OP-252 [Beekeeping Technology and Quality]
SHARP-FB:Short Hive Audio Recording Predictor of Frames of Bees

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[1]Nectar Technologies
[2]INRS-EMT

Over the past decade, researchers and practitioners have explored the potential of audio recording for precision beekeeping. Most of the research focused on in-hive sensors and real-time detection of critical events, such as swarming, queen state or hive strength. However, adoption of such sensors is difficult in a low margin industry such as beekeeping. On the other hand, most, if not all, beekeepers have a smartphone. As such, in this work we explore the potential of using short audio segments recorded from beehives. Such non-invasive assessment has been gaining interest mainly to allow beekeepers to lower the number of interventions they make on a hive. To train our model, we used a combination of recordings captured by Nectar beekeepers using their mobile phone (N: 536) and a subset of recordings from an in-hive microphone from the recently open-sourced URBAN dataset (N: 5000). First, we split each signal into 15 one-second frames, which were then transformed to the mel-spectrogram. Domain adaptation was used to ensure that both data sources, which were recorded under different conditions, could be used to train our models. In our work, we utilize a two-stage approach, where the first stage relies on an AutoEncoder as a feature extractor, which is then input to the second model which predicts the number of frames of bees with an uncertainty estimate. Experimental results with unseen mobile data resulted in a mean absolute error (MAE) of 3.71frames. This was significantly better than a random model which achieved a MAE of 5.23 on an independent test set. This study demonstrates the potential of short mobile recording to augment the intelligence of beekeepers and promote low touch beekeeping. Additionally, this model is deployed on devices promoting sustainable use of AI. By doing the inference and the fine-tuning of the model directly on the user's device, we can lower the carbon emission associated with our model training and serving. In addition, our model is deployed in a continuous training loop leading to performance increase and refinement on a daily basis.

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SHARP - the bee translator

Short Hive Audio Recording Predictor

SEPTEMBER 2025

APIMONDIA SCANDINAVIA 2025
SWEDEN | DENMARK | NORWAY
23-27 SEPTEMBER

Sampling mites is **costly and time consuming**

Low sampling limits the ability to establish **treatment plans**

Varroa infestation is a **main driver** of **mortality**

Project *Apis m.*
HONEY BEE HEALTH RESEARCH
(2024–2025)

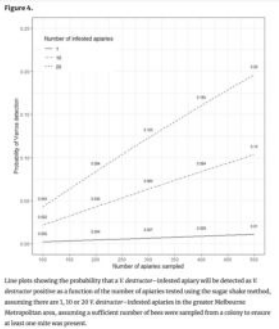
60% losses average in the US in 2025

Viruses and vectors tied to honey bee colony losses

Zachary S. Lamas, Frank Rinkevich, Andrew Garavito, Allison Shaulis, Dawn Boncristiani, Elizabeth Hill, Yan Ping Chen, Jay D. Evans

doi: https://doi.org/10.1101/2025.05.28.656706

This article is a preprint and has not been certified by peer review [what does this mean?].



Line plots showing the probability that a *V. destructor*–infested apiary will be detected as *V. destructor* positive as a function of the number of apiaries tested using the sugar shake method, assuming there are 1, 10 or 20 *V. destructor*–infested apiaries in the greater Melbourne Metropolitan area, assuming a sufficient number of bees were sampled from a colony to ensure at least one mite was present.

***Varroa destructor* detection in non-endemic areas**

Original article | Published: 22 July 2021

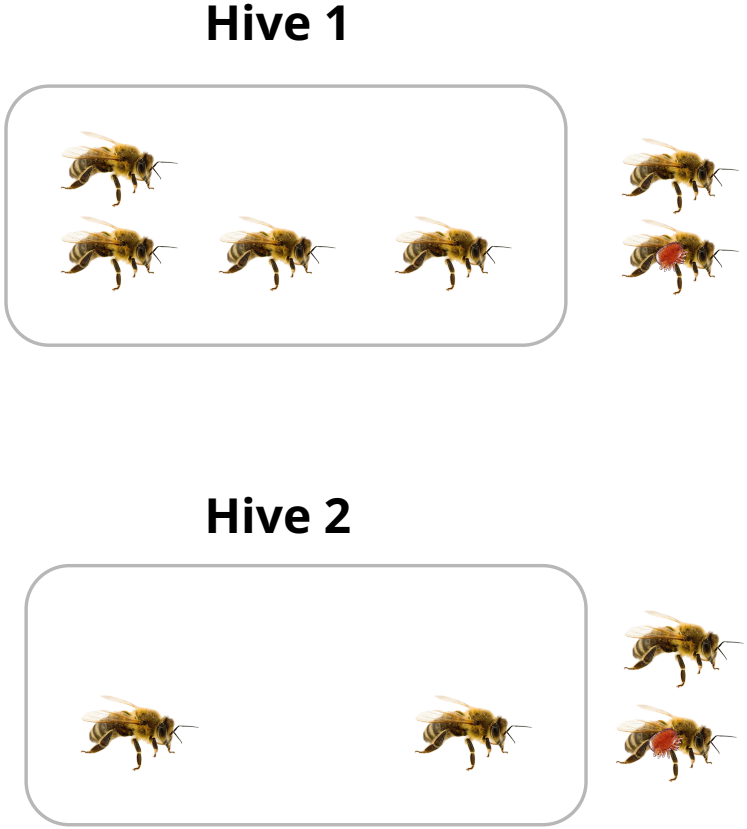
Volume 52, pages 900–914, (2021) Cite this article

