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Short Communication

Blue whales *Balaenoptera musculus* in offshore waters of Kenya

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Observations of blue whales were made in Kenyan offshore waters during a seismic survey from September 2014 to January 2015. These represent the first live at-sea sightings of blue whales reported from Kenyan waters. All 30 sightings occurred between September and October in waters ranging from 2 990 to 4 705 m depth. It is unknown to which of the three possible subspecies the animals sighted belong. Based on timing and geographical location, they are likely to have been either Antarctic blue whales *Balaenoptera musculus intermedia*, Madagascar pygmy blue whales *B. m. brevicauda* or northern Indian Ocean blue whales *B. m. indica*.

Keywords: cetacean, distribution, western Indian Ocean

Introduction

The blue whale *Balaenoptera musculus* is the largest animal to have lived on Earth, reaching lengths of greater than 30 m (Jefferson et al. 2008). Following extensive exploitation during the 20th century, numbers were reduced dramatically and now stand at 3–11% of the estimated population in 1911 (Reilly et al. 2008), the species being listed as 'Endangered' on the International Union for the Conservation of Nature (IUCN) Red List (Reilly et al. 2008). At least five subspecies of blue whale are currently recognised (Committee on Taxonomy 2015; Thomas et al. 2015), with at least nine acoustic populations (McDonald et al. 2006). In the Indian Ocean, there are three recognised subspecies, the Antarctic blue whale *B. m. intermedia*, the slightly smaller pygmy blue whale *B. m. brevicauda*, and the northern Indian Ocean blue whale *B. m. indica* (Branch et al. 2007a; Anderson et al. 2012). The Antarctic blue whale is listed as 'Critically Endangered' and the pygmy blue whale as 'Data Deficient' (IUCN 2015; Thomas et al. 2015). An absence of abundance data has precluded assessment of the northern Indian Ocean subspecies (Thomas et al. 2015). In addition, there remains some ambiguity regarding whether it is a valid subspecies, with some authors considering that it is not significantly different from pygmy blue whales (Mikhalev 1996; Branch and Mikhalev 2008). Evidence of an offset breeding cycle is weak, because it is based on whaling data from a single month (Zemsky and Sazhinov 1982). Recent acoustic studies indicate that there are four acoustic populations in the Indian Ocean, including two separate pygmy blue whale populations (Madagascar and Australia), as well as northern Indian Ocean and Antarctic blue whales, each of which has distinct call types (Stafford et al. 2011; Samaran et al. 2013). For the purposes of this study, we will focus on the three subspecies found in the western Indian Ocean; the

Antarctic blue whale, the northern Indian Ocean blue whale and the Madagascan pygmy blue whale.

At least some of the population of Antarctic blue whales migrate from Antarctic waters, where they spend the austral summer, to low-latitude wintering areas that include parts of the northern Indian Ocean (Stafford et al. 2004; Branch et al. 2007a). It appears that some of the population remains in Antarctic waters during winter months (Širović et al. 2004) and some remain in mid-latitude areas, such as around the sub-Antarctic Crozet Islands (Samaran et al. 2010). In contrast, pygmy blue whales do not migrate to the Antarctic in summer and are rare south of 60° S (Kato et al. 1995; Branch et al. 2007b, 2009; Gedamke and Robinson 2010). Branch et al. (2009) estimated that 0.1% of the blue whale population south of 52° S are pygmy blue whales. The two Indian Ocean populations of pygmy blue whales, however, do undertake seasonal migrations within the region (Branch et al. 2007a; Samaran et al. 2010, 2013). The northern Indian Ocean blue whale population appears to be concentrated in tropical waters year-round within a relatively limited area between Somalia and Sri Lanka, but does show some intraregional movements, migrating between high- and low-latitude areas (Kasuya and Wada 1991; Small and Small 1991; Anderson et al. 2012), with some individuals also recorded south of the equator (Samaran et al. 2010, 2013; Stafford et al. 2011). It is clear that gaps remain in knowledge and understanding of blue whale distribution and movement within the Indian Ocean, especially in more remote, offshore areas where there is limited research effort.

