A Predictive Algorithm for Mitigate Swarming Bees through Proactive Monitoring via Wireless Sensor Networks

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Summary

- Introduction
- Overview
- Related work
- Material and methods
- Results
- Conclusions

Introduction

- Warming in hives

Fig 1. Stress and subsequent escape from the hive

70%

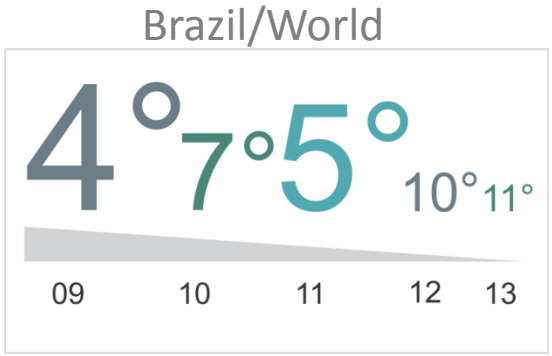
Abandonment

(VIDAL, 2013)

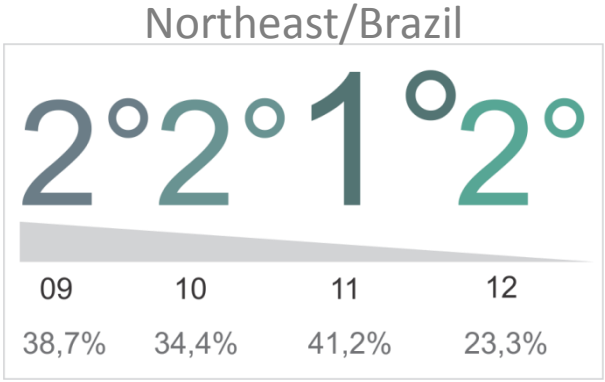
Monitoring the temperature to predict the abandonment

Introduction

- Losses on beekeeping in Brazil



ABEMEL



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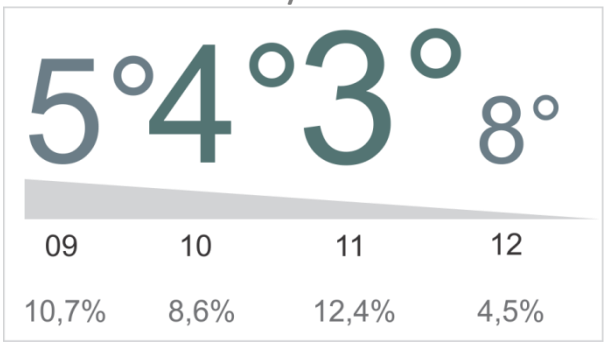

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Overview

- Thermoregulation
  - Poikilothermic
  - Microclimate
  - Homeostasis (33 °C a 36 °C)

