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# Environmental Monitoring: Acoustic Wireless Sensors for Pest Detection

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# Environmental Monitoring: Acoustic Wireless Sensors for Pest Detection

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- We know very little about our environment
- The amount of data is huge and out of control
- Many threats can be avoided if identified early
- Collecting data and understanding it is crucial
- Technology can help monitor and analyze

- Environmental Monitoring and Bio-Security
  - Water Management, Air Quality and Crop Quality
  - Imported Pests, Biodiversity, Forests and Ecosystem
- All these require an enormous collection of data
- Tradeoffs: Cost vs. Efficiency vs. feasibility
- CSIRO, CRC, Government Agencies, Industry

# **Environmental Monitoring: Acoustic Wireless Sensors for Pest Detection**

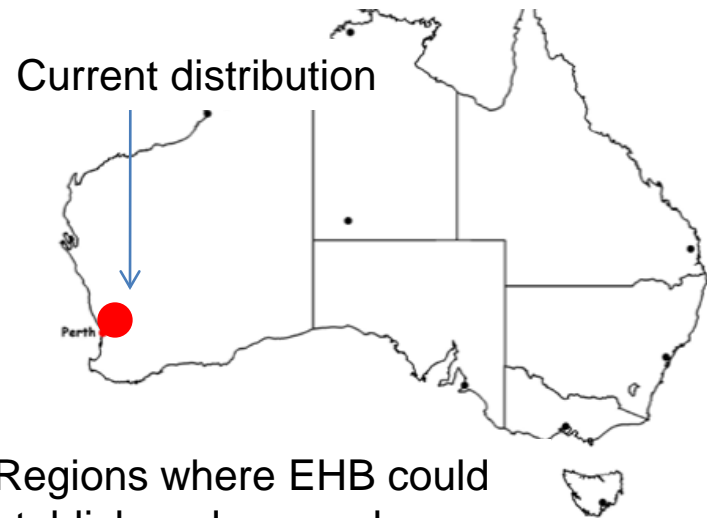
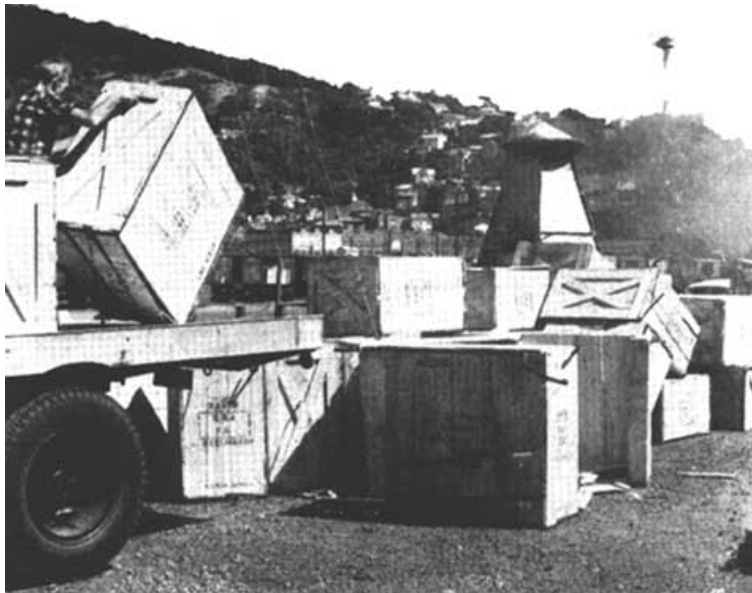
# European House Borer

- A wood-boring beetle exotic to Australia (*Hylotrupes Bajulus* Linnaeus)
- One of the world's most destructive pests of softwood timber, in particular pine
- The damage is done by EHB larvae
- An EHB larva can live between 2 to 12 years until it matures and emerges from the timber as an adult beetle to begin the cycle again
- In the past five years in WA, house with roofs having untreated structural pine are increasingly at risk over the next 15 to 20 years

