

# Movement of two humpback whales (*Megaptera novaeangliae*) satellite-radio tagged off Eden, NSW and matched by photo-identification with the Hervey Bay catalogue

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## ABSTRACT

Photo-identification studies of humpback whales off eastern Australia show low levels of movement between eastern Australia and New Caledonia whales. Some eastern Australian humpback whales migrate through the southern waters of New Zealand on route to Antarctic feeding areas. Photo-identification studies have shown that the waters near the Balleny Islands, in Antarctic Area V, are a feeding area for some eastern Australian humpback whales. However, such studies provide no details of the routes taken between New Zealand and Australia and to and from Antarctic feeding areas. Sixteen humpback whales were satellite-linked radio tagged off Eden NSW in 2008. The number and duration of the tag positions reported revealed complete migratory transits from Eden to Antarctic Area V and IV feeding areas. Photographs of the Eden humpback whales were compared to the Hervey Bay photo-identification catalogue and yielded two matches, identified from lateral body marks and dorsal fins. This study provides the first evidence that during the southern migration some humpback whales stopover at Hervey Bay and also migrate past Eden on the NSW coast. The tracks of the two whales from Eden showed that a male sighted in Hervey Bay in the same season moved southeast from Eden towards southern New Zealand. A female with site-fidelity to Hervey Bay in previous seasons, accompanied by a calf when the tag was deployed, moved down and around the coast of Victoria, across Bass Strait and then southwest into the Antarctic Area IV feeding area. Eden may be a migratory hub for humpback whales departing from and approaching the east coast of Australia. This study suggests that eastern Australian humpback whales may exhibit a more diverse range of feeding destinations, after leaving Australian coastal waters, than previously reported.

KEYWORDS: HUMPBACK WHALE; PHOTO-IDENTIFICATION; SATELLITE TAGGING; MIGRATORY MOVEMENTS; ANTARCTIC; AFRICA; AUSTRALASIA; FEEDING AREAS; BREEDING GROUNDS

## INTRODUCTION

A recent study of eastern Australian humpback whales and humpback whales across Oceania (South Pacific) documented four photo-identification matches between the nearby breeding grounds of New Caledonia and eastern Australia and three matches between New Zealand and eastern Australia (Garrigue *et al.*, 2011). Analyses of these matches showed that some eastern Australian whales migrate through Cook Strait and the southern waters of New Zealand, while travelling to and from Antarctic feeding areas (Franklin *et al.*, 2008b; Franklin *et al.*, 2014). Two of the New Zealand matches were whales photographed in Cook Strait in June 2004 and subsequently photographed in Hervey Bay in September the same year (Franklin *et al.*, 2014). These matches could not provide information about the routes taken by individual humpback whales between New Zealand and eastern Australia.

Dawbin and Falla (1949) and Dawbin (1956) noted that the Ross Sea, particularly around the Balleny Islands, 'almost certainly represents the summer concentration of humpback whales which pass the coasts of New Zealand, East Australia and other parts of the Pacific'. Dawbin (1956) developed the hypothesis that dispersal across the Antarctic Area V feeding area is a primary determinant of the routes taken by humpbacks as they approach New Zealand on their return to winter breeding grounds. Recent photo-identification evidence supports this view. Matches have

been reported between the Antarctic Area V feeding area and breeding grounds to the north (Kaufman *et al.*, 1990; Rock *et al.*, 2006; Franklin *et al.*, 2008a; Franklin *et al.*, 2012; Constantine *et al.*, 2014). Most of these sightings were in close vicinity to the Balleny Islands (67°S, 163°E) (Rock *et al.*, 2006; Franklin *et al.*, 2008a; 2012; Constantine *et al.*, 2014), and one was near to the eastern border of the Antarctic Area V feeding area (69°S, 171°W) (Rock *et al.*, 2006). The longitude of the most westerly sighting was 155°55'E, and the most easterly was at 170°52'W. The distance between these two sightings was approximately 817 n.miles (Rock *et al.*, 2006; Franklin *et al.*, 2008a). All of these individuals are reported as having site fidelity to eastern Australian breeding grounds (Kaufman *et al.*, 1990; Rock *et al.*, 2006; Franklin *et al.*, 2008a; 2012; Constantine *et al.*, 2014). Franklin *et al.* (2012) and Constantine *et al.* (2014) both concluded that some eastern Australian whales feed in and around the Balleny Islands in Antarctica Area V. Rock *et al.* (2006) also reported two individual humpback whales sighted in both Hervey Bay and Eden.

