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The calling song of *Meimuna opalifera*; difference of the functions between the former and the latter part of the song

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Introduction

[TOPIC OF MY STUDY]

Acoustic communication in which **only males vocalize**

Anurans

Wells 2007

Orthopterans

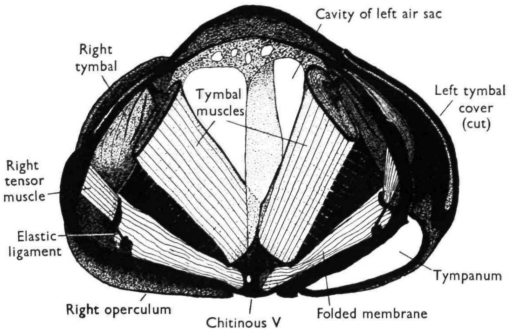
Cicadas

Miyatake 2011

- Attracting females & inducing pair formation for mating
  Alexander et al. 1997
- Indicating body size
  Arak 1983; Latimer and Sippel 1987
- Forming chorus group etc…
  Sueur and Aubin 2002

Cicadas

[Specific structure: **Tymbal**]



Pringle 1954

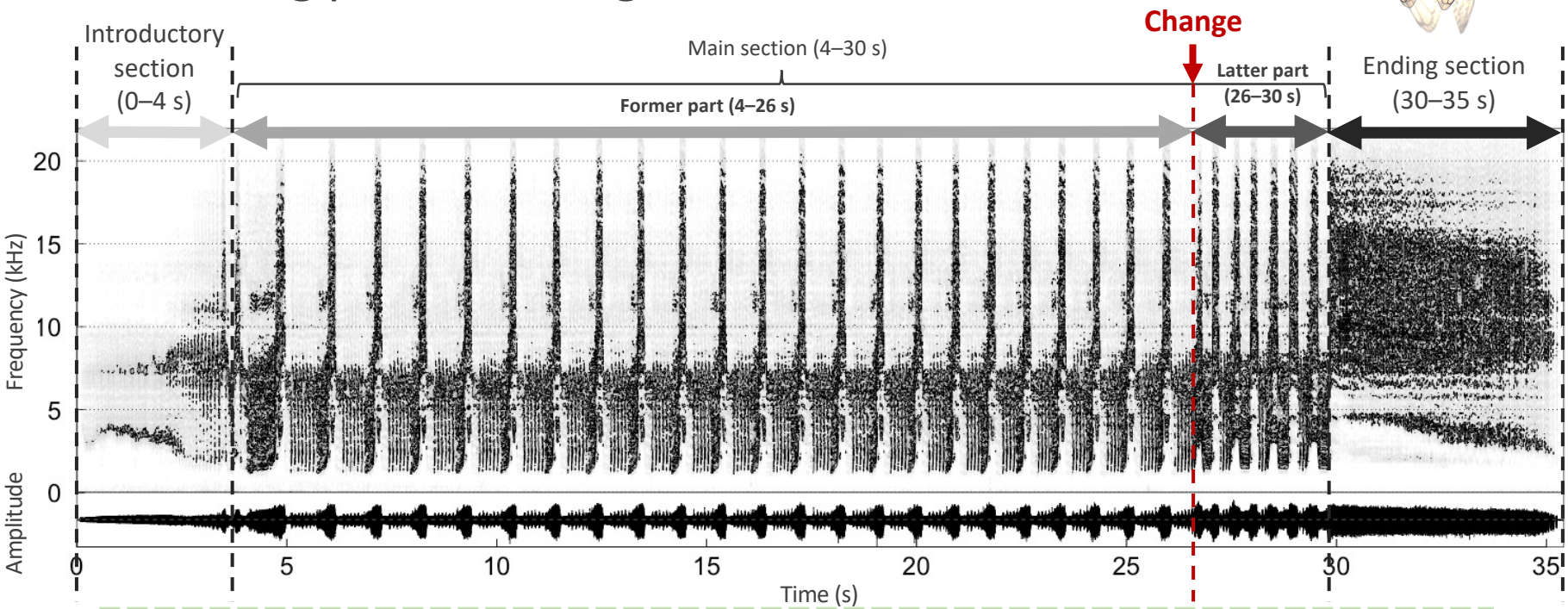
Muscle contraction
Membrane vibration
Resonance in cavity
Big sound Römer 2018

