



NOTE

# Acoustic detections and sightings of blue whales *Balaenoptera musculus* in the Seychelles, western tropical Indian Ocean (2020–2022)

Kathleen M. Stafford<sup>1,\*</sup>, Germain Boussarie<sup>2</sup>, Michelle Caputo<sup>2</sup>, Ladd Irvine<sup>1</sup>,  
Stuart Laing<sup>3</sup>, Ella Nancy<sup>3</sup>, Hugh Pearson<sup>4</sup>, Jeremy J. Kiszka<sup>2,5</sup>

<sup>1</sup>Marine Mammal Institute, Oregon State University, OR 97365, USA

<sup>2</sup>Institute of Environment, Department of Biological Sciences, Florida International University, North Miami, FL 33181, USA

<sup>3</sup>University of Seychelles, Department of Environmental Sciences, Mahé, Seychelles

<sup>4</sup>Oceanic Films, Gloucestershire GL-1, UK

<sup>5</sup>Island Biodiversity and Conservation Centre, University of Seychelles, Anse Royale Campus, Box 1348, Victoria, Mahé, Republic of Seychelles

**ABSTRACT:** Historically, the Seychelles archipelago was an opportunistic whaling ground for fleets en route to and from the Antarctic. Soviet whalers illegally killed 500 blue whales near the Seychelles in the 1960s. Since then, no dedicated research has occurred to understand the ecological importance of this region for blue whales. Based on opportunistic sightings, we undertook 2 expeditions to assess the occurrence of blue whales. The overall goals were to determine blue whale distribution, obtain photo-identification data and collect the first acoustic data on this species in this region using a hydrophone deployed for a year. The expeditions consisted of vessel-based visual surveys that focused on the slope habitat (500–2000 m) off the northern portion of the Mahé Plateau. Over the 2 expeditions, a total of 5 sightings of up to 10 animals were seen. The results of our acoustic monitoring off Seychelles demonstrate that blue whales occur there regularly, primarily from December to April, and that the acoustic population identity matches that from near Sri Lanka. Published records and the results of our work suggest that blue whales from the northwestern Indian Ocean are seasonally present in the western equatorial Indian Ocean.

**KEY WORDS:** Blue whale · Seychelles · Distribution · Acoustics · Visual survey · Indian Ocean

## 1. INTRODUCTION

In 1978, as a new member of the International Whaling Commission (IWC), the Republic of Seychelles proposed that the Indian Ocean be designated as a whale sanctuary, which was implemented in 1979 (Holt 1983). The Seychelles, an archipelago in the western tropical Indian Ocean, is characterized by a high abundance and diversity of cetaceans.

As such, the Mahé Plateau, in the eastern Seychelles, has been designated as an Important Marine Mammal Area by the International Union for the Conservation of Nature (IUCN-Marine Mammal Protected Areas Task Force 2021). Historically, the Seychelles archipelago as a whole was an opportunistic whaling ground for fleets on their way to and from the Antarctic, particularly for blue whales *Balaenoptera musculus* spp. and sperm whales *Physeter macrocephalus*.

\*Corresponding author: kate.stafford@oregonstate.edu

Soviet whalers during the 20<sup>th</sup> Century killed 500 blue whales near the Seychelles in the 1960s (Branch et al. 2007, 2018, Ivashchenko et al. 2011). To date, no dedicated research has been carried out to understand the ecological importance of this region for blue whales or how populations have recovered from whaling.