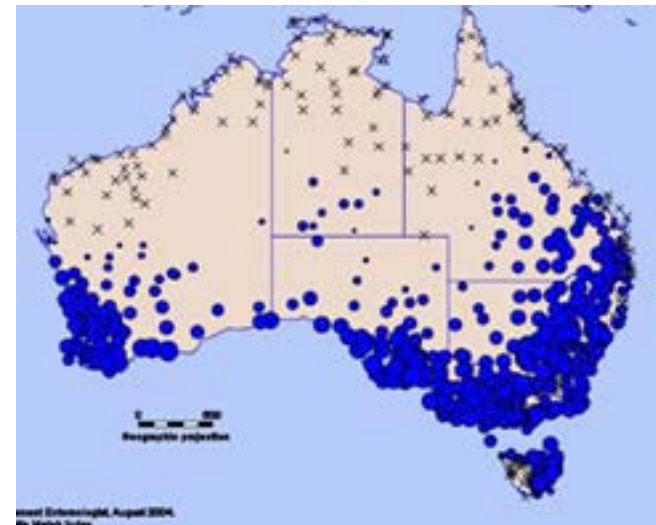


- It is estimated that the EHB has been in WA for 10-15 years but were only discovered in January 2004 when they started to emerge out of a decorative beam that has been installed in a house in Parkerville in the Hills.

Estimated potential cost is \$6 billion  
(CRC Plant biosecurity)



Regions where EHB could establish and cause damage



# Potential Impact of EHB

- The timber can be repeatedly infested until:
  - no sound wood remains
  - Structural collapse may occur
- Infected wood is hard to identify
- Detected visually after the mature beetle has emerged from the timber
- Threat to houses as well as pine industry
- In South Africa, it took 20 to 25 years for EHB to infest 70% of homes where 90% were at point of structural collapse.



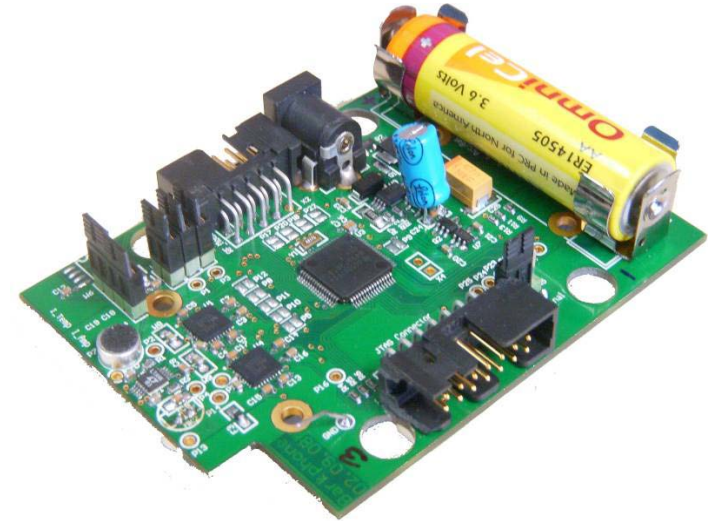


- Project ECU-DAFWA
- EHB detection parameters:
  - Noise audible in quite zone
  - Smell: Dog Program
  - Visual: adults cut holes in the infected timber 6–10 mm



