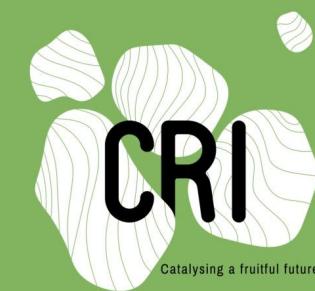


Author : Irina DELAMARE
Supervisor : Pauline PROVINI

MORPHO-FUNCTIONAL STUDY OF BIRDS VOCAL SYSTEM: INFLUENCE OF THE PHYLOGENY, SIZE AND NOCTURNALITY ON ACOUSTIC PARAMETERS

INTERNSHIP DEFENSE

01/09/2020 To 31/12/2020



SUMMARY

- 1 Context and Background
- 2 Introduction
- 3 Material and Methods
- 4 Results and discussion

- 5 Conclusion and perspectives
- 6 Acknowledgments





Pauline
Provini



Rachel
Olson



Alireza
Kazemi

1

Context and Background

“The goal of our lab is to understand the mechanisms by which birds are producing vocalisations. One application of our research is to produce bio-inspired vocal prostheses to improve the voice quality of people with laryngectomies.”

Pauline Provini,
Long term fellows at CRI

2

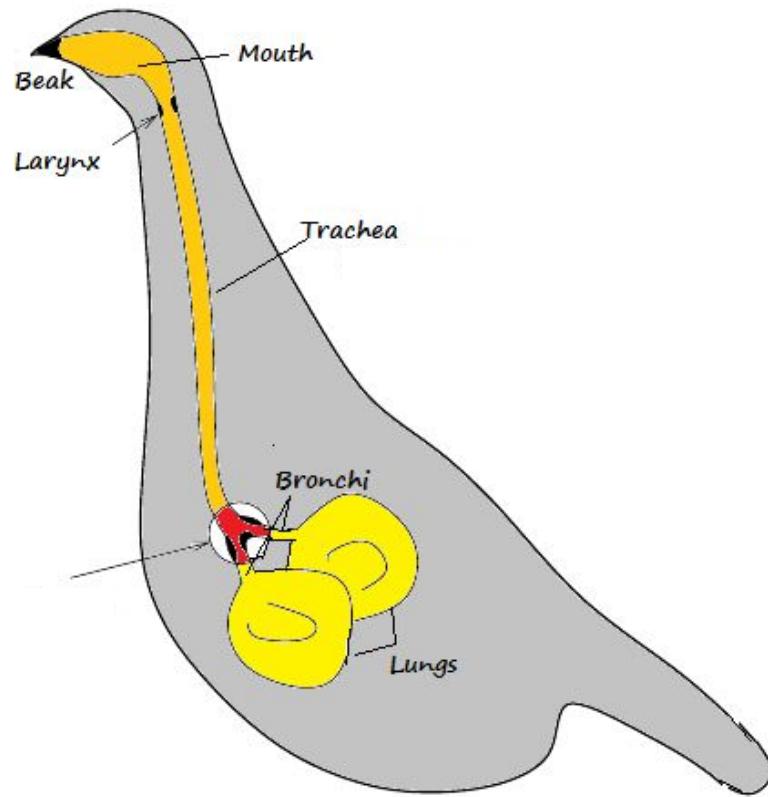


Introduction

They produce sounds with their **SYRINX**

How do birds vocalize ?

They modulate the sounds with their **VOCAL TRACT**



They produce sounds with their **SYRINX**

How do birds vocalize ?

They modulate the sounds with their **VOCAL TRACT**



Does it depends on :

Evolutionary history

Shape

Body size

Motion and deformation

Life style

Airflow

Introduction

- Ames PL. The Morphology of the Syrinx in Passerine Birds. 1971
- Gaunt AS, Gaunt SLL. Syringeal Structure and Avian Phonation. 1985
- Suthers RA. Contributions to birdsong from the left and right sides of the intact syrinx. 1990
- Goller F, Larsen ON. In situ biomechanics of the syrinx and sound generation in pigeons. 1997
- Riede T, Goller F. Functional morphology of the sound-generating labia in the syrinx of two songbird species. 2010
- Ibrahim IA-A, Hussein MM. Comparative Morphological Features of Syrinx in Male Domestic Fowl *Gallus gallus domesticus* and Male Domestic Pigeon *Columba livia domestica*. 2020

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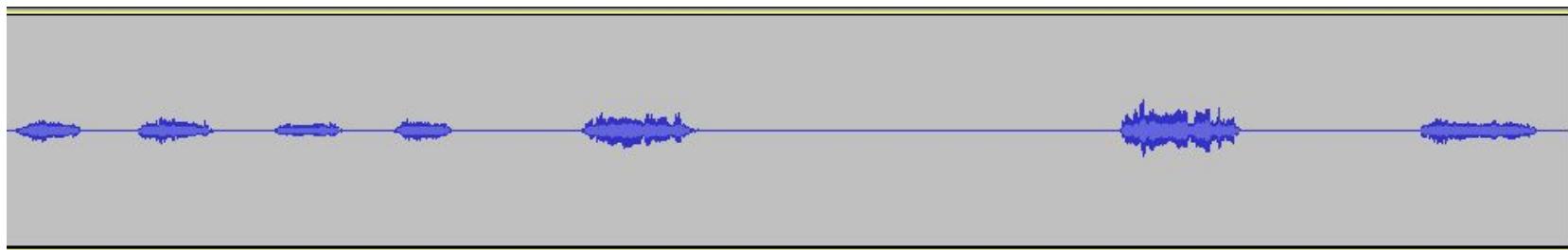
Airflow

