A quarter of a world away: female humpback whale moves 10 000 km between breeding areas

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Fidelity of individual animals to breeding sites is a primary determinant of population structure. The degree and scale of philopatry in a population reflect the fitness effects of social facilitation, ecological adaptation and optimal inbreeding. Patterns of breeding-site movement and fidelity are functions of social structure and are frequently sex biased. We report on a female humpback whale (Megaptera novaeangliae) first identified by natural markings off Brazil that subsequently was photographed off Madagascar. The minimum travel distance between these locations is greater than 9800 km, approximately 4000 km longer than any previously reported movement between breeding grounds, more than twice the species’ typical seasonal migratory distance and the longest documented movement by a mammal. It is unexpected to find this exceptional long-distance movement between breeding groups by a female, as models of philopatry suggest that male mammals move more frequently or over longer distances in search of mating opportunities. While such movement may be advantageous, especially in changeable and unpredictable circumstances, it is not possible to unambiguously ascribe causality to this rare observation. This finding illustrates the behavioural flexibility in movement patterns that may be demonstrated within a typically philopatric species.

Keywords: philopatry; breeding stocks; humpback whale; Megaptera novaeangliae

1. INTRODUCTION

Fidelity of individual animals to breeding sites is common in many taxa [1]. It is a primary determinant of population structure [2,3] and thus informs effective conservation and management. The degree and scale of breeding-area philopatry reflect the interacting fitness effects of social facilitation, ecological adaptation and optimal inbreeding [4]. Patterns of breeding-site movement are functions of social structure and are frequently sex biased [1,4,5].

The severe depletion of humpback whales (Megaptera novaeangliae) throughout the Southern Hemisphere [6] and apparent inconsistencies in the regional patterns of recovery [7] make understanding of regional movement patterns a considerable conservation concern. However, this knowledge remains fragmentary.

Humpback whales are long-distance seasonal migrants between high-latitude feeding areas and low-latitude breeding and calving habitat, with several documented instances of migration greater than 8000 km [8–11]. Although the current model suggests that individuals migrate between seasonal habitats at approximately similar longitudes, this is based primarily on work in the Northern Hemisphere where movement is, to some extent, constrained by continents, and even there substantial longitudinal movement in migration has been documented [8,12].

The mating system of humpback whales has been described as a ‘floating lek’, with high concentrations of individuals at relatively discrete mating and calving sites [13]. Substantial movement has been documented within these sites, but although instances of movement between two breeding sites that are separated by approximately 6000 km have been reported [14,15], long-distance movement of individuals between discrete breeding grounds is rare [16]. This leads to restricted gene flow and relatively distinct breeding stocks between and frequently within ocean basins [17,18]. Seven breeding stocks and several sub-stocks are recognized in the Southern Hemisphere [19]. We report on the movement of an individual humpback whale between non-adjacent breeding stocks that are separated by nearly 10 000 km.

2. MATERIAL AND METHODS

The Antarctic Humpback Whale Catalogue (AHWC) is an international collaborative project investigating movements of humpback whales in the Southern Ocean and corresponding lower latitude waters [20]. Whales were identified by photographs of the individually distinctive markings on the ventral fluke surface using standard procedures [20,21]. More than 260 collaborating researchers and individuals have contributed to this project. The AHWC contains records of 3665 individuals. Geographical coverage includes all of the breeding and feeding stocks in the Southern Hemisphere. New sightings were compared with all previously identified individuals in the collection regardless of the time or area of any prior sighting, so pre-conceptions about probable movement patterns do not influence the results.

The AHWC contains records of 888 whales from the breeding stock in the western South Atlantic Ocean (figure 1). Most were collected by Instituto Baleia Jubarte during systematic research cruises along the Abrolhos Bank, the main concentration in the Brazilian coast [22,23]. Another 226 individuals were identified from the breeding stock in the western Indian Ocean [24].

Skin biopsy samples were collected off Brazil under licence SISBIO 21489-1 [25]. Molecular sex determination was carried out by polymerase chain reaction amplification followed by TaqI digestion of the ZFX/ZFY region of the sex chromosomes [26,27].