During late October 2008, 16 satellite-linked radio tags were attached to southbound humpback whales off Eden, NSW (Gales *et al.*, 2009). The tags remained active from 3 to 156 days providing a full description of the transit tracks of some whales from Eden to Antarctic feeding areas (Fig. 1). All but one individual humpback whale travelled southward into the Antarctic Area V (130°E–170°W) feeding

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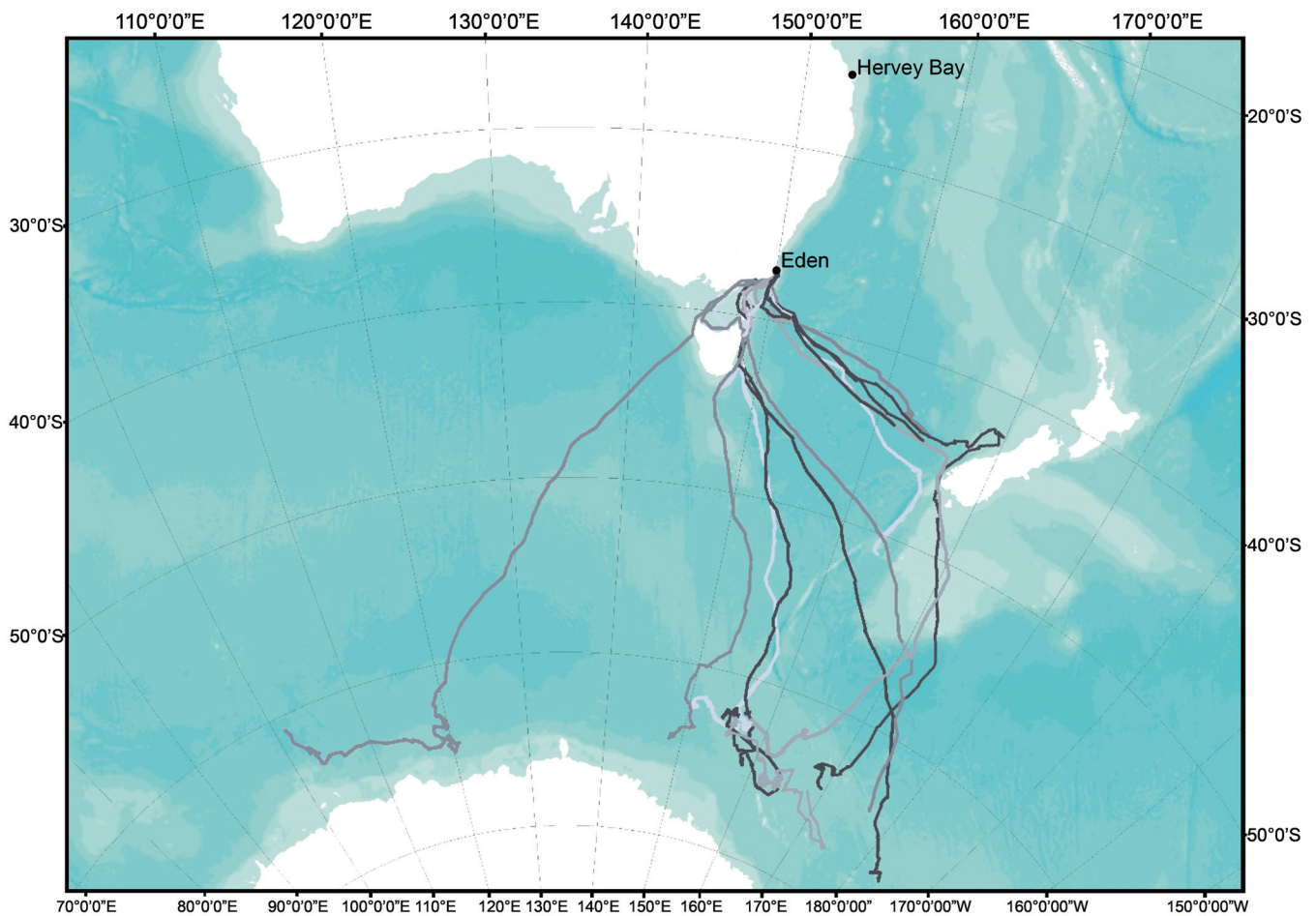


Fig. 1. Tracks of the 16 individual humpback whales satellite-linked radio tagged off Eden in October 2008 (from Gales *et al.*, 2009).

area. As predicted by Franklin *et al.* (2008b), several individual humpback whales travelled southeast from Eden passing to the southwest of southern New Zealand and then at least two of these whales continued south, well to the east of the Balleny Islands. Several other individual humpback whales moved down along the Victorian and Tasmanian coast and then migrated towards the Balleny Islands (approximately 67°S, 163°E), with some dispersing well to the west (approximately 148°E) and to the east (approximately 176°W) of the Balleny Islands. A single humpback whale, accompanied by a calf at the time of tag deployment, followed the Victorian coast westward, then travelled through Bass Strait to northwest Tasmania and from there southwest to the edge of the Antarctic ice shelf in Antarctic Area IV (Gales *et al.*, 2009; Fig. 1).

