

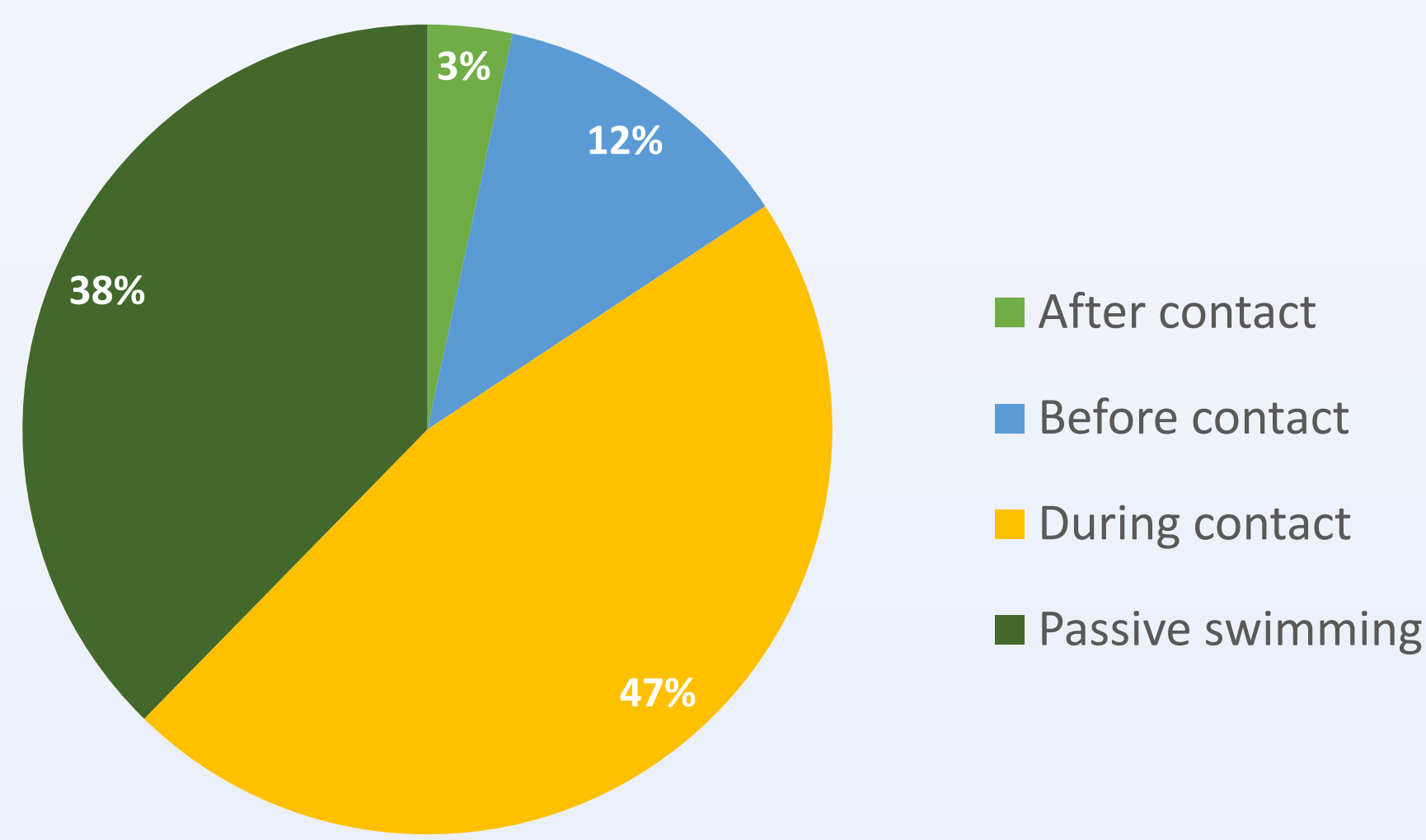
Preliminary etho-acoustic study of sperm whales (*Physeter macrocephalus*) codas

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Introduction

Sperm whales (SW) codas are described to be emitted during social activities and can be shared between individuals as group identity. Codas are successive clicks with various durations and with different interval inter clicks (ICI). The objectives of our study are 1) to show if codas can be linked to specific behaviors and 2) to find specific patterns for these Mauritius SW.

Results



Definitions:

- Before Contact: Distance between SW decreases
- After Contact: Distance between SW increases
- Passive Swimming: Distance between SW doesn't change

Majority of codas are emitted during the contact. 12% codas are emitted before and only 3% after contact.

