	9	90	0	0	10
Total	**122**	**58**	**52**	**25**	**36**	**17**	**210a**

a Resights not included

Table 2

Distribution of body type

Category	Area V	
	N	%
Type 1	13	7
Type 2	47	27
Type 3	40	23
Type 4	64	37
Undetermined	10	6
Total	**174**	**100**

Table 3

Sixteen animals were resighted once, and two were resighted twice over the entire study period, for a total of 20 resights. Nine (45%) resights were based upon fluke patterns only, nine (45%) resights were confirmed using both fluke and lateral body patterns, and two

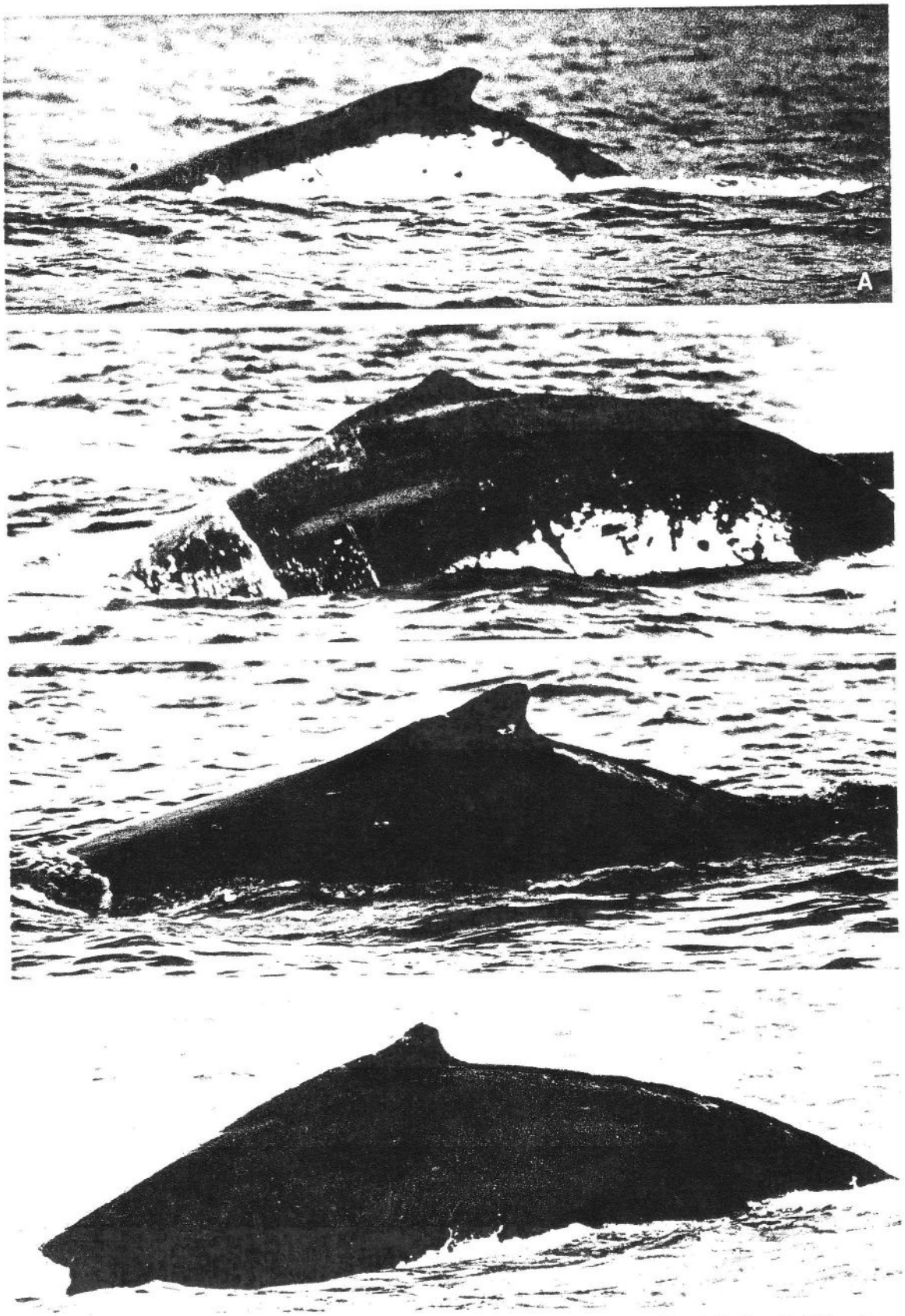


Figure 3. Typical examples representing the 1-4 lateral body pigmentation types: A, Type 1; B, Type 2; C, Type 3; D, Type 4. Photographs by Gregory D. Kaufman