Introduction

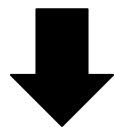
3

Material and Methods

Spectrogram of *Plegadis falcinellus*



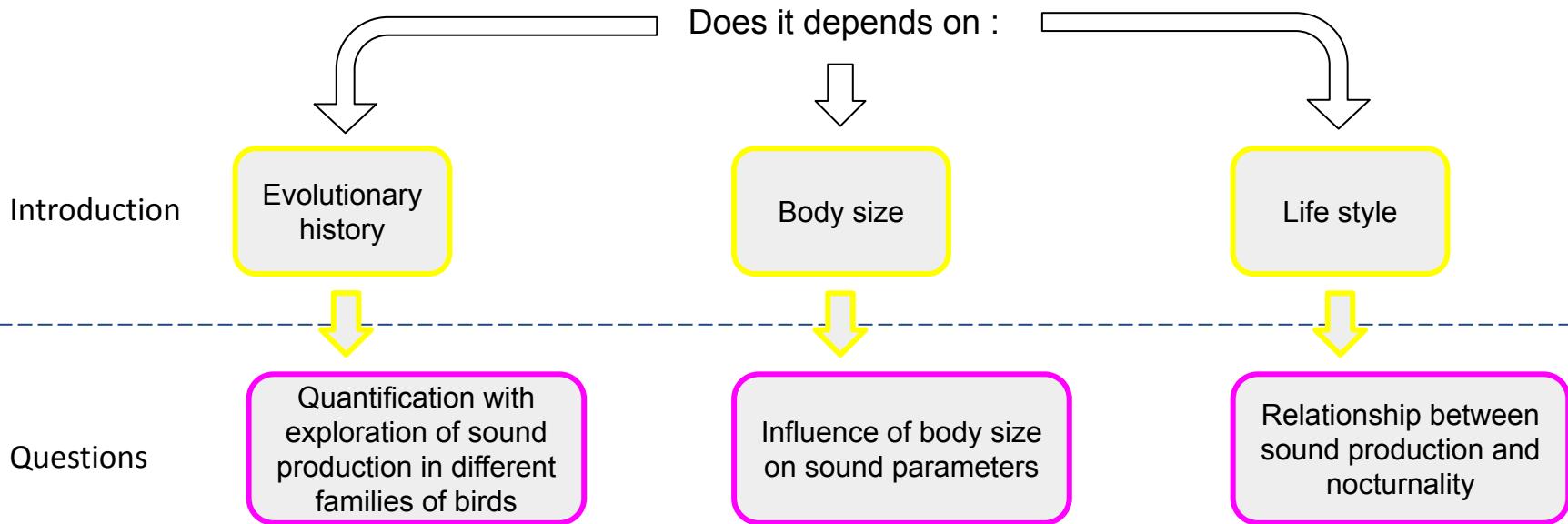
130 Recordings



Mean, Min, and Max Pitch, Loudness ...

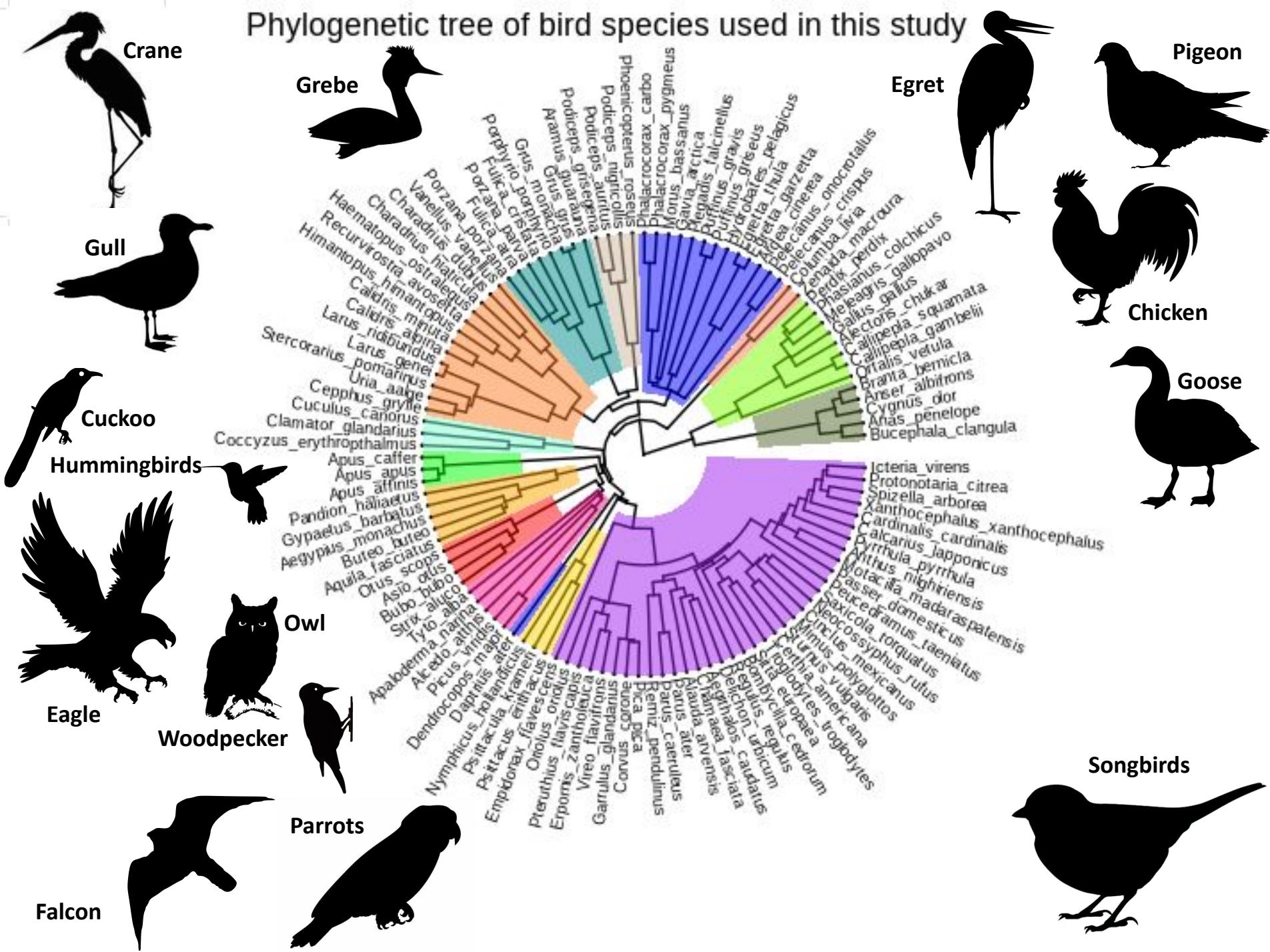


Characteristics of sound	Loudness	depends on the amplitude of vibration
	Soft	
	Loud	
Pitch	depends on frequency	
	Low	
Quality or Timbre	High	
	depends on waveform	
Quality or Timbre	Clearer	
	Mixed	

