

Remote detection and monitoring of invasive species of hornets (*Vespa velutina* and *Vespa mandarinia*) using acoustic tools

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Beehero Inc

Beekeeping in Europe has faced significant challenges from *Vespa velutina* since its introduction in France in 2004, with the species now widespread across the continent. Similarly, the arrival of *Vespa mandarinia* (Asian Giant Hornet) in 2019 and *V. velutina* in 2024 threaten North American beekeeping. These invasive wasps prey on honey bees and other pollinators, potentially causing ecological, economic, and public health impacts if established. The ability to detect their presence as well as monitor their spread is fundamental to any measures aimed at eradication or control. This paper describes how acoustic based tools were used to remotely detect the unique flight signature of *V. velutina* and *V. mandarinia*. Over the past 8 years, working in apiaries across Europe, a device was trained for the detection of *V. velutina* near beehives, sending alerts to beekeepers. The equipment was tested in a number of environments including the apiaries hosting *V. crabro*, a protected species of honey bee predator.

Following the introduction of *V. mandarinia* into Washington state, working in collaboration with the USDA the device was used to monitor the entrance of an established *V. mandarinia* nest. This generated large quantities of high-resolution audio recordings of *V. mandarinia* flight activity; these recordings were used to produce robust detection algorithms. From the data we were able to profile the daily nest activity, such as commencement and cessation of daily flight and overall traffic, which correlated well with the nest's population and manual observation. The differences in acoustic signatures of hornets of known sizes and weights, constrained within a flight tent, were extrapolated to profile the nest demographic. The system has since been adopted by the department of agriculture in Georgia (US) for use on mainland and remote islands following the introduction of *V. velutina*.

Practical application of this technology provides early detection of hornet presence in apiaries and potential entry points, while tracking activity at established sites. Additionally, it could inform longer term strategies for eradication and containment, by improving knowledge of hornets' behaviour while identifying areas of activity, better define how and where resources should be focused for maximum effect.



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OF INVASIVE SPECIES OF HORNET (VESPA
VELUTINA AND VESPA MANDARINIA) USING
ACOUSTIC TOOLS

APIMONDIA 2025
COPENHAGEN

Dr Huw Evans

2025



2018



Bordighera



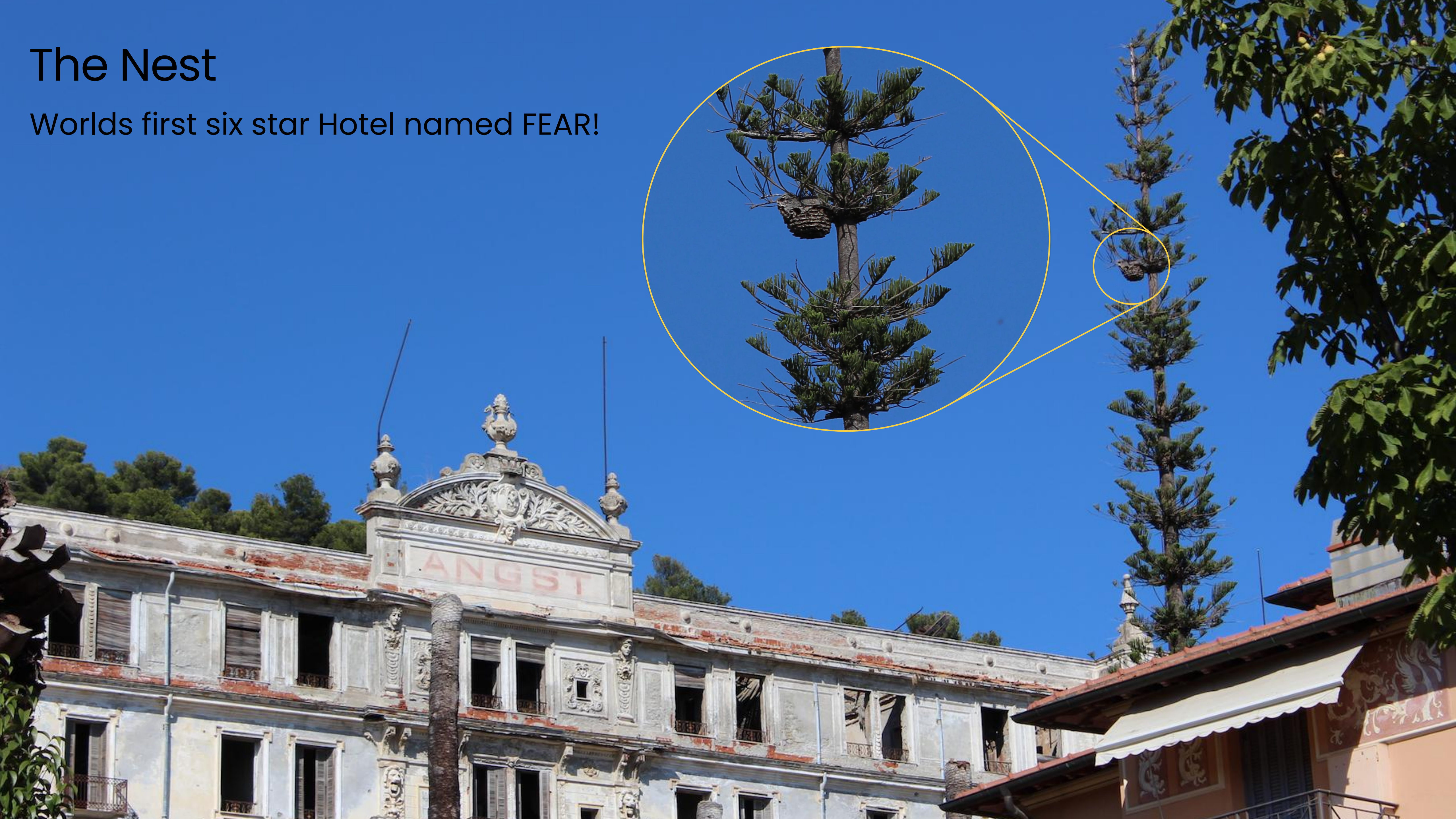






The Nest

Worlds first six star Hotel named FEAR!





Acoustic signature

2020

The New York Times

‘Murder Hornets’ in the U.S.: The Rush to Stop the Asian Giant Hornet

Sightings of the Asian giant hornet have prompted fears that the vicious insect could establish itself in the United States and devastate bee populations.