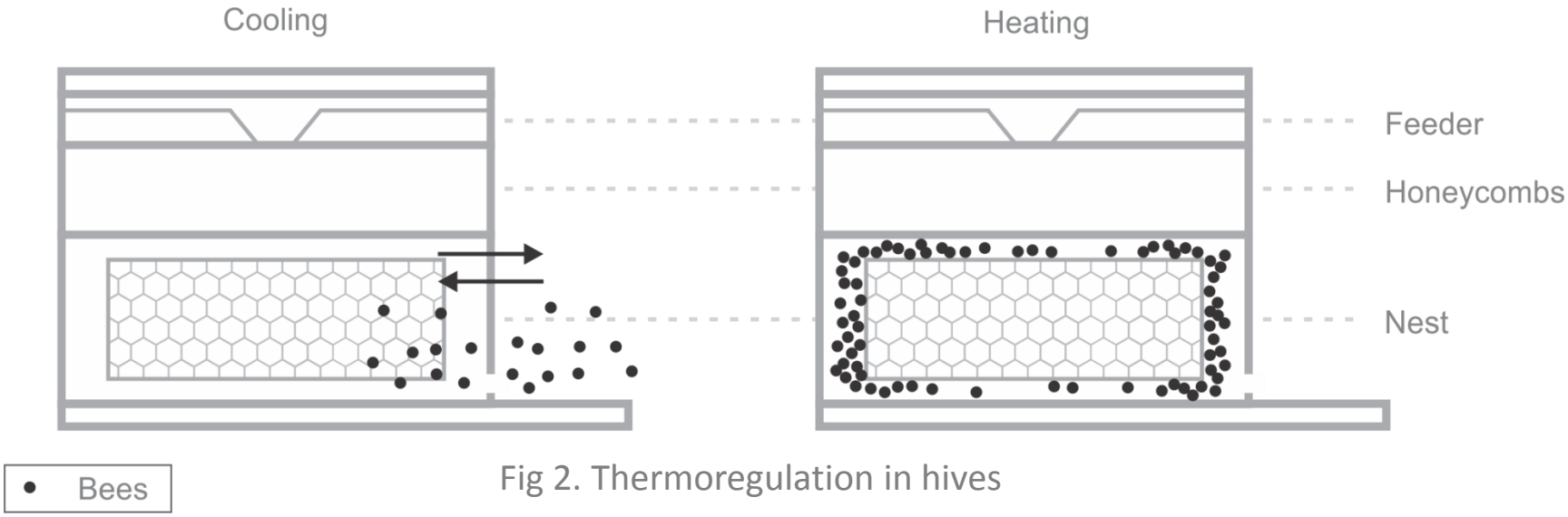

Fig 2. Thermoregulation in hives

Overview

- Monitoring
  - Alert warming
  - Data reduction

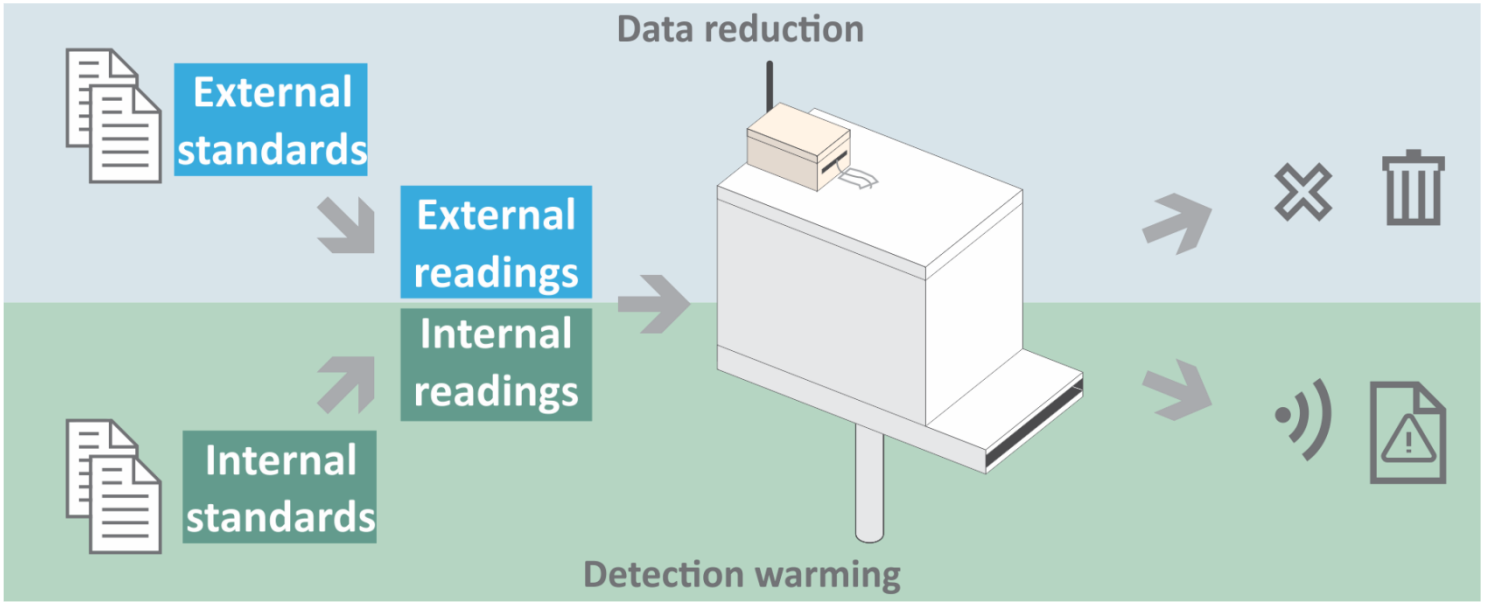

Fig 3. Solution Overview

Related work

[Zacepins and Karasha 2013] – Temperature

[Bencsik et al 2011] – Vibration

[Almeida 2006] – Temperature, humidity

[Rangel and Seeley 2008] – Audio, video

[Ferrari et al 2008] – Audio, temperature, humidity

* All solutions containing wired devices

Material and methods