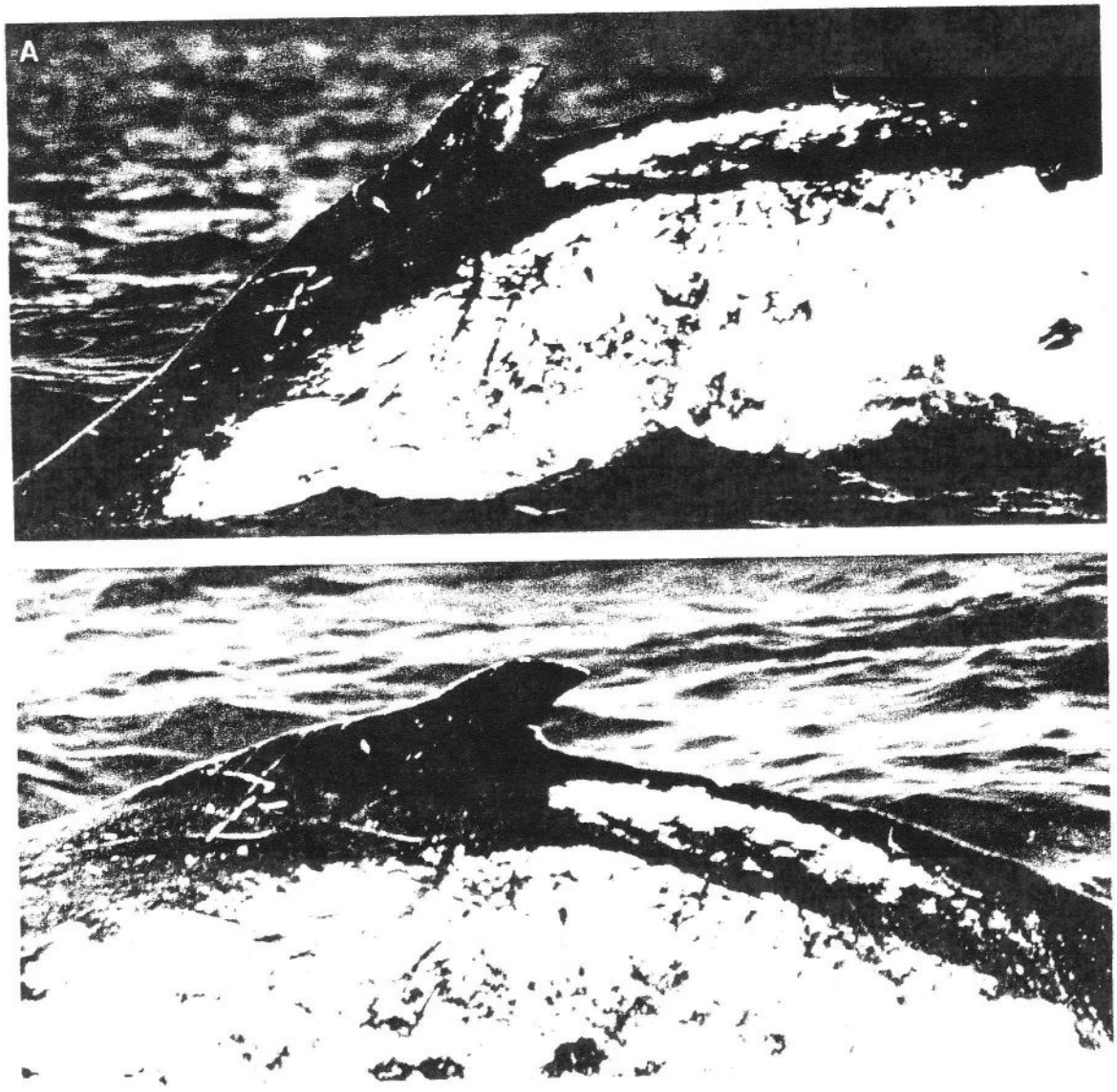
(10%) were confirmed using lateral body identifications only. The range of intervals between resights based solely on lateral body markings was from 3-145 days.

DISCUSSION

On the basis of land observations, Bryden (1982) noted that humpbacks migrating past North Stradbroke Island most often presented just a small portion of the back and dorsal fin upon surfacings, only occasionally exposing the flukes. In addition, most of the flukes observed were reportedly all-white with no discernible markings. He concluded that opportunities were minimal for obtaining useful identification photos of migrating east Australian whales. The identification of 210 east Australian whales over a two-year period suggests that effective photographic identification of individuals is possible in this region. In fact, of the 228 whales aproached by the research vessel off North Stradbroke Island alone, 178 (78%) were photo-identified using fluke, lateral body markings, or both (Table 1).

In addition, lateral body pigmentation patterns indicate that opportunities for obtaining identifications for certain population classes are increased. Since cows, calves, and subadults appear to demonstrate surfacing and peduncle arching behavior more consistently than fluking-up behavior, the use of lateral body pigmentation patterns as a primary source of reference provides a significant increase in identification and resight rates over fluke identification alone. Overall, 25% of the identifications depended upon lateral body markings alone.

Figure 4. Lateral body identifications of A0075 used in resight analysis. A. Sighted July 15, 1985, off Point Lookout, North Stradbroke Island. Photograph by Gregory D. Kaufman. B. Resighted August 28, 1985, in the Capricornia Group. Photograph by Helen Sneath



Perkins et al. (1985), Reid (1985), and Hammond (1986) discussed the effect of non-fluking animals on mark-recapture population estimates as described by Seber (1973). It was found that differences in fluking rates between population classes introduced a bias into mark-recapture population estimates, causing an underestimation of the population. In this study, lateral body identification techniques have succeeded in identifying all age classes. The introduction of mark-recapture population estimates incorporating lateral body identification of Area V whales should reduce biases introduced through differential fluking behavior exhibited by various population segments. It should be pointed out, however, that this improvement in population estimates will only be found in stocks exhibiting high frequencies of lateral body pigmentation patterns.

