Acoustic loggers for soundscapes of forest exploitation

C. Patrick Doncaster

Biological Sciences, University of Southampton

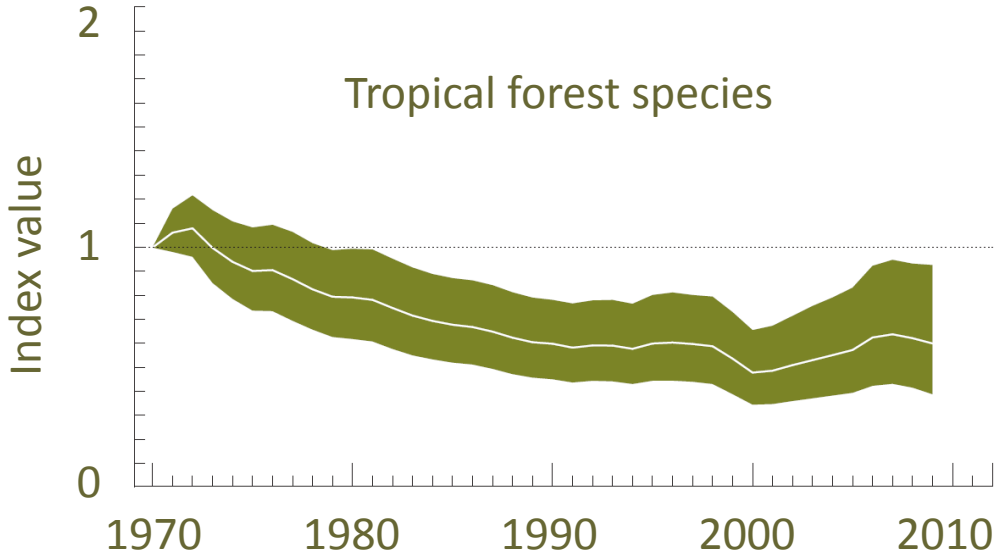
Collaborators: Dr Jake Snaddon[1], Prof Alex Rogers[2]
PhD students: Andy Hill[1,3], Pete Prince[1,3], Evelyn Piña Covarrubias[1]

[1]*Biological Sciences, University of Southampton*
[2]*Department of Computer Science, University of Oxford*
[3]*Electronics and Computer Science, University of Southampton*

CONACYT Consejo Nacional de Ciencia y Tecnología
ARM NERC SCIENCE OF THE ENVIRONMENT

The issue:

- Biodiversity → ecosystem functions → ecosystem services.
- Global biodiversity loss currently 100-1,000 times natural rate.



41% decline in population abundances from 1971 reference to 2009.

Greatest loss of area of any habitat in dry broadleaf: 49% converted to human use.

[WWF Living Planet Report 2016]

- Forest services particularly at risk, and impact most on the rural poor
  - Food security: wealth … depleted resources of wild meat
  - Environmental quality: health … polluted water by agricultural runoff
  - Regulation of systems: stability … drier rainy seasons
  - Cultural legacies: identity … communal forests → private agriculture

The opportunity:

- The Internet of Things …
- At present …
  - Devices tied to WiFi
  - Limits use to smart home technology

Do I need cheese?

- But, rapidly increasing availability of new technologies …
  - Reducing costs of microphones and processors
  - Opportunities for open online manufacturing
  - LoRa: long-range, low-power, low-bandwidth, low-cost communication

$1 per radio!

- Exploitable trends for developing new tools to monitor the environment

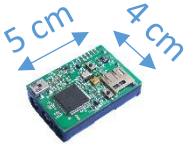
Two forest rangers put their lives on the line to patrol tens of thousands of km^2 of protected forest with inadequate equipment for fighting organised crime.

Limitations of current systems of environmental monitoring:

• Size	3,200 g	… need cryptic sensors
• Cost	> $1000	… most needed by rural poor
• WiFi	reliant	… dead zones in forests
• Detection range	50-500 m	… vast forests, 100 devices / km²
• Memory capacity	4 Gb	… high maintenance costs
• Battery life	2 weeks	
• Ethics	records all	… drug deals in the forest

State of the art:

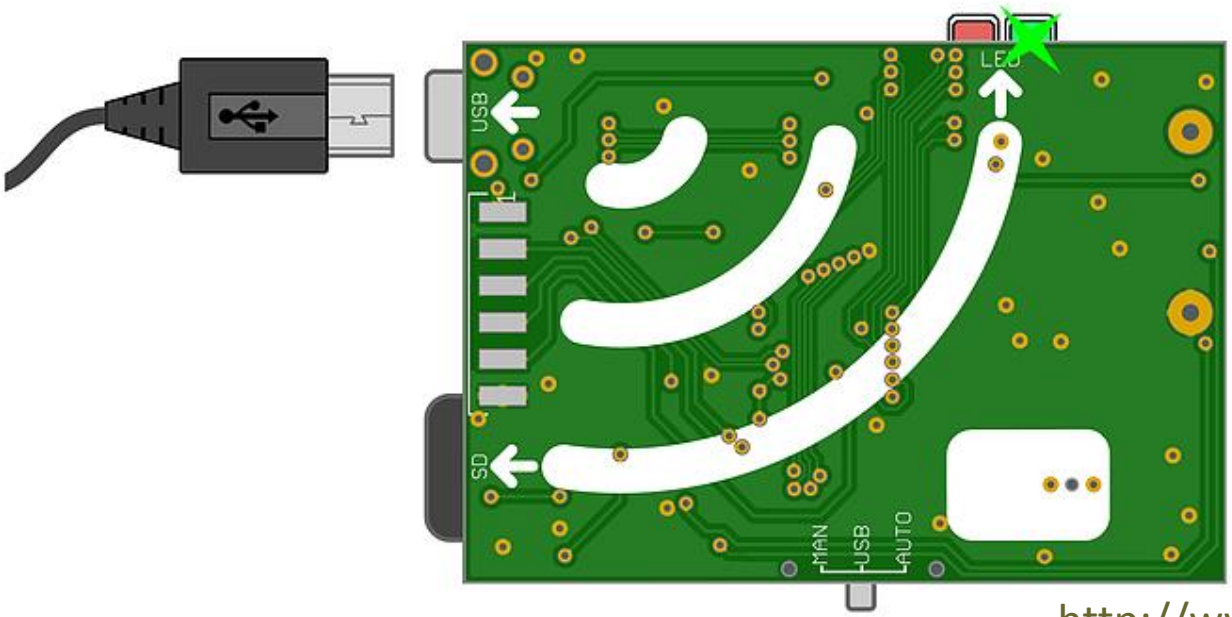
Need:



A new device: ‘AudioMoth’

Developed by Andy Hill, Peter Prince, Alex Rogers

• Size	32 g	… cryptic
• Cost	< $20	… affordable, open access
• WiFi	no	… radio communication to base
• Detection range	500-1000 m	… 1 device / km^2
• High sampling rate	320 kHz	… low maintenance costs
• Smart detection/storage	algorithmic	… low maintenance costs
• Ethics	no speech	… custom use



Current trials in:

- UK: New Forest cicada
- Kenya: Hartlaub's Turaco
- Madeira: bats
- Cuba: endangered bat
- Belize: forest extraction