Published May 2, 2020

Vespa Mandarnia



Worlds largest hornet



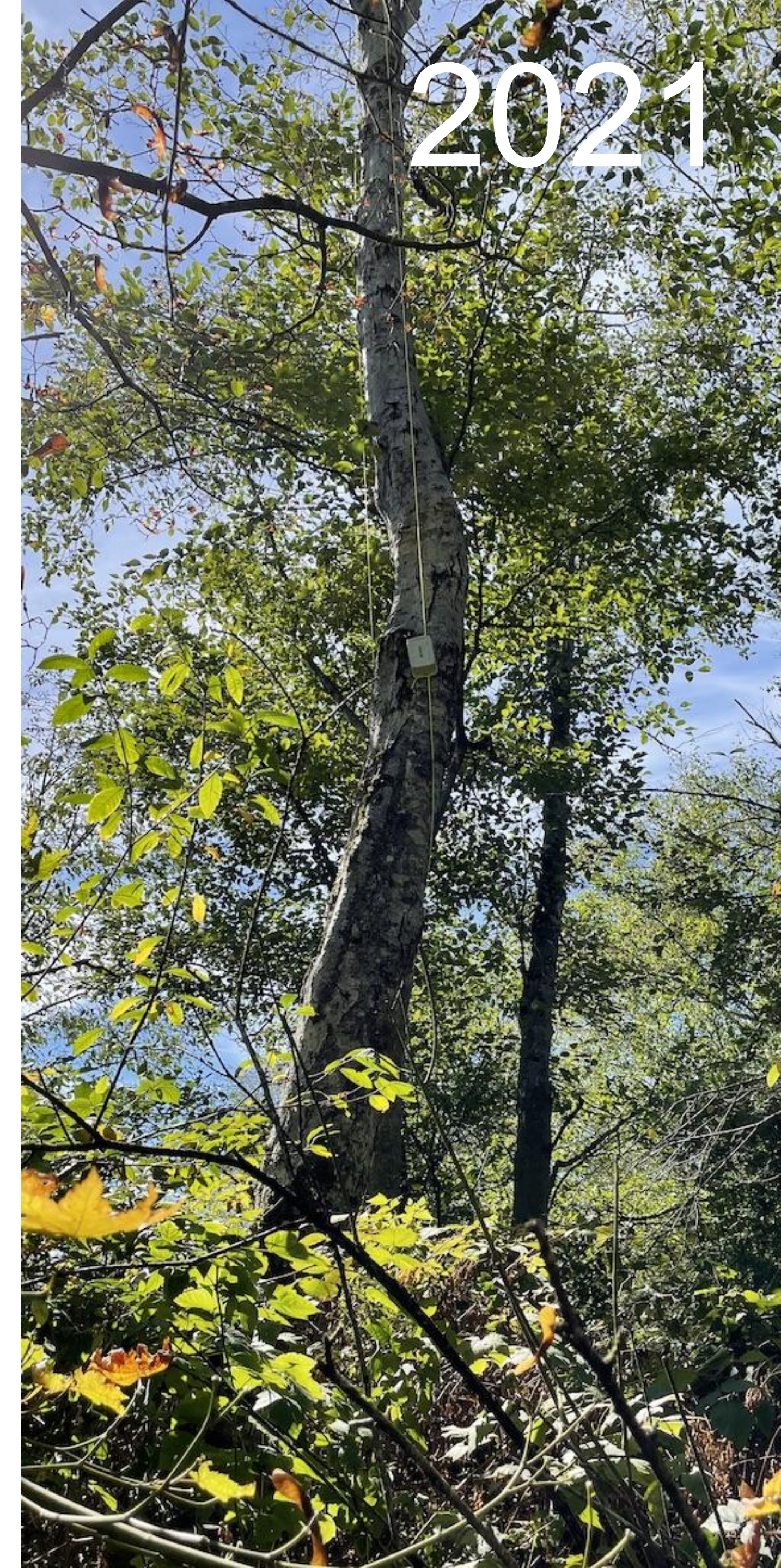
Dr. Todd Gilligan APHIS



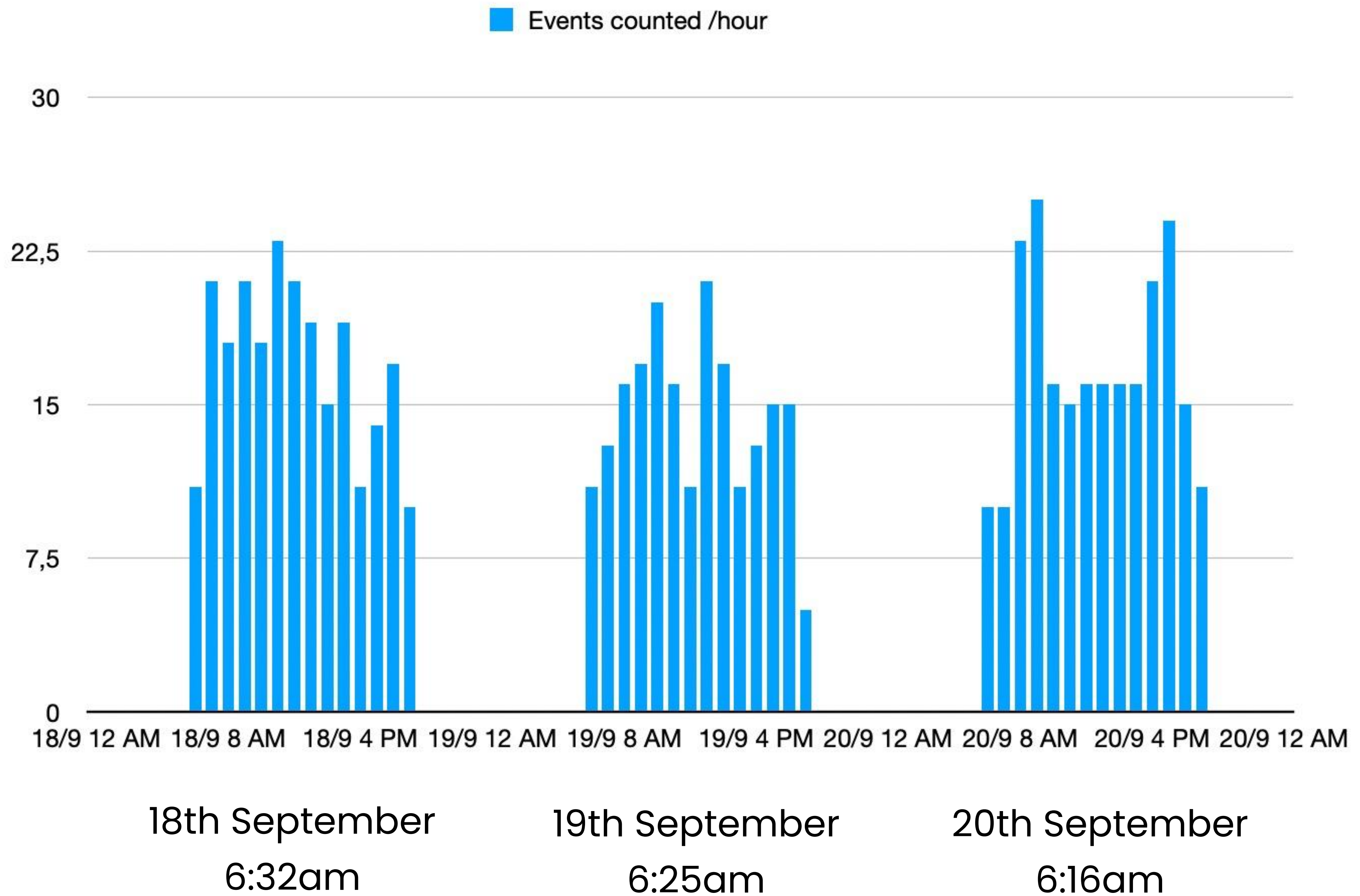
Dr. Chris Looney WSDA

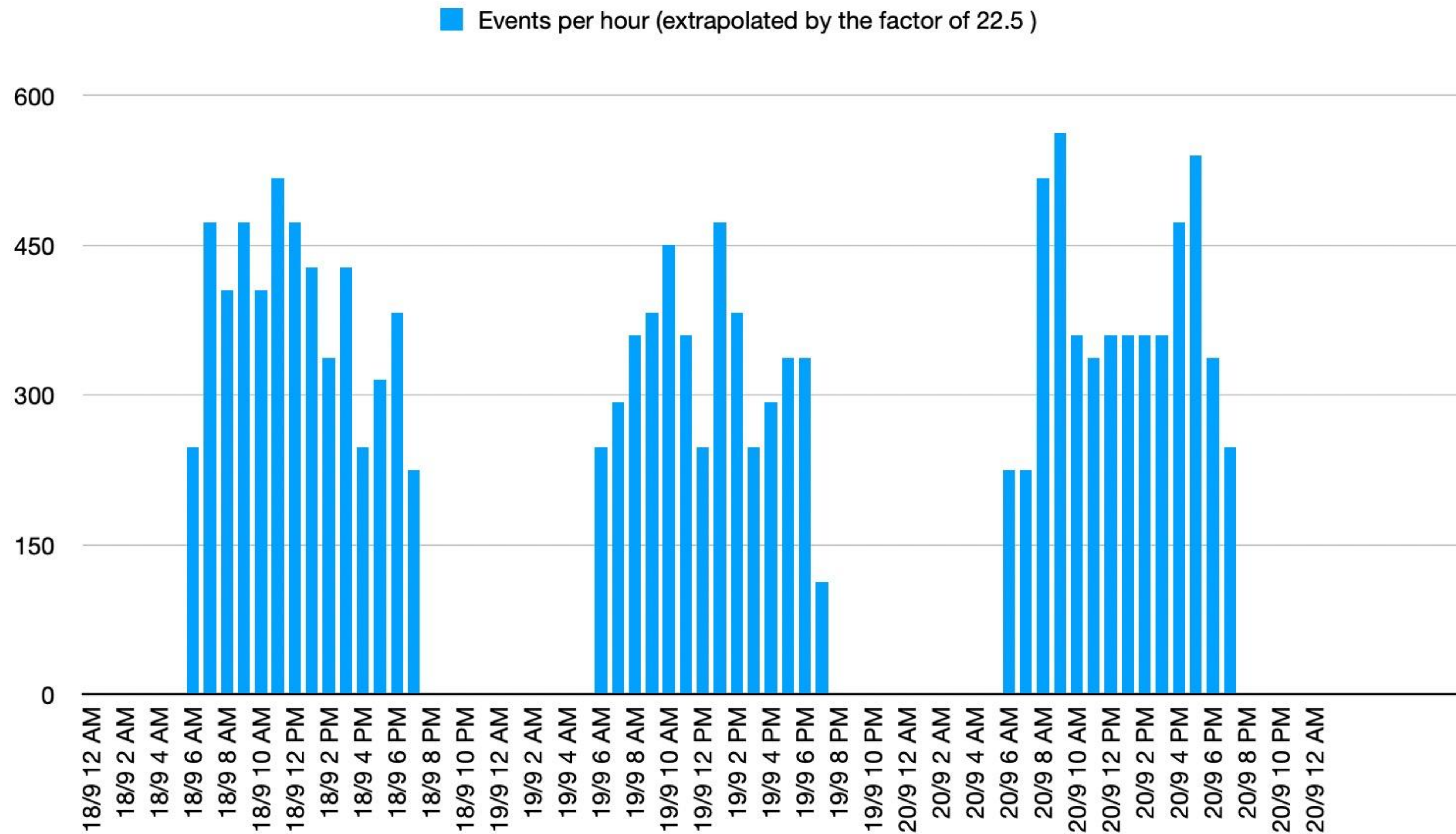


Anne M Lebrun APHIS









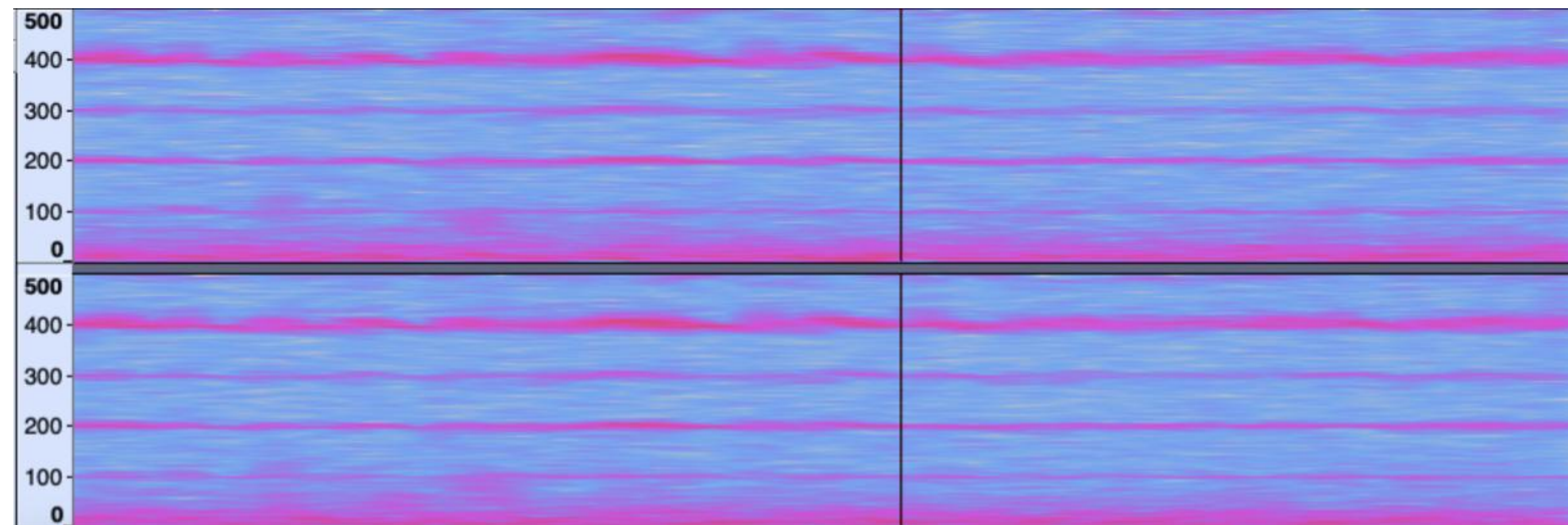
1 Hornet every 10 seconds



