

## 9.2 A challenge for computational bioacoustics

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### Abstract

Antarctic Minke whales are the most abundant baleen whale species on earth. As the main target of today's controversial "scientific whaling" and possibly of a re-established commercial whaling enterprise as proposed by some countries, they are in the focus of interest for many NGOs and the public. Until few months ago nothing was known about their vocal behavior, so they had no "own voice" and no bioacoustic methods could be used to investigate the many open questions about them. On the other hand, for several decades a strange sound of unknown origin has been recorded repeatedly in the Southern Ocean – but only during polar winter when the sea is covered almost completely by a dense layer of ice. Long term recordings from our acoustic observatory at the ice shelf show it is in fact the dominant acoustic emission around Antarctica during that time. Tenth of thousands of hours of this sound have been recorded during the last 8 years and are published under an open access policy. And recently, during a winter expedition to Antarctica we could finally assign this sound to the Minkes. We invite everybody to look into that data using advanced methods to extract definitely new knowledge about this important species.

### 1 Antarctic Minke Whales Acoustics

Throughout the southern ocean a unique rhythmic underwater sound with a frequency range of 100 Hz to 20 kHz has been recorded repeatedly by many researchers and navy sonar officers [1-6]. The first published evidence of its existence dates back to 1964 where it appeared in an audio recording as an "unidentified signal in the background" [1]. The crew of an Australian submarine designated the sound "the bioduck" because of its auditory impression [3,4]. The PALAOA observatory, located north of Neumayer Station on the Antarctic Eckström ice shelf [8] and several moored audio recorders throughout the Weddell sea pick up this sound regularly - but strictly during austral winter only, which explains much of the difficulty in its investigation. From end of April to begin of November it is continuously audible and most of that time it even constitutes the most intense sound source in the southern ocean. However, the source of this signal remained a mystery until recently.

The largest inhabitant of the wintery pack ice is the Antarctic Minke whale, *Balaenoptera bonaerensis*. Up to 10 meters long and weighing 10 tons it is a rather small member of the baleen whale family. While its larger relatives like blue, fin, and humpback whales mostly leave Antarctica during winter for their subtropical mating grounds, this species has adapted for a permanent life in the ice. Little is known about this most frequent of all great whale species, population estimates differ between 360.000 to 1.000.000 individuals and there are contradicting opinions whether the stock is growing or shrinking. To the public it became famous as the main target of the controversially discussed contemporary whaling. Especially during polar night the study of these animals is extremely difficult.

While it had been suggested, that the unidentified rhythmical sound might be produced by Antarctic Minke whales [2] along with some known irregular downsweeps [7] this was proven by several parties only recently in 2013 [e.g. 9].

So far, no detailed study of the acoustic behavior of this species has been performed yet. The 8 year continuous acoustic recordings from the PALAOA observatory thus provide a unique opportunity to investigate this species for the very first time. As the minke sounds are present continuously from April to November more than 20.000 hours are available in total, making it a good candidate for modern computational methods.

A livestream of the under-ice hydrophone is available under <http://www.awi.de/PALAOA> and the complete data set (2005-2013) is published in the PANGAEA database of the World Data Center for Marine Environmental Sciences [10]: <http://doi.pangaea.de/10.1594/PANGAEA.773610>

## References

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