At the regional level, the conservation status of blue whales remains poorly known decades after commercial and illegal whaling in the region removed over 12 000 pygmy blue whales *B. m. breviceauda* from the Indian Ocean (Branch et al. 2023). Most of what is known of the current distribution and population identity of blue whales in this region is from passive acoustic monitoring studies that provide acoustic population identity, seasonality and general distribution of acoustically active whales (Leroy et al. 2018, Torterotot et al. 2020). While these data do not provide information on their abundance or demographics, the Indian Ocean may encompass the distribution of up to 6 different acoustic populations of blue whales, including Antarctic blue whales (Leroy et al. 2018). Opportunistic sightings of blue whales off Kenya, Somalia, Pakistan, the Maldives and Sri Lanka (Robineau 1991, Small & Small 1991, Anderson et al. 2012, Gore et al. 2012, Barber et al. 2016, Anderson & Alagiyawadu, 2019, Russell et al. 2020) suggest that the western tropical Indian Ocean may be a region where blue whales occur regularly. The only region in the Indian Ocean where blue whales have been the subject of frequent and relatively long-term studies is Sri Lanka (e.g. Alling et al. 1991, Ilan-gakoon & Sathasivam 2012, De Vos et al. 2014, Kirumbara et al. 2022, Liyanage et al. 2023).

There is an ongoing debate on the taxonomy of blue whales in the western Indian Ocean, and the Southern Hemisphere in general, and 4 subspecies are currently recognized by the Committee on Taxonomy of the Society for Marine Mammalogy, including 3 (Antarctic *B. m. intermedia*, pygmy *B. m. breviceauda*, and Northern Indian Ocean *B. m. indica*) that potentially occur in the Seychelles. Each has a different conservation status, with the Antarctic blue whale considered 'Critically Endangered' while 'pygmy' and northern Indian Ocean blue whales are listed as 'Data Deficient' or 'Endangered' on the IUCN Red List of Threatened Species (Cooke 2018).

Sightings and whaling records have documented blue whales in the Seychelles since the early 1960s (reviewed in Branch et al. 2007), including a sighting of 2 blue whales very close to shore of D'Arros Island in November 2016 (Save Our Seas Foundation 2016).

More recently, in October 2017, 2 opportunistic blue whale sightings in the northern Seychelles were reported to one of the authors (H. Pearson), including a feeding aggregation of at least 6 individuals (Fig. 1). However, the current abundance, seasonality, population identity and spatial distribution of blue whales are unknown for this region, information which is critical for establishing conservation and management recommendations.

## 2. MATERIALS AND METHODS

In November 2020 and 2021, 2 expeditions were organized to assess the occurrence of blue whales off the northern Seychelles, where the opportunistic sightings were reported in October 2017 (Fig. 1). The overall goals were to determine blue whale distribution, obtain photo-identification data and collect the first acoustic data on this species in this region. The expeditions consisted of vessel-based visual surveys that focused on the slope habitat (500–2000 m) off the northern portion of the Mahé Plateau. On 30–31 October 2021, reconnaissance flights were carried out in the northern Seychelles to direct vessel-based efforts (Fig. 1). Visual surveys from the 2 vessels involved 2 to 6 observers scanning 180° in front of the boat during daylight hours. The vessel used in 2020 was a motorsailer with an observation platform 4 m off the water while that used in 2021 was a supply vessel whose wheelhouse was 9.5 m off the water and thus had a greater range for visual detections. When blue whales were sighted, they were approached slowly to obtain group size and behavior and photo-identification of both left and right sides of the dorsal region were taken.

In November 2021, an acoustic recorder (Sound-Trap ST600SD, Ocean Instruments) was deployed near Denis Island (Fig. 1) to obtain year-round recordings to assess the occurrence of blue whales and ascertain their acoustic population identity. This location was selected as it was relatively close to recent blue whale sightings. The acoustic recorder was deployed by divers at 24 m water depth on 3 November 2021 and recovered on 2 November 2022 (Fig. 1). The data were collected on a duty cycle of 15 min h<sup>-1</sup> and down-sampled from 48 to 4.8 kHz for analysis.