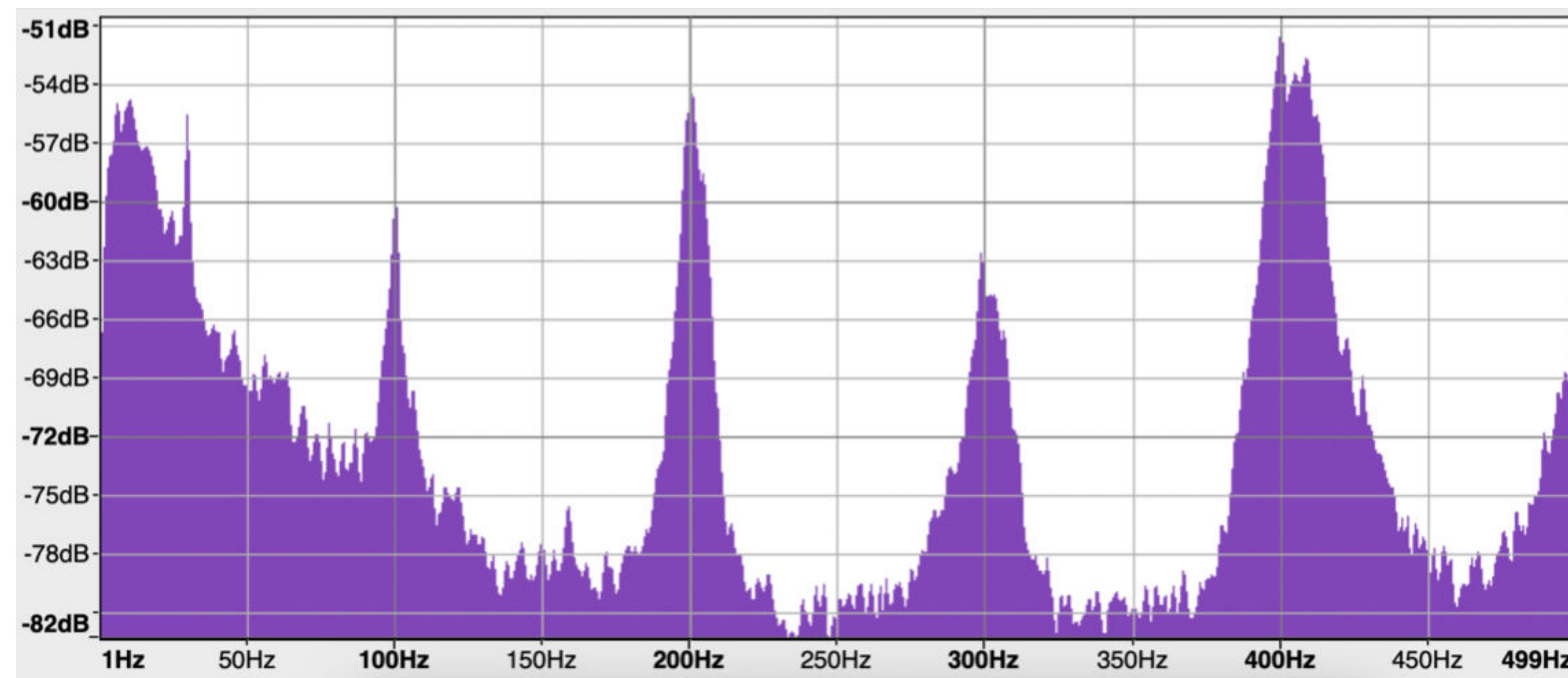


Institut Royal
de
France.
Académie des sciences.
FOURIER,
(Joseph.)
Membre de la Légion d'honneur, etc.
*Né à Auxerre, le 21 Mars 1768, élu en 1817
et Secrétaire perpétuel pour les sciences mathématiques en 1833.*

Spectrogram

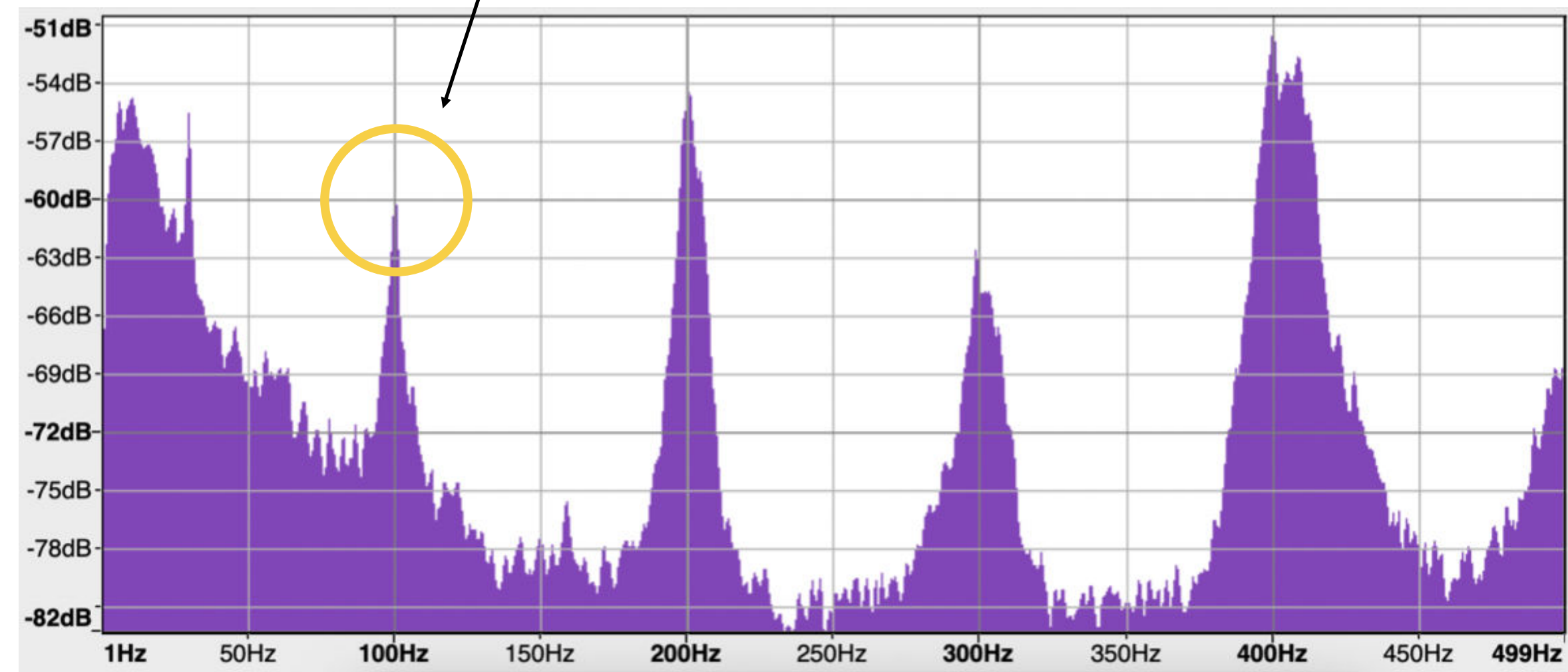


Power Spectral Density (PSD)



