Biodiversity sampling using a meta-acoustic method: micro-endemism detection in New-Caledonia

Echantillonnage méta-acoustique de la biodiversité et étude du micro-endémisme en Nouvelle-Calédonie

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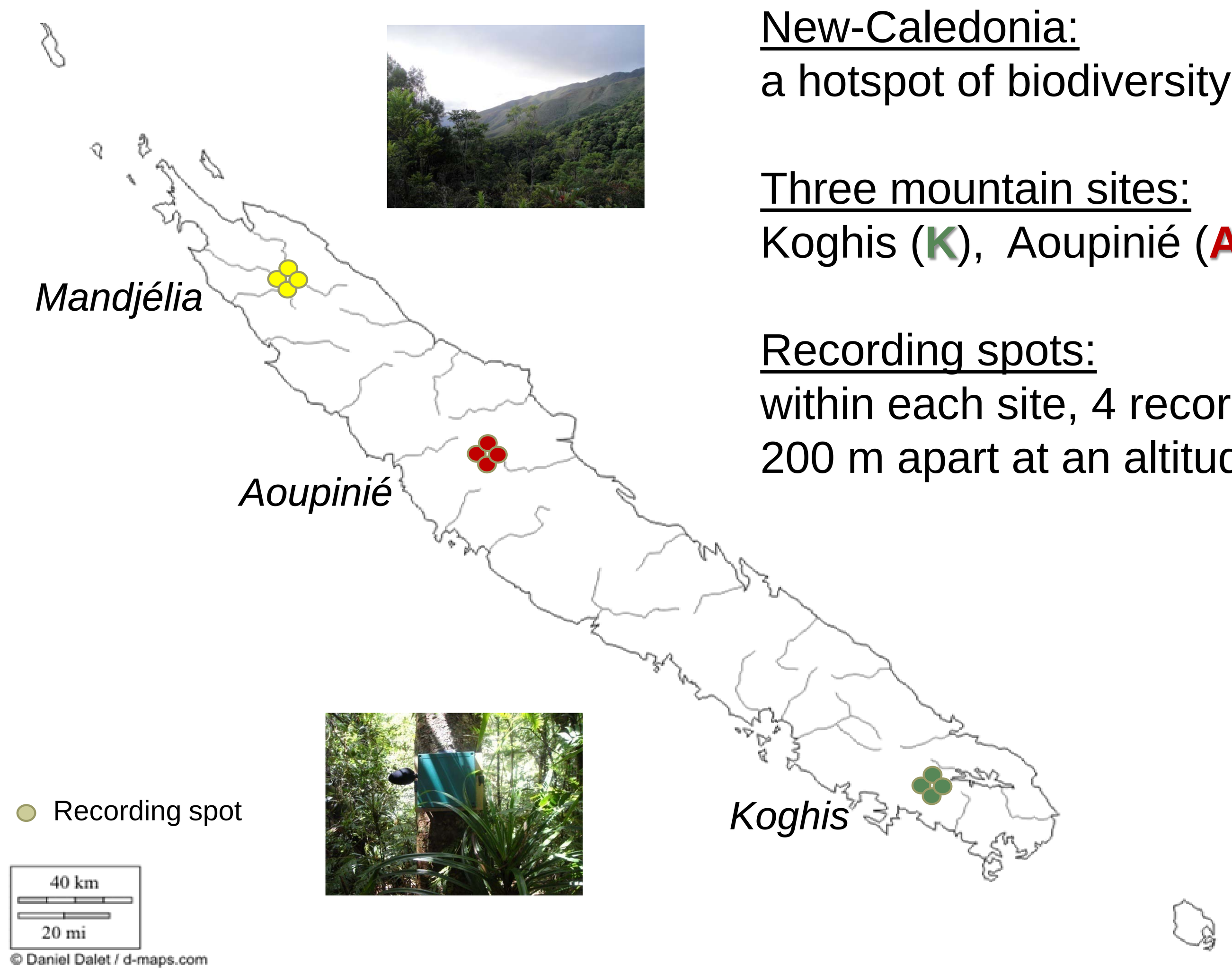
Abstract

