Interlocking Rhythmic Composition Style of Borneo Ketebong - The Gendang Pampat

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This work was conducted using the PicoScope signal extraction and Adobe Audition procedure, which revealed significant insights regarding the Iban traditional drum called ketebong. Three ketebong of different lengths, *i.e.*, long, medium, and short sizes were studied. The amplitude of the long ketebong signal remains constant, showing that it had sustained its timbre for a longer duration compared to medium and short ketebong. Considering the diameter, all ketebong are almost similar, all the ketebong yield fundamental frequency at 50.15 Hz (*i.e.*, G1# ~51.9 Hz). Although all ketebong showed similar fundamental frequency, Adobe Audition showed that the long ketebong has a brighter sound than the medium ketebong followed by the short ketebong. The purpose of this study is to derive the musical qualities of Gendang Pampat (GP), with a particular emphasis on the ketebong performance technique. The goal is to produce a rhythmic composition that integrates and reinforces a connected, expressive, rhythmic musical arrangement. The study aims to establish a framework by investigating the interlocking of rhythmic of GP to generate musical interpretation for composing a new repertoire for GP performance.

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Keywords: Gendang pampat; Interlocking rhythmic composition; Borneo 'Ketebong'

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INTRODUCTION

Malaysia is well-known for traditional drums. At the east and west coasts of Peninsular Malaysia, 'rebana ubi' and 'kompang,' respectively, are traditional percussions that belong to the Malay ethnic culture. In Sarawak, Malaysia (the Borneo Island) the Malay are famous for the Gendang Melayu Sarawak (Sinin 2024a) and Tar for Hadrah Performance (Sinin 2024b), whereas the Iban are famous for the traditional Iban percussion drum called ketebong. Ketebong is assumed to be sacred, used for various functions in the Iban community and is made from a piece of wood that is hollowed out manually with a sharp tool. At Batang Rajang, Sarawak, the Iban normally play Gendang Rayah, Gendang Betan, Gendang Kanto, and Gendang Pampat (GP) during their 'miring' (ritual) ceremony. The GP is the art of beating the ketebong and is part of calling their ancient god, especially among the Iban. During the war, the GP sound was used to motivate the spirit of the Iban warrior. The GP can be played by up to 11 people in a group setting consisting of 4 groups.

The beat from GP produces a harmonic sound. The ‘miring’ ceremony is held before every GP session. The players wear traditional clothes where the man wears a ‘baju burung’ (bird shirt) or ‘baju perang’ (warrior shirt) with ‘terabai’ (armor) and ‘parang ilang’ is only tied at his waist like an Iban warrior as part of the traditional dress. Parang literally means sword. Ilang is described as, the special shape of sword, curved cutting edge, slightly convex blade, and hollow ground’. Figure 1 shows a ‘parang ilang’. The drum is struck by both open hands only on the drum skin.

(a) **(b)**

Fig. 1. A ‘parang ilang’ with curved cutting edge: (a) slightly convex side; and (b) slightly concave side

The Gendang Pampat (GP) is used during the rites (calling upon the old gods), especially those of the Iban people. The sounds of the drums were once employed to improve the morale of Iban warriors during times of conflict. The GP are frequently associated with a tradition called ‘Paluan Perang Seru Semangat Pahlawan Iban’ (war beating calling for Iban warrior spirit) (Cikgu Emmet Menulis 2022). By hitting the surface of the drum skin, the GP uses traditional beating to produce an interlocking rhythmic sound.