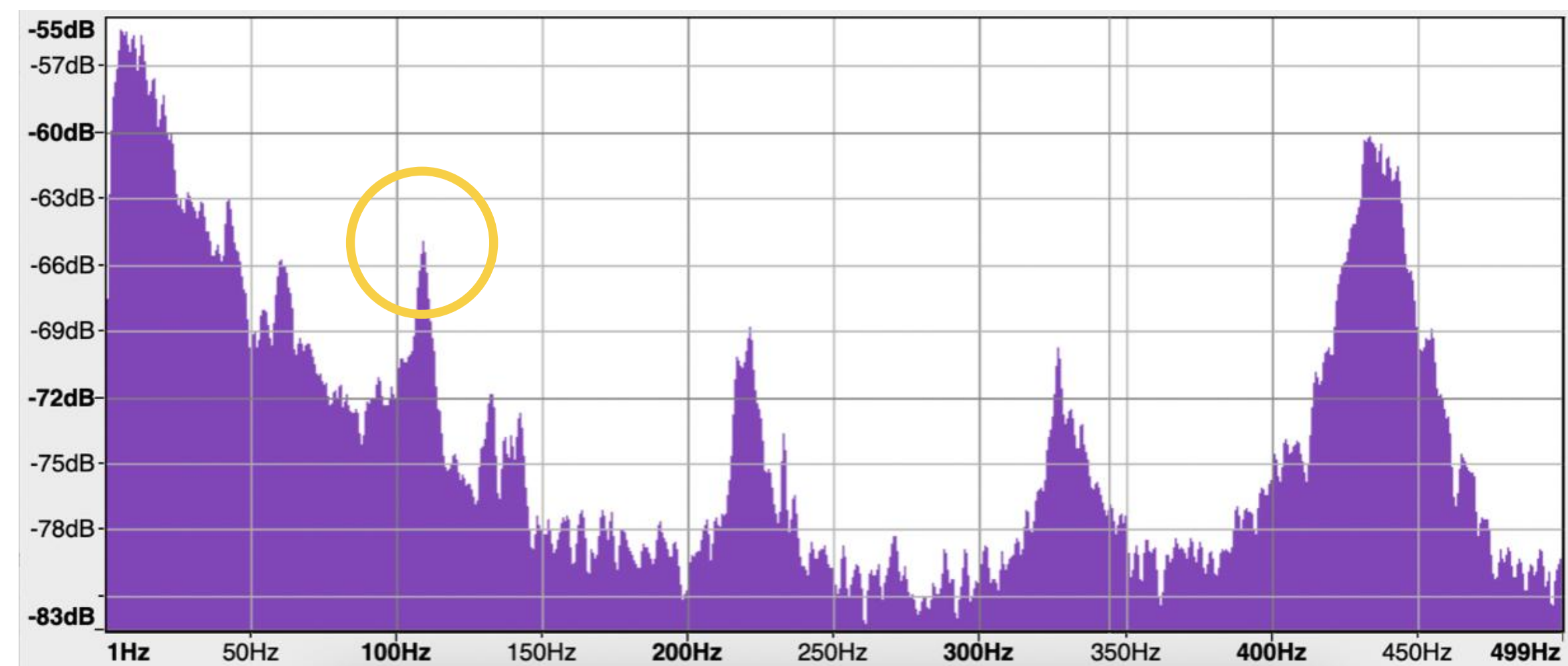
Fundamental Frequency

BH2



100 Hz

BH3



109 Hz

	Fundamental frequency	Length	Mesosoma	Weight
BH2	101,0000	29,1800	7,9300	0,8138
BH3	109,0000	26,1400	6,8800	0,5655

Size Matters!

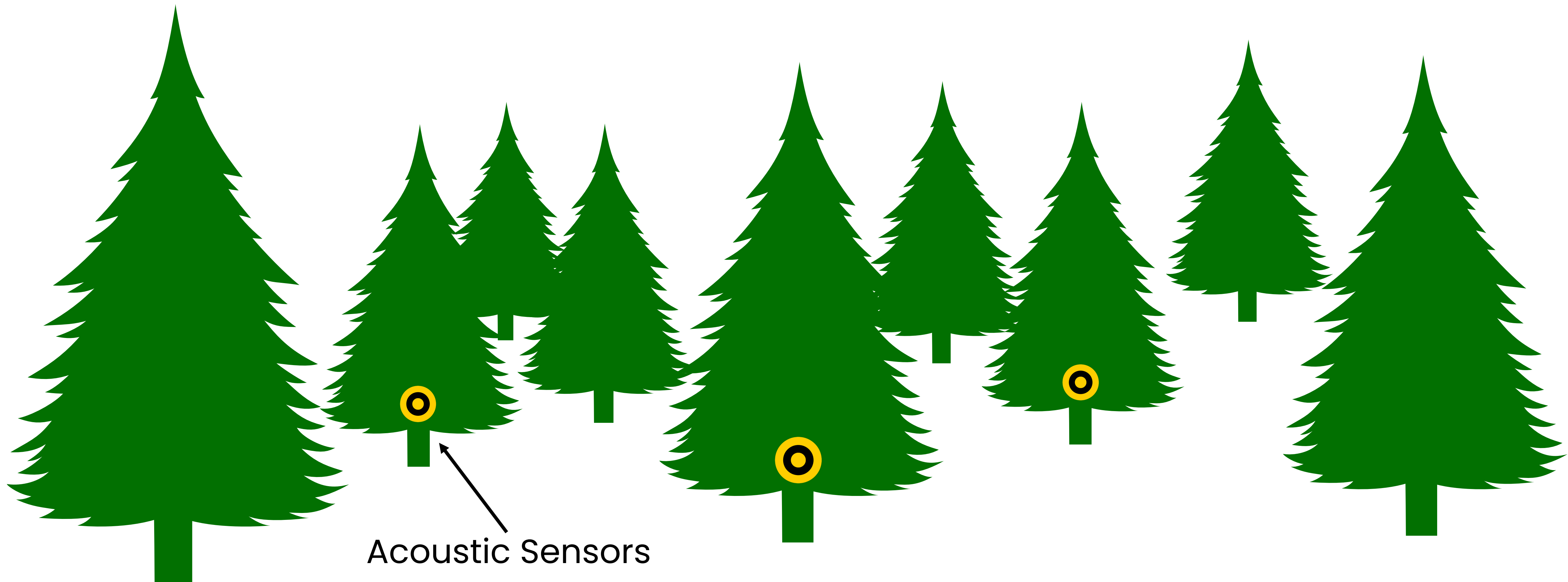
	Fundamental frequency	Length	Mesosoma	Weight
BH2	101,0000	29,1800	7,9300	0,8138
BH3	109,0000	26,1400	6,8800	0,5655
MIN nest	82	36.4	10.4	1.406
MAX nest	120	21.9	5.46	0.2286

Smallest Hornet left the nest 21.9 mm long*

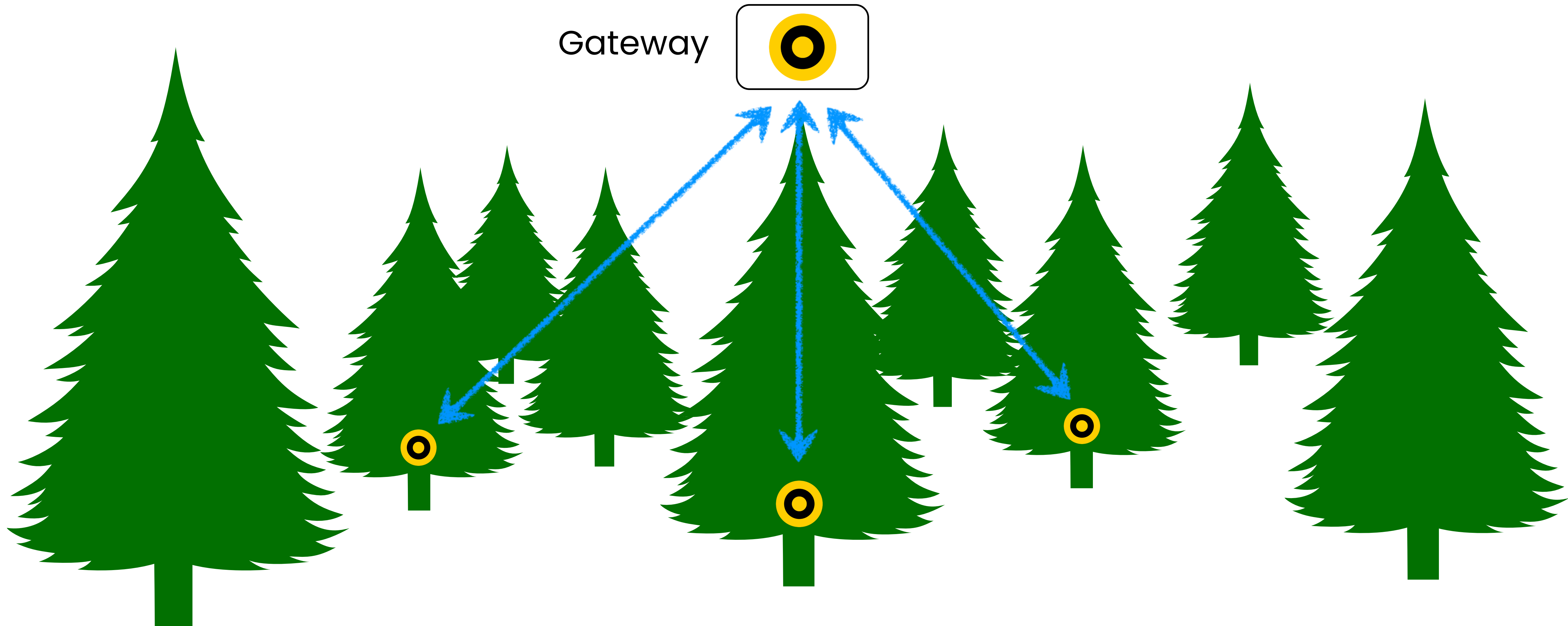
Biggest Hornet left the nest 36.4 mm long*

