

New insight into migration patterns of western North Pacific humpback whales between the Babuyan Islands, Philippines and the Commander Islands, Russia

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ABSTRACT

The population structure of humpback whales (*Megaptera novaeangliae*) in the North Pacific has received significant attention in recent years through the collaborative Structure of Populations, Levels of Abundance, and Status of Humpback whales in the North Pacific (SPLASH) study. However, the analysis of humpback whales in the western North Pacific Asian population was limited in the SPLASH study, due to small sample size. Much of the Asian population summers off Kamchatka, Russia and spends the winters in breeding grounds in Okinawa and Ogasawara, Japan and the Babuyan Islands in the northern Philippines. Prior studies grouped the Commander Islands feeding ground in Russia, with the eastern Aleutian Islands as part of the central humpback whale stock. This paper uses additional years of photo-ID data from both the Philippines (160 whales from 2000–12) and the Commander Islands (531 whales from 2008–10) to establish a previously unreported migratory connection by matching four animals between the two sites. The new migratory linkage found in the present study suggests that a small portion of humpback whales hypothesised to be migrating to a 'missing' breeding ground in the central North Pacific are actually migrating to the Philippines. However, additional studies on a wider geographical scale are required.

KEYWORDS: HUMPBACK WHALE; ASIA; PACIFIC OCEAN; MOVEMENTS; BREEDING GROUNDS; FEEDING GROUNDS; MIGRATION; DISTRIBUTION; CONSERVATION; SURVEY-VESSEL; PHOTO-ID

INTRODUCTION

The migration patterns and population structure of North Pacific humpback whales (*Megaptera novaeangliae*) are highly complex. Humpback whales often exhibit strong site fidelity to both winter breeding and summer feeding grounds, but many whales do not conform to a single migratory path. Wintering areas in the eastern North Pacific include the mainland coast of Mexico and Central America and the offshore Revillagigedo Islands (Mexico); in the central North Pacific, the main Hawaiian Islands; in the western North Pacific, the Ogasawara and Ryukyu Islands in Japan and around the Babuyan Islands in the northern Philippines (Acebes *et al.*, 2007; Baker *et al.*, 1986; Calambokidis *et al.*, 2000; Calambokidis *et al.*, 2001; Darling and McSweeney, 1985; Nishiwaki, 1959).

While humpback whales were first scientifically documented in the northern Philippines by Yaptinchay (1999), opportunistic sightings have been recorded by local residents since the 1960's (Sumangil, 2000; Tan, 1995). Dedicated small-vessel research surveys in the Philippines began in 2000 and have continued every year since, albeit on varying spatial and temporal scales. Previous photographic comparisons found 12 humpback whales from the Babuyan Islands that matched whales in the breeding grounds off Okinawa and Ogasawara, including one animal that moved between Ogasawara and the Philippines in one season (Acebes *et al.*, 2007; Yamaguchi *et al.*, 2002). Additional matches have been made between Philippine and

Japanese breeding grounds, as well as one match to the main Hawaiian Islands (Calambokidis *et al.*, 2008). Earlier connections between Japanese and Hawaiian breeding grounds (Darling and Cerchio, 1993; Salden *et al.*, 1999) and between Japan and eastern Pacific feeding grounds (Calambokidis *et al.*, 2001; Darling *et al.*, 1996) have been reported, although infrequently.

Calambokidis *et al.* (2008) suggested that the predominant feeding ground used by Philippine humpbacks is the area off the Kamchatka Peninsula in Russia, as demonstrated by six photographic matches between the two regions. No matches were found to the adjacent Commander Islands, which were subsequently grouped with the Aleutian Island and Bering Sea populations. Three of seventeen humpback whales from the Commander Islands matched individuals in breeding grounds with one match each to Ogasawara, Hawaii, and the Revillagigedo Archipelago. In contrast, whales using Kamchatka feeding grounds were matched only to Japan and the Philippines (Barlow *et al.*, 2011; Calambokidis *et al.*, 2008). Low sample sizes in both Philippine ($n = 77$) and Russian waters ($n = 17$ from Commander Islands, $n = 102$ from all Russian sites) contributed to uncertainty regarding the migration of humpback whales in the western North Pacific. The purpose of this study was to examine additional years of data from the Babuyan Islands, Philippines (2000–12) and compare photographs with an expanded catalogue of whales from the Commander Islands (whales seen from 2008–10) to investigate the interconnectivity between the two areas.