[INTERESTING POINT]

Extremely complex calling song

Meimuna opalifera

- **The calling song is extremely complex**
  The song pattern changes in the middle



It is still an open question
why the song structures are so complex

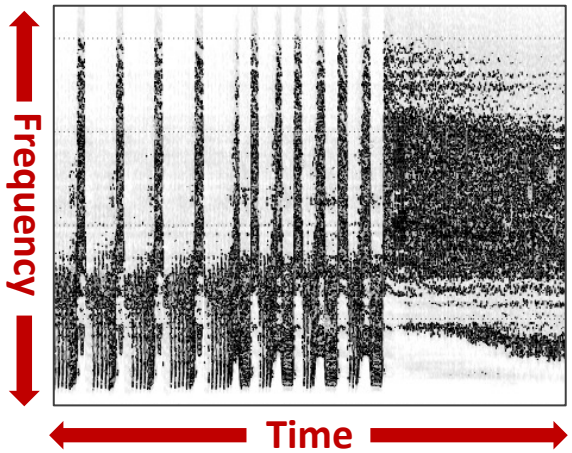
Acoustic characteristics may contain various biological information

Time domain: rhythm, timing, duration, and etc.

Frequency domain: pitch and etc.

Functioning as species identification or courtship Doolan and Young 1989; Fonseca and Revez 2002

A part of spectrogram of the calling song of *M. opalifera*



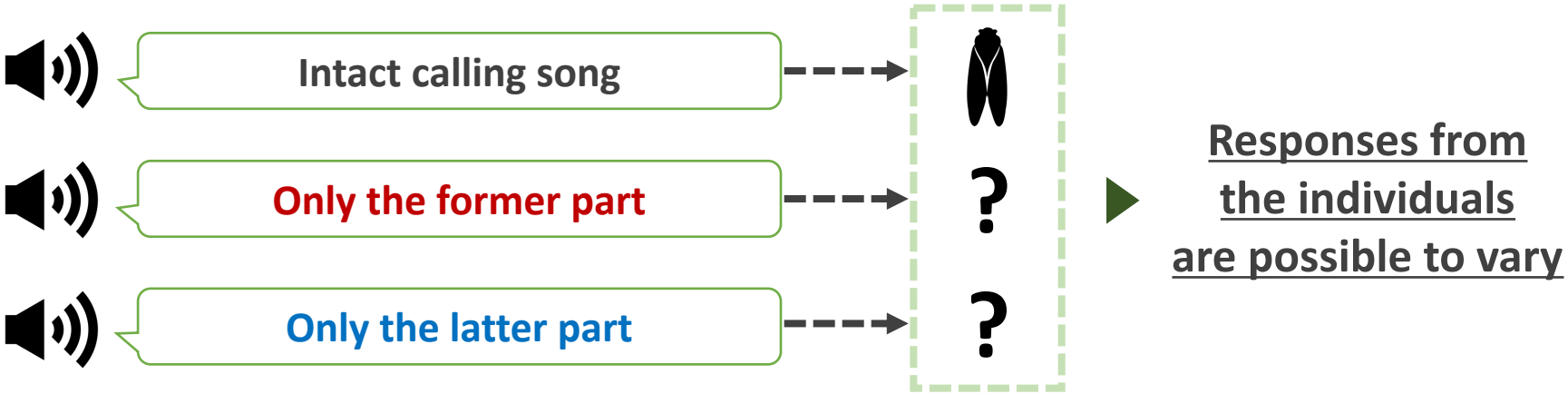
Two parts of the song may contain different information or functions

Methods

Hypothesis: these two parts have different functions

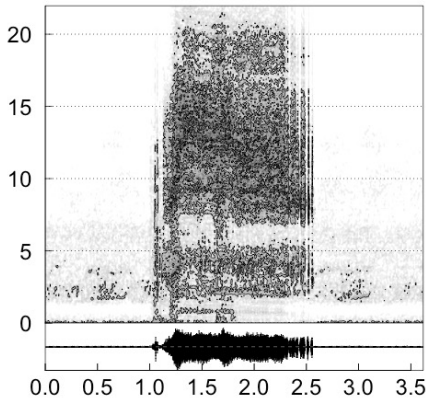
If the functions differ by the parts…

[Playback experiment] … Experiment by **playback** of sound stimuli from a loudspeaker



