Monitoring African Bush Elephants with the OSOP Raspberry Shake and Boom

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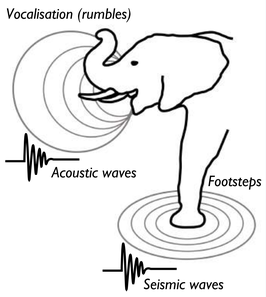
EGU2020-1503

Elephant monitoring

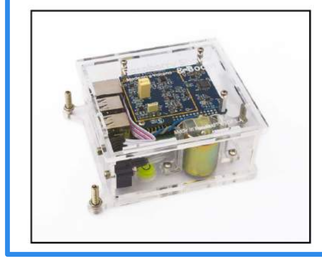
- Acoustics offer rich information on the abundance, distribution, and behaviour of vocalizing animals within a target area.
- African elephants (*Loxodonta africana*) have been documented to make extensive use of low-frequency vocalisations, or 'rumbles'.
- Seismic waves have also been recorded from elephant footsteps.

- Here we assess a newly developed, low-cost sensor (originally developed for tectonic earthquakes and atmospheric infrasound) for monitoring wild Elephants.



Sensors

- The Raspberry Shake and Boom (RS&B) incorporates a seismic geophone, acoustic pressure sensor, and data digitiser into single compact package.
- Originally developed for home use, but shown to be successful in scientific field deployments (e.g. regional earthquakes, and rockfall).
- Compared in field alongside higher cost but more sensitive instruments (InfraBSU microphone, Lennartz seismometer.)

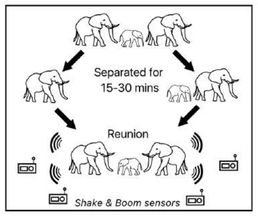


Left: The Raspberry Shake and Boom unit. (Used with permission from the Raspberry Shake website.)

Right: Deploying a RS&B unit at the elephant reserve near Bela Bela, SA

Reunions

- Seismic and acoustic recordings were collected from a herd of 7 elephants in South Africa.
- Vocalisations were recorded during two social contexts: spatial separation and subsequent bondings (a.k.a. reunions; see schematic, right).

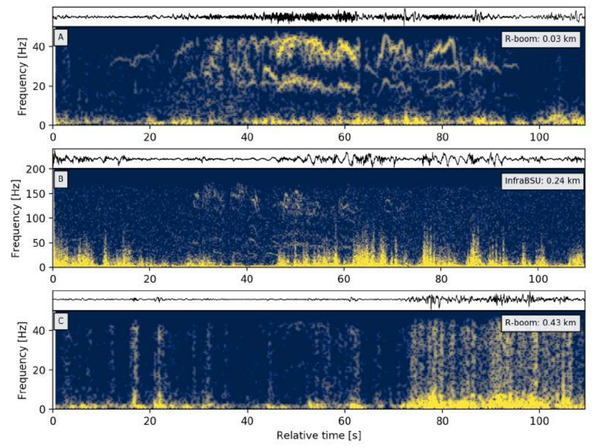


Results: Acoustic

- The RS&B was able to record complex reunion vocalisations at low (<50 Hz) frequencies not clearly seen by more sensitive instruments (panels A and B, right).

- However, not able to record higher frequencies due to low sampling rate (100 sps) and had apparent limited detection range (<400 m; panel C).

Right: Acoustic waveforms (top) and their frequency spectrograms (bottom) as recorded by acoustic sensors at three different locations during a reunion. The sensors and distances to the reunion are indicated in the top right of each spectrogram. Note different y-axes for spectrograms due to different samping rates across sensors.



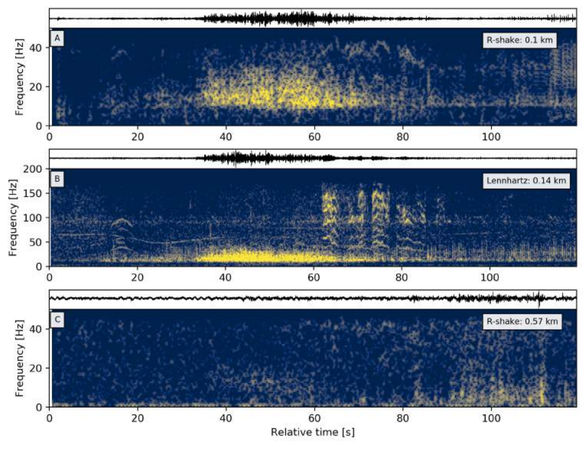
Results: Seismic

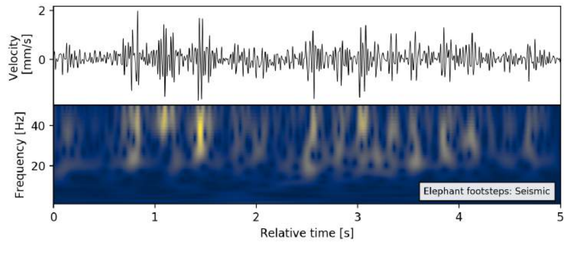
Vocalisations

- Generally, the geophone in the RS&B unit was able to record faint signals of interest related to vocalisations generated during reunions (panel A, right). More sensitive instruments were able to record more details at higher frequencies (panel B).

- The detection range of the seismic geophone was similar to the acoustic pressure sensor (see above), with no clear detections for sensors at distances >400 m from reunion (panel C).

Right: Seismic waveforms (top) and their frequency spectrograms (bottom) as recorded by acoustic sensors at three different locations during a reunion. The sensors and distances to the reunion are indicated in the top right of each spectrogram. Note different y-axes for spectrograms due to different samping rates across sensors.



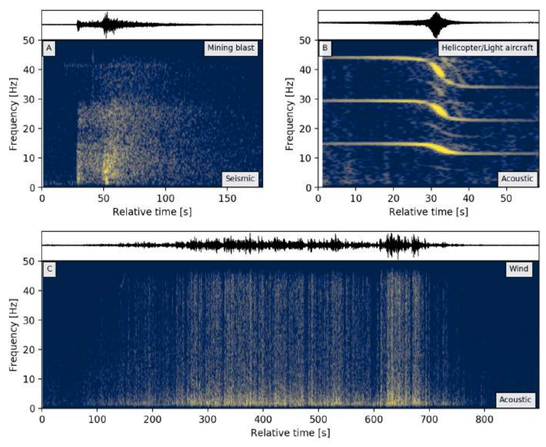


Footsteps

- The vertical geopone was successful in recording seismic waves generated by individual footsteps from elephants within <50 m of the RS&B location.
- Range is much smaller than previous studies, so more work needed to improve sensitivity of RS&B geophone.

Left: Seismic waveform (top) and frequency spectrogram (bottom) of footsteps as recorded by geophone inside RS&B unit during a reunion event. The station was located approximately 30 m from the reunion location. Spectrogram was calculated using continuous wavelet transform due to small time window.

Results: Noise



- Noise from various sources were prevalent throughout the test, including mining blasts (panel A), light aircraft or helicopters (panel B), and wind noise (panel C).

Key findings

- The RS&B performed well in recording African elephant vocalisations and footsteps.
- Limited in frequency range and detection range.
- Offers a low-cost solution for complementing other sensors within a field deployment.

More details on the test will be found in the article currently under review at the Bioacoustics *journal, titled 'Assessing OSOP Raspberry Shake and Boom Sensors for recording African Elephant acoustic vocalisations'*

Future outlook

- Future fieldwork will explore different deployment configurations to improve the sensitivity of the RS&B sensors.
- Explore and develop the use of signal recognition algorithms to automatically detect presence of elephants.