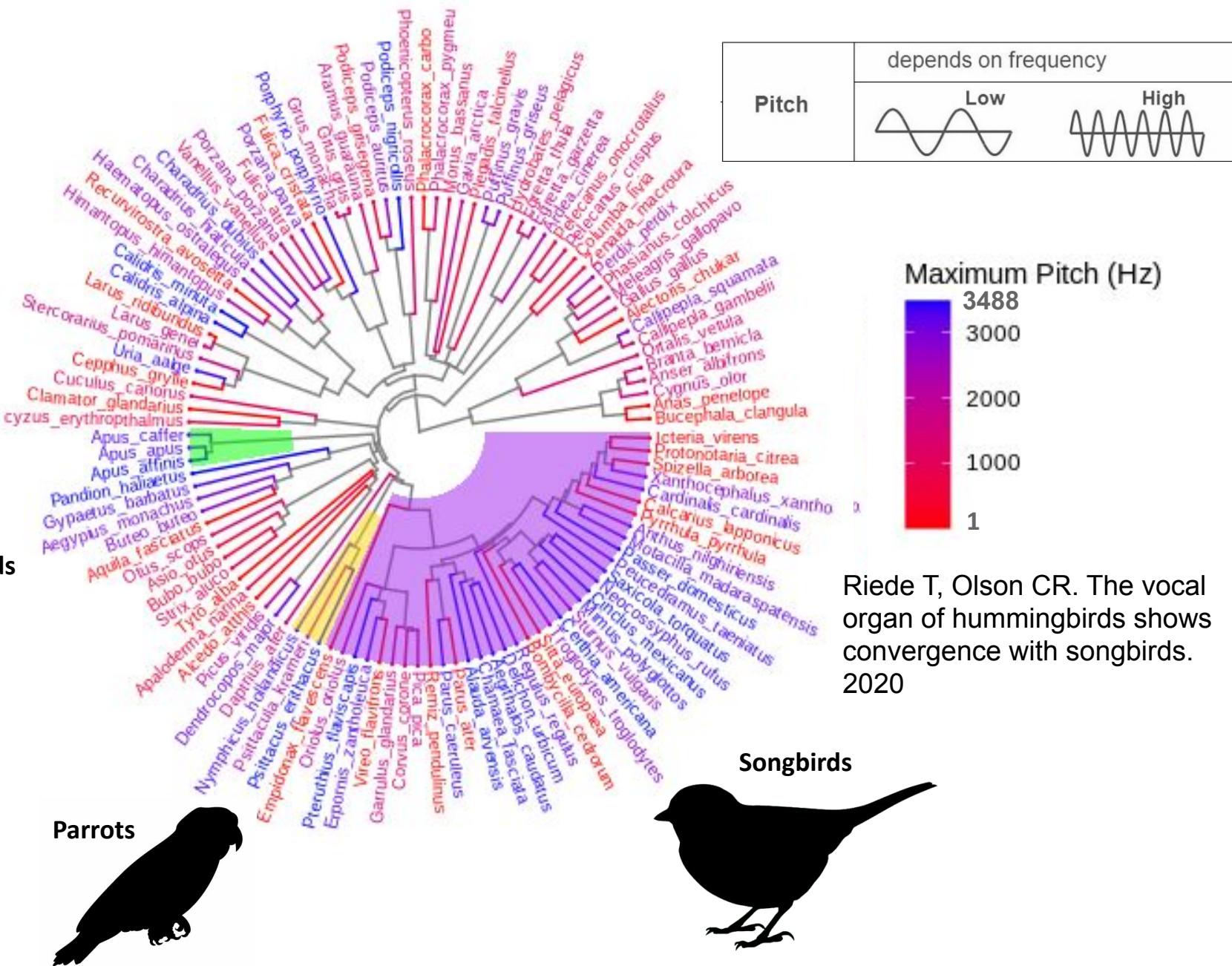


Results and Discussion

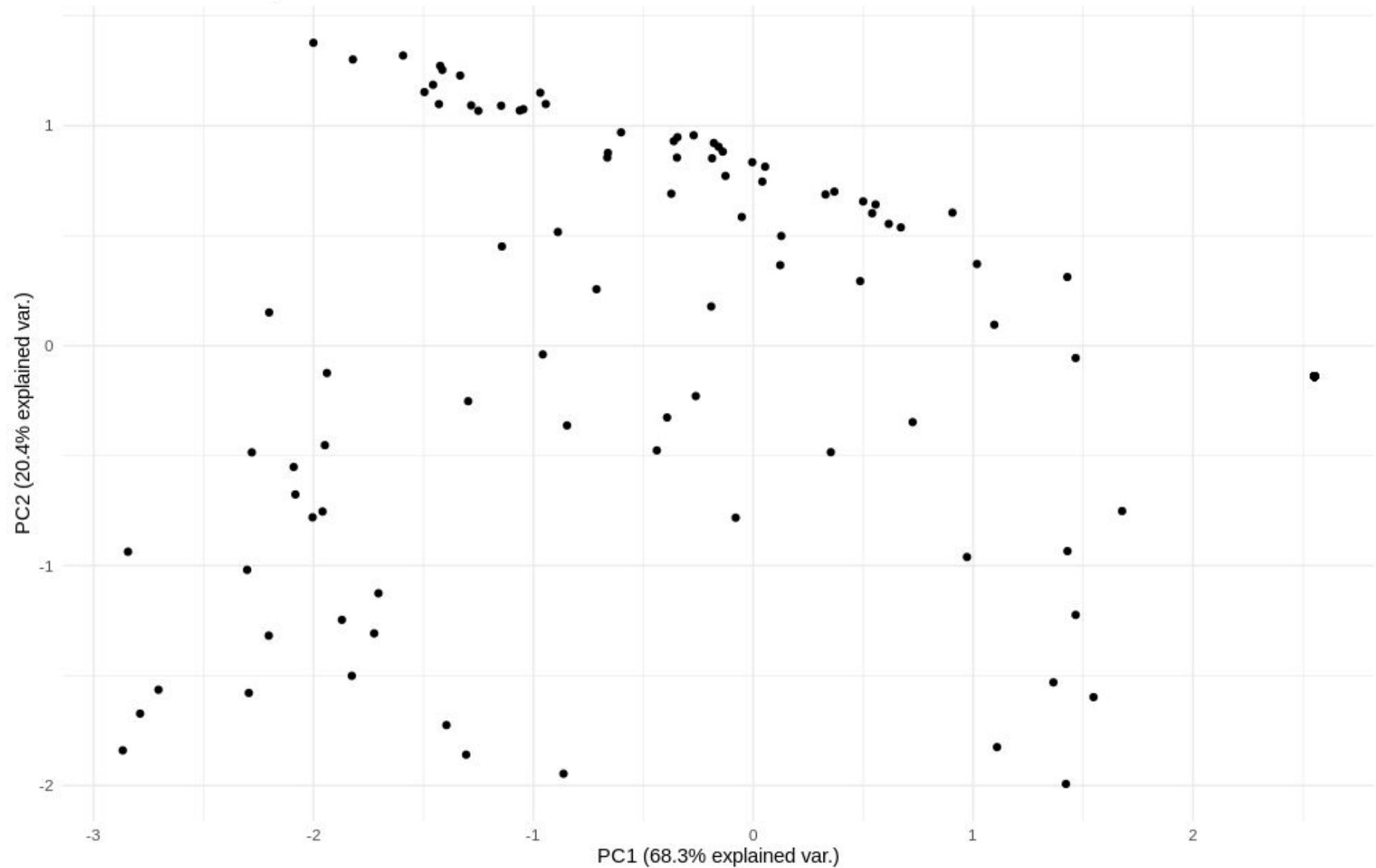
Phylogenetic tree of bird species used in this study