* this assumes a linear size vs frequency relationship

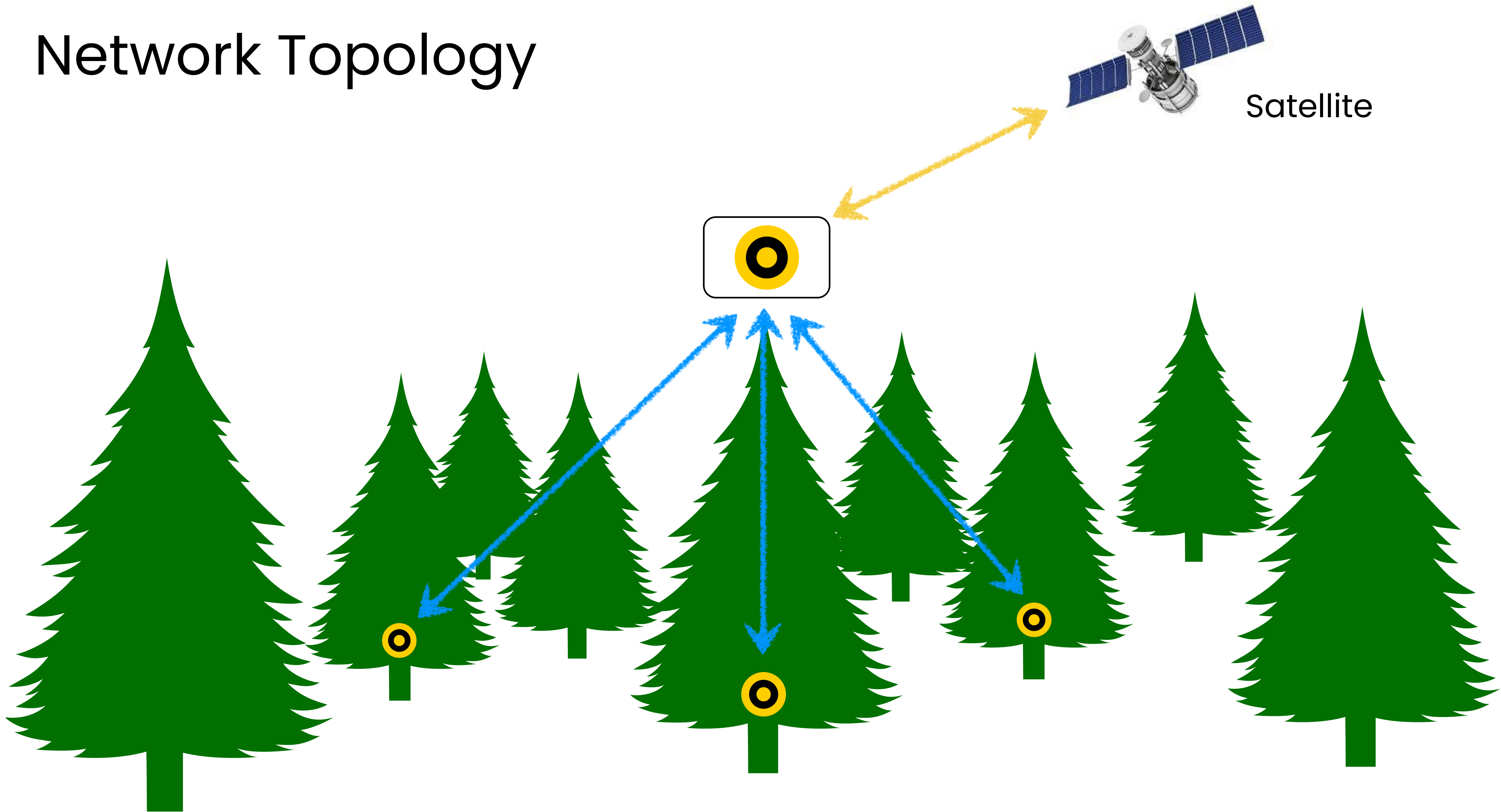
Network Topology



Network Topology

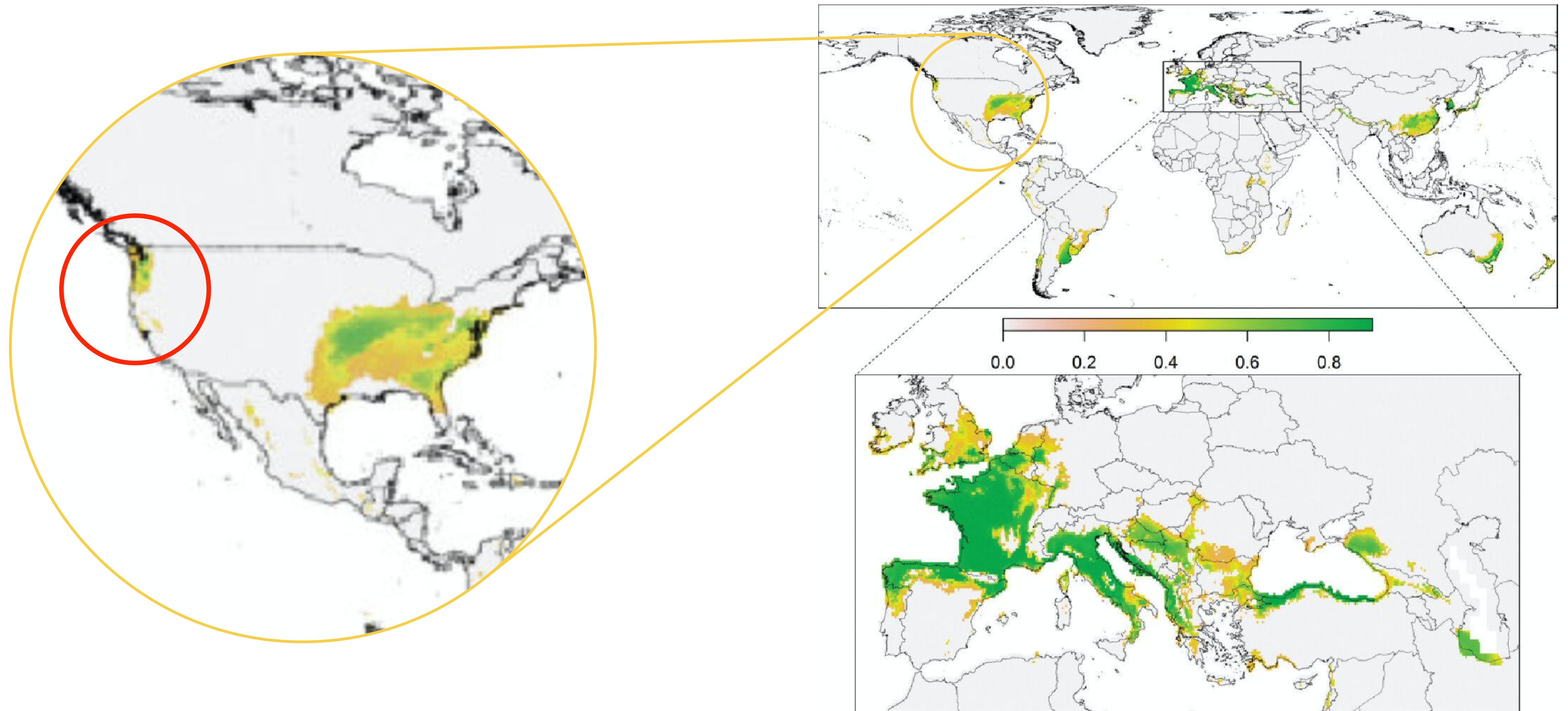


Network Topology



US Climate suitability

Source: "The economic cost of control of the invasive yellow-legged Asian hornet"
Morgane Barbet-Massin¹, Jean-Michel Salles², Franck Courchamp¹. 2020



2023

An invasive hornet that hunts honeybees is spotted in the U.S. for the first time

August 17, 2023 · 5:00 AM ET

By [Bill Chappell](#)