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METHODS

Small vessel surveys were conducted from 2000–06 off all of the islands in the Babuyan chain (18°53'N, 121°51'E): Camiguin, Fuga, Babuyan Claro, Calayan and Dalupiri (see Acebes *et al.*, 2007). From 2007 onwards, due to logistical constraints, surveys were limited to the western coast of Camiguin Island where the sighting frequency was highest (Fig. 1). All surveys were conducted between February and May, however this varied annually (Table 2). Predetermined tracklines were followed along the western coast of Camiguin Island with track legs running perpendicular and parallel (alternately) to shore. The choice of which trackline to follow was dependent on sea conditions and time of day. When a whale was encountered, the fluke(s) were photographed and recordings were made of behaviour, composition of the group and the presence of other cetacean species.

Photos were graded using an established process (Calambokidis *et al.*, 2008; Calambokidis *et al.*, 2000; Calambokidis *et al.*, 1997). Best fluke shots were scored on a 1–5 scale for quality of proportion visible, vertical angle, lateral angle, focus/sharpness and exposure. Any flukes were removed that scored a three in more than three quality categories, or that received any score of four or higher in any category. Photographic matches were made by at least one

of two experienced personnel. All fluke matches were verified by at least three experienced personnel.

Catalogued flukes from the Commander Islands (55°03'N, 166°17'E) came from two separate groups: the Kamchatka Branch of Pacific Institute of Geography (KBPIG) and the State Nature Reserve Komandorski (SNRK) (Fig. 1). Surveys included in the KBPIG catalogue were conducted between June and September from 2008–10 and surveys included in the SNRK catalogue were conducted between September and November in 2009 (Table 3).

RESULTS

There were 160 humpback whales which met the photographic criteria to be included the Philippine catalogue, representing a minimum population number for the breeding area around the Babuyan Islands. For the Commander Islands, after reconciling the SNRK (2008) and KBPIG (2008–10) catalogues, 66 whales were included from the SNRK catalogue and 465 whales were included in the KBPIG catalogue ($n = 531$).

Four photographic matches were made between the Philippine and Commander Island catalogues (Table 1). None of the animals were seen in both areas in the same year and none have been seen in the Philippines since 2006.