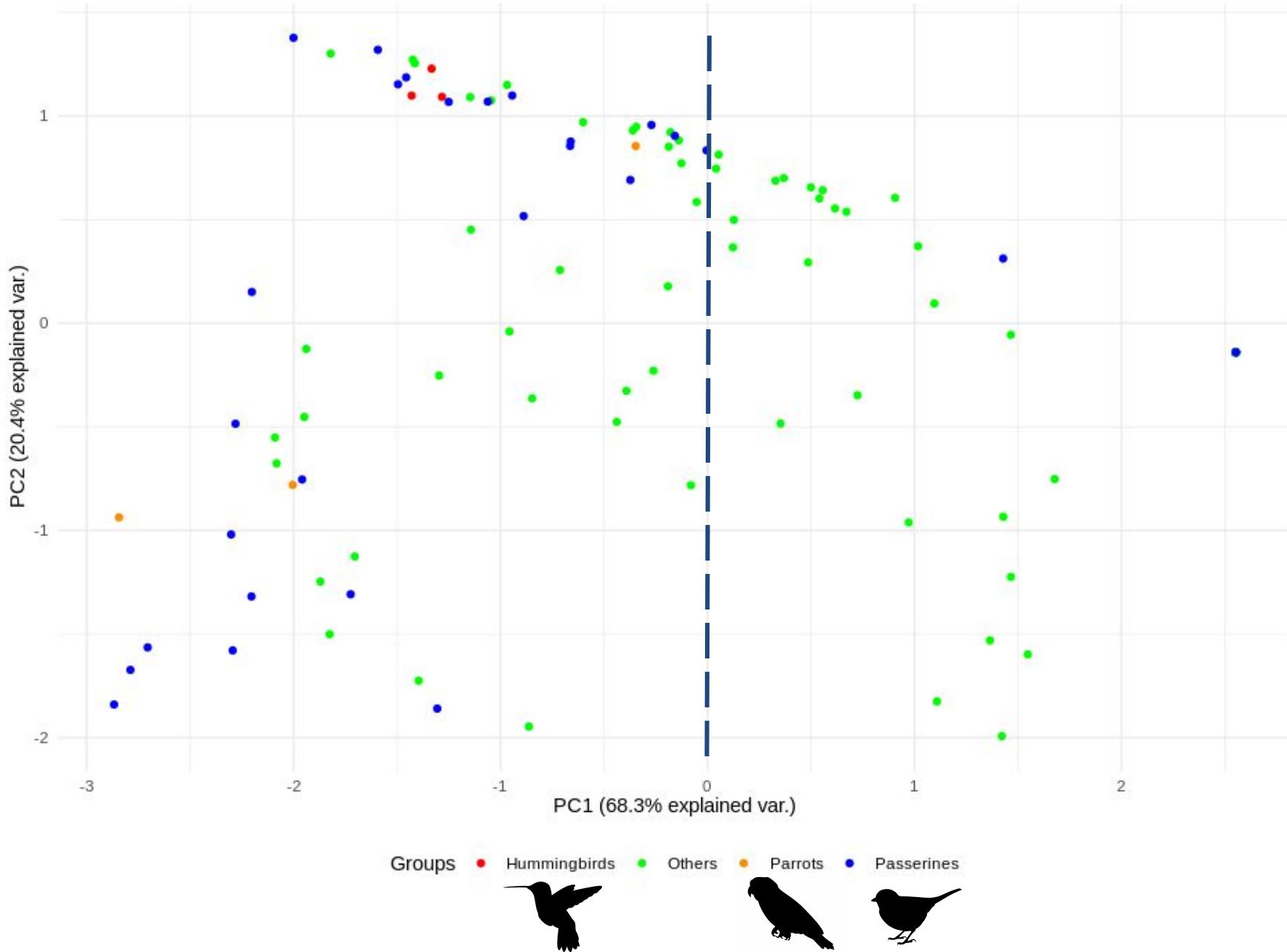
Phylogenetic tree of birds higlighting maximum pitch