A new biodiversity sampling method based on community acoustic activity was recently proposed (Sueur et al., PLoS One 2008). Acoustic complexity of sound emitted by animal communities is globally analysed without any species identification. The **aim** of the present study is **to test the method to reveal community micro-endemism**. New-Caledonia is a Pacific island, acknowledged for its unique species richness and micro-endemism (Grandcolas et al., Phil. Trans. R. Soc. 2008 ; Kier et al., PNAS, 2009). Three recording sites were chosen considering their high distinctiveness (Pellens et al., in prep.). All sites were localised in similar habitat (tropical forest) to avoid acoustic differences due to vegetation structure.

Preliminary results reveal acoustic complexity differences between sites in spectrum composition. This work confirms the results obtained previously with traditional sampling methods and supports the reliability of the meta-acoustic method.

Study sites



New-Caledonia:
a hotspot of biodiversity

Three mountain sites:
Koghis (**K**), Aoupinié (**A**) and Mandjélia (**M**)

Recording spots:
within each site, 4 recording spots were placed 200 m apart at an altitude of 600 metres

Passive acoustic recording

The recordings were made between April 10 and June 30 2010 with 12 digital audio field recorders Song Meter SM2 (Wildlife Acoustics, 2009). These off-line and weatherproof recorders (fig 1) are equipped with an omni-directional microphone. All day long, sound were recorded each twelve minutes during two minutes (*n* = 19188 files). The signals were digitized at 44.1 kHz / 16 bit. Rainy and windy days were excluded of analyses due to disturbing noise (37% of files excluded).