Hourly long-term spectral average plots were used to search for blue whale signals. Once calls were found, spectrogram correlation with a detection threshold of 0.3, in Ishmael (Mellinger 2001), was

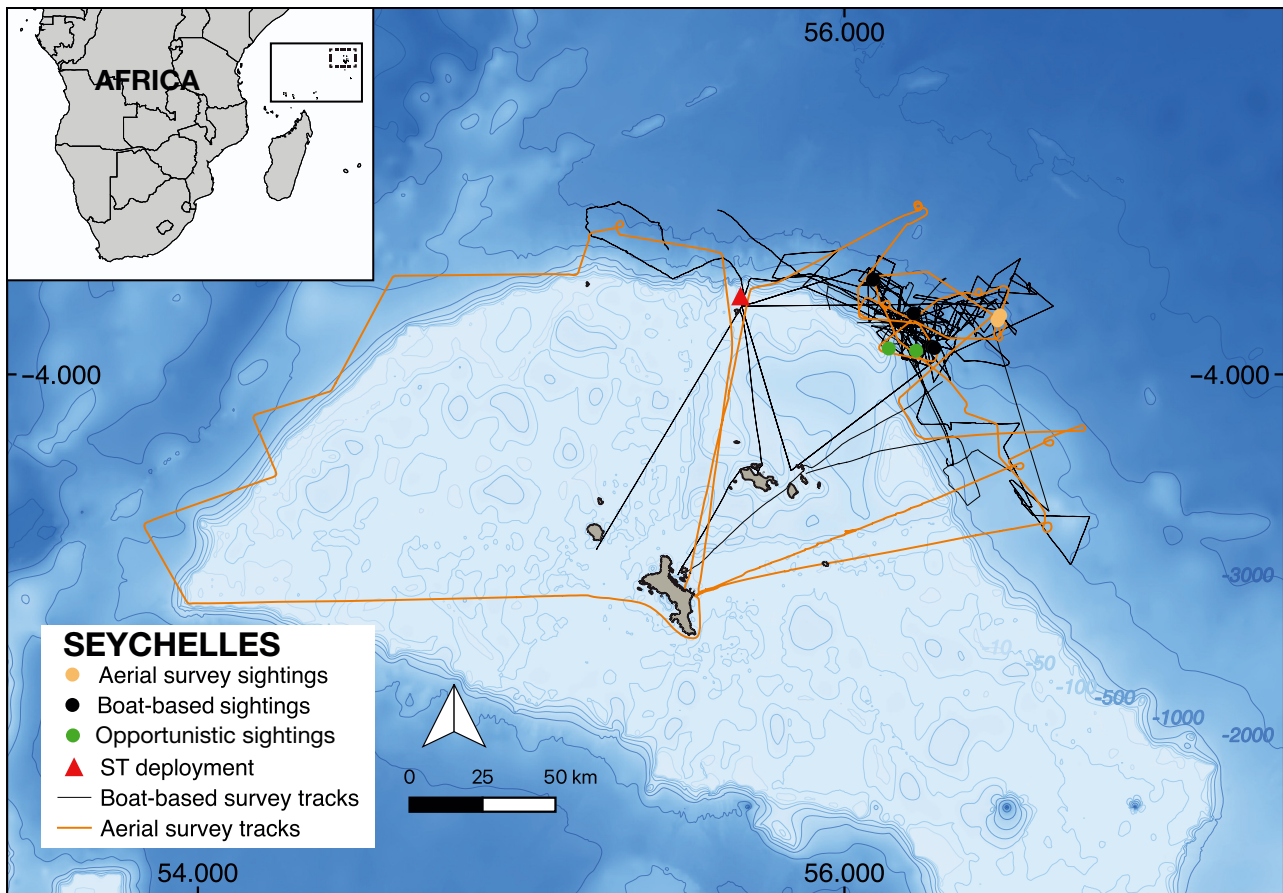


Fig. 1. Vessel (black lines) and aerial survey (orange lines) effort and blue whale sightings (black and orange dots) during November 2020 and 2021. Green dots: opportunistic sightings from October 2017. Red triangle: acoustic recorder location. ST: acoustic recorder SoundTrap

used to automatically detect unit 3 of the Sri Lankan song type (see Fig. 2), which is the unit most commonly used for detection by other studies (e.g. Stafford et al. 2011, Panicker & Stafford 2021). All detections were subsequently visually inspected, and false detections discarded. The total proportion of datafiles (given 1 data file  $h^{-1}$ ) with at least 1 detection was then plotted by month.