Males of *M. opalifera* vocalize **"response call (RC)"** to conspecific calling song

Hayashi & Saisho 2015, Ishimaru & Aihara 2022



A spectrogram and an oscillogram of an RC →
Y-axis: Frequency (kHz), X-axis: Time (s)

Counting the number of RCs as responses to the playbacks

Comparing the number of RCs in each type of sound stimuli

Methods

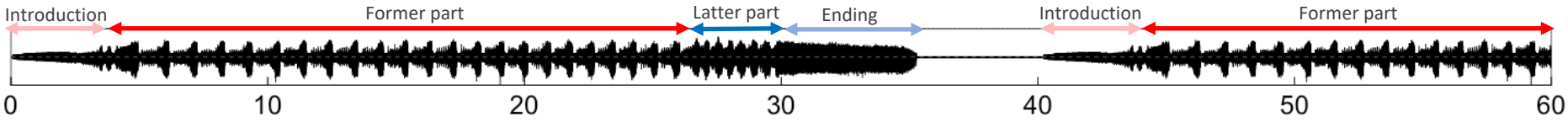
Recording: songs of 5 individuals

▼

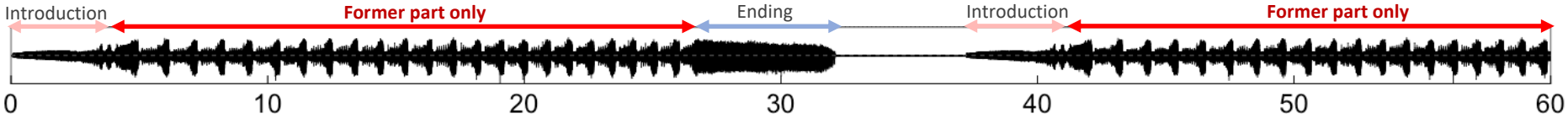
Editing: 5 types of playback sounds

Site	Ito Campus, Kyushu Univ. (33°35'41.8"N, 130°13'08.2"E)
Date	August 17th –30th, 2019

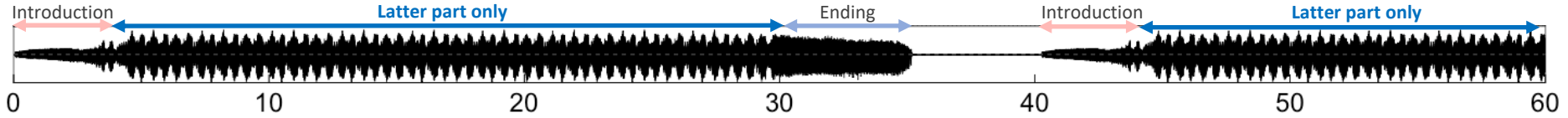
1. Intact song (IS)