Very little is known about the presence, distribution, and seasonality of blue whales (and cetaceans in general) off the coast of Kenya. Research currently conducted is based in coastal areas (Kenya Marine Mammal Network 2013),

with little or no work being undertaken in more remote offshore areas. In addition, there are no recorded strandings of blue whales in Kenya, with only one individual reported farther north off the Arabian Peninsula (Anderson et al. 2012). Here we present new sightings of blue whales, which were recorded by trained and dedicated marine mammal observers during a geophysical survey conducted 120 nautical miles off the Kenyan coast. The observers implemented a mitigation protocol, in addition to collecting sightings data during the survey.

Material and methods

Sightings data were collected during a geophysical offshore seismic survey off Kenya (2° – 3° S) between September 2014 and January 2015. The survey site was located 120 nautical miles (224.24 km) north-east of Lamu in waters c. 2 700–4 700 m deep and covering an area of some 6 000 km² (Figure 1). Throughout the survey, marine mammal watches were conducted by dedicated observers from the bridge and bridge wings of the survey vessel, at a height of 22 m. Between one and three observers were on watch throughout all daylight hours and scanned around the vessel with the naked eye and binoculars (8 \times magnification). Effort logs were completed at least once per hour during every marine mammal watch, and position, water depth, vessel activity and environmental data, including Beaufort wind speed, sea state, swell height, and visibility, were recorded. When marine mammals were sighted, the species identification, number of individuals, behaviour, distance, bearing, and position were recorded. Observers also used digital SLR cameras with 100–300 mm zoom lenses to aid identification. Effort was conducted during: (i) dedicated seismic survey lines; (ii) line turns; and (iii) transit to and from sites during daylight hours. Vessel speed ranged from 0.4–15.7 knots (0.2–8.1 m s⁻¹), with a mean of 3.5 knots (1.8 m s⁻¹).

Results

In total, 1 309 hours and 55 minutes of dedicated survey effort were completed by the observers over a period of 127 days between 9 September 2014 and 15 January 2015. There were a total of 30 confirmed sightings of 38 individual blue whales, all of which occurred during the first two months of the survey (September and October). The distribution of sightings is shown in Figure 1. Figure 2 shows the total effort, percentage of effort completed in each sea state for each month of the survey and the number of sightings. Most of the sightings were of individual animals, although groups of up to three animals were recorded. Individuals in 15 of these encounters were photographed (see Figure 3 for an example). A summary of the sightings is provided in Table 1.

Discussion

According to the nineteenth century whaling records, blue whales were regularly reported in the western Indian Ocean off the Somali coast, especially in the Gulf of Aden during September and November (Anderson et al. 2012). Japanese scouting ships reported seven blue whales