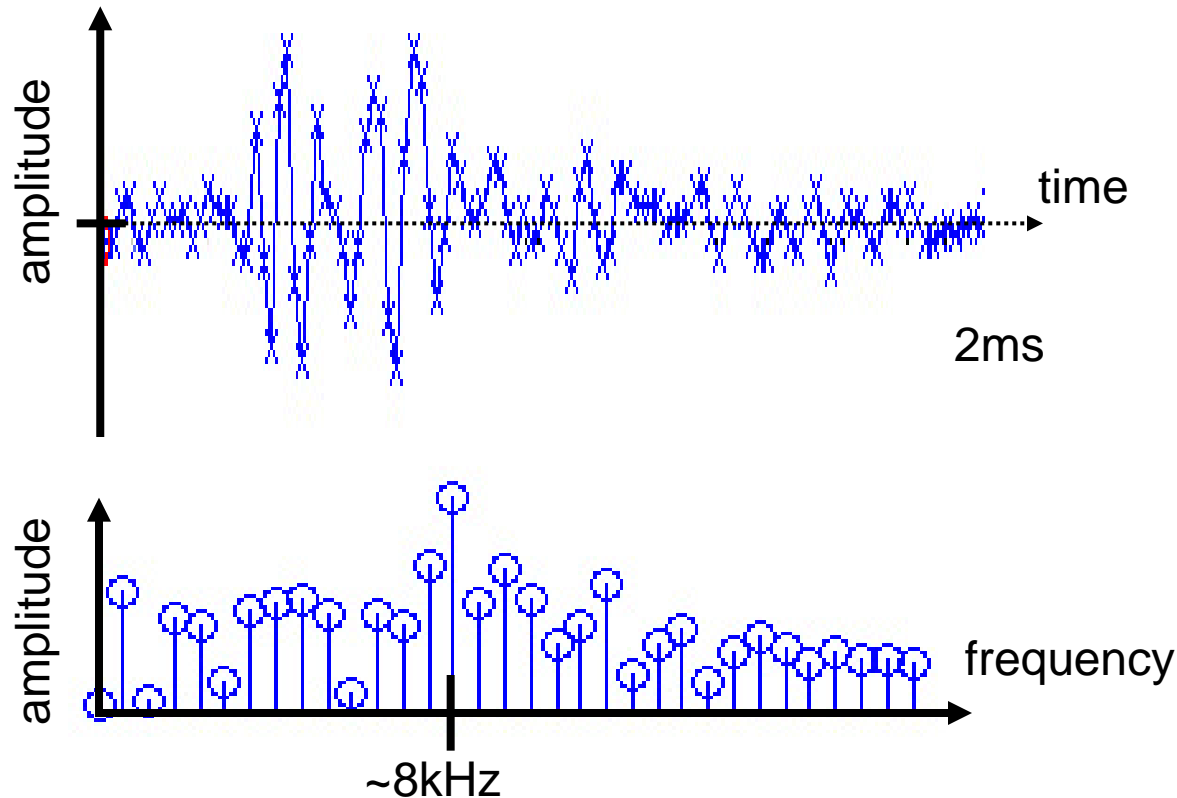
# Acoustic Wireless Sensor

- Listening Device
- Self monitoring system
- Radio Frequency remote access
- Wireless Network functionalities
- Long battery lifetime / Low power system
- No need for specialists on the field



# Detection Algorithm

- Multi stage algorithm
  - Time domain, frequency domain (FFT)