2. Former-part song (FPS)

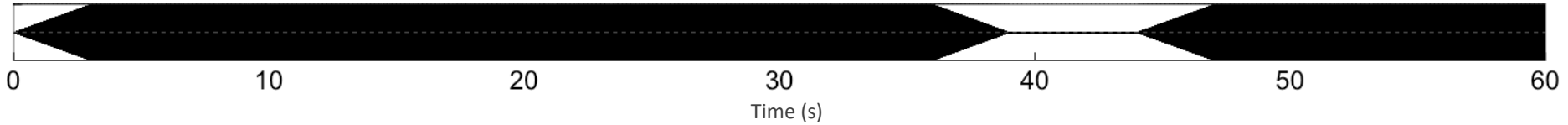


3. Latter-part song (LPS)



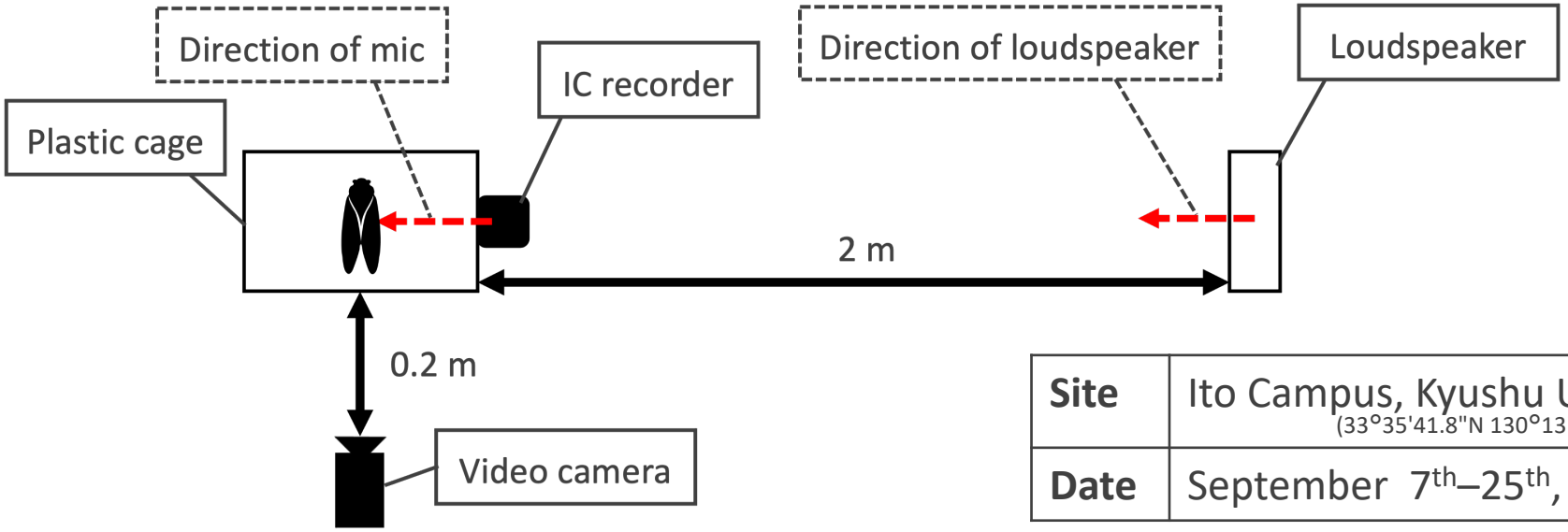
4. No sound (NS): control

5. White noise (WN): control



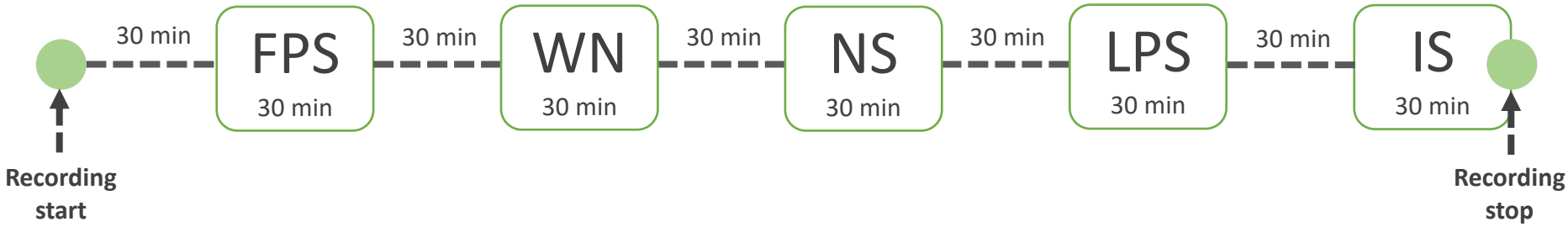
Methods

Playbacking: Under laboratory condition



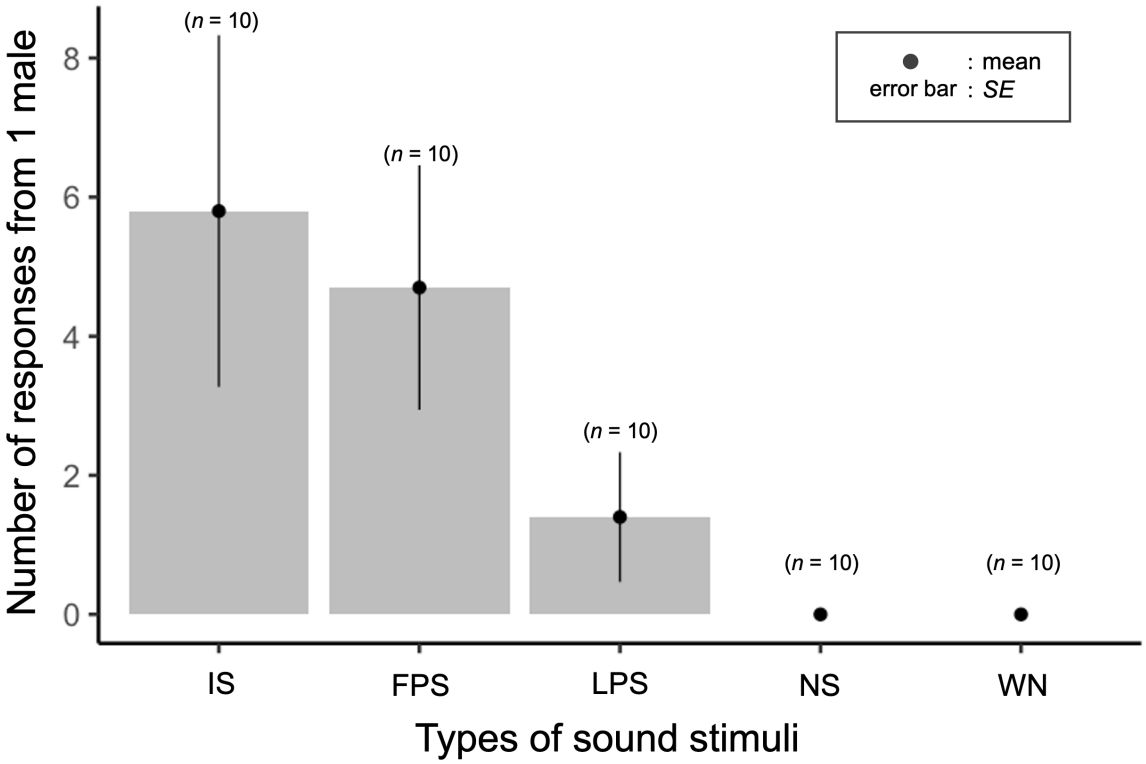
Site	Ito Campus, Kyushu Univ. (33°35'41.8"N 130°13'08.0"E)