→ Codas therefore have a role in the contact between individuals

Hypothesis that the large percentage of passive swimming:

- o Videos are truncated
- o Codas produced do not correspond to the individuals present in the video.

- Only 17 codas are in common in Before + During contact and Passive swimming.

- Some codas are produced only during contacts and others are produced mainly during passive swimming.

→ Hypotheses rejected

→ There are categories of coda specific to the actions of these SW.

	Numbers of codas type
Before + During contact	52
Passive swimming	28

Fig 2: Distribution of codas type before contact, during contact and passive swimming

Material et Methods

Dataset

Visual and acoustic data were collected from March to June between 2013 and 2018

Videos analysed (only 2017 to 2018):

- 287 videos
- Mean duration: 1min2sec, max : 6min7sec, min : 10s
- Total : 6 hours

Definition of behavioral repertoire:

- Contacts (different types)
- Clicks including codas, creaks, buzz.
- Movements
- Others (rest, brush, etc...).

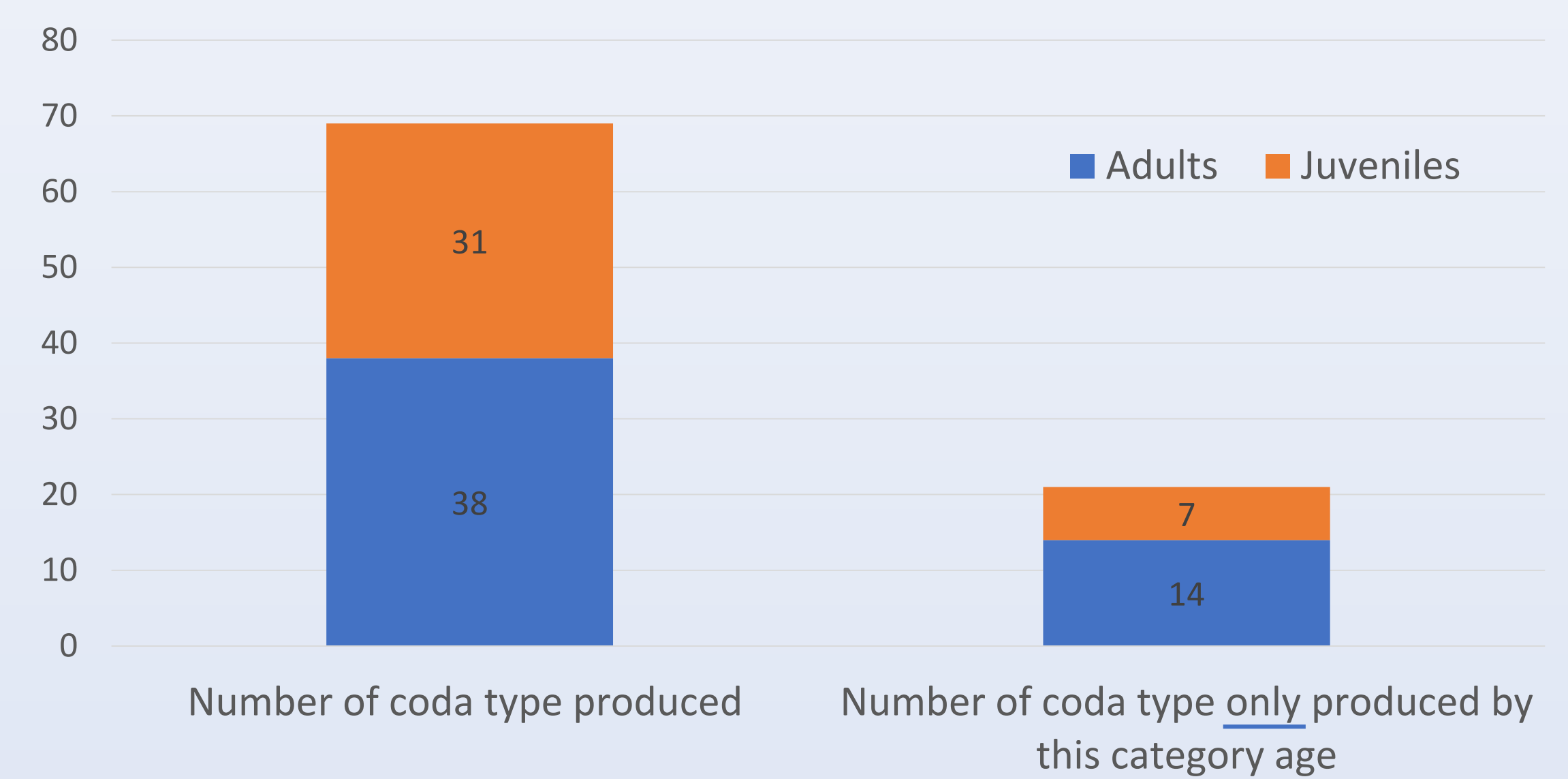


Fig 3: Different types of codas according to age

- Juveniles have an acoustic repertoire similar to the adults one:
 - o 77,42% similar
 - o Juveniles emit less types of codas (81% of adults)
 - o Some codas are produced only by juveniles and others by adults

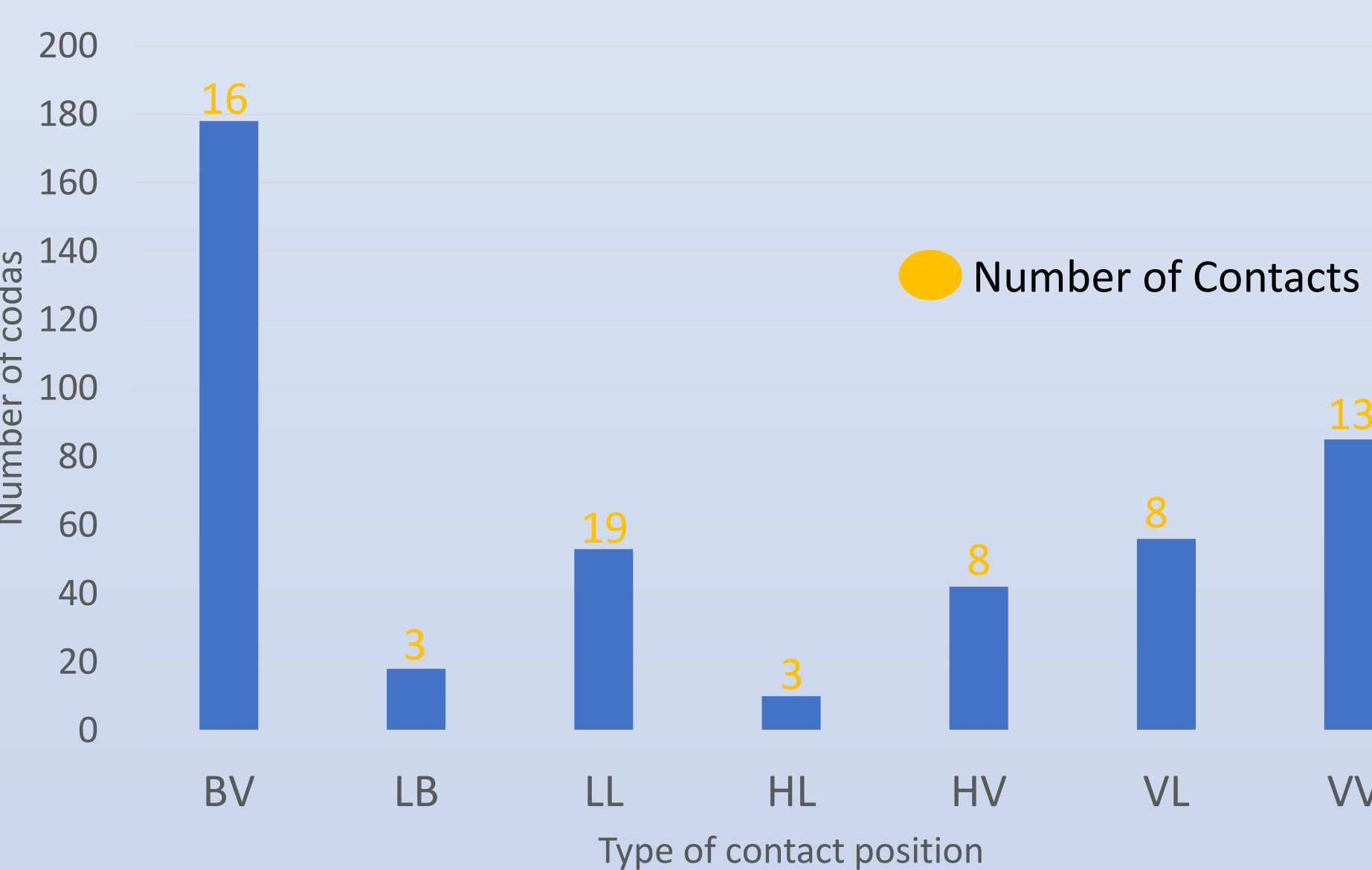
Codas:

