

Press Release

The power of sound: results of bioacoustics study offer potential for biodiversity measurements to investors

- Biodiversity research study first launched in September 2022 now complete
- Conservation areas and areas where palm oil is being produced showed notably different acoustic landscapes
- Areas where palm oil is being produced were dominated by monotonous activity of only insects and no mammals were detected
- Conservation and Control plots were populated by varying bird species, frogs and mammals

Today, on the [UN's International Day for Biological Diversity](#), we are reminded that there is a growing demand for ways to measure progress towards stated biodiversity goals. One of the biggest hurdles is obtaining reliable data that provides real time insights into the effectiveness of different approaches for managing biodiversity impact.

In light of this, Cardano, along with partners Fidelity International and Nomura Asset Management, sponsored Green PRAXIS, a nature-based solution provider to conduct a bioacoustics study. The research was also in collaboration with Professor Hervé Glotin, Head of the DYNi research team at LIS, University of Toulon, and Professor Gianni Pavan, Director of CIBRA, University of Pavia.

The study, which used bioacoustics technology to monitor and measure biodiversity levels associated with varying land use intensities within a palm oil concession, produced encouraging and clear results. The Green PRAXIS team analysed sound recording data gathered from six recording days over nine locations in West Kalimantan, Indonesia on land owned by a palm oil producer. The recordings were set up across three types of plots:

- A Control plot: Forested area outside of the concession
- Conservation plots: Secondary forest resulting from conservation efforts
- Production plots: Active monoculture palm oil plantations

To distinguish between the elements in the recordings, Green PRAXIS developed an innovative technique using bioacoustics methodologies to create visual representations (or spectrograms) of the sounds. These spectrograms allow the 'sounds to be seen' and are compiled to inform biodiversity levels.

The study found that the Conservation areas and Production plots produced notably different acoustic landscapes. Production plots were dominated by monotonous insect activity, primarily cicadas, and no mammals were detected. The absence of gibbons in Production plots is a very important indicator of the degraded state of agricultural areas since primates play vital roles in ecosystem structure, function, and resilience. Conversely, Conservation and Control plots were populated by varying bird species, frogs and mammals – including primates (gibbons).

While both the Control and Conservation plots produced a significantly higher number of acoustic events in a wider range of frequencies correlated with species richness, the Conservation plots did not demonstrate the same quantity of events.

Globally, these results corroborate earlier academic findings that conservation efforts by companies are valuable in terms of restoring biodiversity, however, they cannot replace the protection of natural forests.

Looking ahead

The goal of the study was to lay the initial foundations for building an affordable, speedy, reliable and non-invasive tool for measuring biodiversity richness and abundance in a certain area. Discussions with a second palm oil producer are already underway to conduct recordings within multiple conservation plots, production areas and control plots (ideally within primary forests). This group of investors intend to use the combined results to encourage companies and their suppliers to incorporate this technology into their own biodiversity monitoring processes.

Greta Fearman, Senior Responsible Investment Officer, Cardano, commented: “At Cardano, we are committed to playing our part in engaging with companies to redirect investments away from activities that destroy biodiversity towards those which allow nature to bounce back. This initiative shows that there are ways for companies to measure their impact as they work towards achieving their biodiversity targets. This tool can improve accountability and demonstrate whether companies are actually on track to meeting their Nature Positive commitments.

“We acknowledge that there is a need for further studies with larger sample sizes, that are geographically diverse and done at different times of the year to check for seasonality, but the investor group is pleased with the initial set of results and believe they are promising and in-line with previous scientific findings.”

Daniela Dorelova, Equity Research & ESG Analyst, Nomura Asset Management UK, said: “At Nomura Asset Management, we are particularly excited about being part of this project and the promising initial set of results from the study. One key finding and limitation we encountered was our inability to find a true pristine forest adjacent to the plantation to serve as a control group for the study. We learned that all of those forests had been cleared in the 1980s. Future phases of this project will aim to identify pristine forests that are suitable to serve as a control group.”