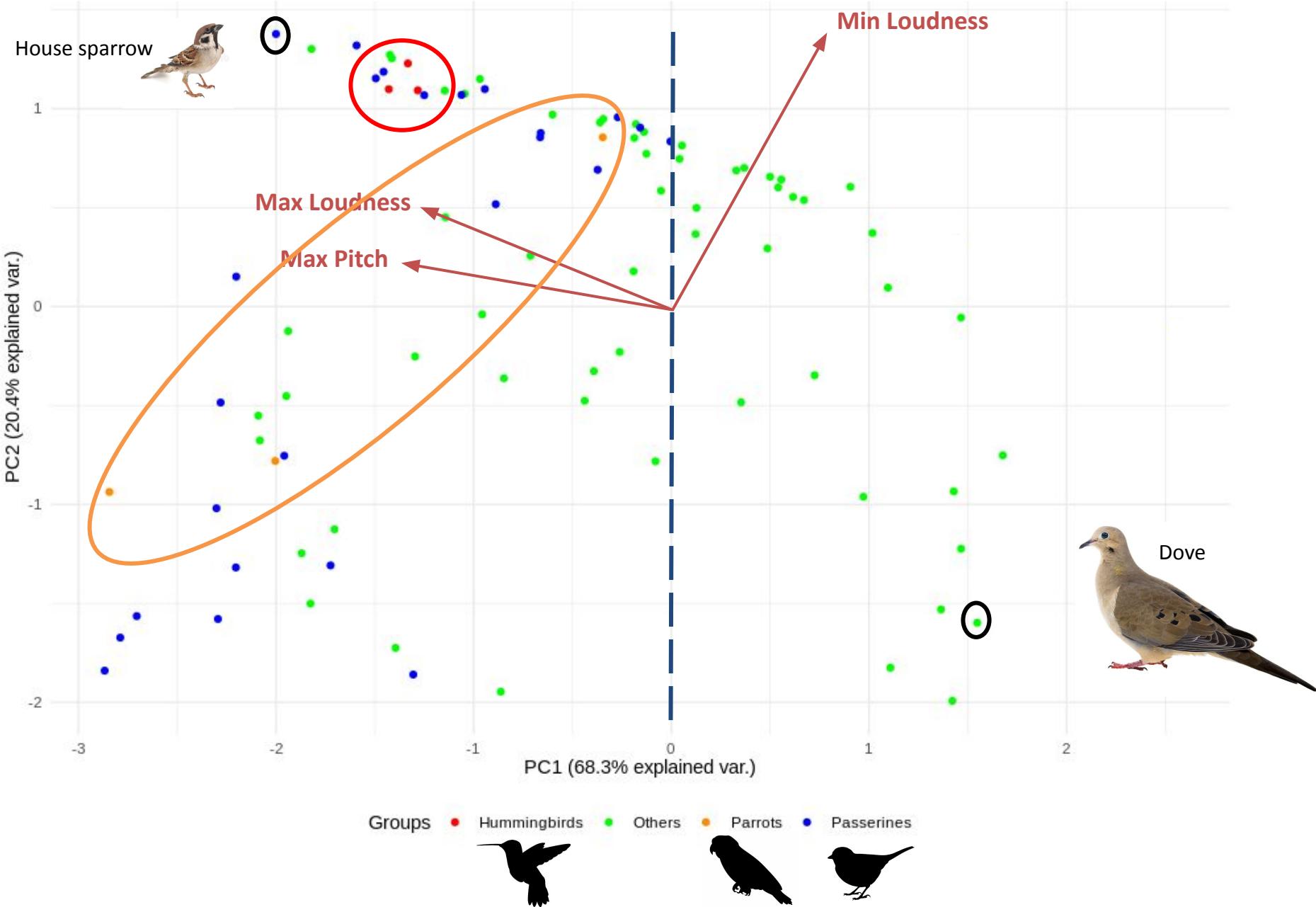
PCA of bird sound parameters



PCA of bird sound parameters grouping by Songbirds, Hummingbirds, and Parrots



PCA of bird sound parameters grouping by Songbirds, Hummingbirds, and Parrots



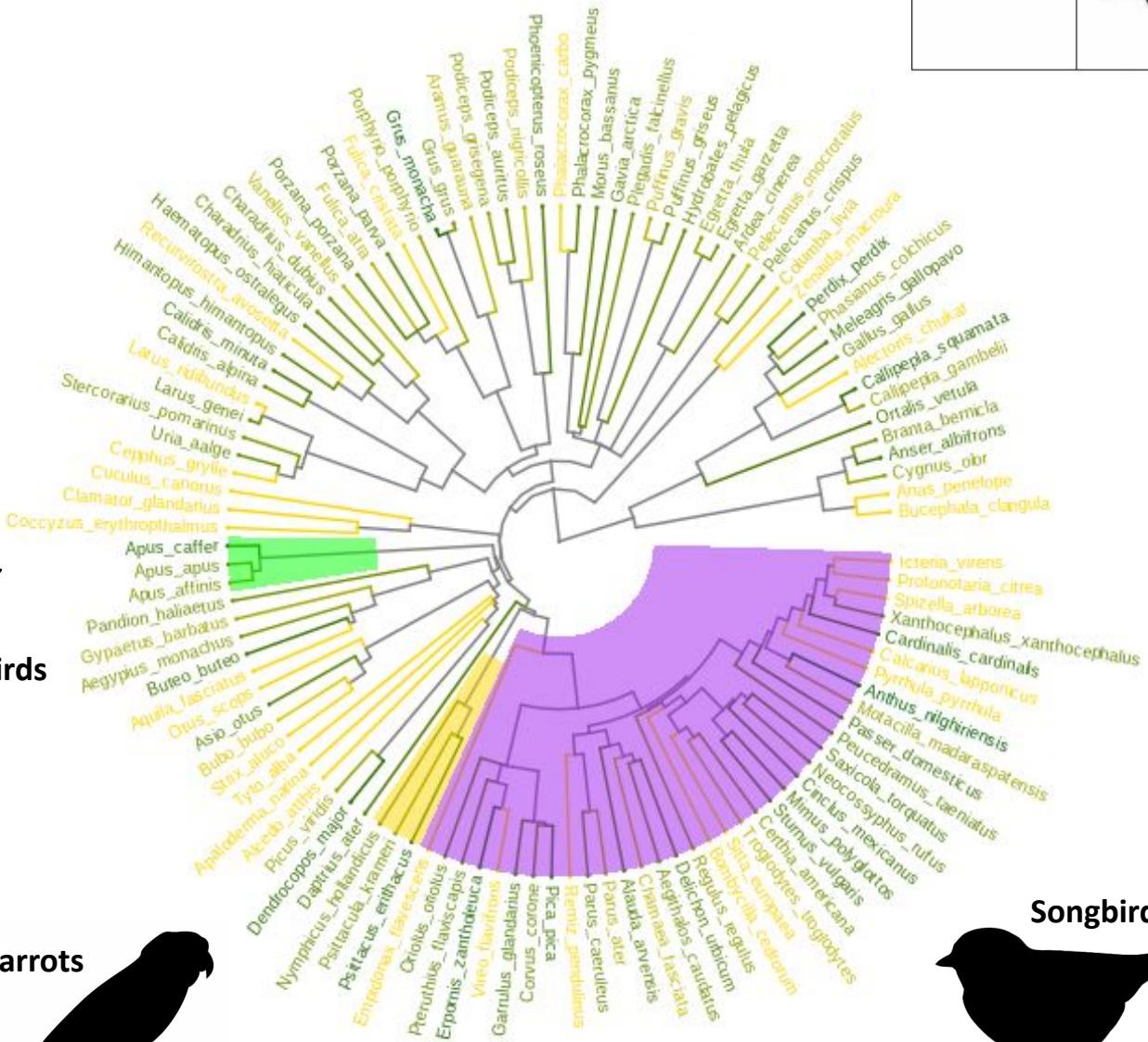
Phylogenetic tree of birds higlighting maximum loudness