- Scenario
  - Embrapa Meio-Norte
  - *Apis Mellifera*
  - November (2013)

Fig 4. Place of experiments

Material and methods

- Device
  - Arduino: 32 KB, SD card, Xbee 900Mhz

Fig 5. Implanted device

Material and methods

- Device in the hive
  - Close to the nest
  - Sensor adapted bees

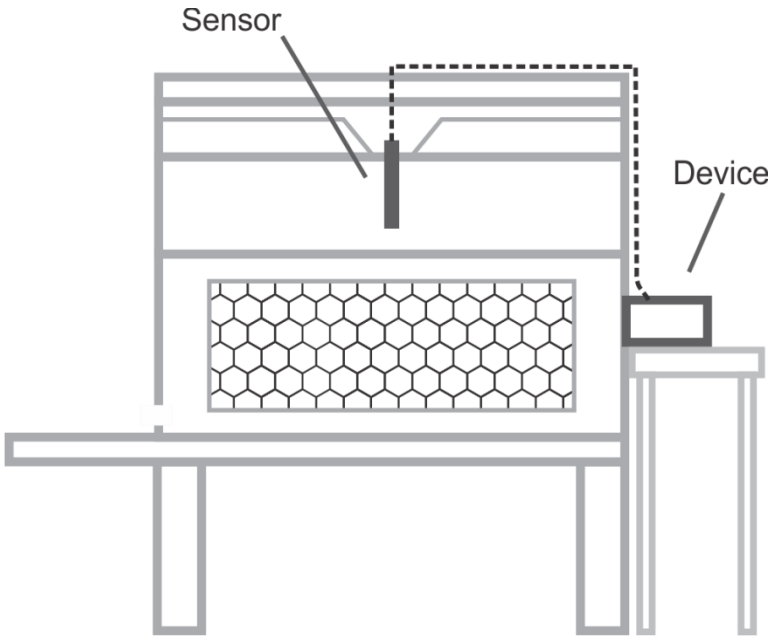

Fig 6. Deployment in the hive

Material and methods

- Monitoring technique
  - Preprocessing of the Data
    - Average and standard deviation of each hour