Date	September 7th–25th, 2021

Schematic diagram of playback



Five types of sound stimuli were used in randomized order

Results



RCs were vocalized only to the stimuli made of the calling songs

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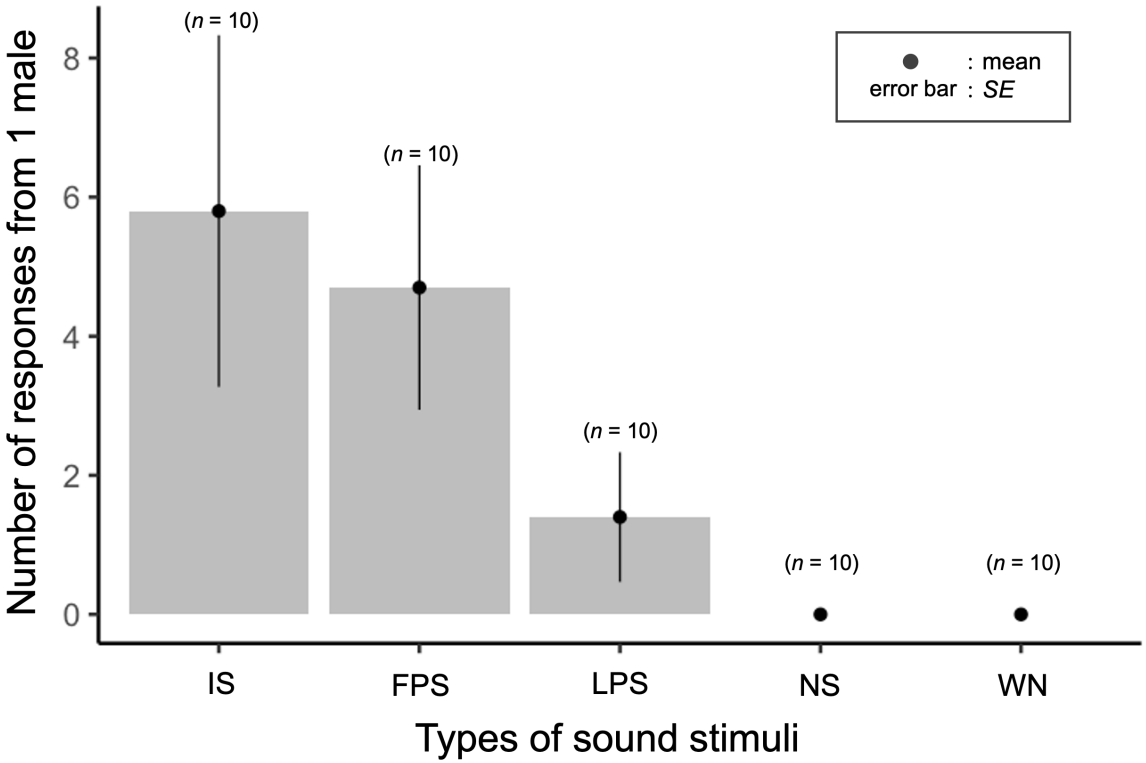
NS and WN were excluded from the subsequent statistical analysis