Hummingbirds



Parrots

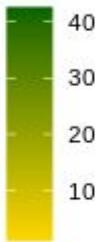


Loudness	depends on the amplitude of vibration
	

Loudness

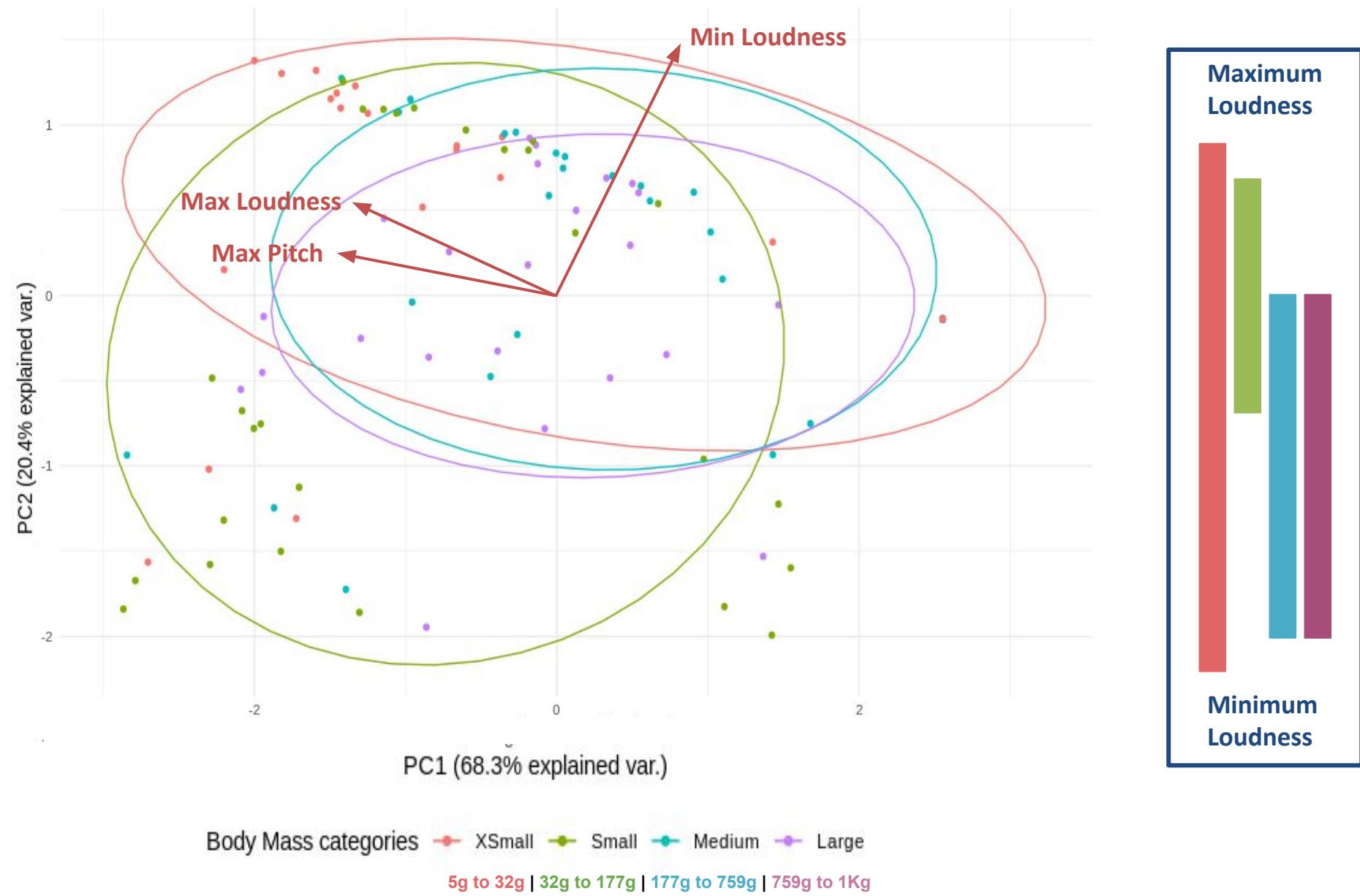
S

Maximum Loudness (dB)



Songbirds

PCA of bird sound parameters grouping by body mass level



5

Conclusion and Perspectives



Does it depends on :

Introduction

Evolutionary history

Body size

Life style

Questions

Quantification with exploration of sound production in different families of birds