Acoustic and human cognition technologies enable us to address the relationship between instrumental timbre, musical form, and perception of pitch, consonance, and harmony (McAdams and Seidenburg 2019). Using electronic sound generation and sound recording technology, complex sound sources can be explored. The frequency and harmonicity of the sound timbral of a range of a single-headed drum of ketebong were analyzed using acoustic spectrum (through Fast Fourier Transform (FFT)) and spectrogram (through Adobe Audition). The acoustic spectra disclosed the uniqueness of the ketebong by comparing the FFT spectrum. The available literature on the manufacture and acoustic behavior of ketebong is scarce. The ketebong is often revered as a spiritual instrument. A cone-like shape (*i.e.,* between 0.5 to 1.0 m in length) is formed at both ends where the center has been hollowed out with a section with diameter smaller than both ends of the ketebong (Fig. 2). It is manufactured from ‘menggris’ (scientific name *Koompassia malaccensis,* in the family, Leguminosae), or ‘nibong’ (*Oncosperma tigillarium*-a type of palm (coconut palm)) (Fig. 3).

Fig. 2. The Ketebong

(a) (b)

Fig. 3. (a) ‘Menggris’ (*Koompassia malaccensis*), and (b) Nibong palm (*Oncosperma tigillarium*)

One of the fundamental elements of music, which has grown to be a powerful force in people's lives, is rhythm (Anku 1997). Interlocking rhythms is one of the various categories into which rhythmic patterns have been subdivided. The definition of interlocking rhythms is rhythms that are superimposed on each other so that they share the same orientation as the regulative beat. Gomez *et al*. (2009) defined the interlocking rhythms with a few characteristics, which are complementary rhythmic canons, distinct rhythmic motifs that blend together to form a seamless figuration, and rhythms that have been overlaying upon one another to align with the regulative beat's orientation. There are a few examples shown in African drumming, Balinese Gamelan, and Afro-Cuban Music. Interlocking rhythms occur when the GP interact using various rhythmic patterns. This traditional music group's overlapping beat begins in the song's introduction and lasts all the way towards the end. According to Chukan (The Stars 30th October 2023) the Kemada group (GP group of players that was formed in 2016) remind various generations of the GP. Using the transcription of the composition, this study aims to create a novel approach for archiving the traditional music ensembles.

EXPERIMENTAL

The acoustic data and spectrogram were obtained using PicoScope oscilloscope and Adobe Audition analysis, respectively. The length is 95 cm and the diameter of the ketebong is 153 mm (6 in) at both ends and 115 mm (4.5 in) at the small section. The artisans have produced ketebong using whatever accessible method, with most of their labor being unrecorded. A manufacturer, Mr. Sigan (71 years old) of Kampung Lebur, Serian Division, Sarawak used coconut tree of medium diameter as the workpiece. The workpiece is subjected to a sharp tool to create the symmetrical hole along the axis. The coconut tree has been utilized in ketebong production recently (typically because of its hollow matrix in the middle like the Nibong). Acoustic spectra were recorded on the ketebong to determine which elements generate a certain connection between vibrational overtones and ketebong length. Changes in length cause noticeable variations in the ketebong spectrum. The characteristics of the ketebong are displayed in Fig. 4.