In this study photographs of the humpback whales tagged off Eden in 2008 are compared to the Hervey Bay humpback whale photo-identification catalogue for the period 1992–2009.

## METHODS

Satellite-linked radio tags were deployed on 16 southbound humpback whales off the coast of Eden, NSW (37.15°S, 150.07°E) between 24 October and 1 November 2008 (Gales *et al.*, 2009). During deployment of the tags photo-identification images were taken of each of the 16 individual humpback whales. A total of 33 photographs was obtained.

Of the 33 photographs, 24 were right lateral body and dorsal fin photographs, 7 were left lateral body and dorsal fin photographs and 2 were ventral tail fluke photographs.

Photo-identification of humpback whales in Hervey Bay, Queensland was undertaken for ten weeks each year between 1992 and 2009 as part of a long-term study of humpback whales in Hervey Bay (Franklin, 2012; 2014). Photographs of ventral tail flukes, and related left and right lateral body and dorsal fins were obtained wherever possible. The Hervey Bay fluke catalogue for the period 1992–2009 consists of  $n=2821$  individual whales. A full description of the Hervey Bay study area, fieldwork, effort and data obtained is provided in Franklin *et al.* (2011).

To identify any matches between the humpback whales in the 2008 Eden catalogue and the humpback whales in the Hervey Bay catalogue, each ventral tail fluke, left and right lateral body and dorsal fin photograph in the Eden catalogue ( $n=16$  whales) was compared to each ventral tail fluke, left and right lateral body and dorsal fin photograph in the Hervey Bay catalogue ( $n=2,821$  whales).

## RESULTS

The comparison of the Eden photography with the Hervey Bay photography yielded two matches. Both matches were based on right lateral body and dorsal fin photographs. The photo-identification images and the details of each individual whale matched are provided in Figs 2 and 3 below.





Fig. 2. Photographic match of a humpback whale photographed in Hervey Bay on 21 September 2008 (A) and subsequently photographed off Eden on 24 October 2008 (B) by Gales *et al.* (2009). The whale was coded as satellite-radio tagged whale 88746 off Eden and was identified in the field as a male. This male humpback whale was only sighted on one occasion in Hervey Bay during 2008, and was not identified in Hervey Bay during other years.

A satellite-linked radio tag was deployed on the male humpback whale 88746 on 24 October 2008 (Gales *et al.*, 2009). The whale was in a pod of two adults. The tag remained active for 20 days until 12 November 2008 and provided 138 position locations. The whale moved south from Eden and upon reaching open water in Bass Strait turned eastward and travelled in a steady south-easterly direction towards the southern coast of New Zealand until the tag ceased reporting (Gales *et al.*, 2009). The full track of whale 88746 is shown in Fig. 4, below.

A satellite-linked radio tag was deployed on the female humpback whale 88729 on 29 October 2008 (Gales *et al.*, 2009). A calf accompanied the female at the time the tag was deployed. The tag remained active for 98 days until 3 February 2009 and provided 1,160 position locations. The female followed the coastline from Eden moving westward around the Victorian coast until off Wilsons Promontory. Then the whale travelled southwest passing close to the northwest corner of Tasmania before continuing steadily southwest, moving out of Antarctic Area V (130°E–170°W) and into Antarctic Area IV (70°E–130°E) at approximately 55°S. It continued southwest until reaching approximately 60°S, 121°E on 4 December 2008. From there, female 88729 moved south towards the Antarctic ice edge and then turned west, tracking along the ice edge and slowly moving northwest until the tag ceased reporting on 3 February 2009. The full track of whale 88729 is shown below (Fig. 4).