Sampling method combines **two underlying probabilities**

Hive 1

Hive 2

Sampling method combines **two underlying probabilities**



Sampling method combines **two underlying probabilities**

Hive 1

Detection probability 2/6 = 33%

Hive 2

Detection probability 2/4 = 50%

Experienced beekeepers claim they can **detect problematic hives** by **listening** to them

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Bioacoustics at Nectar and open dataset

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Digital Traceability & Management Platform

300k colonies tracked across Canada, U.S., and New Zealand!

RFID Tags

Mobile App

Web Portal

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INRS Institut national de la recherche scientifique

2023

Early prediction of honeybee hive winter survivability using multi-modal sensor data

Publisher: IEEE | Cite This | PDF

Yi Zhu ; Mahsa Abdollahi ; Ségolène Maucourt ; Nico Coallier ; Heitor R. Guimarães ; Pierre Giovenazzo **All Authors**

2023

Performance Comparison of Voice Activity Detectors for Acoustic Beehive Monitoring

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Heitor R. Guimarães ; Mahsa Abdollahi ; Yi Zhu ; Ségolène Maucourt ; Nico Coallier ; Pierre Giovenazzo **All Authors**

2024

MSPB: a longitudinal multi-sensor dataset with phenotypic trait measurements from honey bees

Yi Zhu ✉, Mahsa Abdollahi, Ségolène Maucourt, Nico Coallier, Heitor R. Guimarães, Pierre Giovenazzo & Tiago H. Falk

2025

UrBAN: Urban Beehive Acoustics and PheNotyping Dataset

Mahsa Abdollahi, Yi Zhu, Heitor R. Guimarães, Nico Coallier, Ségolène Maucourt, Pierre Giovenazzo & Tiago H. Falk ✉

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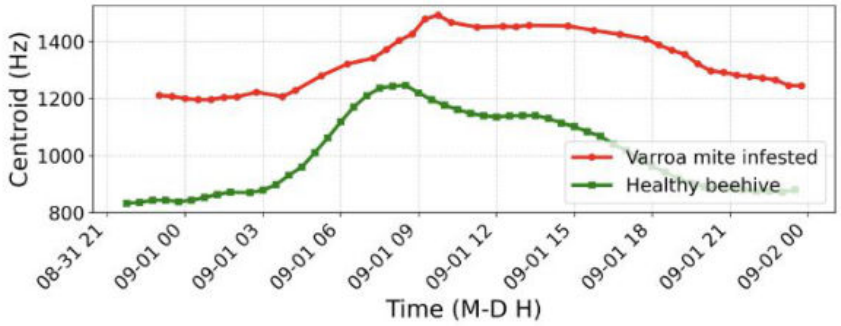
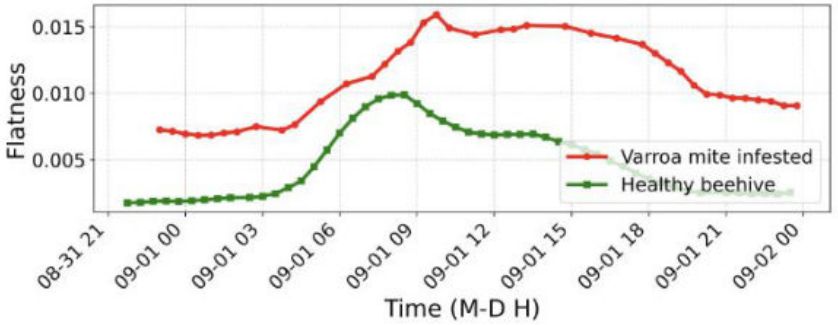
Early results show strong discriminatory signal in infested colonies



(a)



(b)

Fig. 5: The temporal dynamics of the conventional spectrogram a) centroid, and b) flatness measured across the entire day on September 1, 2022.