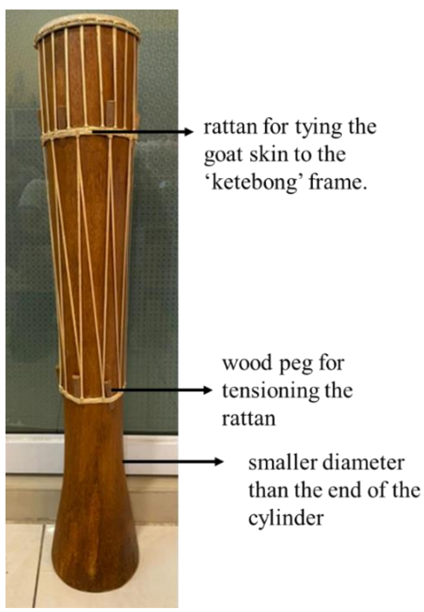

Fig. 4. The characteristics of the ketebong

The ketebong were digitally captured using a PicoScope oscilloscope and microphone data acquisitions. The microphone was positioned within a distance of 20 cm from the drumhead, as shown in Fig. 5. The palm of the right hand was utilized to strike the ketebong. The oscilloscope from Pico Technology 3000 series in Eaton Socon, UK was utilized to perform the Fast Fourier transform (FFT). The outcomes were subsequently examined utilizing PicoScope software (version 6), emphasizing FFT, voltage-based triggers, and spectrum analysis. The sound recordings were obtained at a sampling rate of 48 kHz. The experiment took place in the Music Department of Universiti Malaysia Sarawak (UNIMAS) within an anechoic room. The Time Frequency Analysis (TFA) was conducted in Adobe Audition, focusing on the specific intensity in hertz to differentiate the power of partial frequencies, using measurements in seconds. Tone systems are commonly studied in sound analysis and re-synthesis using this approach (Hamdan *et al*. 2020).

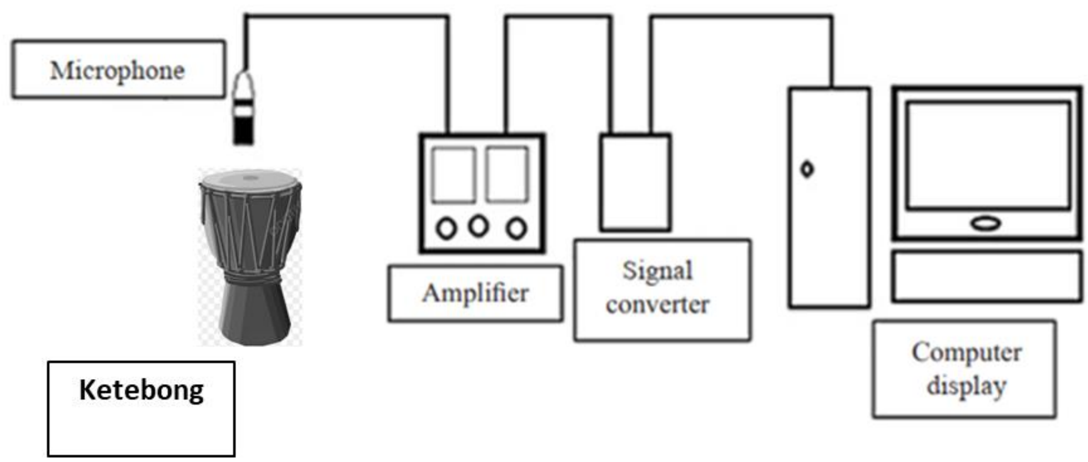

Fig. 5. Schematic diagram of microphone data acquisitions

The vibrations produce sound waves that create the notes heard in music. Several factors influence the sound generated, including the tension, diameter, length, and specific hitting technique of the drumhead. Various parameters, such as drumhead tension, diameter, hitting technique, resonance, and the drum's acoustic qualities, greatly influence the resulting sound. To ensure a consistent hitting pattern and exercise prudence, it is common practice to collaborate with a skilled professional GP player well-versed in these nuances. The ingredients combine to produce the harmonious tones that are typical of the GP. The audio signals were captured in monaural format with a sampling rate of 48 kHz and a resolution of 24 bits. The audio profile was saved in wave format for later processing. The calibration process confirmed that the recording system was set up properly, ensuring that the audio signals would be recorded at the optimal levels. This calibration procedure was crucial to maintaining the integrity of the recorded signals and producing high-quality audio recordings free from distortions and clipping. Before the session was recorded, a calibration was done to make sure the recording settings were ideal. The following steps were included in the calibrating process:
1. Test Tone Generation: To facilitate calibration, a test tone with a sine wave frequency of 1.0 kHz was created. The European Broadcasting Union (EBU) technique for standard calibration was used in choosing this frequency.
2. Output Level Adjustment: The calibration makes sure that the device outputs a digital recording level of 0 VU in accordance with the EBU requirements. This translates to either -18 dBFS in digital format or +4 dBu in analog format.
3. Equipment Isolation: To avoid interfering with the signal amplitude during calibration, all nearby equipment were either switched off or isolated.