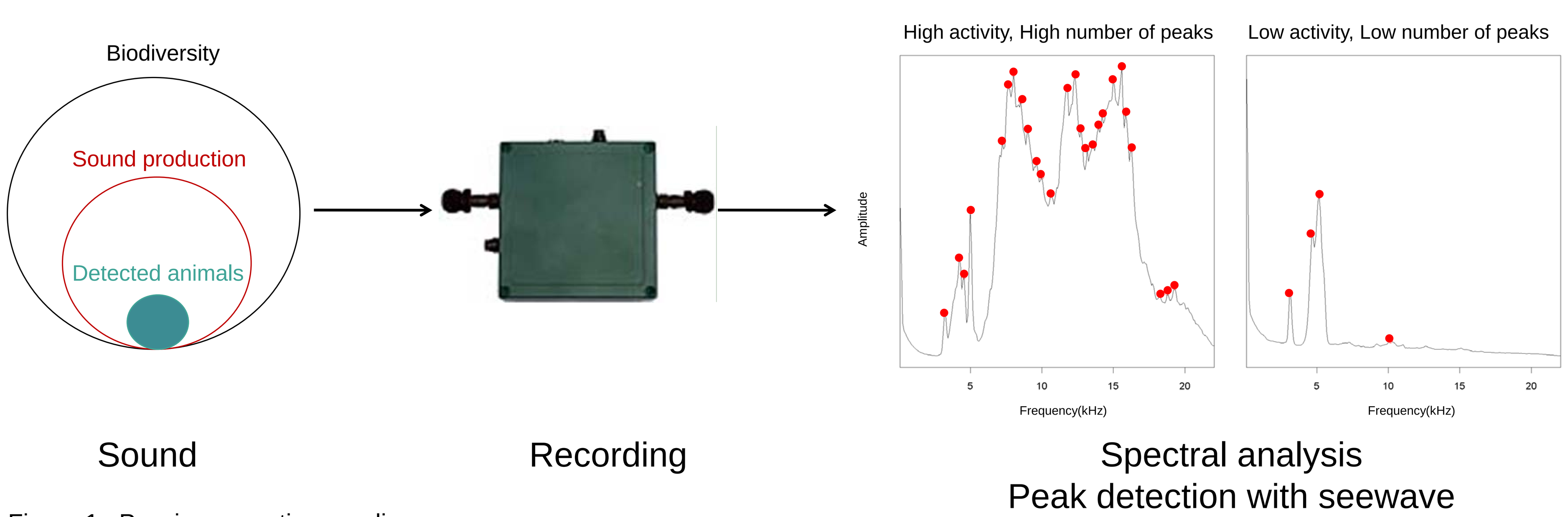


Figure 1: Passive acoustic recordings

Analyses

The frequency content of the recordings was analysed with a STFT (Short-term Fourier Transform, windows size = 11 ms). The number of frequency peaks being related to acoustic complexity, a function was developed within the R environment (package seewave) to allow automatic spectral peaks detection (fig1). In addition, the dissimilarity index Df, that measures the spectral difference between two recordings, was used. A dissimilarity matrix was calculated between all recordings and analysed with a Principal Coordinate Analysis (PCA) and a Ward clustering method. Average differences among the three mountain sites were tested via a distance-based Redundancy Analysis (dbRDA) (Legendre and Anderson, Ecol. Monogr.,1999) .