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SHARP: a quick overview

Brief introduction to applied signal processing using deep learning

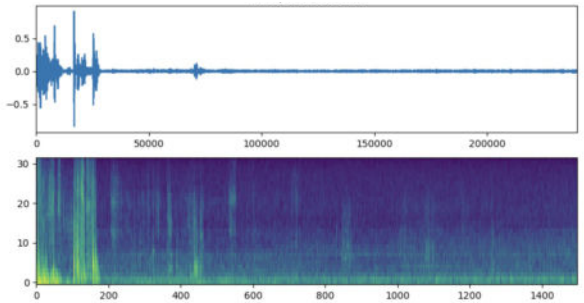
SEPTEMBER 2025

Domain adaptation to leverage recordings from different sources

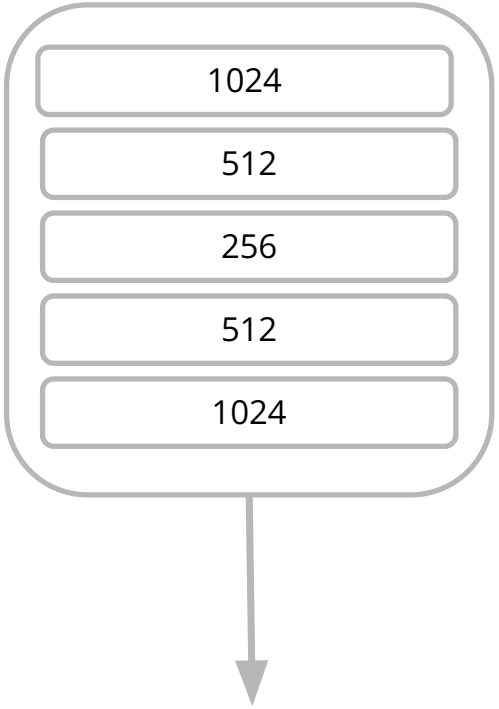
UrBAN: Urban Beehive Acoustics and PheNotyping Dataset

Mahsa Abdollahi, Yi Zhu, Heitor R. Guimarães, Nico Coallier, Ségolène Maucourt, Pierre Giovenazzo & Tiago H. Falk

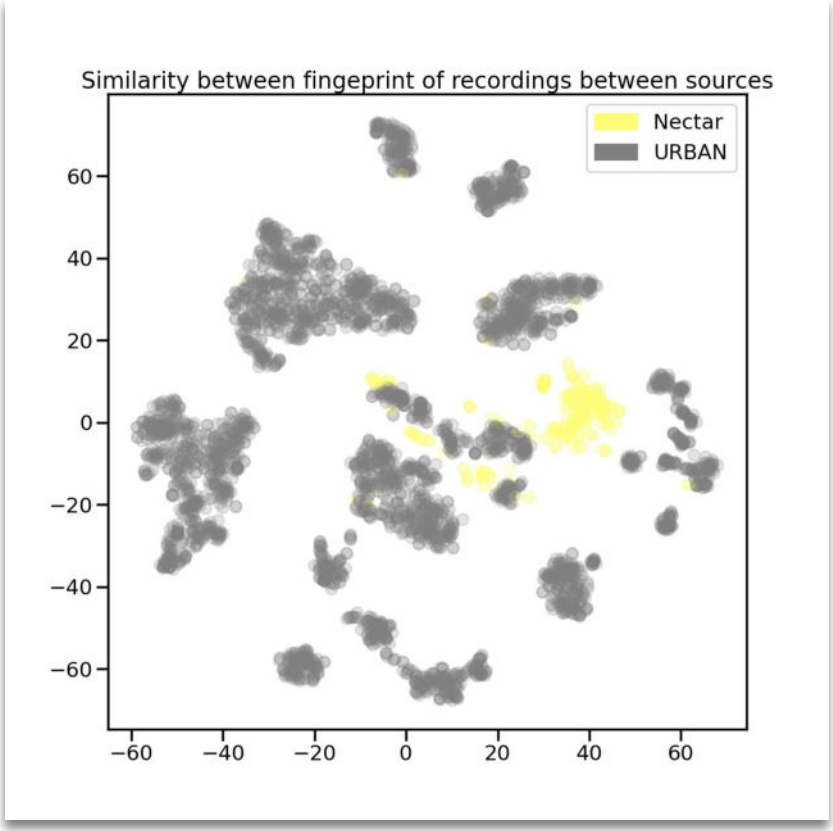
3500 x 15 seconds recordings on **120 Flavo research hives**, annotated with **frames of bees, varroa level and queen status**