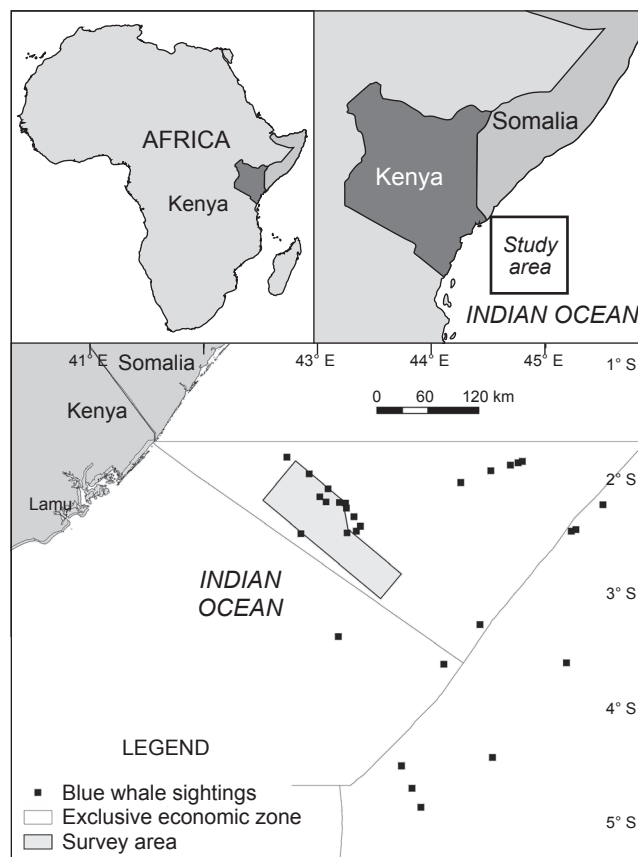


Figure 1: Sightings of blue whales recorded during a geophysical survey in Kenyan offshore waters, September 2014–January 2015. Note that sightings recorded outside of the survey area were recorded either when the vessel was turning between seismic survey lines or when deploying/recovering seismic survey equipment

at $00^{\circ}22'$ N, $50^{\circ}31'$ E, offshore of the southern coast of Somalia, in March 1982 (Kasuya and Wada 1991) and Small and Small (1991) reported sightings of 18 blue whales off the coast of Somalia in October, November and December 1985. The 30 recorded sightings of blue whales reported here represent the first known at-sea sightings of this species off the Kenyan coast. These observations are consistent with the knowledge of the occurrence of this species within the wider western Indian Ocean. Blue whales are generally associated with deep water throughout most of their range, with occurrences in shallower water usually recorded from regions with narrow continental shelves or in areas immediately adjacent to deeper water (Branch et al. 2007a). All sightings during the current survey occurred in waters ranging between 2 990 m and 4 705 m deep. None were recorded during transit to the survey area in shallower waters. Blue whales have high energy demands and their distribution year-round is linked to areas of high productivity and high euphausiid density (Branch et al. 2007a; Anderson et al. 2012). In contrast to other species of baleen whale that do not feed on winter breeding grounds, blue whales appear to seek out high productivity areas during both winter and summer (Branch et al. 2007a; Calambokidis et

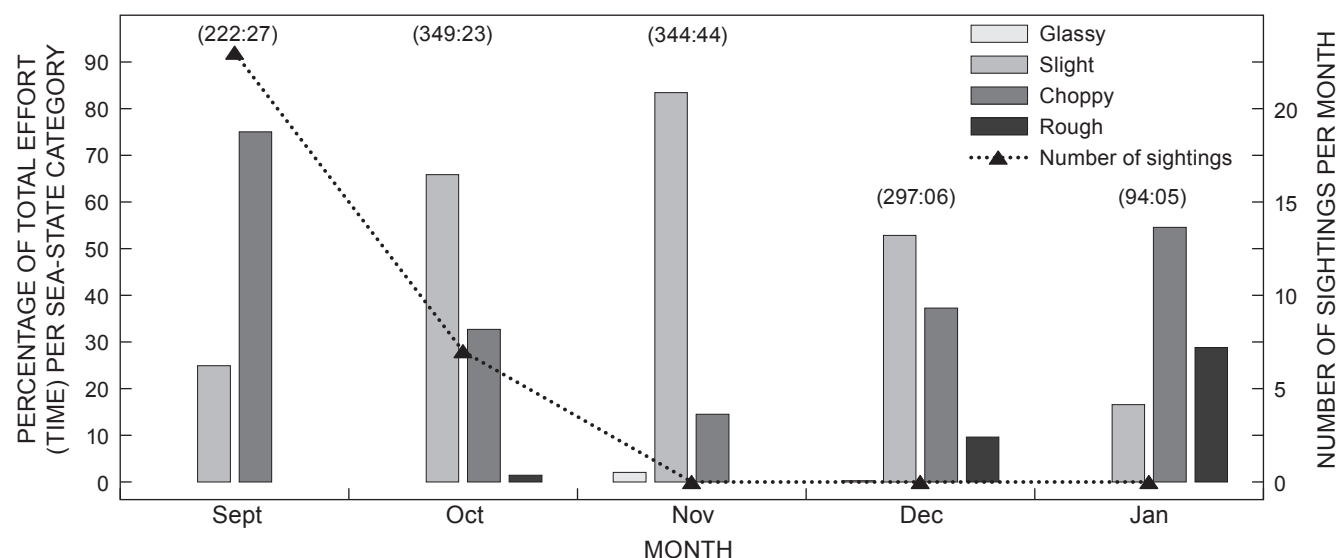


Figure 2: Percentage of effort completed in each sea state during each month (left axis) and number of sightings (right axis), September 2014–January 2015. Total effort (h:min) per month shown in brackets