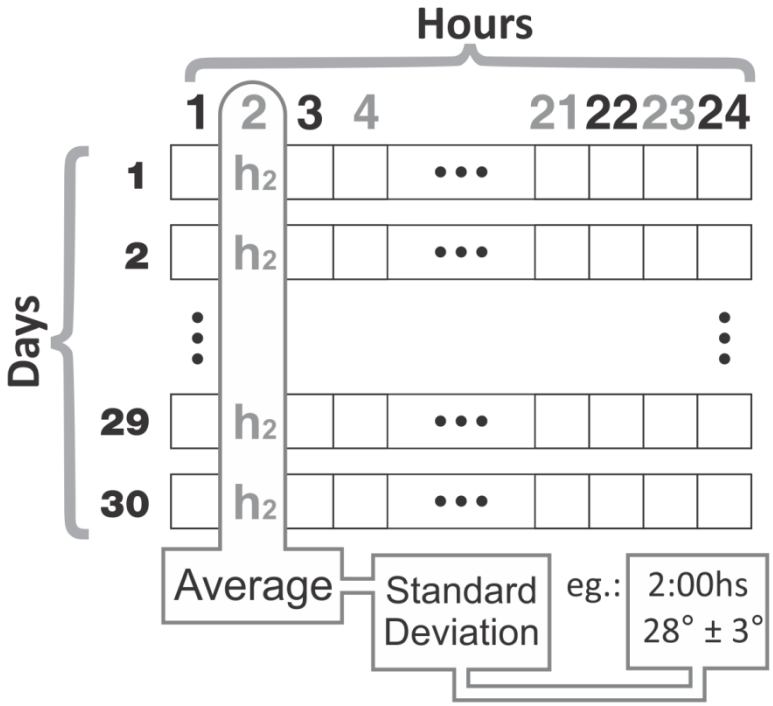

Fig 7. Preprocessing of the Data

Material and methods

- Monitoring technique
  - Obtaining Temperature Patterns
    - Clustering by similarity
    - K-means with 4, 5 and 6 groups

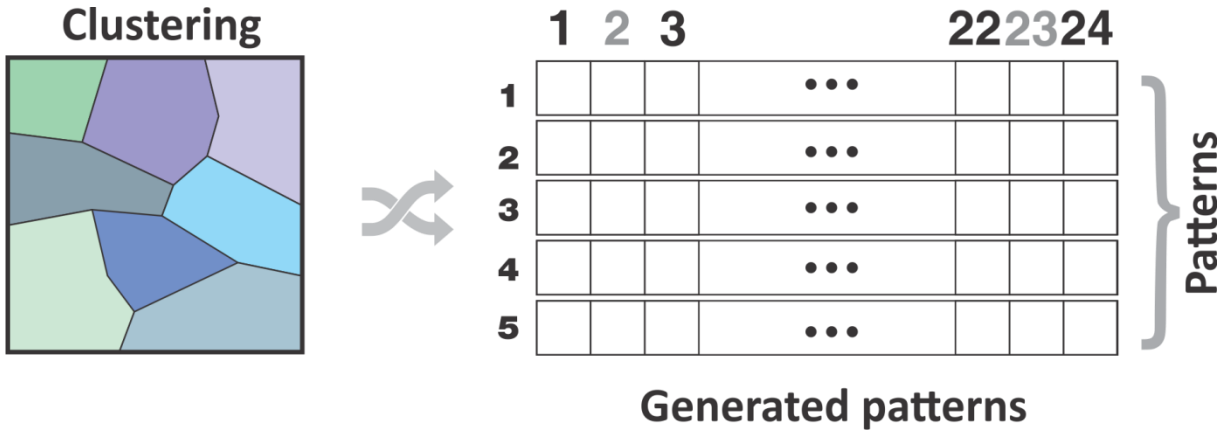

Fig 8. Obtaining Patterns

Material and methods

- Monitoring technique
  - Comparison of Data Collected with the Obtained Models
    - Initial buffer readings (3,4 and 5)