Only present with juveniles

Only present with adults

2+1+1+1+1	2+1+1+1	2+1+1+1+2+1
2+1+1+1+1+1+1	2+1+1+1+1+1+1+1	3+1+1+1+1+1+1+1
4+1+1+1+1+1+1+1	2+1+1+1+1+1+1+3	3+1+1+2+1+1
4+2+1+1+1+1	2+1+1+1+1	3+3+2+2+2+1+1+1
4+2+1+1+1+1+1+1+1+1+1+1+1	2+1+1+1+1+1+2	3+4+1+1+1
5+1+1+1+1+1+2+1	2+1+1+1+1+1+4	5+1+1+1+1+1+1+1+1+1+1
5R	2+1+1+1+1	1+1
		9R

→ Some type of codas are specific to type categories of individuals



Key:

- BV: Back-Ventral
- LB: Lateral-Back
- LL: Lateral-Lateral
- HL: Head-Lateral
- HV: Head-Ventral
- VL: Ventral-Lateral
- VV: Ventral-Ventral

- 70 contacts analysed

- Max of contacts are BV

- Favorite contacts seems to be in the belly

Fig 4: Number of codas during the different contact positions → There are favorite places for contact for these SW

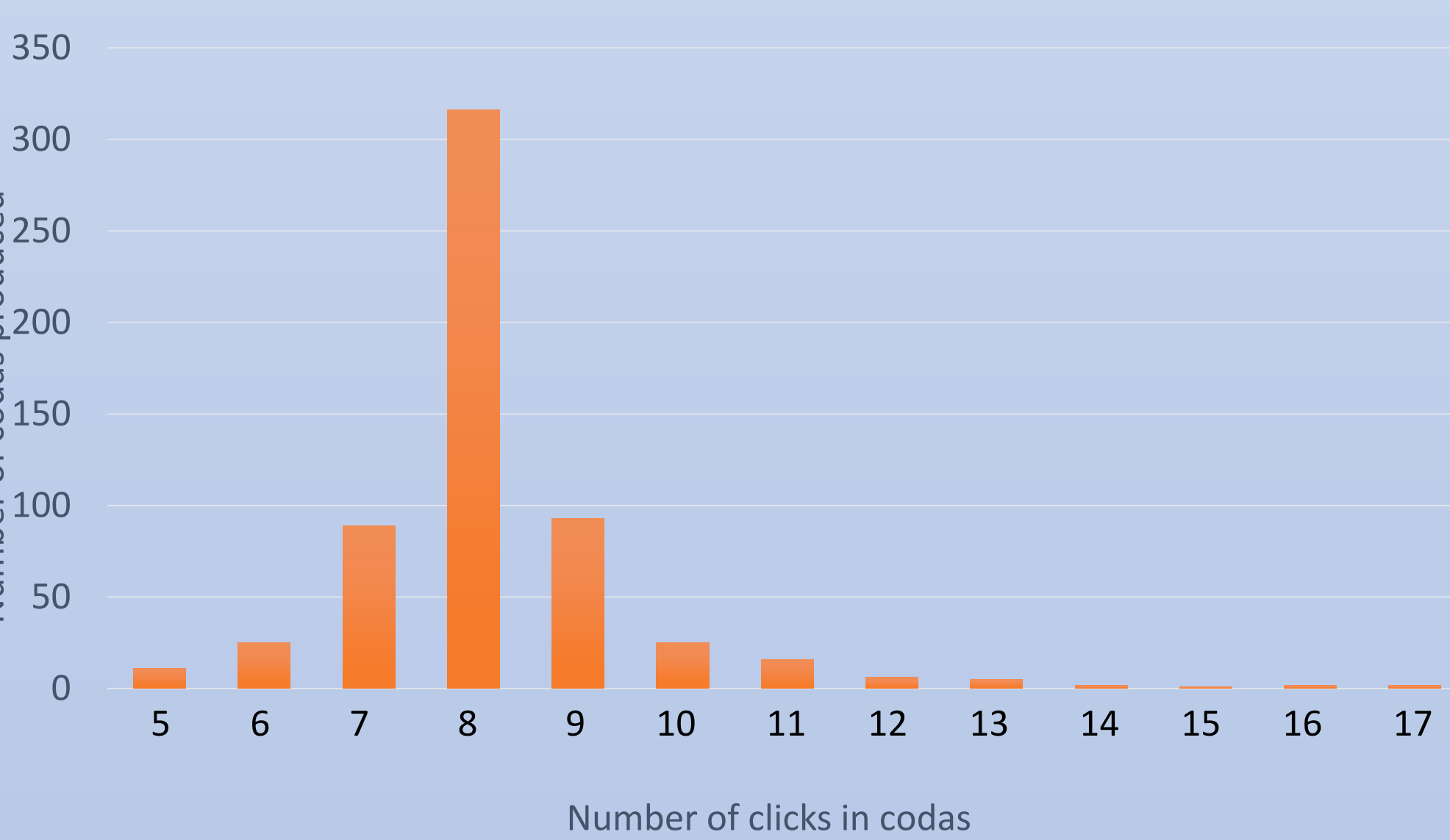


Fig 5: Number of clicks by codas types

- We found 81 different type of codas.
- The most common coda is 2+1+1+1+1+1+1 present in 211 out of 597 codas

→ Observation of a vocal signature of 8 clicks.