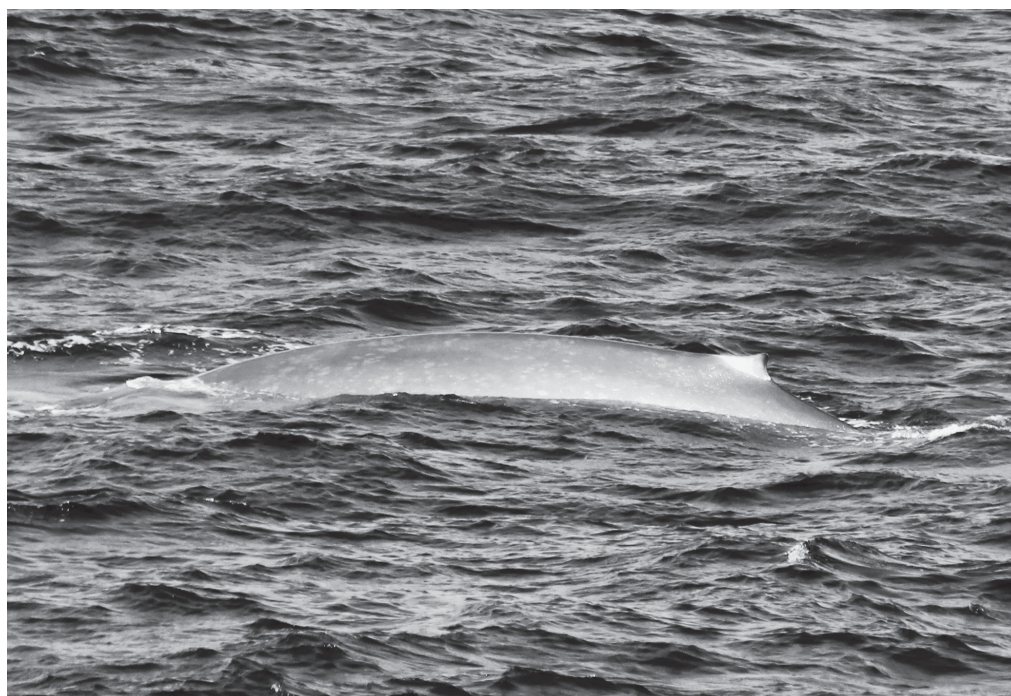


Figure 3: Example of individual blue whale photographed during the geophysical survey offshore Kenyan waters. Note the spinal ridge, small dorsal fin and mottled colouring characteristic of this species

al. 2009; Samaran et al. 2010, 2013; Anderson et al. 2012). Productivity in such areas is created by physical processes and may vary on an interannual, seasonal, and intraseasonal time-scale (Palacios et al. 2006). Oceanography and primary productivity off the Kenyan coast are affected by the seasonally reversing monsoon winds that are driven by the migration of the Intertropical Convergence Zone, which creates two seasons; the North-West Monsoon and the South-East Monsoon (McClanahan 1988). The

current survey was conducted at the end of the South-East Monsoon (May–October) and in the months heading into the North-West Monsoon period (December–March). However, all 30 sightings of blue whales occurred during the first two months of the survey (September and October) at the end of the South-East Monsoon period. During the South-East Monsoon, major upwellings of nutrient-rich waters and associated plankton productivity occur particularly off the Somali coast (McClanahan 1988; Isaac and

Table 1: Summary of blue whale sightings recorded during the geophysical survey off Kenya, September 2014–January 2015