Charlotte Apps, Sustainable Investing Analyst, Fidelity International, said: “At Fidelity International, we believe the loss of natural capital is a systemic risk to capital markets, the health and preservation of our biodiversity and ecosystems is a top priority for us. We are really encouraged by the initial results of the Green PRAXIS study. Green PRAXIS have been able to devise a potential methodology to assess biodiversity, showing meaningful differences in biodiversity between conservation and production plots over the recording period. This is important proof that bioacoustics could offer a low-cost, non-invasive, rapid and scalable means by which to assess the health of ecosystems, driving better company disclosure, targeted engagement and effective allocation of capital in the future.”

Jérôme Di Giovanni, PhD, Co-founder, Green PRAXIS, said: “Our goal at Green PRAXIS is to help companies with a large environmental footprint reduce the impact of their vegetation and natural assets management practices. Our core metric is biodiversity preservation. These preliminary results strongly encourage us to accelerate R&D efforts and scale up our bioacoustics approach to deal with the urgent need of quick and rigorous biodiversity assessments, and in turn drive more investments towards nature restoration.”

- Ends -

Notes to editors

About the study

For the analysis, an online tool was built to play the recordings by day and plot type. Each two minute sound sample was inspected manually to identify discrepancies. The samples were processed to break down each of the signals and be translated into short spectrograms. Summing these up created long-term spectrograms, which make it possible to monitor entire soundscapes, identify various taxa in a given time frame and therefore estimate species richness.

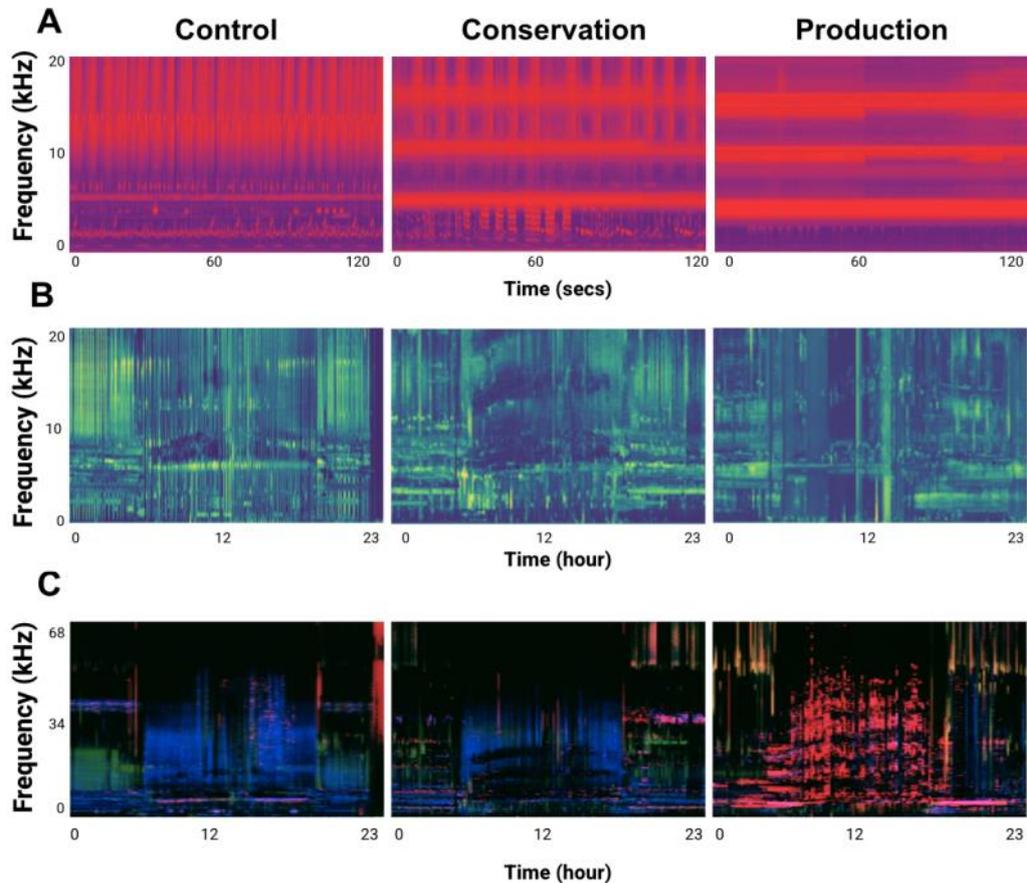


Figure 1. Sound spectrograms

- Short spectrograms displaying sound intensity at each frequency over time created from the raw signals in each 2 minute sample recording
- Long-term spectrograms summing up all 2 minute recording samples from a day
- Long Duration False Colour Spectrograms where red pixel intensity corresponds to the ACI value, green to ENT, and blue to EVN.