### 3. RESULTS

From 14–26 November 2020, 1240 km of vessel-based survey effort resulted in a single encounter of a group of 2–4 blue whales on 21 November. From 1–21 November 2021, 4253 km of vessel-based survey effort resulted in 2 sightings of blue whales. On 12 November 2021, 2 individuals were observed. Their behavior could not be determined. On 17 November 2021, an individual blue whale was also

observed milling. During the reconnaissance flights carried out on 30–31 October 2021 (Fig. 1), 2 sightings were collected, including a single individual and a pair.

The only acoustic population recorded was the ‘central Indian Ocean’ (CIO) population (‘Sri Lanka’ song type, Alling et al. 1991, Fig. 2). No other blue whale call types were recorded. These signals occurred most often in March and April but also appeared in December and January with fewer hours of detections from May–October (Fig. 3).

### 4. DISCUSSION

Published records and the results of our work suggest that blue whales in the northwestern Indian Ocean are seasonally present at low densities in the western equatorial Indian Ocean. The November timing of our expeditions was driven by

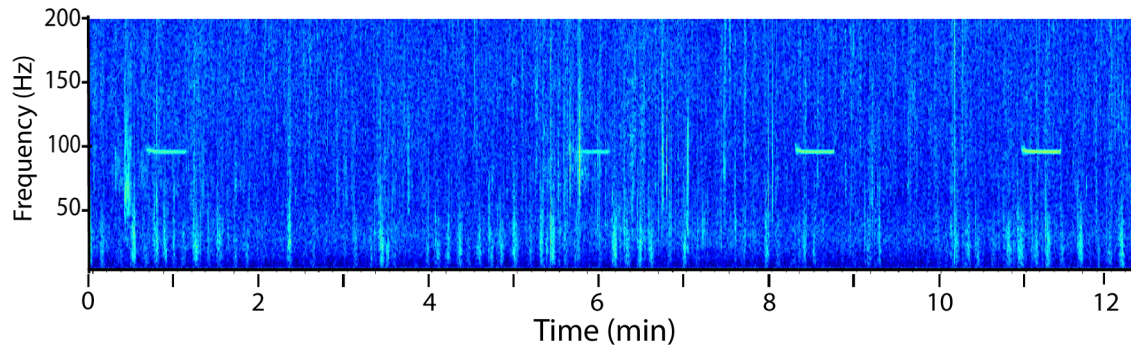


Fig. 2. Spectrogram (4096 point FFT, 50 % overlap) of 4 blue whale calls recorded on 19 June 2022 at 1000 (UTC) near Denis Island, Seychelles