4. Recording System Configuration: The recording system was equipped with the following devices:
-Interface for audio: Steinberg UR22mkII
-Audio-Technica AT4050 microphone - Behringer Powerplay Pro XL amplifier
-Cables: XLR connectors
5. Configuring the Microphone: A low-cut filter was applied to the Audio-Technica AT4050 microphone in order to remove undesired low-frequency noise.

RESULTS AND DISCUSSION

Figure 6 shows the typical voltage *vs* time for the long, medium, and short ketebong. The long ketebong showed that the decay time is sustained. Note that a different horizontal scale was used in Fig. 6a relative to Fig. 6b and 6c due to the long decay time. Figure 7 shows the typical intensity *vs* frequency for the long, medium, and short ketebong. The long ketebong showed that the fundamental frequency (f_o) is 50.15Hz with a higher partial at 299.94Hz ($6f_o$). The medium ketebong showed that the f_o is 50.15Hz with a higher partial at 106.21Hz ($2f_o$). The short ketebong showed that the f_o is 50.15Hz with a higher partial at 134.73Hz ($2.7f_o$). Although the long and medium ketebong showed harmonic partial (an integer of f_o), the short ketebong showed an inharmonic partial. Note that the length of the ketebong determine the harmonic of the partials as shown in Fig. 7. The data of Fig. 7 were collected exactly at 0 ms after striking the drum. Figure 7 is the FFT of the signals in Fig. 6.

