Inter-oceanic movement of an adult female humpback whale between Pacific and Atlantic breeding grounds off South America

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ABSTRACT

We report the first documented movement of an individual humpback whale between the eastern South Pacific stock off Ecuador and the western South Atlantic stock off Brazil. This constitutes the first record of a humpback whale in both the Atlantic and Pacific breeding grounds off South America, and one of a small number of inter-oceanic movements documented to date. It is possible that, even at quite low levels, this movement of individuals between breeding grounds contributes to the current high level of mtDNA diversity in these once-depleted Southern Hemisphere populations. When first sighted, the whale was accompanied by a young calf, and is therefore identified as an adult female. This movement to a different and distant breeding ground is the first reported by a reproductively mature female, and shows that extreme long-distance travellers among humpback whales are not restricted to young males.

KEYWORDS: HUMPBACK WHALE; BREEDING GROUND; SOUTH AMERICA; MOVEMENTS; PHOTO-ID

INTRODUCTION

Seven breeding stocks of humpback whales (*Megaptera novaeangliae*) are recognised in the Southern Hemisphere based on their wintering distribution (IWC, 1998). The western South Atlantic stock (Breeding Stock A) is found along the coast of Brazil, primarily in the vicinity of Abrolhos Bank (Martins *et al*., 2001; Andriolo *et al*., 2006) and the eastern South Pacific stock (Breeding Stock G) winters from 6°S off northern Peru to 12°N off Costa Rica (Flórez-González *et al*., 1998; Pacheco *et al*., 2009). The discreteness of these two stocks is supported by movement patterns of naturally marked animals (Garrigue *et al*., 2002; Stevick *et al*., 2004) and by genetic analyses (Caballero *et al*., 2001; Olavarría *et al*., 2007; Cypriano-Souza *et al*., 2010). We report the first documented movement of an individual humpback whale between these two areas.

METHODS

Whales were identified by photographs of the individually distinctive markings on the ventral fluke surface using standard procedures (Katona *et al*., 1979; Allen *et al*., 2011). The finding was made possible through the collaborative efforts of three institutions: Museo de Ballenas of Ecuador (MBS), Instituto Baleia Jubarte of Brazil (IBJ) and the Antarctic Humpback Whale Catalogue (AHWC).

The AHWC is an international collaborative project that contains records of 4,268 individual whales identified by fluke photographs (Allen *et al*., 2011). This includes 815 whales from the western South Atlantic stock, of which 586 are from work conducted by MBS off mainland Ecuador since 1991 using whale watching boats as research platforms (Félix and Haase, 2001). There are 1,931 whales identified from the western South Atlantic stock. Nearly all of these were collected by IBJ during systematic research cruises along the Abrolhos Bank (Engel, 1996; Martins *et al*., 2001).

RESULTS AND DISCUSSION

An individual humpback whale (AHWC# 0664; Fig. 1) first recorded by MBS off Puerto Cayo, Ecuador (01°18'45"S, 80°49'34"W), on 8 September 1996 was subsequently photographed on 14 October 1998 by IBJ on Abrolhos Bank, Brazil (17°55'S, 38°57'W). These locations are separated by more than 40° of longitude and a minimum travel distance of around 12,000km (Fig. 2). This constitutes the first record of a humpback whale in both the Pacific and Atlantic breeding grounds off South America, and one of a few inter-oceanic movements documented to date (Chittleborough, 1959; Pomilla and Rosenbaum, 2005; Stevick *et al*., 2010; Kaufman *et al*., 2011).

When first sighted, the whale was accompanied by a young calf, and is therefore identified as an adult female. The reproductive fitness benefits and costs of movement to new reproductive groups have been widely discussed as drivers for long-distance movement (Greenwood, 1980; Chepko-Sade and Halpin, 1987; Johnson and Gaines, 1990; Hanski and Gilpin, 1997), and evolutionary theory argues that young mammals and males are more likely to travel long distances than are females and adults (Greenwood, 1980; Johnson and Gaines, 1990; Lawson Handley and Perrin, 2007). MtDNA studies found a higher female structure in both of these stocks (Rosenbaum *et al*., 2009; Félix *et al*., 2012), supporting the assumption of greater female philopatry and male dispersal in these breeding grounds. This movement to a different and distant breeding ground is the first reported by a reproductively mature female, and shows that extreme long-distance travellers among humpback whales are not restricted to young males.

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Fig. 1. AHWC#0664 photographed off Salinas, Ecuador in 1996 accompanied by a calf of the year (top – Museo de Ballenas photograph) and on Abrolhos Bank, Brazil in 1998 (bottom – IBJ photograph).

While it is not clear what physical or social cues humpback whales use to identify breeding habitat, nor how they navigate, they are able to follow remarkably direct tracks across open ocean (Horton *et al*., 2010) and, whether intentionally or not, this individual was able to locate and move between two breeding areas separated by a continent and thousands of kilometers. Typically, whales from the eastern South Pacific migrate to the west coast of the Antarctic Peninsula and adjacent islands to feed (Stevick *et al*., 2004; Dalla Rosa *et al*., 2012). Some whales from this area also feed in the Strait of Magellan (Acevedo *et al*., 2007). Whales from Brazil appear to feed in the Scotia Sea (Stevick *et al*., 2006; Engel and Martin, 2009). No overlap in feeding range has been detected to date, and the feeding area(s) used by this whale and the route that it followed are not known.