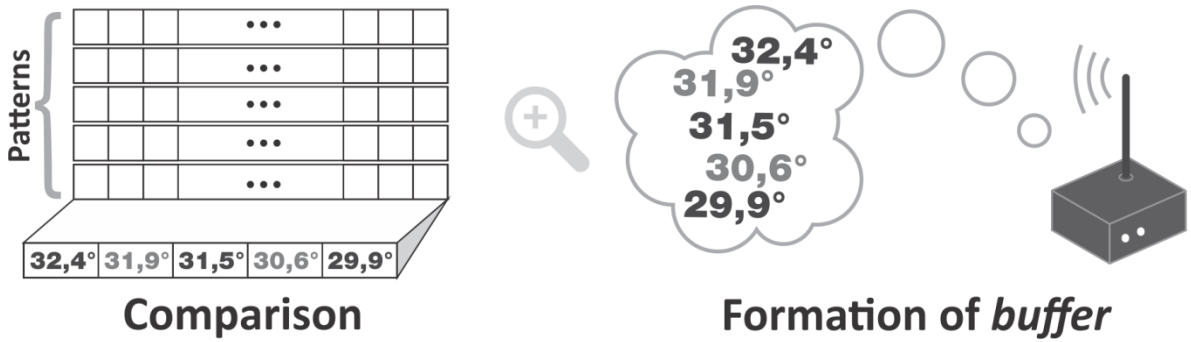

Fig 9. Comparison with patterns

Results

- Cummulative error
  - Influence of the quantity of patterns

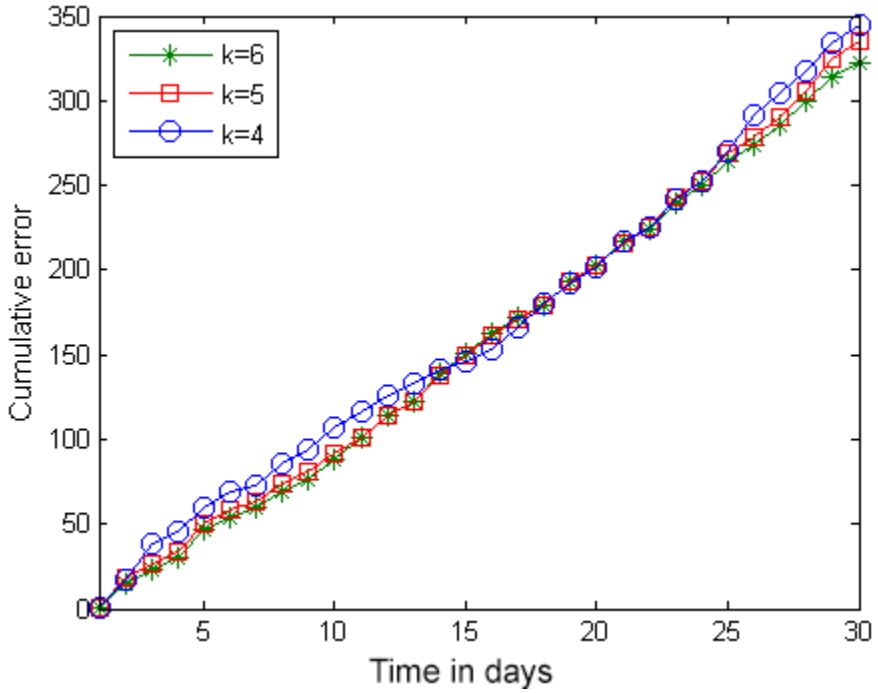

Fig 10. Cummulative error

Results

- Energy consumption and packets sent

The smaller the buffer
Greater the reduction
the consumption will
be lower

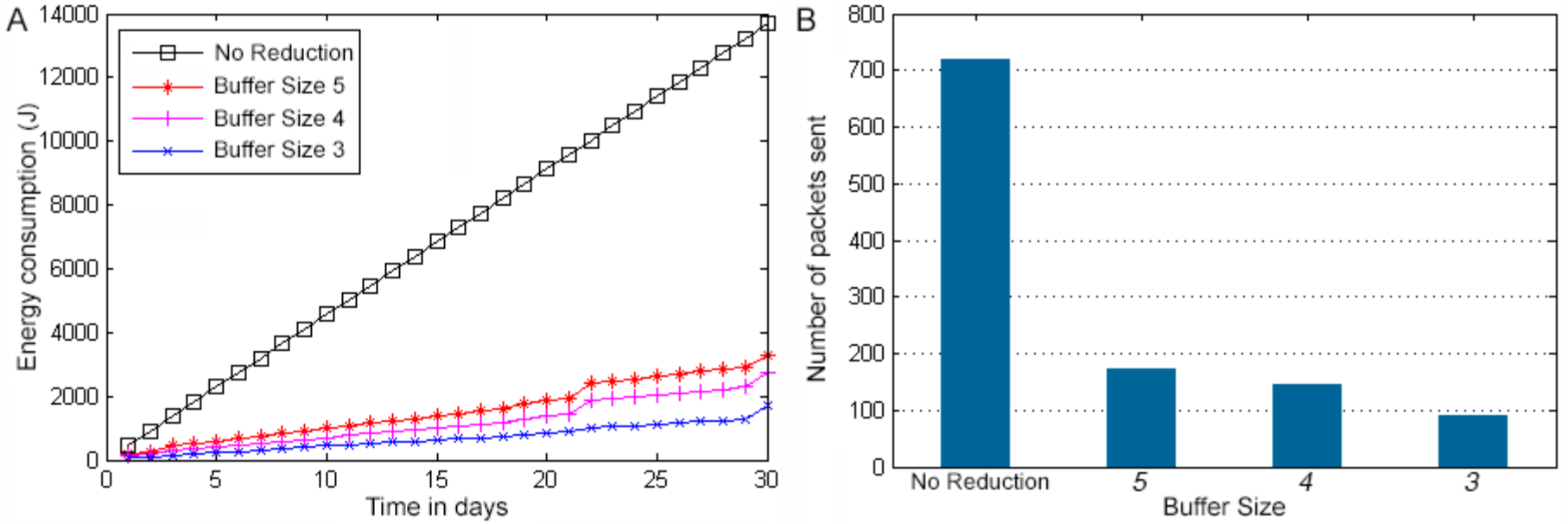

Fig 10. In (A) energy consumption and (B) packets sent

Results

- Detection warming