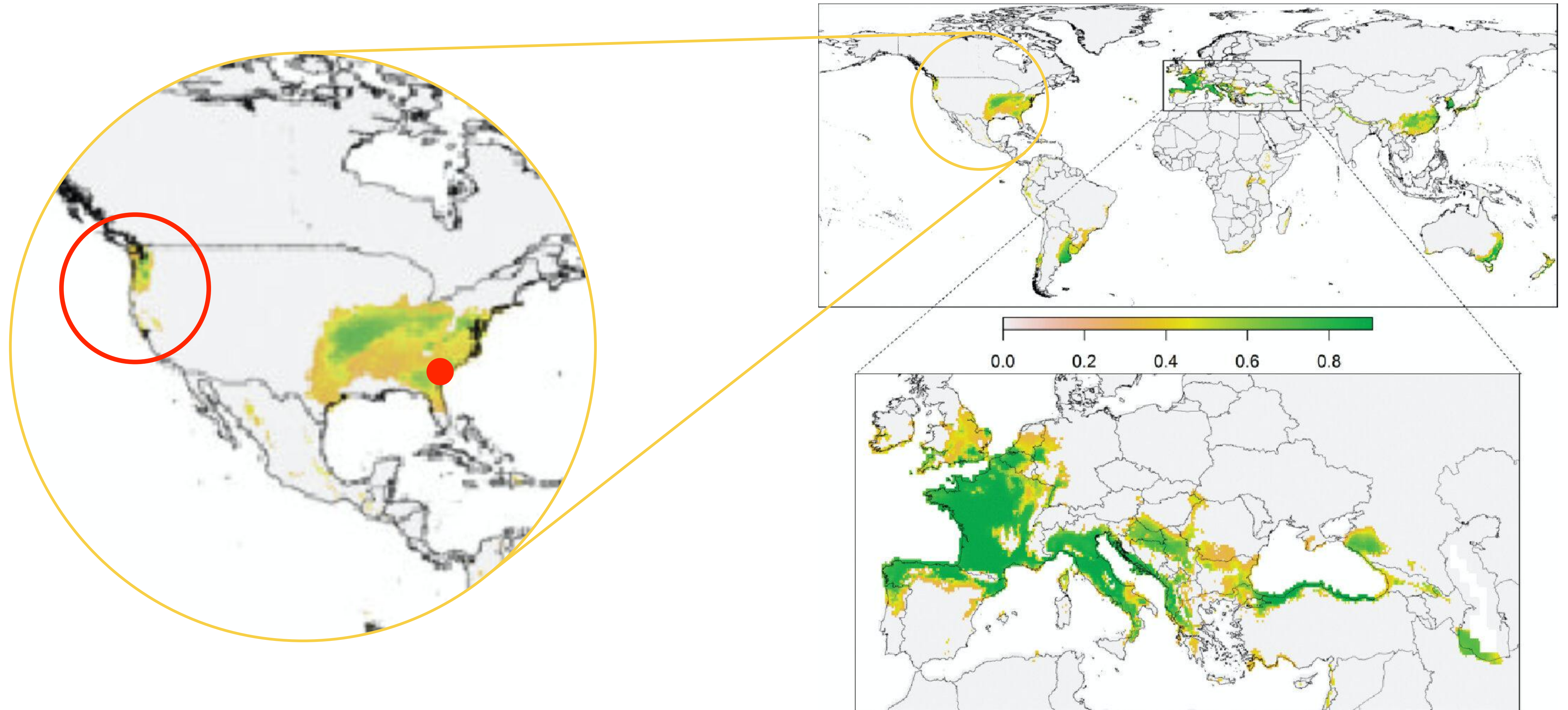
The yellow-legged hornet is a prolific predator of honey bees and other pollinators. Now it's been spotted alive in the wild in the U.S. for the first time.

