Effects of seismic surveys and vessel traffic noise on the seasonal acoustic detectability and behaviour of Antarctic blue and fin whales off the west coast of South Africa

Antarctic Science Bursary report (Awarded 2022)

Fannie W. Shabangu[a]

[a]*Mammal Research Institute Whale Unit, Department of Zoology and Entomology, University of Pretoria, Private Bag X20, Hatfield, Pretoria 0028, South Africa*

Introduction: Antarctic baleen whales such as Antarctic blue whales (*Balaenoptera musculus intermedia*) and fin whales (*B. physalus*) migrate between their major summer feeding grounds in Antarctica and their supposed overwintering and breeding grounds in the low latitudes such as the South African coast (Shabangu et al. 2019, 2020a). Movements of Antarctic whales to the low latitudes allow marine mammal researchers to conveniently study some of the least studied animals without bearing the cost of traveling to Antarctica. For example, the seasonal acoustic occurrence of whale species such as Antarctic blue, fin, Antarctic minke (*B. bonaerensis*), humpback (*Megaptera novaeangliae*), southern right (*Eubalaena australis*), and sperm (*Physeter macrocephalus*) whales were first defined using acoustic data collected off the west coast of South Africa (Shabangu and Andrew, 2020; Shabangu and Kowarski, 2022; Shabangu et al., 2019, 2020b, 2021; Letsheleha et al., 2022). Results from these studies provide critical baseline information on the acoustic ecology and interaction of Antarctic blue and fin whales and other Antarctic whales with environmental conditions in the low latitudes (e.g. Shabangu et al., 2019; Letsheleha et al., 2022). Importantly, this kind of data provides useful information on the soundscape of areas inhabited by Antarctic whales outside of Antarctica. Nonetheless, the occurrence on these whales in the low latitudes exposes them to anthropogenic underwater noise (Shabangu et al., 2022) and other threats (e.g. Schoeman et al., 2020).

The west coast of South Africa (Figure 1) is presently experiencing rapid blue/ocean economic growth linked to the nationwide government initiative, called Operation Phakisa, designed to accelerate and unlock the growth and development of ocean economy within the South African EEZ by 2030 (Zuma, 2014). Activities associated with this economic development initiative include marine transport and manufacturing, and offshore oil and gas exploration that produce underwater noise (Duarte et al., 2021). The current study aimed to provide an update on underwater noise levels and noise influence on Antarctic blue and fin whale acoustic ecology off the west coast of South Africa.

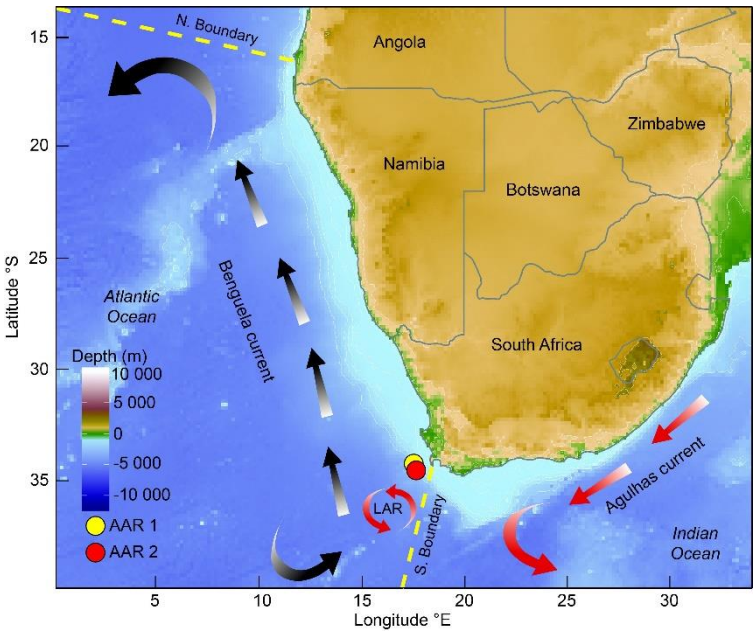

Figure 1. Location of the acoustic recorder off the west coast of South Africa. AAR2 represents the exact oceanographic mooring location. Adopted from Shabangu et al. (2019).