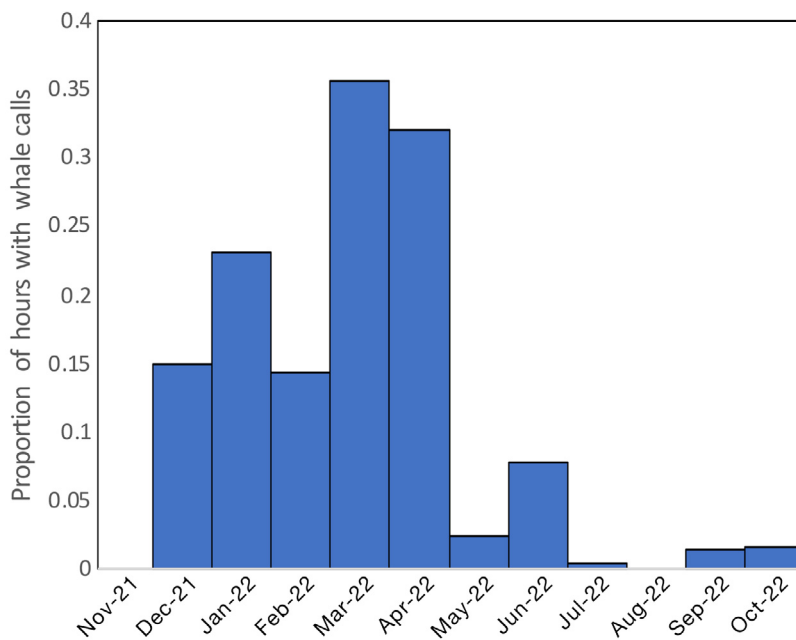


Fig. 3. Proportion of hours by month with blue whale call detections near Denis Island, Seychelles, from November 2021 through October 2022

the opportunistic sightings from 2017, the timing of Soviet catches (almost all in November), and weather conditions. Although our expeditions were conducted outside the peak season based on the acoustic detections, we were able to collect photo-identification data and film blue whales in the Seychelles. Photo-identification photographs have been submitted for matching to the Southern Hemisphere blue whale catalog (Galletti Vernazani et al. 2023). The closest contemporary sightings of blue whales were 30 sightings in September and October 2014 off Kenya (Barber et al. 2016). No blue whales were seen from April–June 1980 during a dedicated survey around the Seychelles (Keller et al. 1982), and from 1982–1986 there were only 10 sightings of ‘likely’ blue whales in

the region from observations from the French tuna fleet which fished year-round in the Seychelles (Robineau 1991).

Overall, the results of our acoustic monitoring off the Seychelles demonstrate that CIO blue whales are heard seasonally in the Seychelles, primarily from December to April (summer to mid-autumn, the northeast monsoon period). The peak number of hours by month with calls occurred during the inter-monsoon period (March–April, austral autumn). The lowest proportion of hours with calls occurred during the northeast monsoon (May–October, austral winter to early spring). The acoustic population of the calls recorded link the whales to the CIO (or Sri Lanka) blue whales. This acoustic population was first recorded off Sri Lanka (Alling et al. 1991) and on deep water acoustic recorders in the Indian

Ocean (Stafford et al. 2011, Miksis-Olds et al. 2018, Torterotot et al. 2020) and recently as far north as the Arabian Sea (Panicker & Stafford 2021). No calls from Antarctic blue whales or western Indian Ocean (Madagascar) blue whales were detected (e.g. Torterotot et al. 2020). However, the relatively shallow deployment depth of the acoustic recorder restricts the area over which blue whales can be detected and likely acts as a high pass filter for the lowest frequency sounds of blue whales. It is therefore possible that other acoustic populations were present in the area, but unheard. Further, the relatively high detection rate of songs at this shallow location could be indicative of higher densities of blue whales than would be indicated by the visual data alone.

The acoustic seasonality from the Seychelles is similar to the seasonality of sighting events from Sri Lanka, which are highest from December to April (Ilankoon & Sathasivam 2012, De Vos et al. 2014). Off Mirissa, Sri Lanka, November was the month with the fewest sightings overall, although blue whales are seen there nearly year-round (Russell et al. 2020, Liyanage et al. 2023). Increased efforts in other regions of the western tropical Indian Ocean, including off Kenya, Somalia, the Maldives and the Seychelles, will provide valuable information on the status of blue whales in the region.

This preliminary work will allow us to expand our future research efforts, especially in months where blue whales were heard more often (December–April), to monitor the occurrence of blue whales in the Seychelles, assess their relative abundance, and develop new research methods to investigate their population identity and movements in the Seychelles. Deployment of additional acoustic recorders in different regions and at deeper depths is one avenue of investigation that should be pursued in future studies. These preliminary results, though, give us hope that we can reliably study these elusive animals, despite their low densities in the area.

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