3. RESULTS

AHWC no. 1363 (figure 2) was first identified on Abrolhos Bank, Brazil (17°49.23’ S, 38°43.41’ W) on 7 August 1999. It was one of a pair that was observed for about an hour. Both whales in the group were identified as female by genetic markers. Neither of the two was photographed again on Abrolhos Bank. The whale subsequently was photographed just over 2 years later on 21 September 2001 from a commercial
whale watch tour vessel. It was one of a trio of whales seen between Ile Sainte Marie/Nosy Boraha and the east coast of Madagascar (approx. 16°50' S, 49°50' E).

The minimum travel distance between these locations, via a great circle route rounding Cape Agulhas and Cap Ste Marie, is greater than 9800 km. This is about 4000 km longer than any previously reported movement between breeding grounds and more than twice the species typical seasonal migratory distance. The difference between the two locations spans 88.5° of longitude. It is the longest documented movement by a mammal, about 400 km longer than the longest seasonal migration that has been reported [11]. Between these two sightings are the eastern South Atlantic breeding stock and sub-stocks off the east coast of Africa and around Mayotte and the Comores (figure 1). This is unprecedented, as all previously documented long-distance movement at low latitudes has involved individuals moving between adjacent breeding grounds [14,15,28,29].

4. DISCUSSION

This example of large-scale movement within a typically philopatric species, while rare, illustrates the extremely long tail of the movement distribution in humpback whales. It differs from the expected pattern in both direction of travel and the sex of the individual.

Genetic evidence suggests that the predominant directionality of movement between breeding areas in this region is from east to west [30], as was found in the only previously documented individual movement between the Indian Ocean and the Atlantic Ocean [29]. However, this individual was sighted first in the western site.

It is unexpected to find exceptional movement between breeding groups by a female. Models of philopatry suggest that male mammals move more frequently or over longer distances in search of mating opportunities, while breeding-area fidelity is stronger among females [4,5]. Previously documented movement between humpback whale breeding grounds was made by males [14,15,29]. Using genetic signals, males in the Indian and South Atlantic Oceans...
had higher evidence of movement between breeding stocks [30], and the only other whale to have been identified in both of these oceans was a male [29].

Instances of extreme long-distance movement may represent exploration of a new habitat or a navigational miscue, and the observation presented here could be explained by either of these plausible explanations. Humpback whales may make large longitudinal movements while feeding at high latitudes, especially in changeable or unpredictable circumstances [31,32]. Such movement may occur through tracking prey, exploring potential foraging sites or in the Southern Ocean through drift with the Antarctic Circumpolar Current. Since little is known about the mechanisms that humpback whales use for navigation or for locating reproductively active conspecifics, it is not clear how they would locate or select breeding grounds after moving to a feeding location at a very different longitude. Alternatively, even in populations where there is strong within-group selection for philopatry to breeding grounds, between-group selection may favour emigrants [2], providing incentive for occasional exploration of new breeding habitats. Whatever brings them to these new breeding areas, evidence from genetics suggests that interbreeding has occurred between animals from the western and eastern South Atlantic, and between those from western Africa and Madagascar [30] showing that at least some long-distance movements lead to successful reproduction.

Movement of an individual between breeding areas separated by approximately 90 longitudinal degrees, a continent, an ocean basin and nearly 10 000 km illustrates the ability of humpback whales to range across large portions of the globe. Whatever factors resulted in this rare event, such extensive movement by an individual of a species that is typically philopatric shows the extent of behavioural flexibility in movement that may be demonstrated within a species.

This work would not be possible without the hard work and dedication of the researchers, photographers and individuals who collaborate to make the AHWG possible, and the staff and students who spend countless hours comparing photographs, especially G. McCullough who identified this miscue, and the observation presented here could be explained by either of these plausible explanations. Humpback whales may make large longitudinal movements while feeding at high latitudes, especially in changeable or unpredictable circumstances [31,32]. Such movement may occur through tracking prey, exploring potential foraging sites or in the Southern Ocean through drift with the Antarctic Circumpolar Current. Since little is known about the mechanisms that humpback whales use for navigation or for locating reproductively active conspecifics, it is not clear how they would locate or select breeding grounds after moving to a feeding location at a very different longitude. Alternatively, even in populations where there is strong within-group selection for philopatry to breeding grounds, between-group selection may favour emigrants [2], providing incentive for occasional exploration of new breeding habitats. Whatever brings them to these new breeding areas, evidence from genetics suggests that interbreeding has occurred between animals from the western and eastern South Atlantic, and between those from western Africa and Madagascar [30] showing that at least some long-distance movements lead to successful reproduction.

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