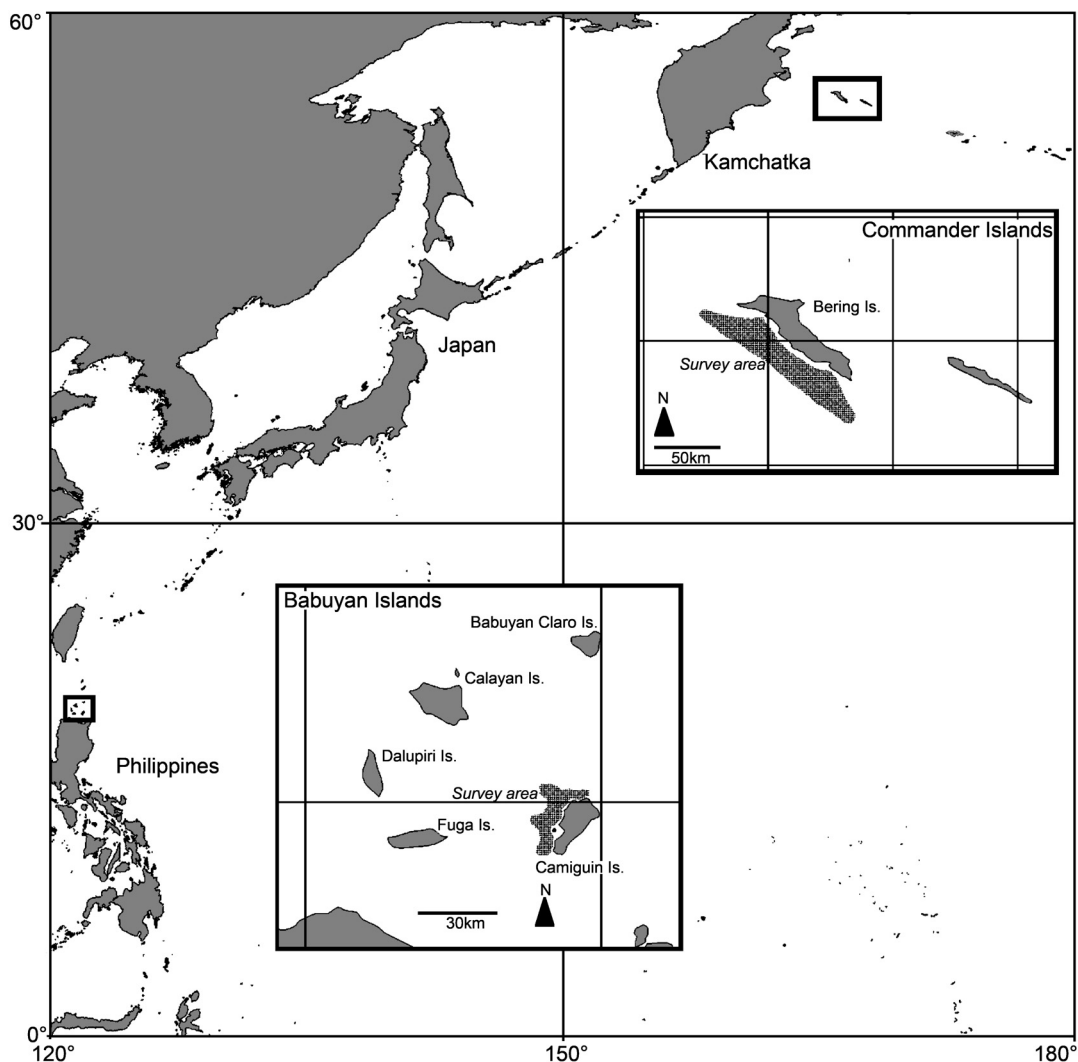


Fig. 1. Humpback whale survey areas in the Babuyan Islands, Philippines and the Commander Islands, Russia.

Table 1

Photographic matches of humpback whales between winter breeding grounds in the Babuyan Islands, Philippines and summer feeding grounds in the Commander Islands, Russia.

SPLASH ID ¹	Philippines ID	Years sighted: Philippines	Commander Islands ID	Year sighted: Commander Is.	Other sightings ¹
N/A	PH008	2001, 2002	066 (SNRK)	2009	–
440014	PH013	2002, 2004	598 (KBPIG)	2010	–
540207	PH063	2003, 2005	254 (KBPIG)	2010	–
440069	PH087	2004, 2006	071 (SNRK)	2009	Ogasawara 2005

¹From SPLASH structure of populations, levels of abundance, and status of humpbacks (see Calambokidis *et al.*, 2008).

PH008 and PH087 were presumed to be male, as they were seen as escorts in 2002 and 2004, respectively. The sexes of PH013 (Fig. 2) and PH063 are unknown.

DISCUSSION

By photographically matching four whales between the Philippines and Commander Islands, these results suggest that the inclusion by Calambokidis *et al.* (2008) of the Commander Islands in a geographical grouping with the Aleutian Islands and Bering Sea populations may not represent the true variability in stock structure within western North Pacific humpback whales. However, the process of assigning individual whales to one specific stock is heavily influenced by uneven sampling effort and may not be representative of the stock structure across the entire North Pacific. Stable isotope analysis has shown that individuals from a particular feeding ground may not migrate to a single breeding area (Witteveen *et al.*, 2009), which is also supported by photographic evidence (Acebes *et al.*, 2007; Calambokidis *et al.*, 2008; Darling and Cerchio, 1993; Salden *et al.*, 1999). Historically, humpback whales feeding off the Commander and Aleutian Islands have a lower match

rate to known breeding grounds than whales from other feeding areas, which led to the proposed existence of an ‘undiscovered wintering area’ in the North Pacific (Calambokidis *et al.*, 2008). It has been hypothesised that the Northwest Hawaiian Islands (NWHI) could represent this missing breeding ground (Johnston *et al.*, 2007; Lammers *et al.*, 2011). Based on 17 whales, Calambokidis *et al.* (2008) found a 17% match rate of Commander Island whales to three geographically distinct breeding grounds spread across the North Pacific, including Ogasawara. The match rate in this study of <1% of Commander Island humpback whales is low. However, this study shows that, along with the previous photographic match to Japan (Calambokidis *et al.*, 2008), at least some portion of the humpback whales feeding around the Commander Islands migrate to Asian breeding grounds, including the Philippines.