Start Recording



Reload Data



Erase Data



Export Data



Import Data

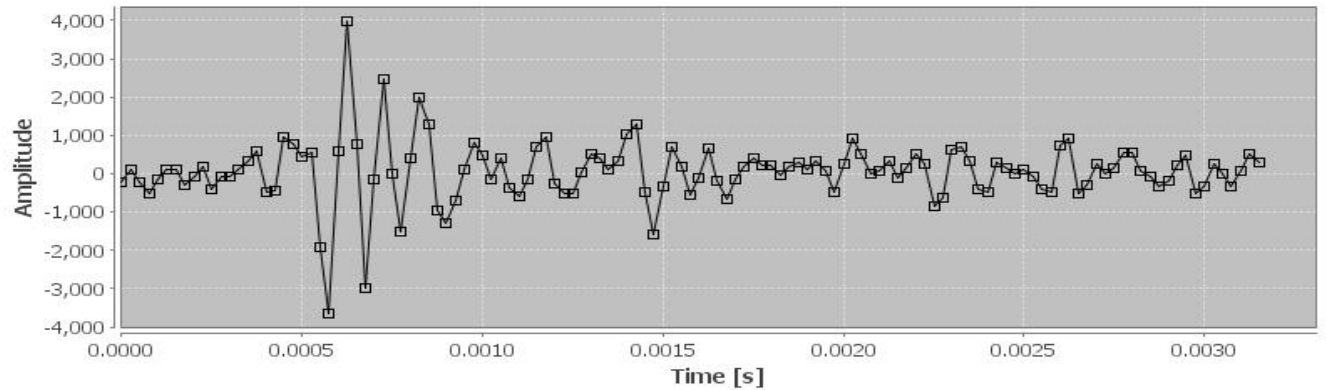
Panel A

Filter

Hold Graph

- S15\_2009-10-14\_at\_15h18\_22.txt
- S15\_2009-10-14\_at\_15h18\_17.txt
- S15\_2009-10-14\_at\_15h18\_09.txt
- S15\_2009-10-14\_at\_15h18\_02.txt
- S15\_2009-10-14\_at\_15h17\_50.txt
- S15\_2009-10-14\_at\_15h17\_44.txt
- S15\_2009-10-14\_at\_15h17\_26.txt
- S15\_2009-10-14\_at\_15h17\_21.txt
- S15\_2009-10-14\_at\_15h17\_16.txt
- S15\_2009-10-14\_at\_15h17\_11.txt
- S15\_2009-10-14\_at\_15h17\_06.txt
- S15\_2009-10-14\_at\_15h16\_57.txt
- S100\_Test\_Recording.txt

