

# Analysing humpback whale migration patterns on a wintering breeding ground using song characteristics

## 1. Introduction

Humpback whales (*Megaptera novaengliae*) migrate from high latitudes to sub-tropical waters during winter (June-October) to breed and give birth. One of their winter breeding grounds is in the coastal waters of Guinjata Bay, Mozambique. Song vocalisations for this population is limited and have only been studied here since 2016, therefore this study will help to provide a knowledge base for future studies on this population.

Male whales produce a complex song whilst on breeding grounds, such as Mozambique, and during their annual migrations. All males from a population will sing the same song, despite progressive annual changes to the structure of the song, known as cultural transmission (Garland et al. 2011).

This may be the addition or repetition of a unit (the small building blocks of a song), or an addition of a unit to a phrase (a group of units sung together in a pattern) (Winn and Winn 1978).

Some changes to the song can occur within a breeding season and this may be due to the immigration of some males from other populations e.g. Madagascar.

## 2. Aims

- Compare vocalisations from 2017 and 2019 to identify new characteristics to identify changes to the song
- To provide a base knowledge for this population of humpback whales for future studies.

## 3. Results

### Phrase duration

There was not a statistically significant difference in mean phrase duration in 2017 (mean =  $4.9274 \pm 0.591$  s S.D.) and 2019 (mean =  $4.6564 \pm 3.12621$  s S.D.) (t-test,  $t = 0.319$ ,  $df = 29$ ,  $P > 0.05$ ).

### Unit repetition:

There was a statistically significant difference in median unit repetition in 2017 (median =  $4.7.830 \pm 1.61$  s S.D.) and 2019 (median =  $3.1090 \pm 11.36$  s S.D.) (Mann-Whitney U-test,  $U = 65$ ,  $n1 = 14$ ,  $n2 = 17$ ,  $P < 0.05$ ).

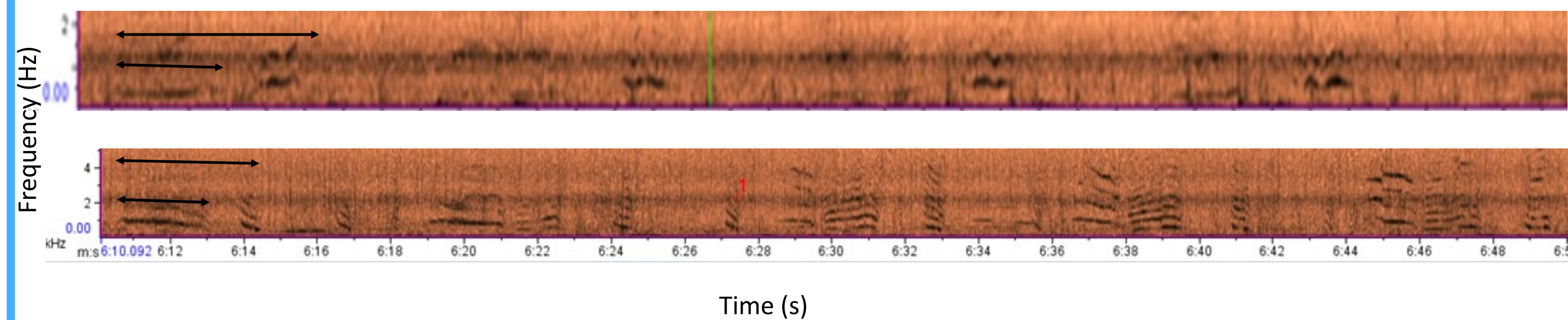


Figure 1: Spectrograms illustrating two phrases identified from different years; 2017 (top) and 2019 (bottom). Short arrows represents a unit. Long arrows represents a phrase.

## 4. Discussion

The data show mixed results regarding song changes from 2017 to 2019. The phrase duration did not change significantly, despite the increase in unit repetition. The phrases became progressively shorter, which may be because of the increased repetitions, meaning the whales can sing more 'notes' but for a shorter period of time., possibly due to physiological constraints.

Visually comparing the spectrograms between the years, they vaguely resemble one another, however it is clear that the units/phrases are different, which could either be due to general cultural transmission which is likely. However, it should not be ruled out that whales from other populations move between breeding grounds within the season, thus have the capacity to introduce new units/phrases to these whales. Future studies should compare the humpback whale song from Mozambique and surrounding areas such as Madagascar and Zanzibar to compare the songs, but ultimately this will need to be continuous studies.