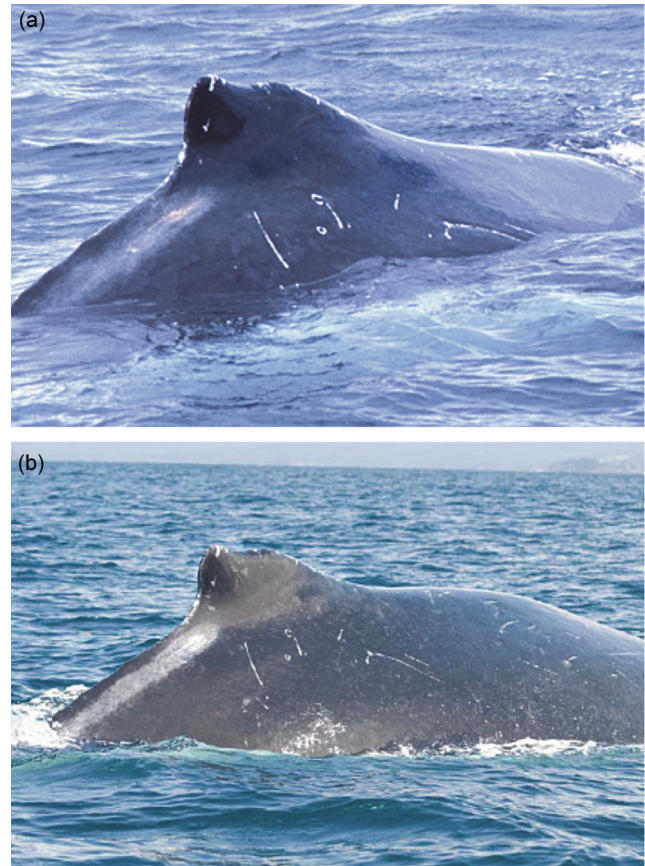


Fig. 3. Photographic match of a humpback whale photographed in Hervey Bay on 11 November 2002 (A) and then photographed off Eden 29 October 2008 (B) by Gales *et al.* (2009). The whale was coded as satellite-radio tagged whale 88729 off Eden and was inferred to be female as a calf accompanied the whale. This whale (mnemonic name 'Rama') was photographed in Hervey Bay in 1998 from 27 September to 1 October; in 1999 on 10 August; in 2000 from 6 to 25 September; in 2001 on 3 October; in 2002 on 11 October and in 2005 from 4 to 7 September. A calf accompanied the female 'Rama' in each year it was sighted in Hervey Bay, except 1999, providing further evidence that this whale is a female.

## DISCUSSION

The photo-identification matches presented here, of two humpback whales satellite tagged off Eden, NSW and also sighted in Hervey Bay, provides further evidence that some humpback whales that use Hervey Bay as a stopover during the southern migration also migrate to and past Eden, off the southern NSW coast. Some eastern Australian humpback whales travel past southern New Zealand on route between eastern Australian breeding grounds and Antarctic Area V feeding area (Franklin *et al.*, 2008b; 2014). However, photo-identification provides no evidence of the routes taken between eastern Australia and New Zealand. Satellite-radio tagging has shown that some humpback whales passing Eden during the southern migration turn southwest directly towards southern New Zealand (Gales *et al.*, 2009).

It has been suggested that the coast off Eden, NSW is an important feeding area for some humpback whales during the southern migration (Paterson, 1987; Stamation *et al.*, 2007). The availability, early in the southern migration, of an accessible coastal feeding area may provide an incentive for southbound humpbacks, particularly immature males and females and females with this seasons calves, to travel close to the coast until they arrive in the feeding area off Eden. The