In order to simplify the data analysis process, acoustics landscapes were split into ecologically meaningful time (e.g. dawn, dusk, etc.) and frequency ranges, as shown in the table below, alongside the main animal groups found within each sound frequency band.

A

Time period	Range of hours	Frequency band (kHz)	Main taxonomic groups
Dawn	5 - 7	0.3 - 4	Birds, mammals, frogs
Morning	7 - 11	4 - 12	Birds, frogs, insects
Noon	11 - 13	12 - 22	Insects, bats
Afternoon	13 - 16	22 - 45	Insects, bats
Dusk	16 - 18	45 - 64	Bats
Night	21 - 24		

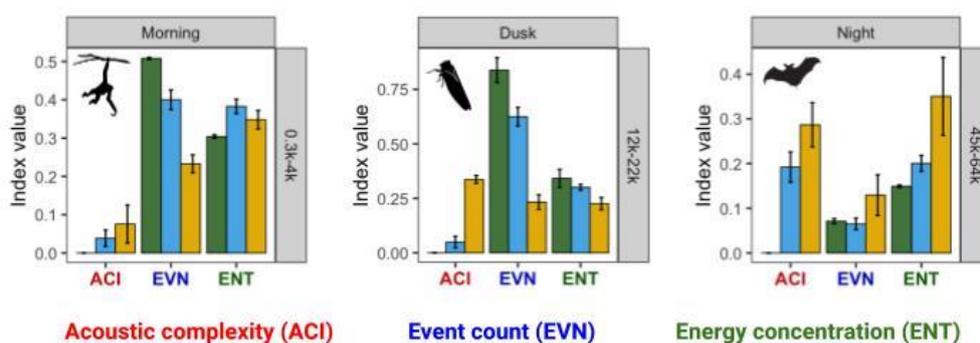
B

Figure 2. Variation in biological activity during the day.

A) Tables time (left) and frequency bins with associated animal groups (right)

B) Selected histograms showing average indices values in Control (green), Conservation (light blue) and Production (yellow) plots. Presence of mammals (gibbons in particular) is associated with increased EVN (number of events) values in the 0.3-4 kHz range in the morning in Control and Conservation plots (left). Dominance of insects in the acoustic landscape of Production plots translates into largely increased ACI values and reduced EVN for instance in the 12-22 kHz range (middle). Presence of bats at night in the Production plots correlates with increased ENT in the 45-64kHz range (right).

To characterise the audio landscape, acoustic indices that reflect various aspects of acoustic energy and distribution across the spectra were computed based on each recording, and averaged within each time and frequency bin.

Three index types were used as they were previously validated as the ideal combination of parameters to describe biological activity: Acoustic Complexity Index (variation in amplitude), Temporal Entropy (energy concentration) and Event Count (number of events).

Indices calculations were performed using Python, statistical models were run on each of the acoustic indices to test for differences and visualisations were built in R software.

The three indices were plotted to yield Long Duration False Colour Spectrograms, where their combination revealed biological activity patterns specific to the different plots.

Study limitations

The aim of the study was to include a pristine, primary forest area as the control plot to compare the production and conservation sites to. However this was not available in the area. While a massive amount of data was accumulated through the recordings, the single control plot was not a true pristine forest, but rather a secondary forest outside of the concession.

What are pristine forests? Pristine, or 'primary' or 'old-growth' forests are those that follow natural dynamics, exist in their original condition and are largely untouched by human interference.

Biodiversity technology

Bioacoustics offers a low-cost, non-invasive, scalable technology which combines sound recordings with artificial intelligence to gain insight into biodiversity abundance and richness. Traditional methods for measuring biodiversity, including going into the field to count species types (richness) and number of individuals of each (abundance) are resource intensive and tend to be relatively invasive to the local ecosystem.

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