Georgia Department of Agriculture

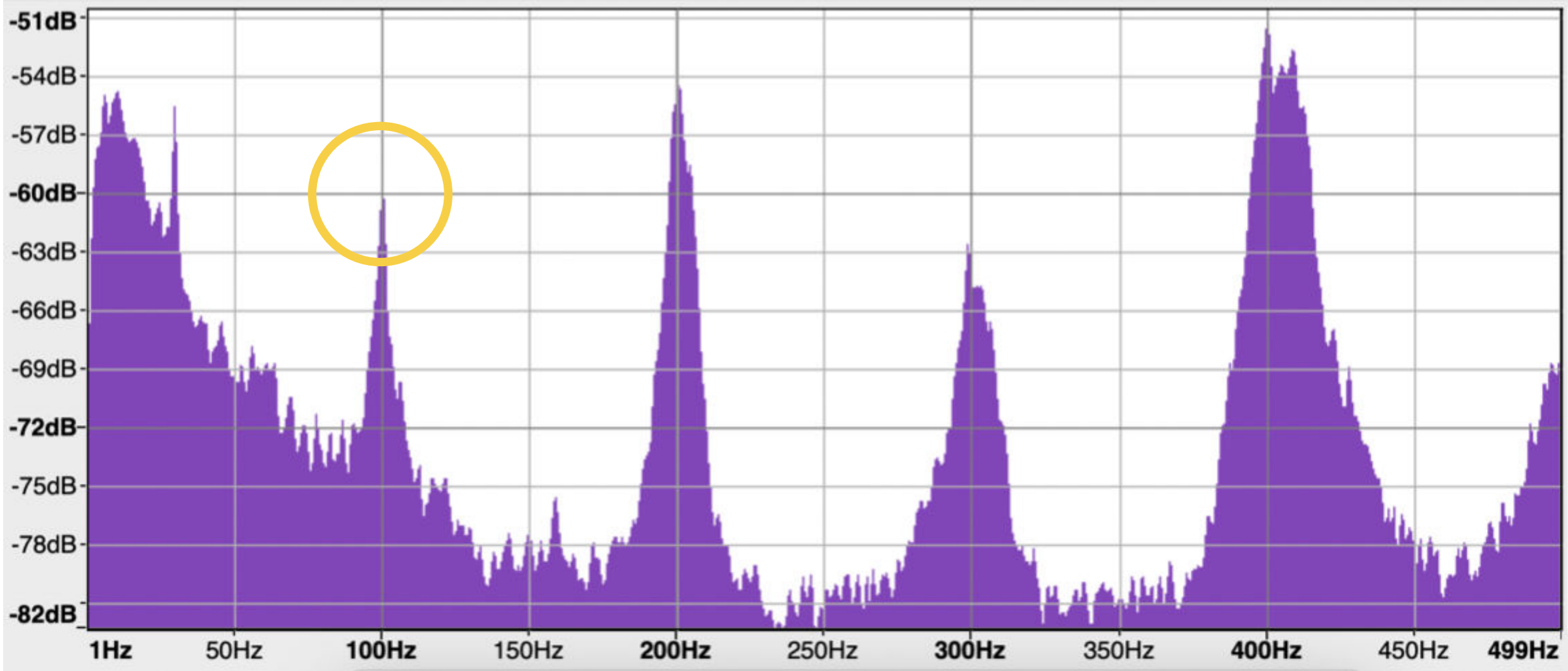
NPR.org August 17th, 2023

US Climate suitability

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V. mandarinia



100 Hz

V. velutina

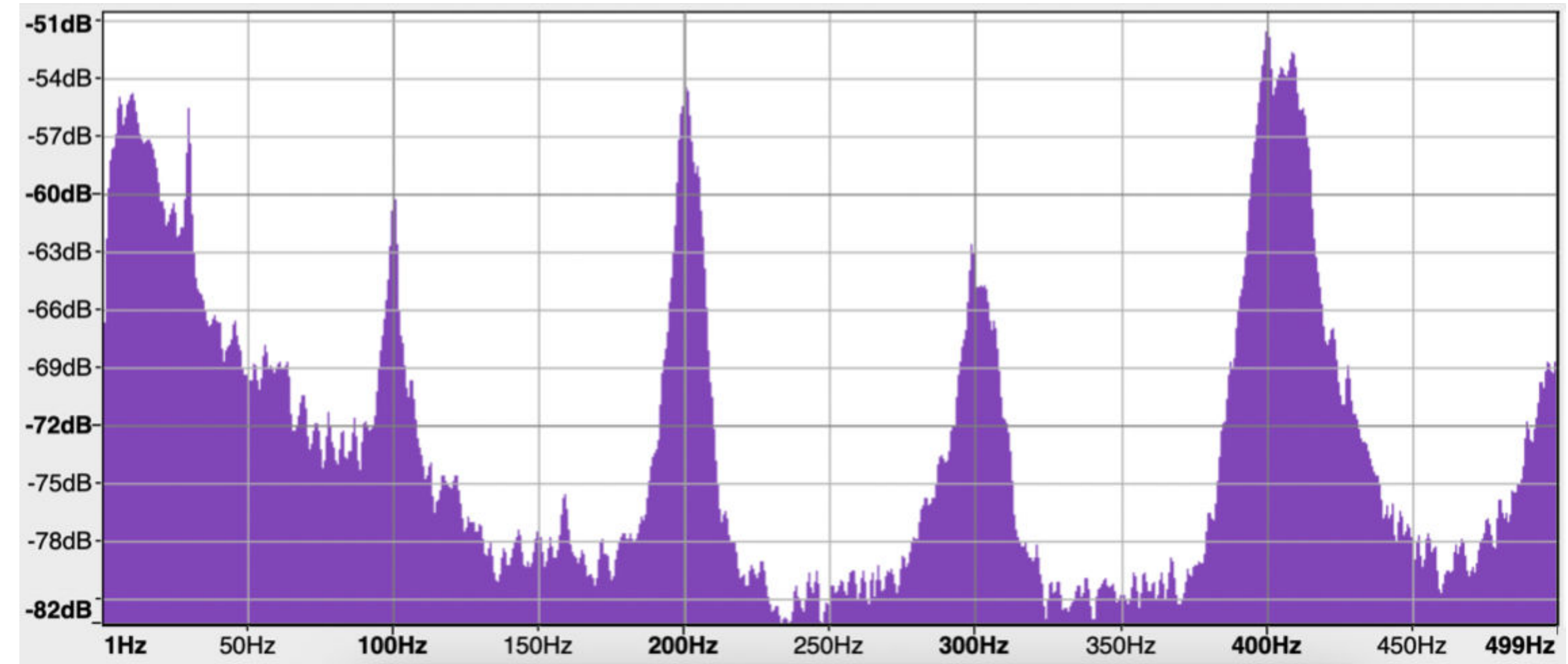


118 Hz

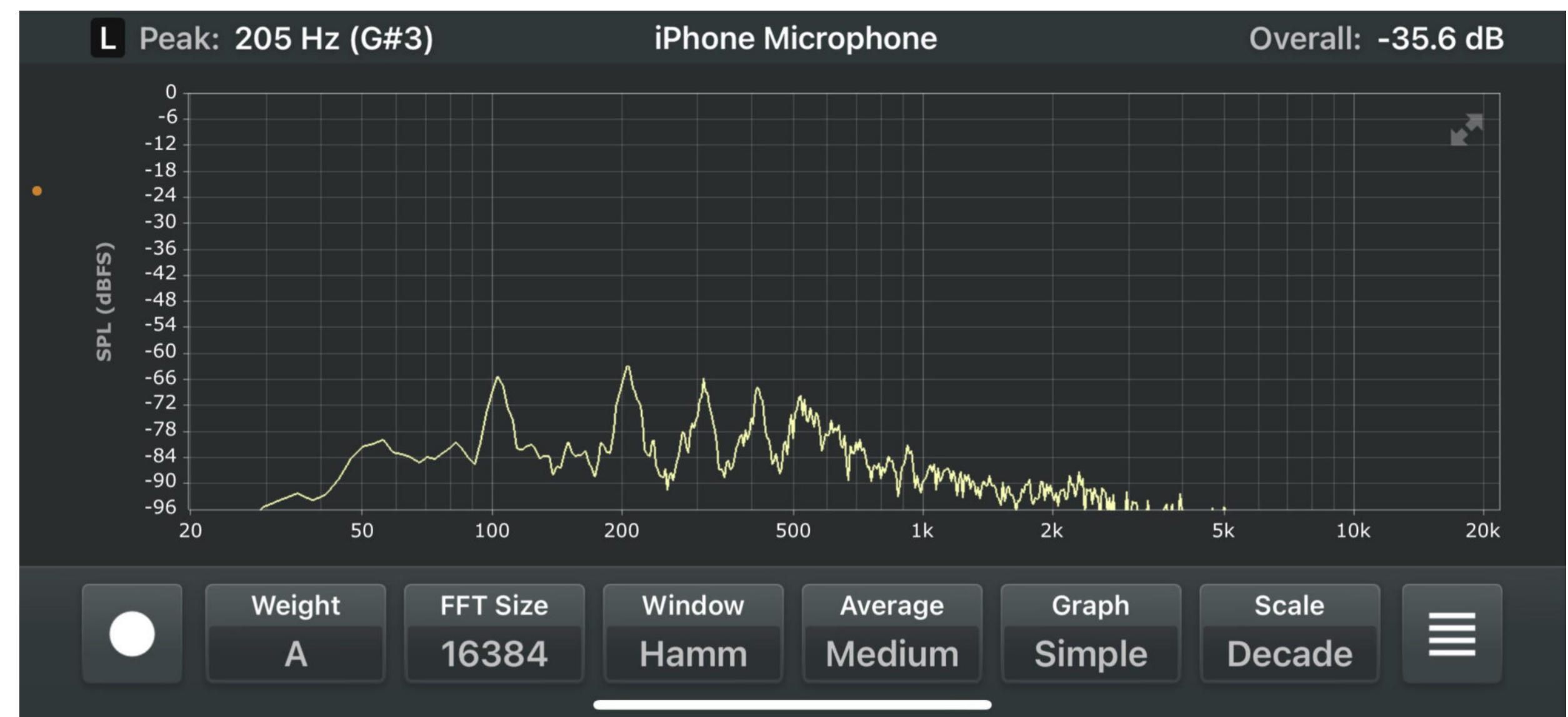
(120 Hz)