Date	Location of sightings	Number of individuals	Photograph
13 September 2014	1°55.11' S, 44°31.25' E	1	Yes
	1°52.17' S, 44°41.56' E	1	Yes
	1°50.88' S, 44°45.52' E	2	Yes
	1°50.12' S, 44°47.82' E	1	Yes
14 September 2014	2°13.05' S, 45°30.20' E	1	Yes
	2°26.01' S, 45°16.00' E	1	No
	2°26.90' S, 45°13.58' E	1	Yes
15 September 2014	3°16.18' S, 44°25.46' E	1	No
	3°36.34' S, 45°11.02' E	2	No
16 September 2014	4°52.41' S, 43°54.36' E	1	No
	4°42.44' S, 43°49.69' E	2	Yes
	4°30.67' S, 43°44.18' E	1	Yes
	4°30.67' S, 43°44.18' E	1	Yes
17 September 2014	3°22.56' S, 43°10.91' E	2	Yes
19 September 2014	2°12.16' S, 43°14.63' E	1	No
20 September 2014	2°04.61' S, 43°05.45' E	1	No
23 September 2014	1°56.79' S, 42°55.58' E	1	Yes
24 September 2014	2°24.32' S, 43°22.49' E	1	Yes
25 September 2014	2°08.80' S, 43°01.18' E	2	No
	2°11.54' S, 43°04.45' E	2	No
26 September 2014	1°47.89' S, 42°43.80' E	1	Yes
27 September 2014	2°14.81' S, 43°15.09' E	1	Yes
	2°11.77' S, 43°11.47' E	1	No
01 October 2014	2°19.41' S, 43°19.15' E	1	No
05 October 2014	2°26.92' S, 43°20.40' E	3	Yes
08 October 2014	4°26.30' S, 44°32.08' E	1	No
09 October 2014	3°37.11' S, 44°32.08' E	1	No
14 October 2014	2°27.85' S, 43°15.47' E	1	No
	2°28.20' S, 42°51.26' E	1	No
18 October 2014	2°01.32' S, 44°15.38' E	1	No
Total	30	38	15

Isaac 1968). These major upwellings break down during the North-West Monsoon, although a slight upwelling could occur where the Somali Counter Current and East African Coastal Current converge and flow offshore from northern Kenya (McClanahan 1988). The absence of sightings after October suggests that blue whales are present in the area seasonally. Figure 2 indicates that effort and weather did not have an influence on the probability of sighting blue whales, given that effort remained high in all months (other than in January, during which the observation period ended) and sea state was no worse after October than in months when sightings were recorded. The subspecies of the whales sighted could not be determined and might have been any of Antarctic blue whales, Madagascan pygmy blue whales or northern Indian Ocean blue whales, which might have been using the survey area as a feeding ground or could have been in transit, migrating through the area from major upwelling areas farther north.

Antarctic blue whale

Previous research has shown that Antarctic blue whales are known to occur in low-latitude areas. Stafford et al. (2004) recorded Antarctic-type calls using hydrophone stations

located at Diego Garcia (at 6.3° S and 7.6° S) from May to September. Samaran et al. (2013) also recorded Antarctic blue whales at three locations in mid- to low latitudes, including a station located in the western subtropical Indian Ocean in the Madagascan Basin. Although not as common as pygmy blue whale calls, and more isolated, Antarctic blue whale calls were recorded year-round, but were highest from July to September. Sightings recorded during the current survey might have been Antarctic blue whales that had been feeding in areas of high productivity in the survey area, before migrating south, or individuals moving south after feeding in areas farther north.

Madagascan pygmy blue whale

Based on Soviet whaling data, Zemsky and Sazhinov (1982) postulated that pygmy blue whales from the sub-Antarctic region move south from around the Seychelles through the Mozambique Channel, past Madagascar to the Crozet Islands, where they spend the austral spring/summer and then return during autumn. Considerable numbers of Madagascan pygmy blue whales have been sighted in the sub-Antarctic, where Branch et al. (2007a) suspect they are distributed between Africa and Australia

from January to March (summer). Gedamke and Robinson (2010) recorded Madagascan pygmy blue whales off Prydz Bay in Antarctica during January and February 2006, indicating at least part of the population moves farther south. They are then believed to move north for the winter (Branch et al. 2007a).