Influence of body size on sound parameters

Relationship between sound production and nocturnality

Methods

Phylogenetic comparative methods

PCA

PCA

PCA

Results

Loudness not linked to phylogeny

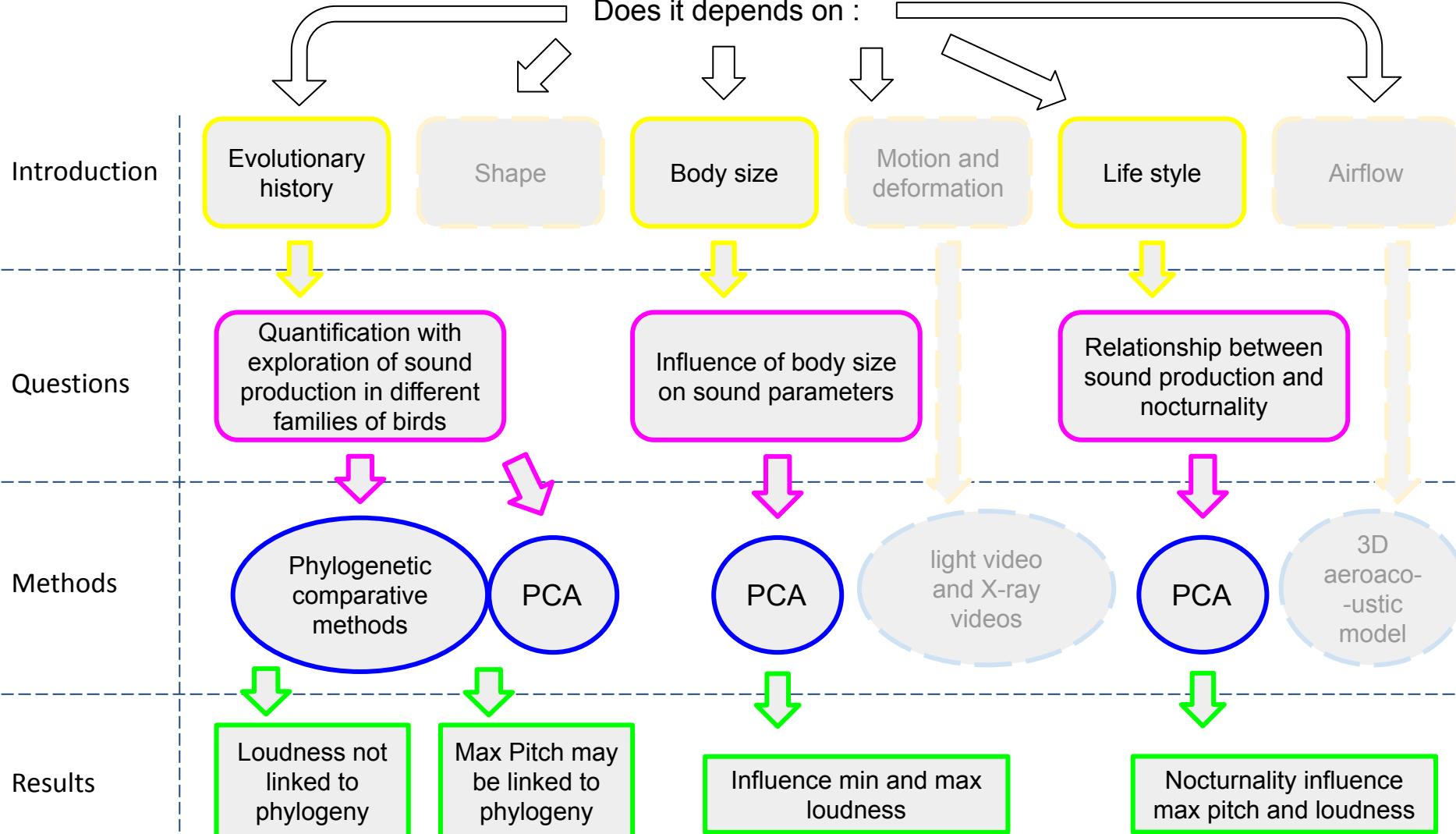
Max Pitch may be linked to phylogeny

Influence min and max loudness

Nocturnality influence max pitch and loudness

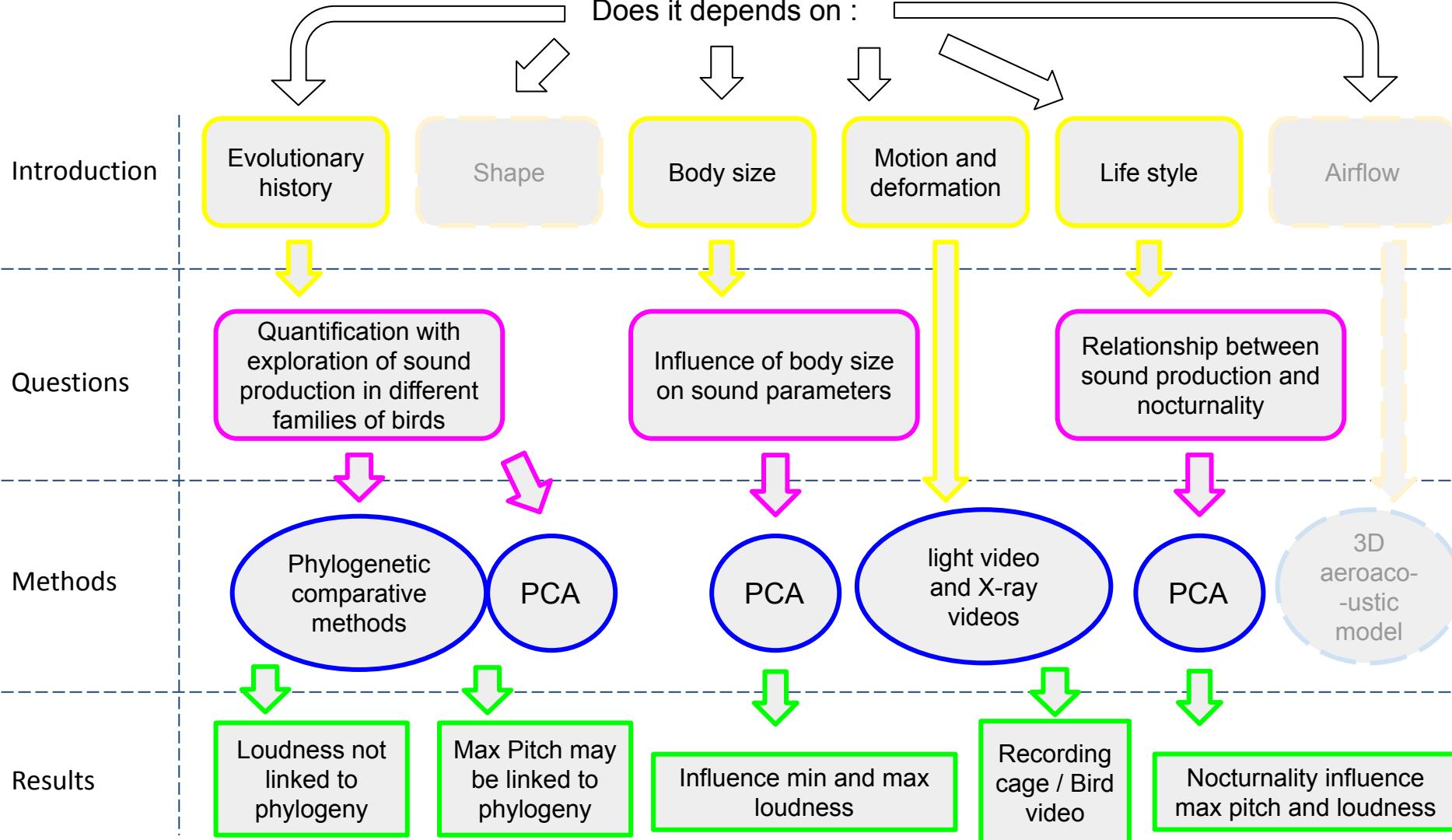


Does it depends on :