Results



(GLM, error structure: quasi-Poisson, log link)

IS, FPS > LPS ?

IS > LPS (t = -2.992, p < 0.05)

FPS > LPS (t = -2.706, p < 0.05)

IS – FPS … Not significant (t = -0.521, p > 0.05)

*p-values were adjusted by Holm correction Holm 1979

RCs were frequent for stimuli which contained the former part

Discussion

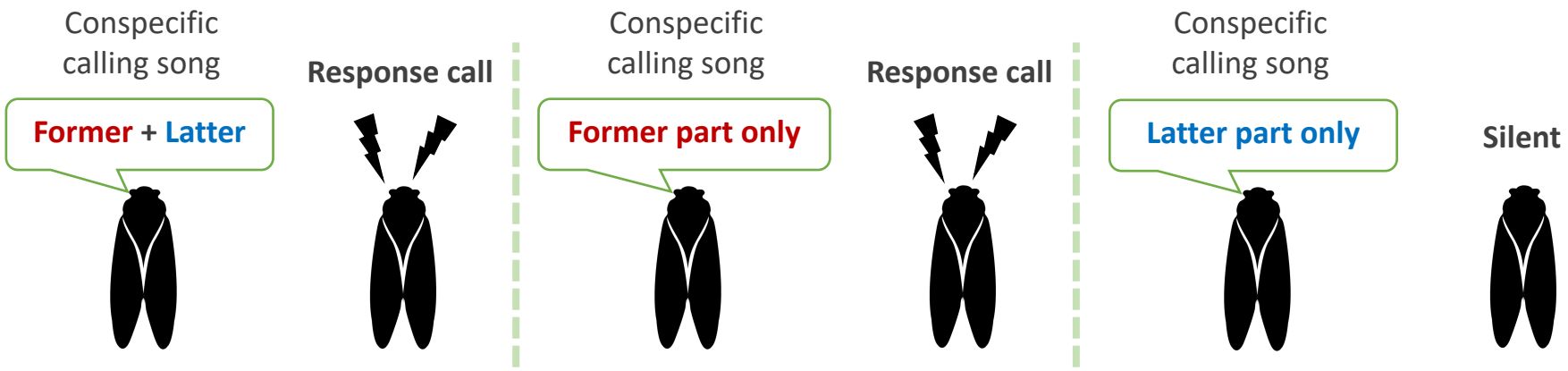
Number of responses

IS, FPS > LPS

=

More frequently to the stimuli which contained the former part

The function as a signal to the males exists in the former part of the calling song



Discussion

What is the function of the response calls?

Hypotheses regarding RCs …
- Disturbance to the calling song
- Variant of chorus Hayashi & Saisho 2015

[Previous study] Ishimaru and Aihara (2022)

Examination of whether the RCs of *M. opalifera* mask the conspecific calling song