Preliminary results

1- Daily cycle of acoustic activity

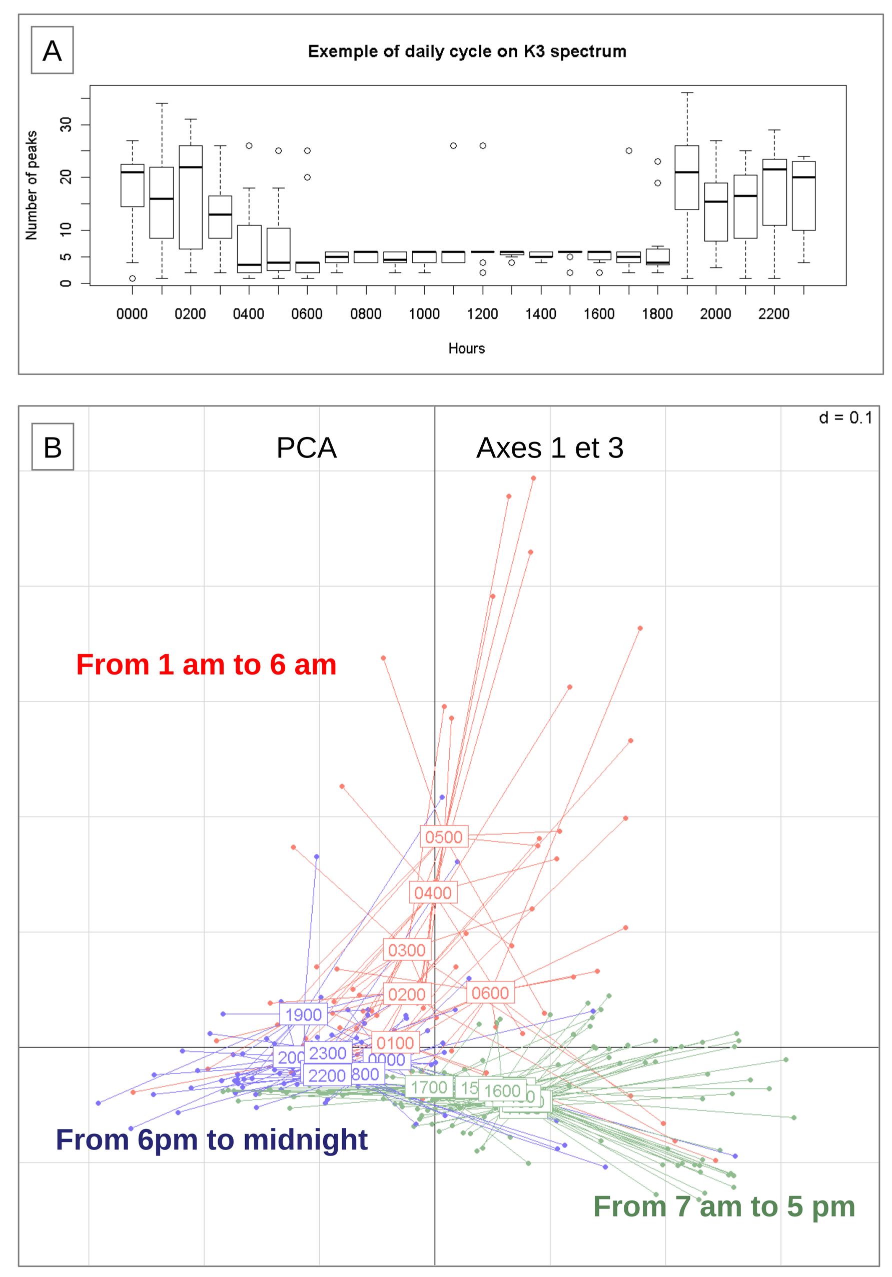


Figure 2: Daily cycle of acoustic activity

Number of peaks evolution during the day suggests a daily acoustic structure with a higher activity from 7 pm to 6 am (fig 2A). The PCA based on the spectral dissimilarities reveals three groups with distinct acoustic activities: beginning (1-6 am), middle (7 am-5 pm) and evening (6-12 pm) of the day (fig 2B).

2- Between-sites > Within-sites diffrences

Based on the average acoustic dissimilarity among the recording spots, a dendrogram was constructed. This dendrogram highlights strong differences among the three sites (with one exception: M3). The dbRDA test confirms a significant difference between the three mountain sites (fig 3).

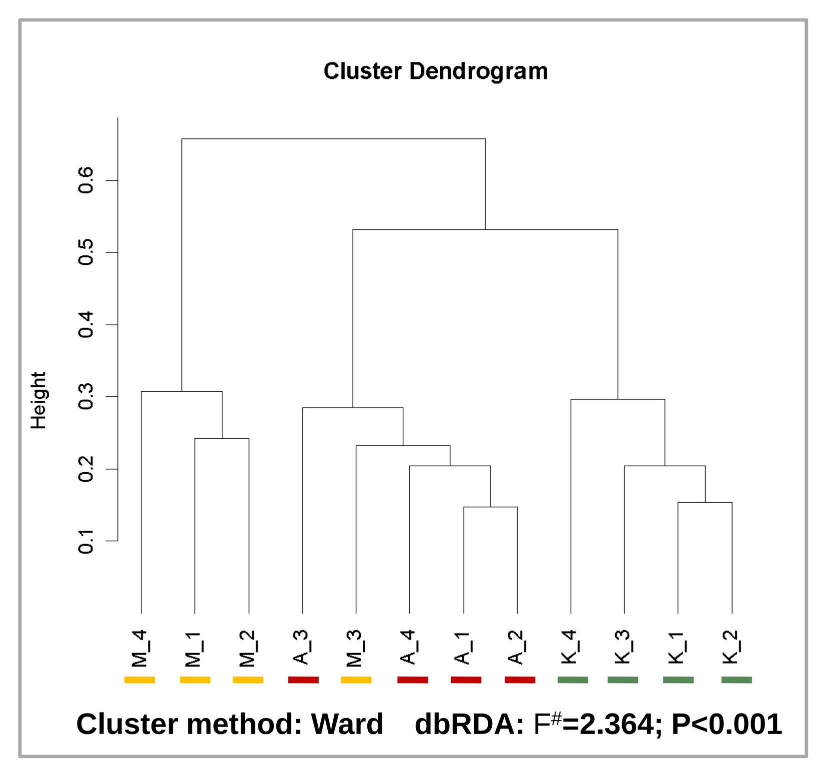


Figure 3: Dendrogram of acoustic sites dissimilarity

Conclusion

Results obtained by traditional sampling and meta-acoustic methods both reveal significant differences in biodiversity between the three sites analysed. Supplementary analyses will be performed in terms of frequency and amplitude of the signal to eventually characterize an acoustic endemism of the mountain sites.

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