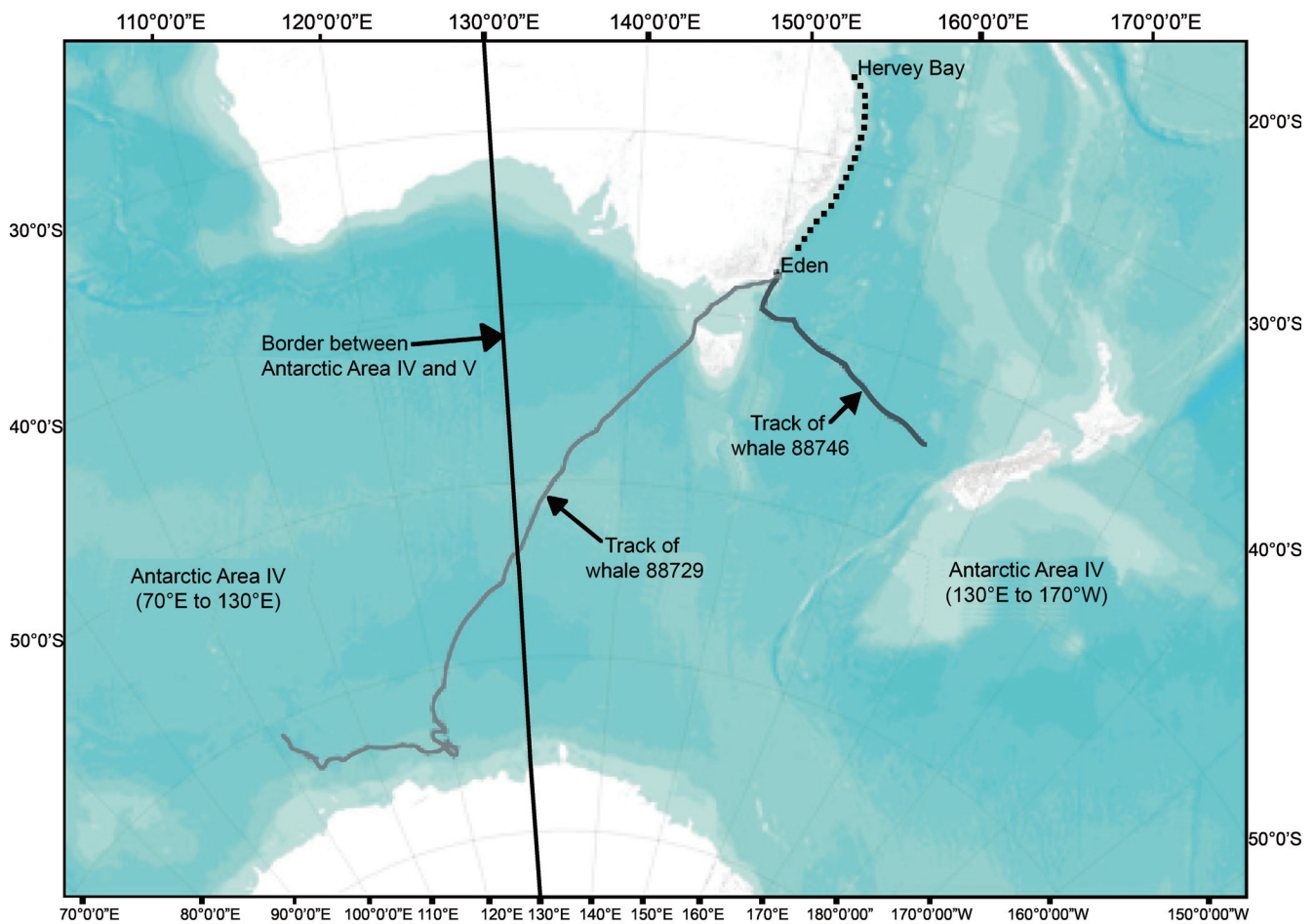


Fig. 4. Satellite-linked radio tag tracks of male humpback whale 88746 and female humpback whale 88729.

two matched whales reported here are likely to have travelled directly along the coast of Queensland and NSW from Hervey Bay to Eden off the south coast of NSW. Eden may be an important migratory hub for southbound humpback whales, and possibly northbound humpback whales. Comparison of any existing Eden fluke catalogues with eastern Australian, Victorian, Tasmanian, New Zealand, Oceania and Antarctic fluke catalogues may provide further insights into the migratory corridors and destinations of humpbacks passing through the waters off Eden, NSW.

Humpback whales leaving Eden travel in three primary migratory corridors prior to moving directly towards and dispersing across the Antarctic Area IV and V feeding areas (Gales *et al.*, 2009): southeast towards the southern coast of New Zealand; southward along the New South Wales, Victorian and Tasmanian east coast, and south past New South Wales, west along the Victorian coast then southwest through Bass Strait (Franklin *et al.*, 2008b; 2014; Gales *et al.*, 2009). This study confirms that some humpback whales using Hervey Bay as a stopover migrate past Eden, NSW before moving into primary migratory corridors towards Antarctic feeding areas.

Mitochondrial segregation of DNA haplotypes in the Northern Hemisphere has been interpreted as maternally directed fidelity to migratory destinations (Baker *et al.*, 1990). Long-term photo-identification studies of humpback whales in the Northern Hemisphere have also documented maternally directed fidelity to feeding destinations (Martin *et al.*, 1984; Clapham and Mayo, 1987; Katona and Beard,

1990; Clapham *et al.*, 1993; Palsboll *et al.*, 1997). Female humpback whales with site-fidelity to eastern Australia, particularly Hervey Bay, have been found to feed in Antarctic Area V near and around the Balleny Islands (Kaufman *et al.*, 1990; Rock *et al.*, 2006; Franklin *et al.*, 2008a; 2012; Constantine *et al.*, 2014). The female humpback whale 88729 reported herein had strong site-fidelity to Hervey Bay during previous breeding seasons, but travelled to the Antarctic Area IV feeding area in the 2008–09 feeding season. This result shows that at least one recent female humpback whale from eastern Australia does not always travel to Antarctic Area V to feed, and suggests that humpback whales may exhibit a diverse range of feeding destinations after leaving Australian coastal waters.

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