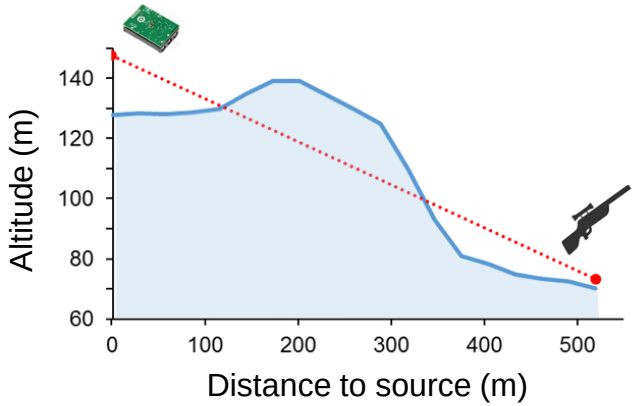
http://www.openacousticdevices.info/

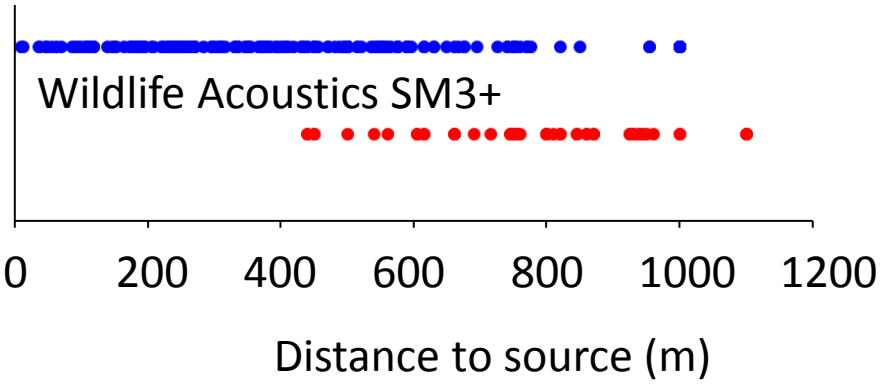
Gunshot detection

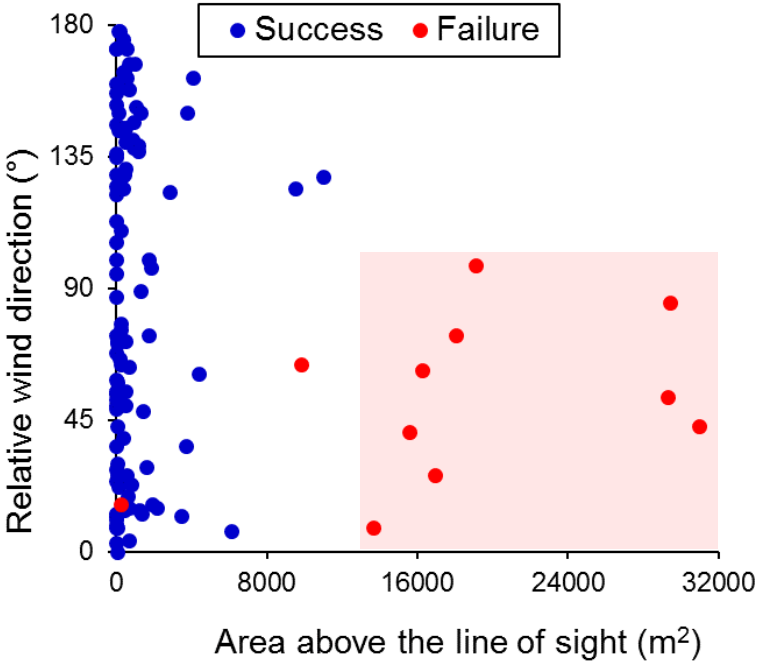
Testing by Evelyn Pina, Jake Snaddon

Rifle and shotgun audibility depends on environment:

- Distance to source , and line of sight

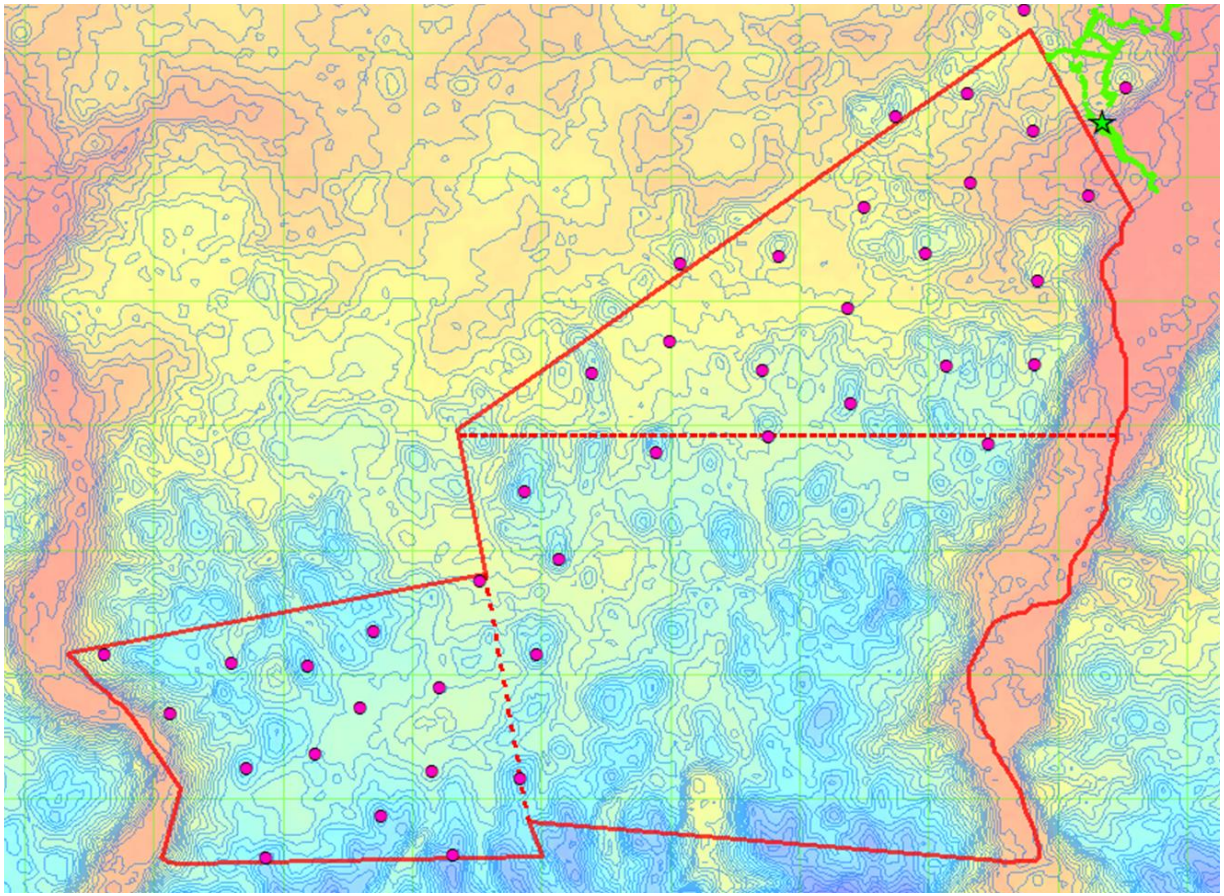


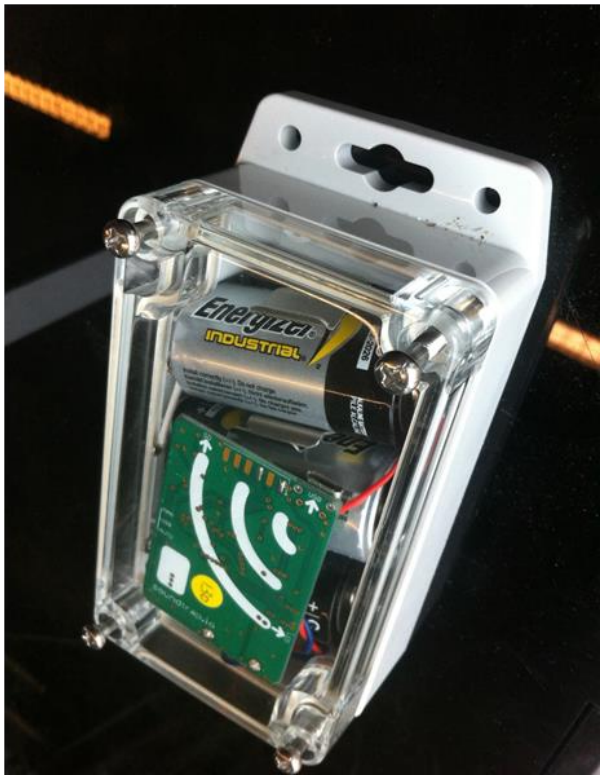




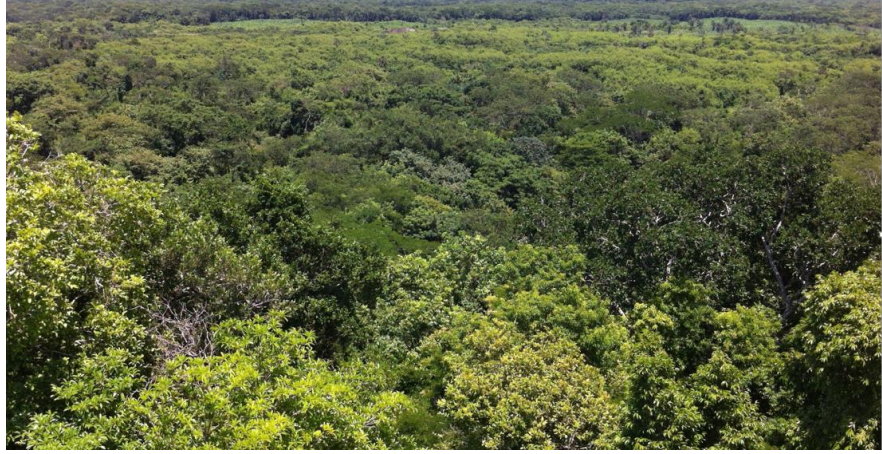
Next steps: network deployment in a practical application

- Belize: 70 km^2 Tapir Mountain Nature Reserve
- Unmanaged and unrecorded poaching and logging
- Belize Forest Department wants long-term protection of biodiversity





How industry might help



- Longer battery life
  - ✘ Solar … little penetration of sunlight
  - ✓ 30 days
  - ? 90 days
- More intelligence into the device. Algorithms to …
  - ✓ Detect gunshots
  - ✓ Filter out human conversation
  - ? Detect chainsaws, dogs, truck engines
- Improved radio relay
  - ✓ Line of sight
  - ? Hilly terrain
  - ? Dense vegetation