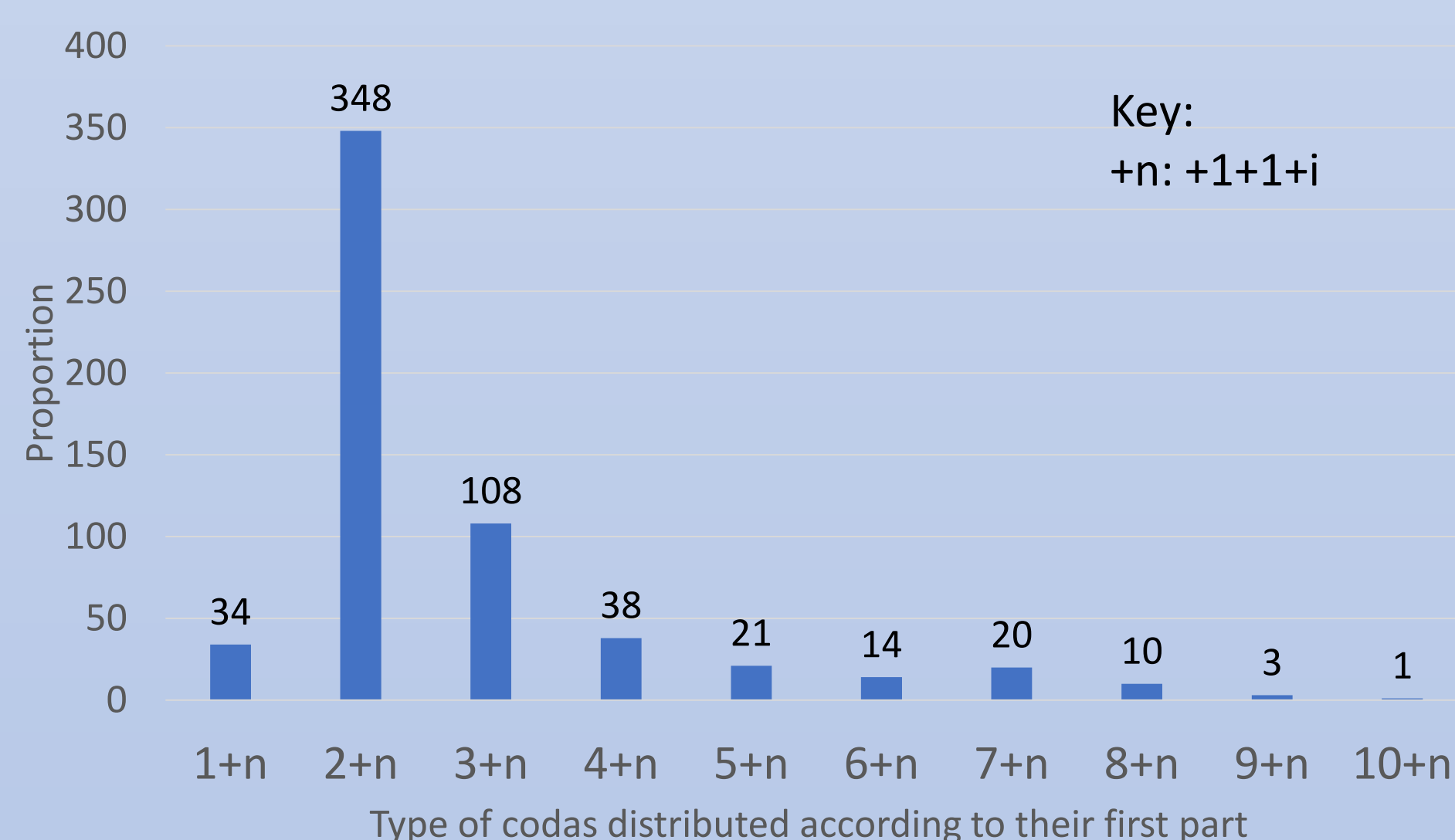


Fig 6: Proportion of codas type starting with the same beginning

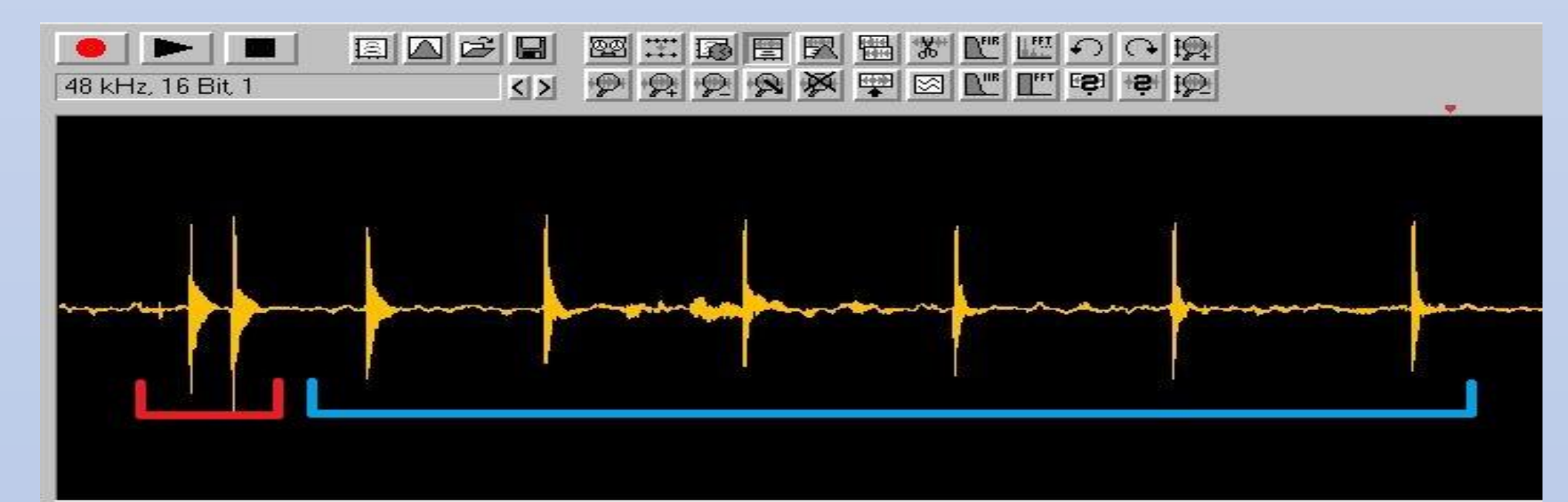


Fig 7: Spectrogram of the coda 2+1+1+1+1+1+1

For 59 codas 2 + 1 + 1 + 1 + 1 + 1 + 1, the first 2 clicks (red) and the next 6 clicks have homogeneous values. The classification of interclick intervals (ICI) for this coda are the same.

→ These sperm whales off Mauritius have a specific vocal pattern: the coda 2+1+1+1+1+1+1

Discussion

- Most codas are emitted before and during contact, suggesting specific codas are dedicated to contact.
- Different structures of codas are emitted for other activities, including passive swimming.
- Common codas are shared by adults and juveniles. Few of structures are specific to adults, suggesting probable learning process for juveniles.
- Contacts are not made in any place: Individuals have a preference for ventral-back contact.
- Sperm whale's codas are a majority of 8 clicks codas and 2+n.
- There is a specific voice signature for these SW population off Mauritius: 2+1+1+1+1+1+1

Limits

- Visual observations are limited (due to the focal of the video camera, water visibility)
- We can not be sure where the codas come from