Little is known about the winter and spring distributions, although Madagascan acoustic recordings were earlier made in May and June (Stafford et al. 2011), whereas historical whaling data indicate part of this population might be found near the South African coast in winter, although the current status is unknown (Branch et al. 2007a). Although very few sightings from around the Seychelles have been reported post-whaling (Anderson et al. 2012; Gardline Environmental Ltd, unpublished data), high numbers of pygmy blue whale sightings have been recorded from the Madagascan Plateau (Best et al. 2003). In the Madagascan Basin, Samaran et al. (2010, 2013) recorded Madagascar call types only in autumn and winter (March–August), but with calls recorded farther south from summer to winter (December–August). There is also some evidence that at least part of this population moves farther north, with Madagascar call types recorded near Diego Garcia during May and June (Stafford et al. 2011). Therefore, the whales sighted during the current survey might have been members of this population feeding in localised upwellings off northern Kenya at the end of spring, before moving south via the Madagascan Basin to the sub-Antarctic.

Northern Indian Ocean blue whale

The whales sighted might have been northern Indian Ocean blue whales. This population tends to feed in highly productive, upwelling zones associated with the South-East Monsoon period, mainly off the western Arabian Sea (off Somalia and the Arabian Peninsula) and the south-west coast of India and Sri Lanka. Such upwelling zones subside during October to November with the switch to the North-West Monsoon. The blue whales then disperse to seek more-localised zooplankton concentrations in locations such as the east coast of Sri Lanka and the west of the Maldives (Anderson et al. 2012). Stafford et al. (2011) reported that calls at a more southerly station off Diego Garcia peaked during the winter (June–August) and spring and summer (September–February), whereas calls at a more northerly station were detected more often from March to June (autumn to beginning of winter). The authors suggest that whales move south during summer and north during winter.

At least some part of the population moves considerably farther south. Samaran et al. (2013) recorded Sri Lanka (i.e. northern Indian Ocean blue whale) call types year-round at a station north-east of the Amsterdam Islands (31° S), but primarily during December to January (summer), whereas calls at a more southerly station (42° S) were recorded only during summer. Samaran et al. (2010) recorded Sri Lanka call types during the austral spring and summer in the sub-Antarctic Crozet region. Anderson et al. (2012) suggested that the area off Diego Garcia is not an important feeding ground for the population detected there, but is on a migration route, potentially to the Amsterdam Islands or Crozet Islands (Samaran et al. 2010, 2013).

Sightings during the current survey off northern Kenya might represent members of this population using the area as a feeding ground during upwelling events caused by the South-East Monsoon, before dispersing south after October as the upwelling subsides. Alternatively, the area could be part of a migratory route for individuals that had been feeding farther north off Somalia before moving south to feeding areas around the Amsterdam or Crozet Islands.

Conclusions

The sightings during the current survey suggest that the area off northern Kenya forms an important habitat for blue whales in the Indian Ocean, at least during the end of the South-East Monsoon period. Whether the waters off Kenya are a feeding ground or on a migratory route is not known. The subspecies of blue whale recorded during the current series of observations could not be determined in the absence of acoustic or genetic studies. Photo-identification matching of the photographs taken during the survey, however, could help to identify links with blue whale populations in the Indian Ocean. Further survey work would be required to establish blue whale presence during the remainder of the year outside the current study period, especially during the earlier part of the South-East Monsoon. Such data could help to establish whether whales are using the area throughout the monsoon season as a feeding area, or are moving through it from areas farther north. As with other areas of the Indian Ocean, it could be that more than one subspecies uses this area (Samaran et al. 2010, 2013), and this could be investigated using a combination of further sightings data, genetic analysis, acoustic records and photo-matching.

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