Lateral body pigmentation patterns are also helpful in the identification of individuals with all-white flukes which possess limited patterns of reference. Eighty-seven per cent of the Area V flukes photographed in 1984 and 1985 were greater than 75% white. The lack of black pigmentation renders discrimination among individual all-white flukes difficult during photo-matching analysis. Resightings of such animals can be confirmed by comparing lateral body pigmentation patterns (Figure 4). Thus, as a supplementary identification reference to flukes, lateral body pigmentation patterns may reduce error in resight interpretation with a presumable increase in resight recognition rates.

The potential for recounting animals identified using flukes on one occasion and lateral body on another must be acknowledged. It should be noted that 78% of the 36 animals identified by "fluke only" were contributed by the Queensland National Parks and Wildlife Service where no effort was made to collect lateral body photographs at that time.

Resights have thus far established that lateral body pigmentation patterns remain unchanged over a period of 145 days. The observation that 57% of the identified Area V whales are characterized by white lateral pigmentation patterns supports the utility of further lateral body identification efforts. Continued photographic identification studies will establish whether such markings remain stable and recognizable over longer periods of time as has been demonstrated with fluke patterns (Katona et al. 1979, Perkins et al. 1985).

While Discovery tag studies contributed to preliminary knowledge on migratory routes of Area IV and V humpback whales (Chittleborough 1959, 1962; Dawbin 1956, 1959, 1964), fewer than three per cent of the 3000 Discovery tags used over a 25-yr period were recovered (Dawbin 1964, Chittleborough 1965). In just two years, the use of photo-identification techniques has resulted in a recovery (resight return) rate of 8.6%. The introduction and development of a South Pacific identification catalog will aid in further understanding of the distribution and social dynamics of Southern Hemisphere humpback whales.

Omura (1953), Pike (1953), and others (Matthews 1937, Nishiwaki 1959, Dawbin 1966) suggested that the amount of white coloration and other morphometric differences may be used to infer discrete humpback whale breeding stocks. Baker et al. (1986), working in the North Pacific, used geographically distinct fluke coloration differences as evidence of feeding group segregation in Alaskan waters. Results from on-going studies off east Australia and preliminary studies begun off west Australia (Anonymous 1986) contribute to an individual identification base of the Area IV and V humpback whale stocks. The successful integration of lateral body pigmentation patterns into the photo-identification process should increase resight rates essential to future whale managment and conservation programs in the Southern Hemisphere.

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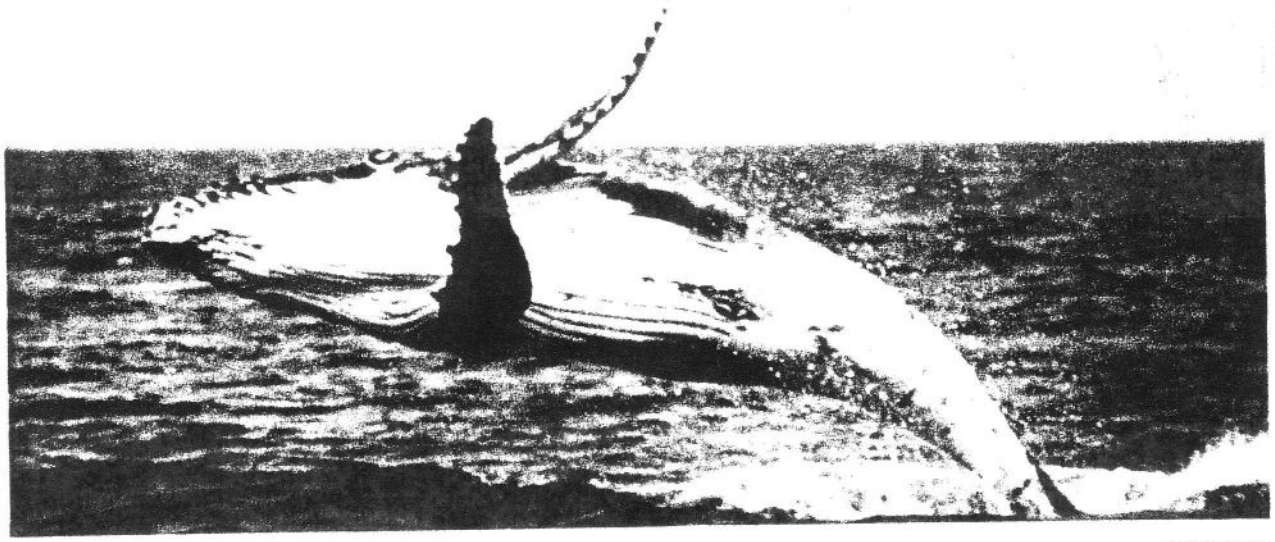

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