Ecological factors may influence migratory patterns. Inter-breeding-area movement by humpback whales between eastern and western Australia was associated with atypical distribution of prey during the intervening feeding season (Chittleborough, 1959), indicating that, in some cases, long-distance movement between breeding sites may follow as a consequence of foraging responses to ecological change. Given this, it may be interesting to note that the interval between the sightings reported here coincides with a particularly strong El Niño Southern Oscillation (ENSO) event during 1997/98. During El Niño years the entire food web in the eastern South Pacific is affected (Barber and Chavez, 1983; Ramírez and Urquizo, 1985), and ENSO impacts may extend well into polar regions (Yuan, 2004), potentially leading whales to forage

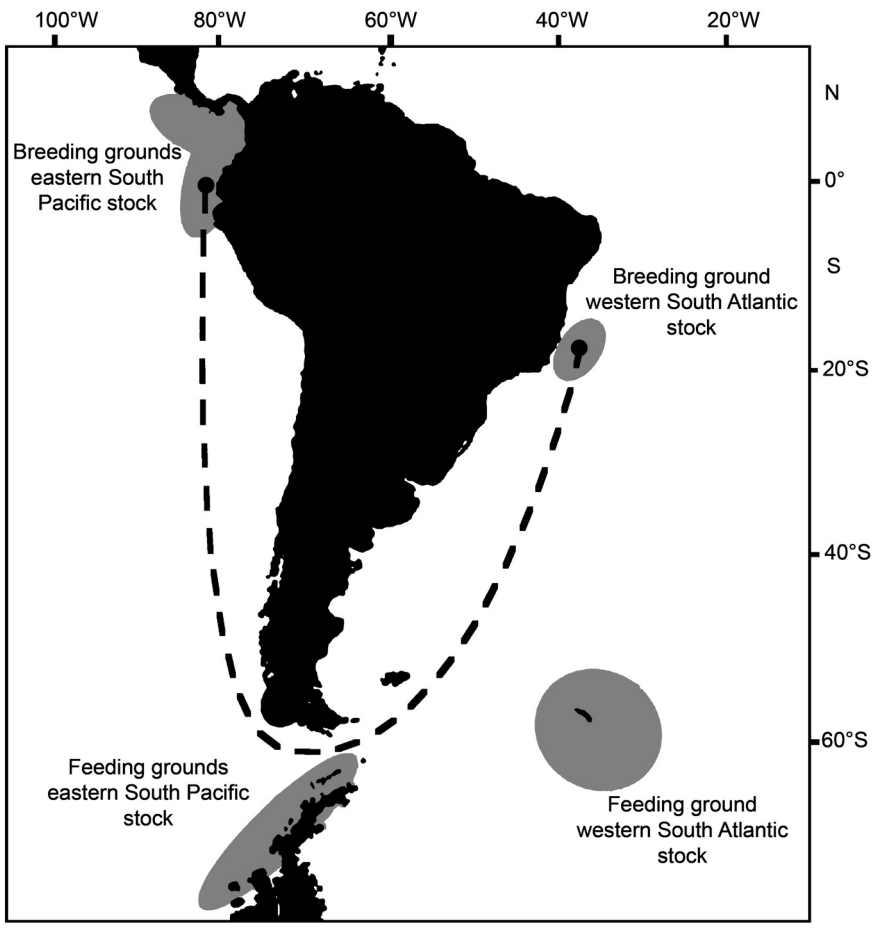

Fig. 2. Low-latitude distribution of humpback whale stocks around South America and documented feeding destinations. Dashed line connects sighting locations for AHWC#0664 and is not intended to indicate travel route.

in atypical locations or move more widely in search of prey.

Though there is evidence for considerable isolation between these two breeding stocks (Stevick *et al*., 2004; Engel *et al*., 2008; Cypriano-Souza *et al*., 2010), this finding supports the genetic evidence for a low level of recent interbreeding (Engel *et al*., 2008; Félix *et al*., 2012). Other inter-breeding-stock movements documented in recent years (Garrigue *et al*., 2002; Pomilla and Rosenbaum, 2005; Stevick *et al*., 2010; Kaufman *et al*., 2011) and additional genetic and acoustic evidence (Darling and Souza-Lima, 2005; Félix *et al*., 2012; Rosenbaum *et al*., 2009) suggest that long-distance movement may not be as atypical in the Southern Hemisphere as has been thought. It is possible that, even at quite low levels, this movement of individuals between breeding grounds contributes to the current high level of mtDNA diversity in these once-depleted populations (Engel *et al*., 2008).

ACKNOWLEDGEMENTS

Thanks to the many who assisted with collection and processing of photographs. Projecto Baleia Jubarte is sponsored by Petróleo Brasileiro S.A. (PETROBRAS). The Whale and Dolphin Conservation Society provided support for the work in Ecuador. This study would not be possible without the hard work and dedication of the researchers and photographers who collaborate to make the AHWC possible, and the staff and students who spend countless hours comparing photographs, especially L. Crowe who identified this re-sighting and C. Carlson for her long-standing support. We are indebted to the IWC and to private donors for financial support for the AHWC.

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