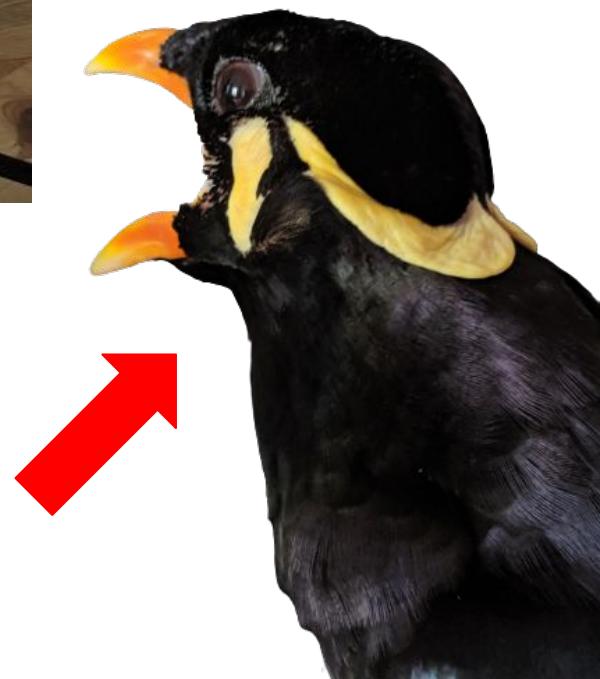
Does it depends on :



LOW PITCH



HIGH PITCH

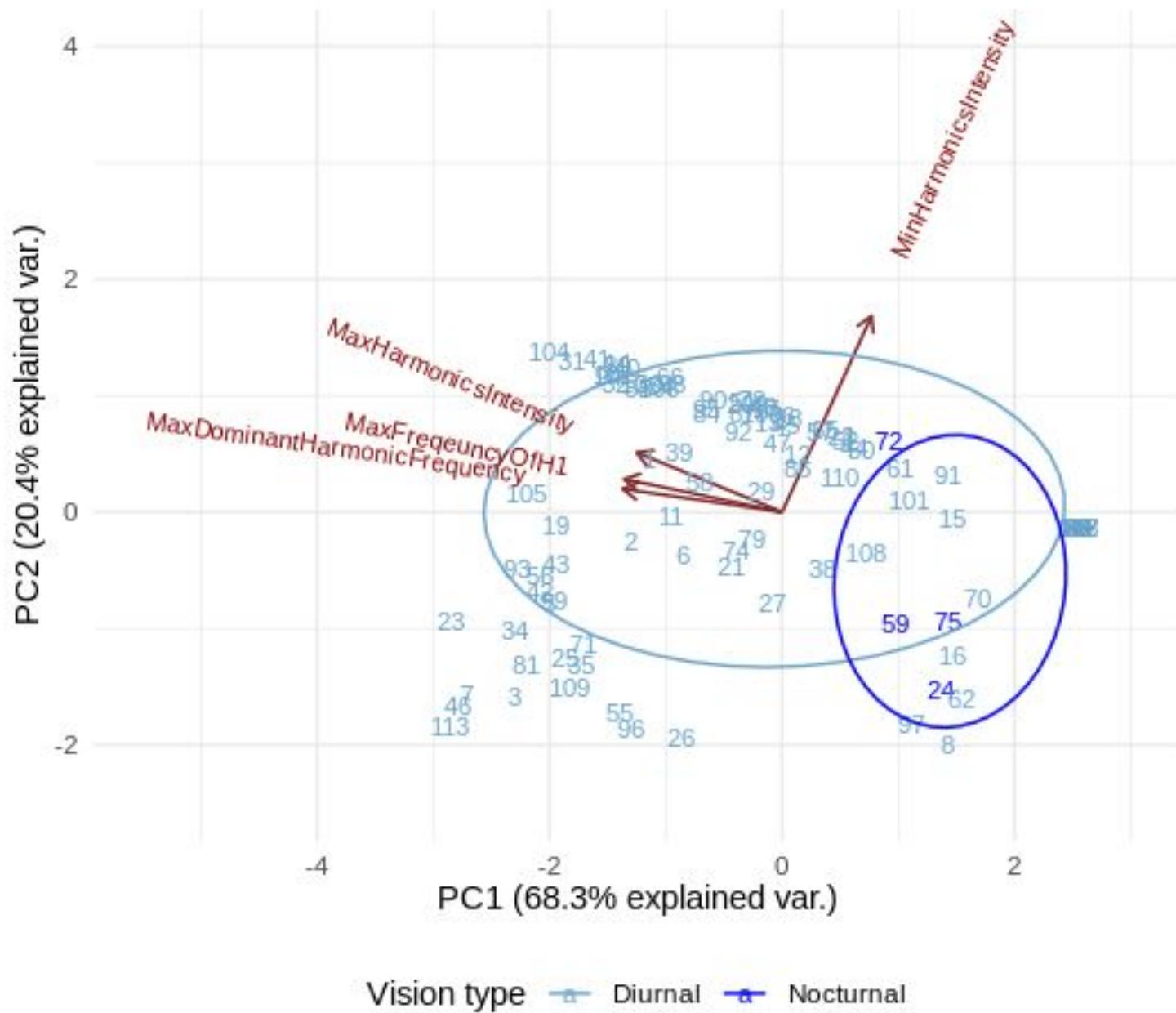


6

Acknowledgments



PCA of bird sound parameters grouping by vision types



They produce sounds with their **SYRINX**

How do birds vocalize ?

They modulate the sounds with their **VOCAL TRACT**

Does it depends on :

Other parameters

Size of the birds

Shape of the syrinx

Evolutionary history of the species

PCA

PCA

Quantification with exploration of sound production in different families of birds

Nocturnality influence max pitch and loudness

Influence minimum loudness

Phylogenetic trees coloured with different acoustic parameters

Max Pitch may be linked to phylogeny

Loudness not linked to phylogeny

Biomechanics of the vocal tract

Airflow of the vocal system

Record birds during vocalisation in visible spectrum

Record birds during vocalisation in X-rays spectrum

Development of an experimental protocol

Cineradiography

3D aeroacoustic model

Recording cage

Bird video

Big picture

Process

Results

Final observation/output