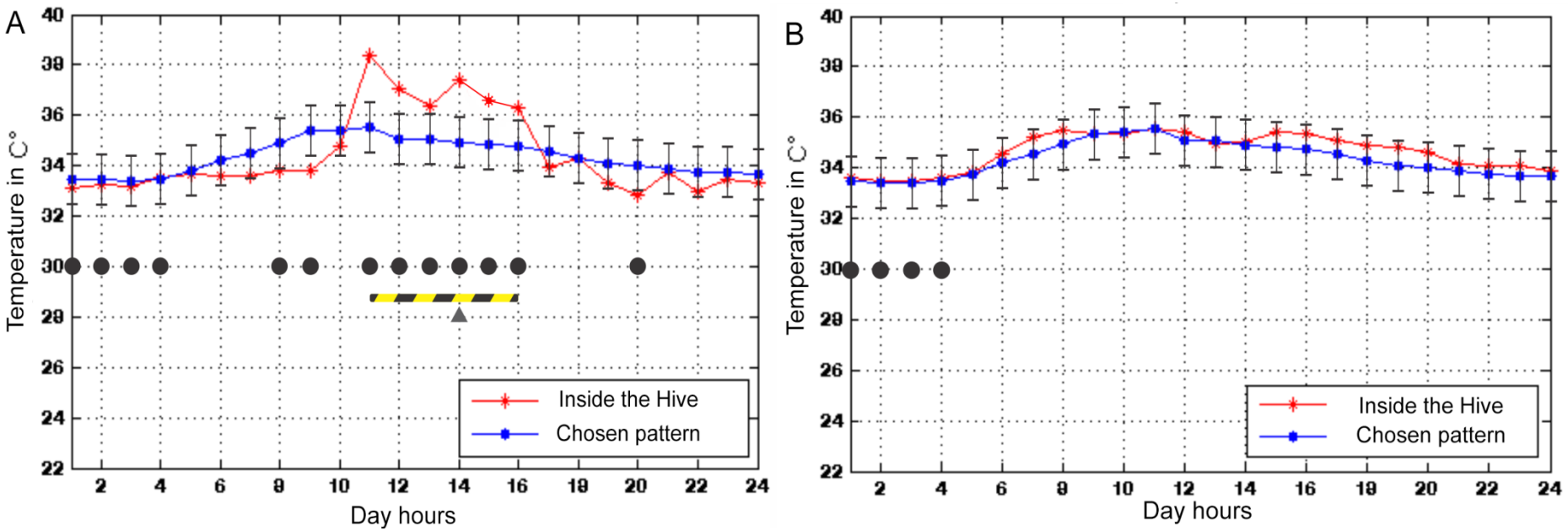

Fig 11. In (A) internal warming and (B) halthy microclimate

Conclusions

- Wireless monitoring of warming in hives as support research in swarming.
- Mining of a thermal pattern in hives which corroborates with the internal homeostasis.
- Predictive algorithm that identifies and alerts about internal warmups before a potential swarming.
- A reduction mechanism which detects redundant external data readings.

Thank you