The population structure of humpback whales on Asian breeding grounds remains unclear. Photographic matches between Ogasawara and Okinawa in Japan were lower than expected considering the relatively short distance between them (Calambokidis *et al.*, 2008; Calambokidis *et al.*, 2001; Darling and Mori, 1993). Genetic analysis of the SPLASH dataset showed high levels of complexity within the Asian population with significant differences in haplotype frequency between adjacent breeding areas of Okinawa and Ogasawara, as well as between Okinawa and Russia (Baker *et al.*, 2008). However, photographic matches exist between both Japanese breeding grounds and the Philippines, suggesting some interchange between breeding grounds.

Table 2

Survey effort to collect humpback whale fluke photographs in the Babuyan Islands, Philippines winter breeding ground from 2000 to 2012.

Year	Survey group	Survey season	No. survey days
2000	WWF	Apr.	14
2001	WWF	Mar.–Apr.	43
2002	WWF	Mar.–May	47
2003	WWF	Feb.–May	51
2004	WWF	Mar.–Apr.	33
2005	WWF	Feb.–May	60
2006	WWF	Feb.–Apr.	79
2007	Balyena.org	Mar.–Apr.	30
2008	Balyena.org	Mar.–Apr.	29
2009	Balyena.org	Mar.–Apr.	26
2010	Balyena.org	Mar.	13
2011	Balyena.org	Feb.–Apr.	28
2012	Balyena.org	Mar.–Apr.	32

Table 3

Survey effort to collect humpback whale fluke photographs in the Commander Islands, Russia summer feeding ground from 2008 to 2010.

Year	Survey group	Survey season	No. survey days
2008	KBPIG	Jun.–Sep.	7
2009	SNRK	Sep.–Nov.	10
2009	KBPIG	Jun.–Sep.	7
2010	KBPIG	Jun.–Sep.	41



Fig. 2. (a) Individual humpback whale (PH013/SPLASH ID 440014) seen in the Babuyan Islands, Philippines breeding ground in the winters of 2002 and 2004. (b) Same individual humpback whale (#598) seen in the Commander Islands, Russia feeding ground in the summer of 2010.

The range of humpback whales within the Philippines also remains uncertain, as to date, no dedicated surveys have been conducted off much of northern Luzon. A 2003 survey that found a mother-calf pair off the eastern coast of northern Sierra Madre, Luzon suggests that the breeding ground may extend further south in the archipelago (Acebes *et al.*, 2007). Historical whaling records indicate that humpback whales had a much wider distribution in the Philippines including areas south and east of Mindanao, southwest of Palawan and in the Sulu Sea between 0° and 10°N and 116° and 131°E (Slijper *et al.*, 1964; for map see Acebes 2009). It is unclear whether this population was a northern extension of Southern Hemisphere humpback range, part of the North Pacific stock, or represented a region of seasonally distinct overlapping habitat use by Southern and Northern Hemisphere whales, such as occurs in Central America (Rasmussen *et al.*, 2011). No recent sightings of humpback whales have been confirmed in Philippine waters south of Luzon or north of the Celebes (Sulawesi) Sea.

Whaling for humpbacks in the 1950s and 1960s in Russian waters (Doroshenko, 2000; Ivashchenko *et al.*) and on Japanese breeding grounds (Nishiwaki, 1959; Rice, 1978) severely depleted western North Pacific stocks of humpback whales. As populations potentially return to historical ranges and recover from whaling, new insight into their distribution and migratory paths are critical to understand stock structure in the western North Pacific. Further studies on Asian humpback whale breeding grounds are necessary to determine how humpback whales in the Philippines fit into the larger population structure in the North Pacific.

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