V. mandarinia



V. orientalis



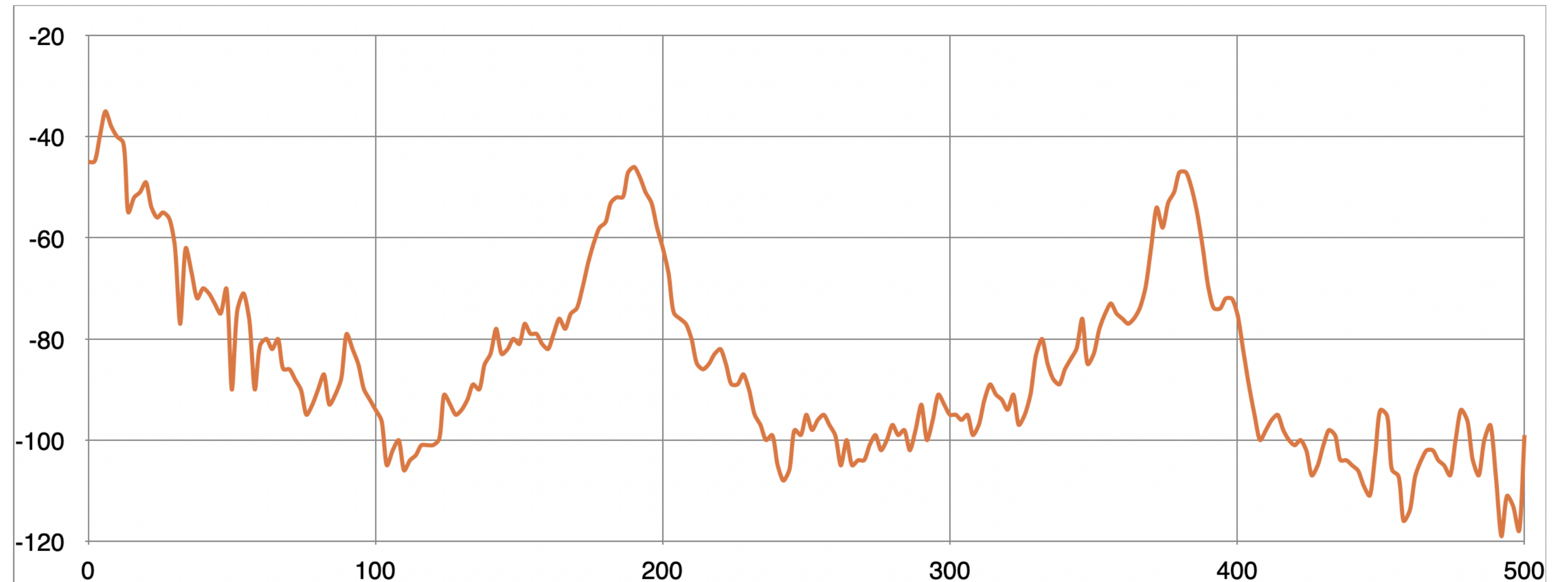
Acoustic Signature



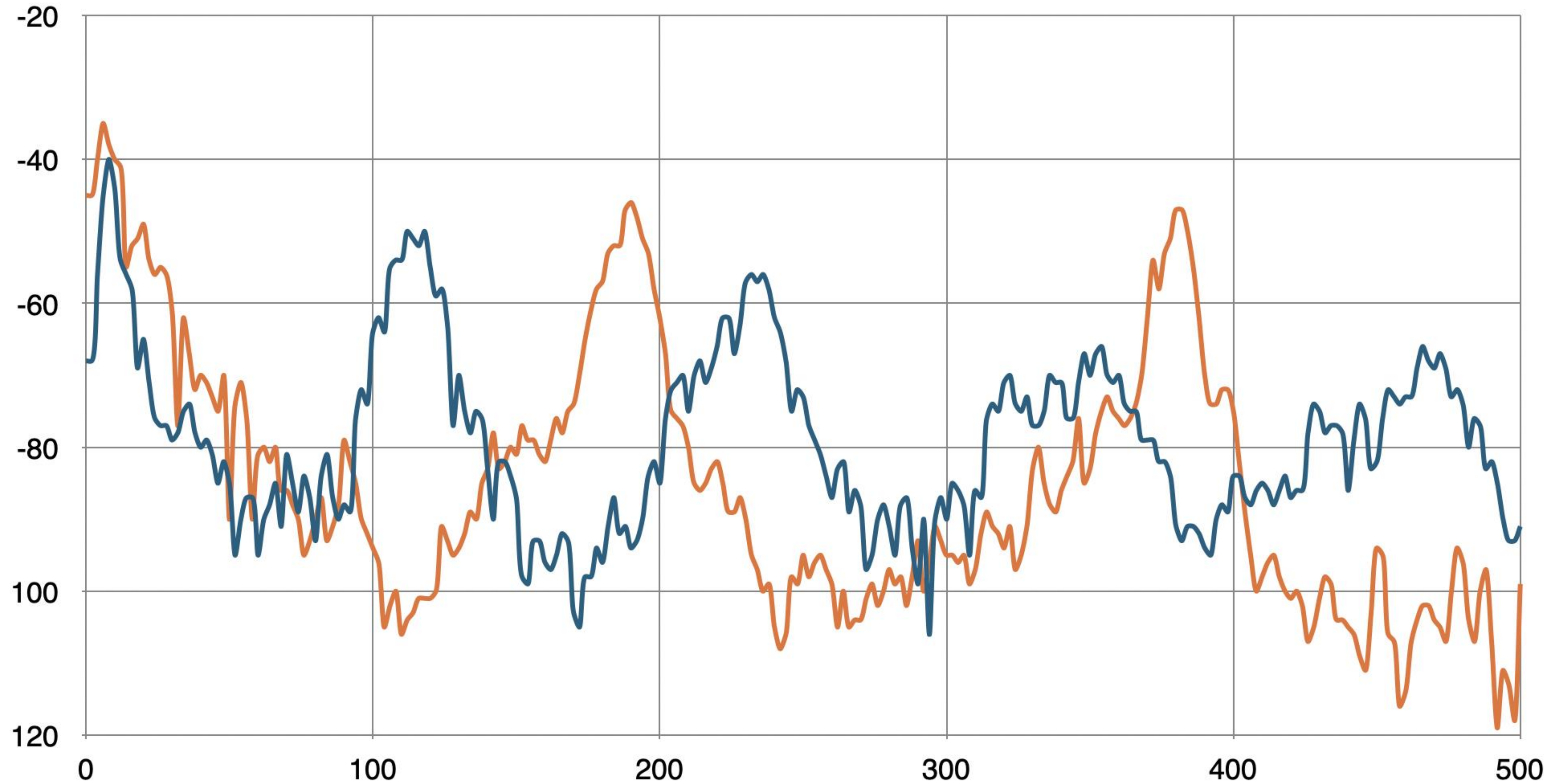
Vespa velutina



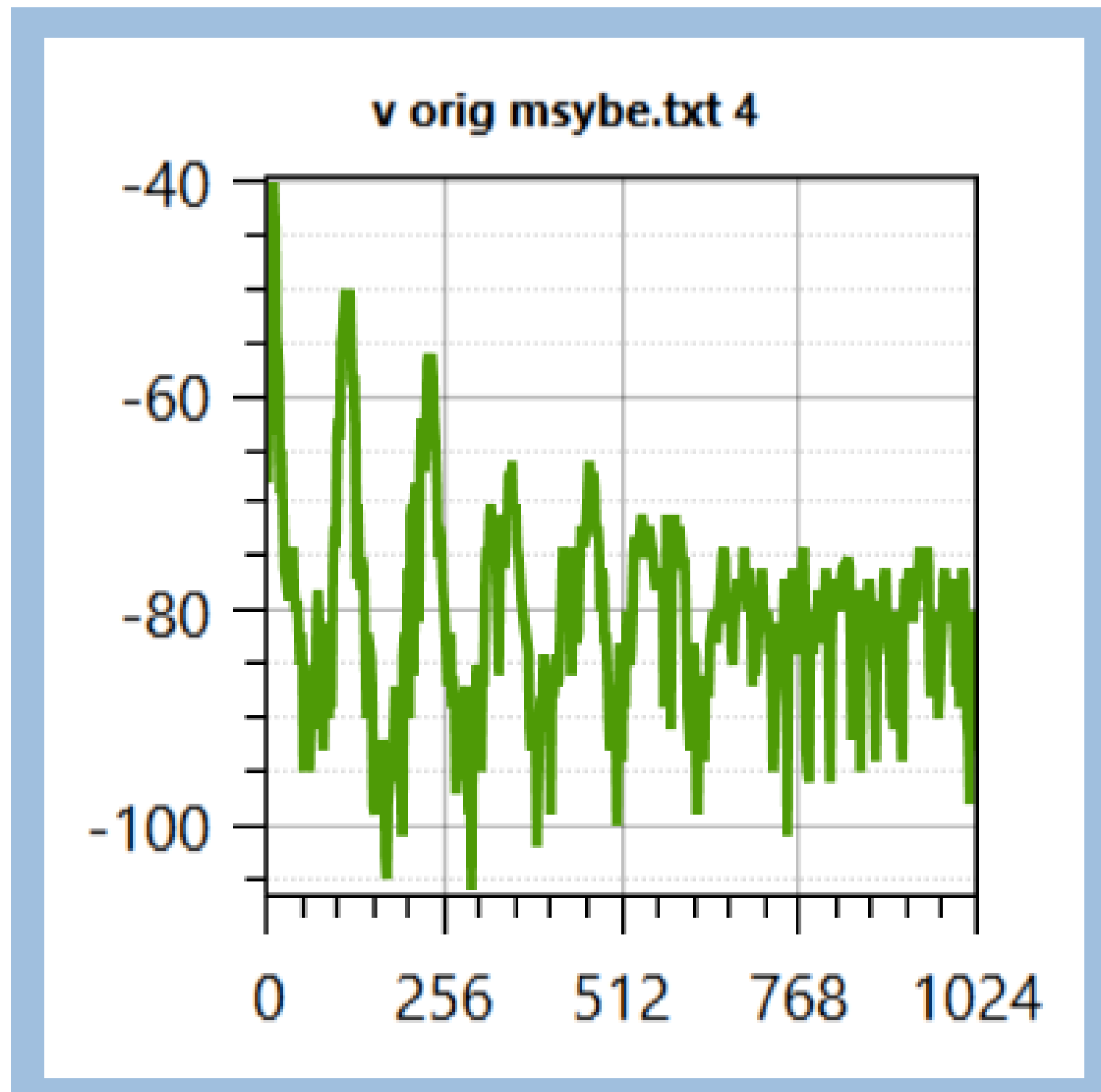
Apis mellifera



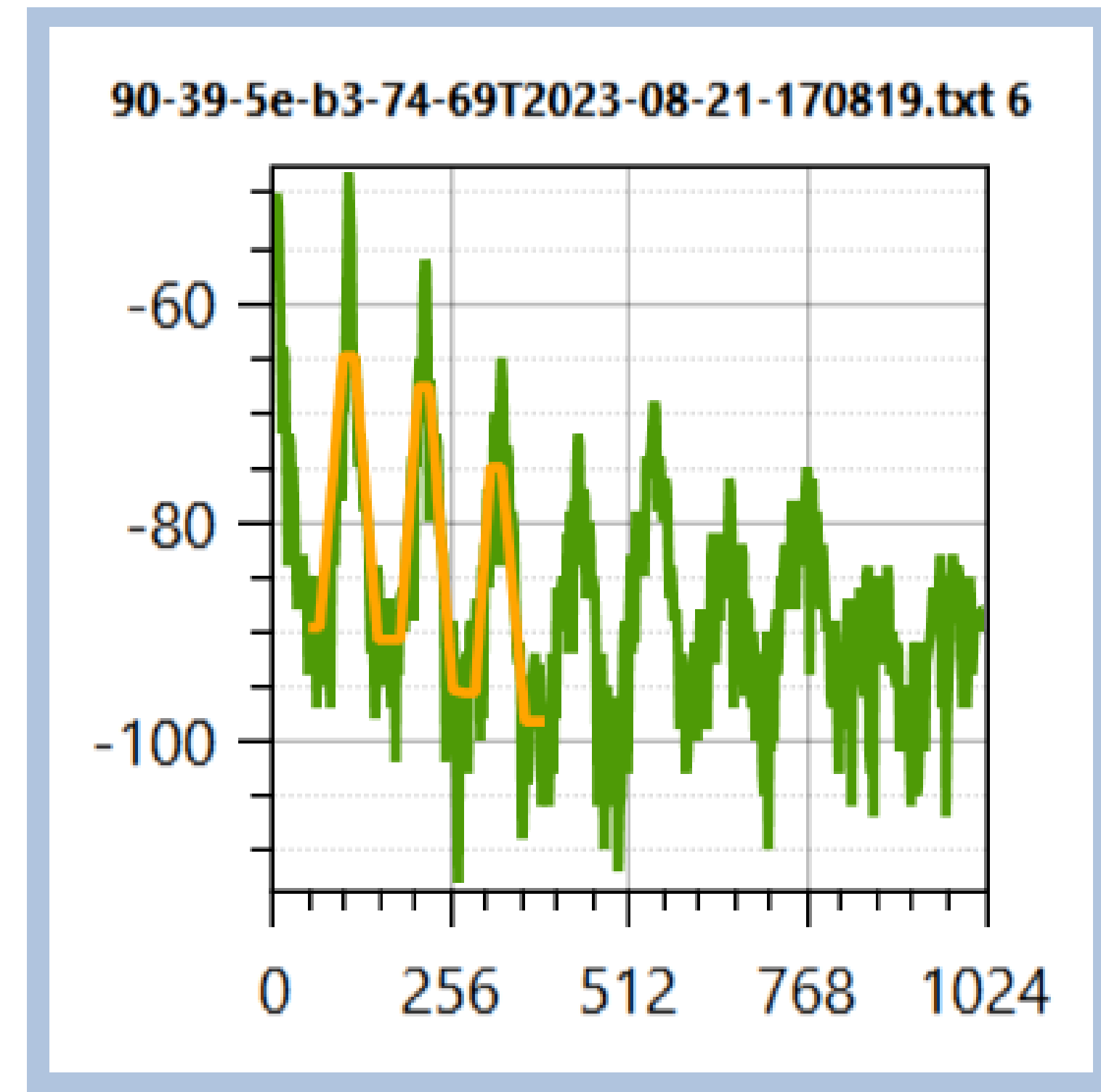
Acoustic Signature



False Positives



V. velutina



Voice

2024



Questions?

44th International Apimondia Congress
SOUTH KOREA



2015