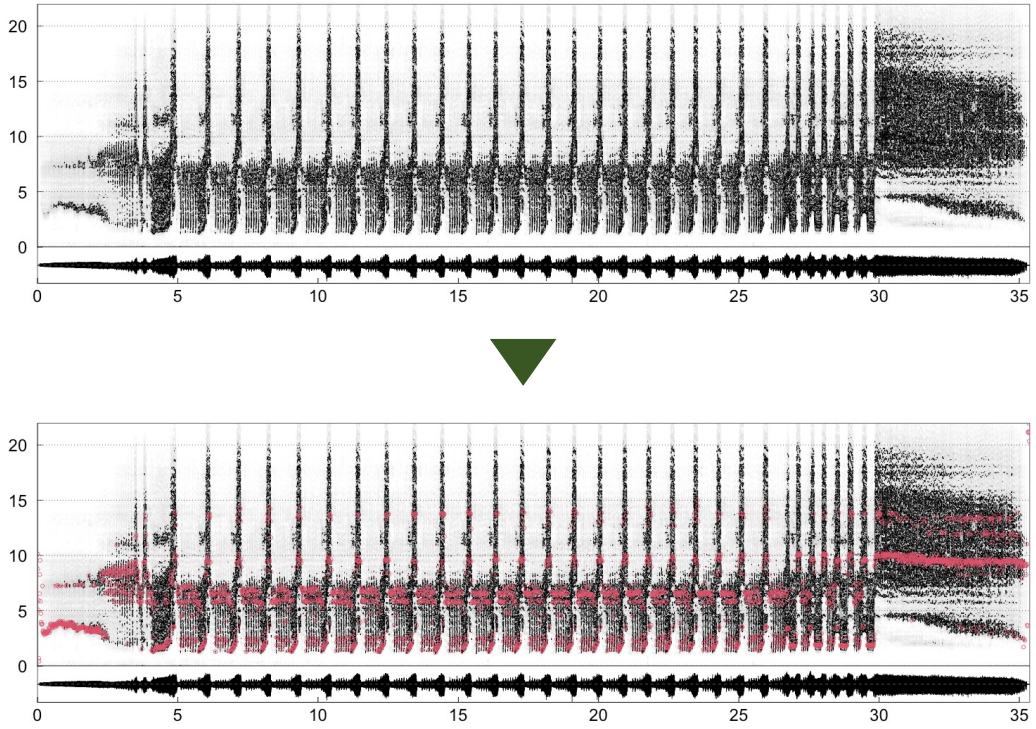
- It could not be said that RCs masked effectively, and new possibilities were proposed
  - (i) Competition hypothesis
  - (ii) Sneaking hypothesis
  - (iii) Cooperation hypothesis

The function of RC is still an open question

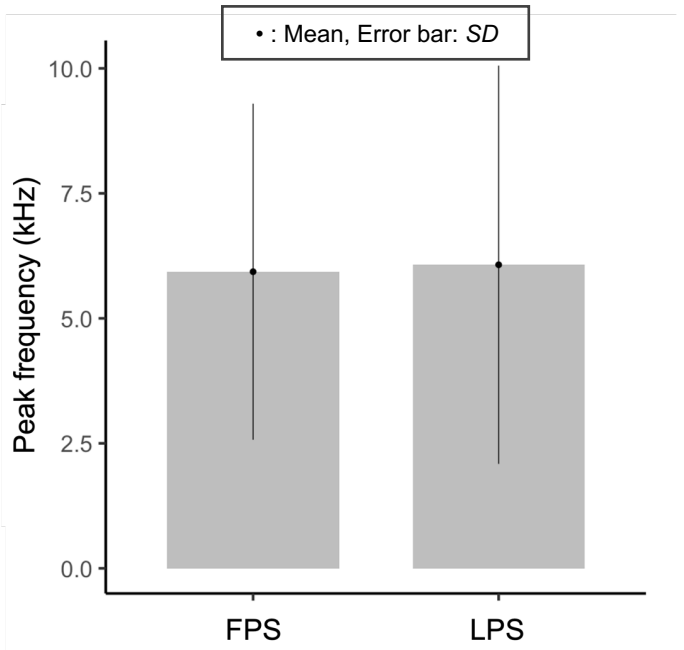
- It should be revealed for the further understanding of the functions of the calling song

Discussion

Comparing the peak frequencies of two parts using FFT



FFT: fast Fourier transform



These were not significantly different

(Wilcoxon rank sum test, $p = 0.2753$)

The temporal characteristics might be critical for evoking other male responses

Conclusion

- *M. opalifera* vocalizes the response calls only to the conspecific calling song, not to other sound
- Synthetic sound stimuli which contains the former part of the calling song induce the response calls
  - **This is the first study which showed that the two parts of the calling song of *M. opalifera* had different functions**

    These results will be the first step to reveal the importance of the complexity of the calling song of *M. opalifera*
- The function of the response calls is still an open question
- The temporal characteristics might be critical rather than the frequency

Acknowledgements

I will thank to the people and the institutions below that supported my study

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Thank you for your kind attention

Photo by Yuya Suzuki