### Recorded Audio Data



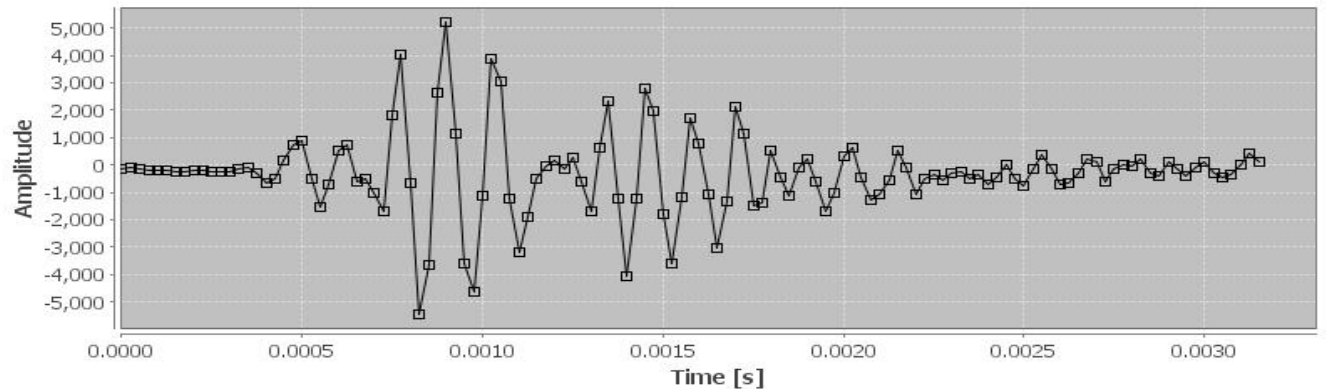
Panel B

Filter

Hold Graph

- S15\_2009-10-14\_at\_15h18\_22.txt
- S15\_2009-10-14\_at\_15h18\_17.txt
- S15\_2009-10-14\_at\_15h18\_09.txt
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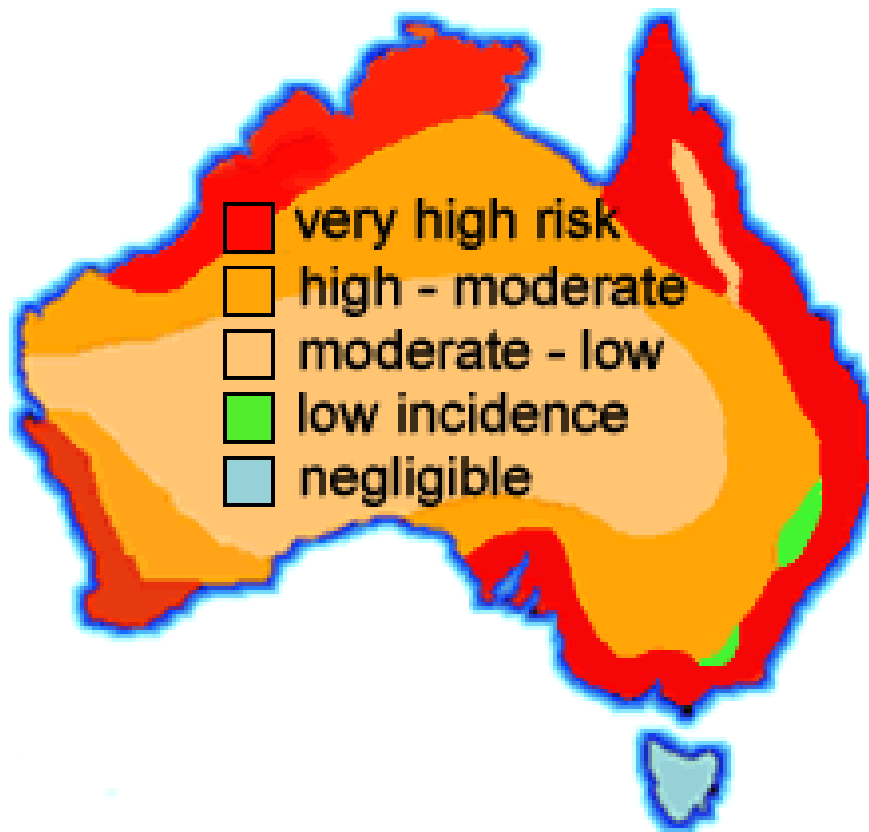


- The prototype demonstrates that:
  - EHB can be detected acoustically
  - Communicates detection through a network of sensors
  - Approach could be use to detect other types of noises

- Research can be extended to other application fields

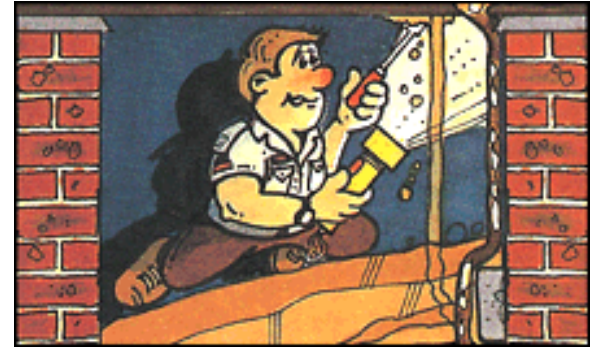


# Termites



- In nature termites assist in the recycling of organic matter and nutrients back to the soil.
- Australia is the third largest market for termite control after the USA and Japan.
- One in five houses in Australia gets attacked by termites.
- Termites alone cost Western Australian home owners \$600 million per annum in treatment and damage repair.

- Termite Detection
- bugFinder
  - Family of devices
  - Individual or part of WSN
  - Early Detection of termites
  - Detering functionality



# Proof of Concept

- Termites in a house in the hills





# Applications of bugFinder

- Termites
  - Early Detection in Houses. Damage Prevention. Less Chemicals
- Agriculture (e-Agriculture Research Group)
  - Wetland Monitoring. Crop Biological Quality
- Forests and Wood Products
  - Imported pests (Asian Gypsy Moth, Sirex Wood Wasp)
- Sugarcane Industry
  - Turnip Moth, the Sugarcane Borer, Cane Grub
- Other Industry using Timber Based Material
  - Western Power (Timber Poles)



- R&D to suit Industry needs
  - Temperature and humidity measurements
  - Adjust system behaviour
    - Stand-by time, recording time, recording repetitions
  - Define collected data transmission
    - Simple alert, recording, temperature, time, statistics, ...

**Thank you for your Attention!**