Methods: Passive acoustic monitoring data were collected using

a SoundTrap ST600 HF acoustic recorder (Ocean Instruments NZ, New Zealand) deployed on an oceanographic mooring [using a design similar to that used by Shabangu et al. (2019)] off the west coast of South Africa (Figure 1). This hydrophone deployment on an oceanographic mooring was a collaborative initiative between marine mammal researchers and oceanography researchers. The mooring was deployed at a water depth of 1100 m. The SoundTrap recorder was set to sample at 48 kHz and recorded at a duty cycle of 3 minutes (i.e. 5%) for every hour of each day. RV Algoa was used to deploy the oceanographic mooring.

Results and discussion: The acoustic recorder autonomously collected passive acoustics data from 03 March 2023 to 27 September 2024. In total, 689 hours of acoustic recordings were made over the 1.5 years. Calls of Antarctic blue whales, fin whales, sperm whales, humpback whales, and delphinids were detected from the data set (Figure 2a-c). Vessel noise and fish choruses were also detected within recordings (Figure 2d). No seismic signals were found from the preliminary review of the data. Above results indicate that Antarctic baleen whales continue to occur in South African waters, an area with increasing marine anthropogenic activities.

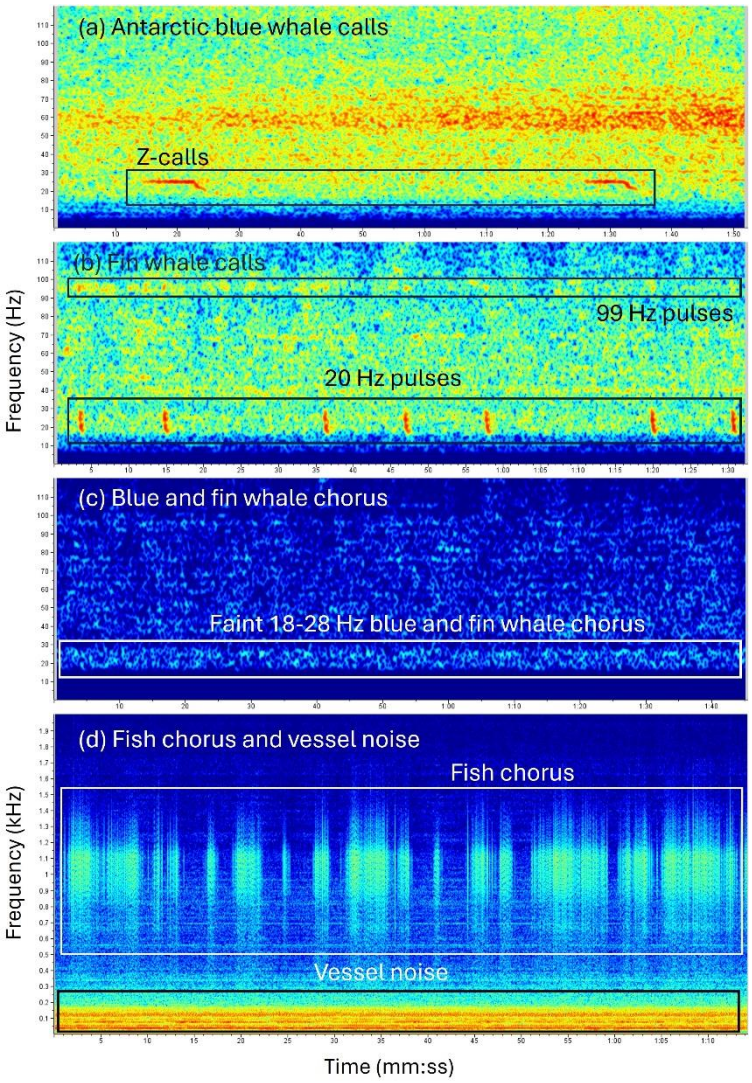

Figure 2. Spectrograms of (a) Antarctic blue whale Z-calls, (b) fin whale 20 and 99 Hz pulses, (c) Antarctic blue and fin whale 18-28 Hz chorus, (d) fish chorus and vessel noise. All sounds are highlighted by rectangles.