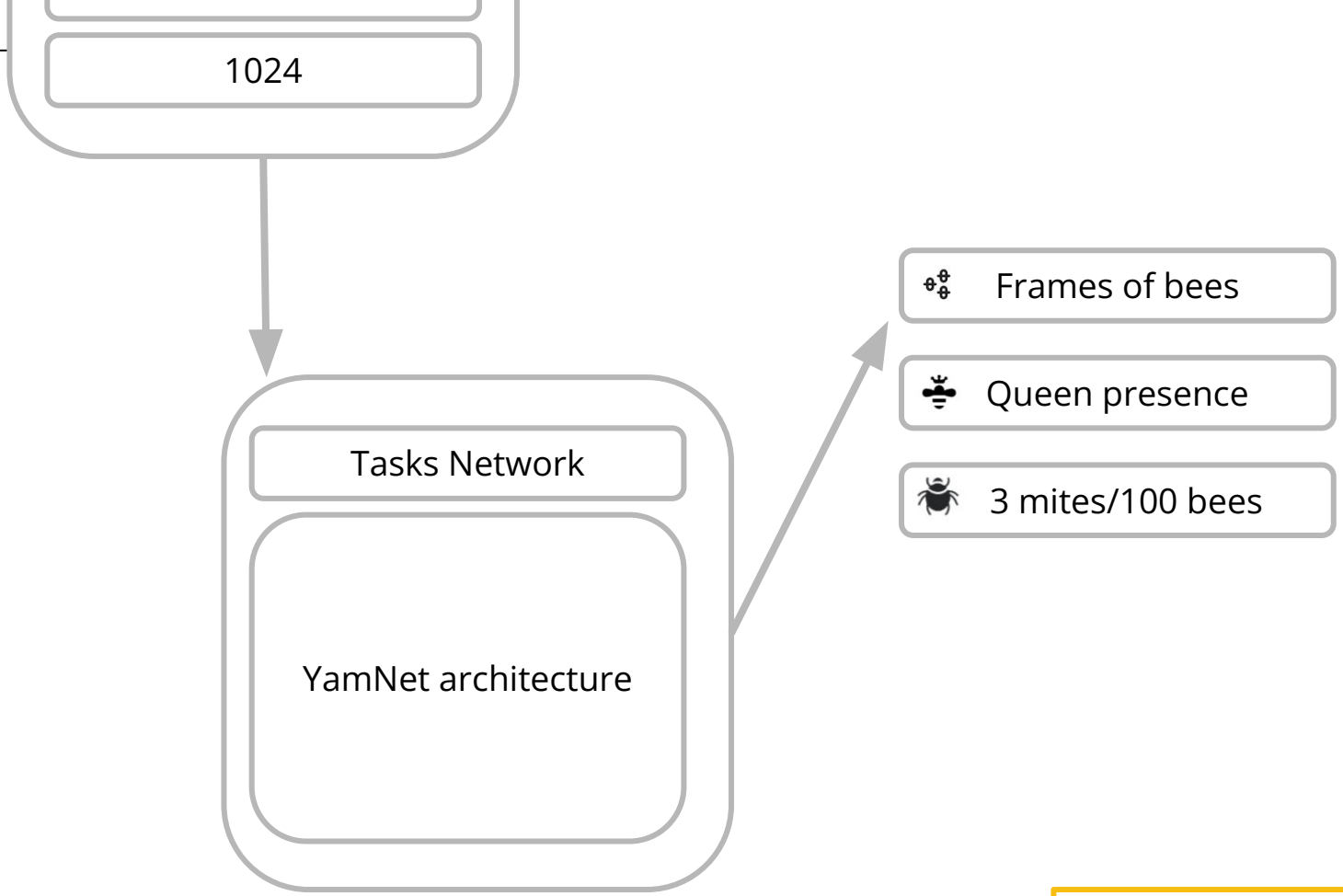


AutoEncoder



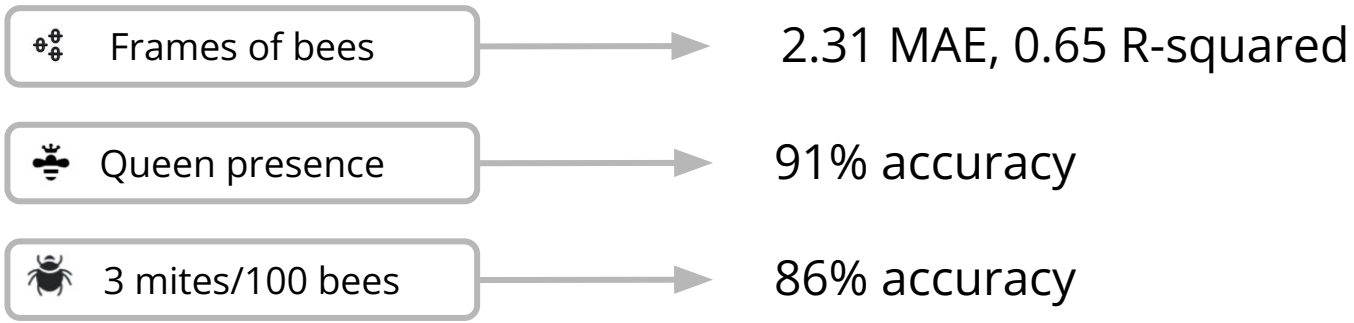
Fingerprints of recordings by sources





Model size: 22 Mb

Model performance on unseen hives



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Field trials

Validating the performance in real life

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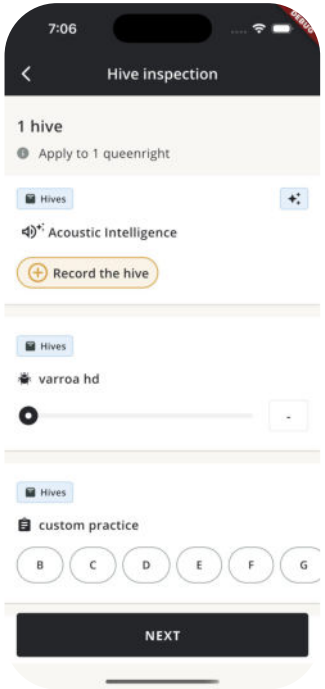
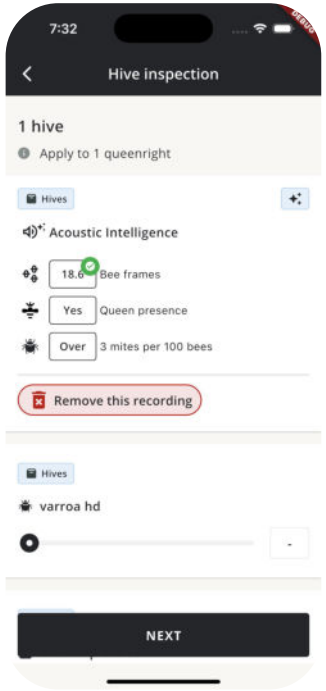
1.Record

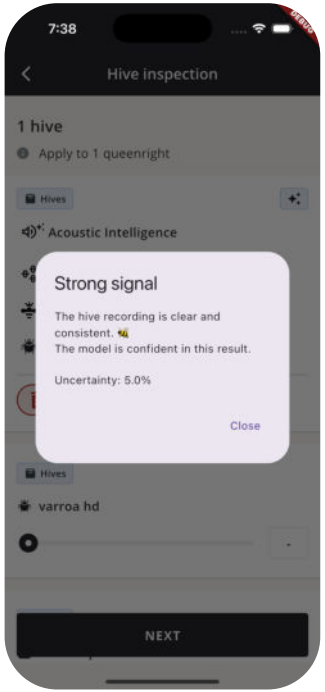


2.Wait

3.Take action



4. Judge prediction and challenge



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contact

TAUZER APIARIES	OHB	Evergreen HONEY COMPANY	MERRIMACK VALLEY APIARIES,INC	MILLER HONEY FARMS	BUSY BEE FARM LTD.	Noyes APIARIES
Island District Honey Company	Barkman Apiaries	BELLEVILLE HONEY	ROYAL HONEY COMPANY	SUSTAINABEE	BEAVERHEAD HONEY	PRESCOTT HONEY FARMS
Lamb's HONEY FARM	St Joe Valley Apiaries	FOOTHILLS HONEY	Beelogic Enterprises FARMS	MOYEN HONEY FARMS	OLD FLORIDA BEE COMPANY	PURE Honey Drange Apiary
interMiel	BEETOPIA	WOLFE HONEY ALBERTA · CANADA	CALIFORNIA APIARIES	LE MIEL d'Émilie	Hill & Ward APIARIES INC.	
Sowers Apiaries	Shoreline HONEY FARM	CAN-AM APIARIES INC. ORLAND	MOORE HONEY	Honey Bees Unlimited	STAYER'S	307 Honey