Future work: Detailed analyses of the collected data will be performed to estimate the temporal variation of underwater vessel noise levels, and model how this noise might be influencing the acoustic detectability and behaviour of Antarctic blue and fin whales and other baleen whales in South African waters. In addition, the seasonal acoustic occurrence of these whales relative to environmental conditions will be determined. The evolution of acoustic properties of Antarctic blue and fin whales will also be determined. It is envisaged that a minimum of four manuscripts will be prepared and published from this data set. Now that an acoustic recorder has been purchased through bursary funds allocated to this project, passive acoustic data collection in this region will continue for as long as possible.

Acknowledgements: I would like to express my sincere thanks to the Antarctic Science Bursary for supporting this work, this funding played a pivotal role at enabling acoustic monitoring of Antarctic baleen whales in this low latitude region. DFFE oceanographers and interns are thanked for assisting with the deployment and retrieval of the acoustic recorder.

References

Duarte, C.M., et al. 2021. The soundscape of the Anthropocene Ocean. Science 371, eaba4658. https://doi.org/10.1126/science.aba4658.

Letsheleha, I.S., Shabangu, F.W., Farrell, D., Andrew, R.K., la Grange, P.L., Findlay, K.P. 2022. Year-round acoustic monitoring of Antarctic blue and in whales in relation to environmental conditions off the west coast of South Africa. Mar. Biol. 169, 41. https://doi.org/10.1007/s00227-022-04026-x

Schoeman, R.P., Patterson-Abrolat, C., Plön, S. 2020. A global review of vessel collisions with marine animals. Front. Mar. Sci. 7, 292. https://doi.org/10.3389/fmars.2020.00292

Shabangu, F.W., Andrew, R.K., 2020. Clicking throughout the year: Sperm whale clicks in relation to environmental conditions off the west coast of South Africa. Endanger. Species Res. 43, 475–494. https://doi.org/10.3354/esr01089.

Shabangu, F.W., Kowarski, K.A. 2022. The beat goes on: humpback whale song seasonality in Antarctic and South African waters. Front. Mar. Sci. 9, 827324. https://doi.org/10.3389/fmars.2022.827324

Shabangu, F.W., Findlay, K.P., Yemane, D., Stafford, K.M., van den Berg, M., Blows, B., Andrew, R.K. 2019. Seasonal occurrence and diel calling behaviour of Antarctic blue whales and fin whales in relation to environmental conditions off the west coast of South Africa. J. Mar. Syst. 190, 25–39. https://doi.org/10.1016/j.jmarsys.2018.11.002.

Shabangu, F.W., Andrew, R.K., Yemane, D., Findlay, K.P., 2020a. Acoustic seasonality, behaviour and detection ranges of Antarctic blue and fin whales under different sea ice conditions off Antarctica. Endanger. Species Res. 43, 21–37. https://doi.org/10.3354/esr01050.

Shabangu, F.W., Findlay, K., Stafford, K.M., 2020b. Seasonal acoustic occurrence, diel-vocalizing patterns and bioduck call-type composition of Antarctic minke whales off the west coast of South Africa and the Maud Rise, Antarctica. Mar. Mam. Sci. 36, 658–675. https://doi.org/10.1111/mms.12669.

Shabangu, F.W., Andrew, R.K., Findlay, K. 2021. Acoustic occurrence, diel-vocalizing pattern and detection ranges of southern right whale gunshot sounds off South Africa's west coast. Mar. Mamm. Sci. 37, 733–750. https://doi.org/10.1111/mms.12760.

Shabangu, F.W., Yemane, D., Best, G., Estabrook, B.J. 2022. Acoustic detectability of whales amidst underwater noise off the west coast of South Africa. Mar. Pollut. Bull. 184, 114122. https://doi.org/10.1016/j.marpolbul.2022.114122

Zuma, J. 2014. Address by President Zuma at the operation Phakisa: unlocking the economic potential of the ocean economy open day, (2014), retrieved from https://www.operationphakisa.gov.za/cc/Documents/Open%20Day%20Operation%20Phakisa%20President%20Speech.pdf. (Accessed 04 February 2025).