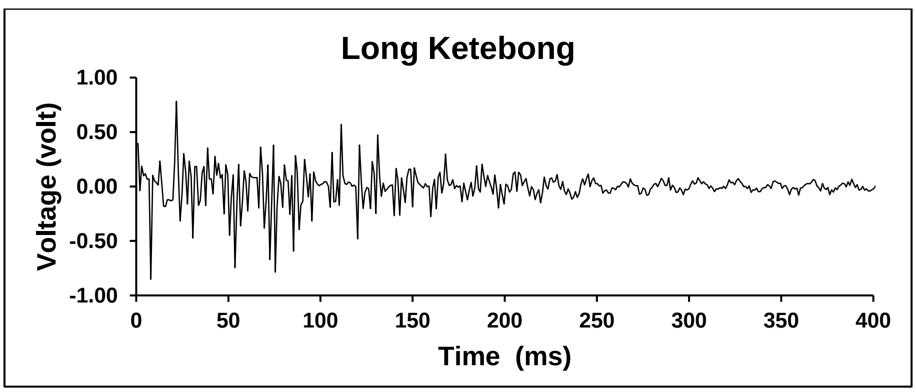

Fig. 6a. A typical voltage *vs* time for long ketebong

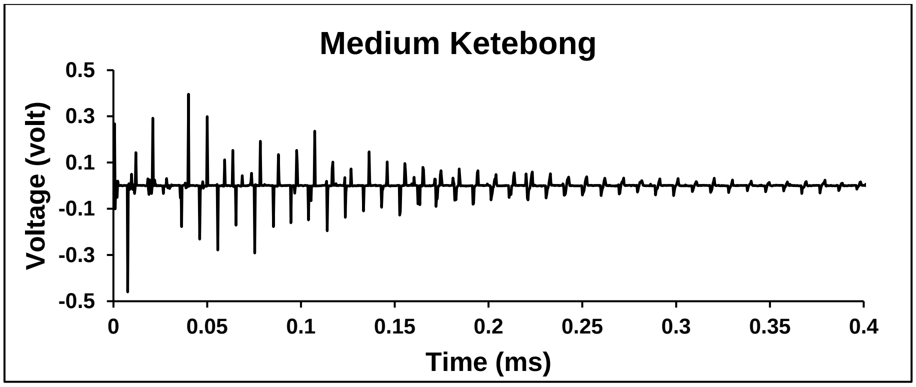

Fig. 6b. A typical voltage *vs* time for medium ketebong

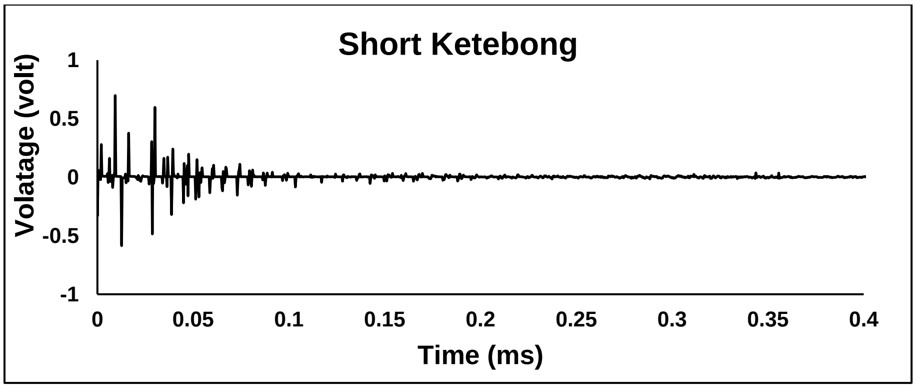

Fig. 6c. A typical voltage *vs* time for short ketebong

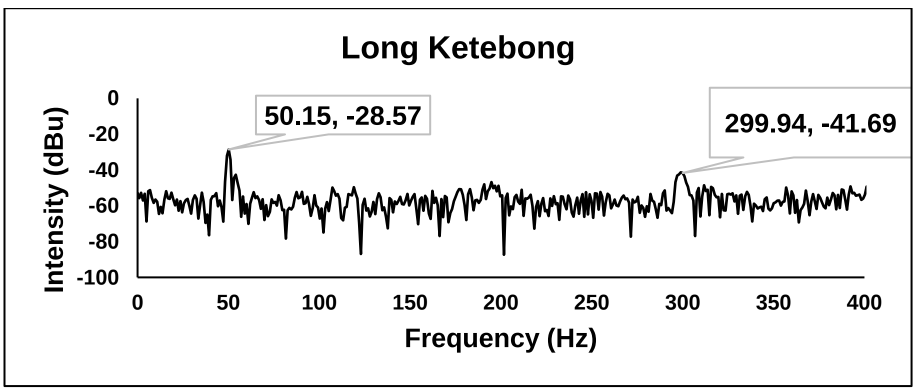

Fig. 7a. A typical intensity *vs* frequency for the long ketebong

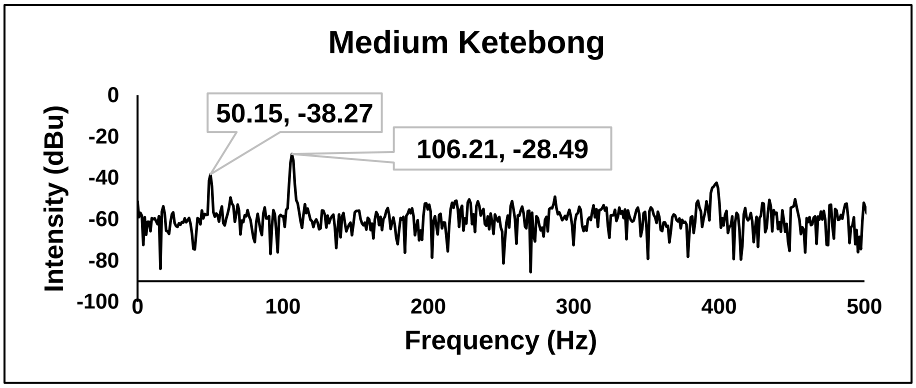

Fig. 7b. A typical intensity *vs* frequency for the medium ketebong

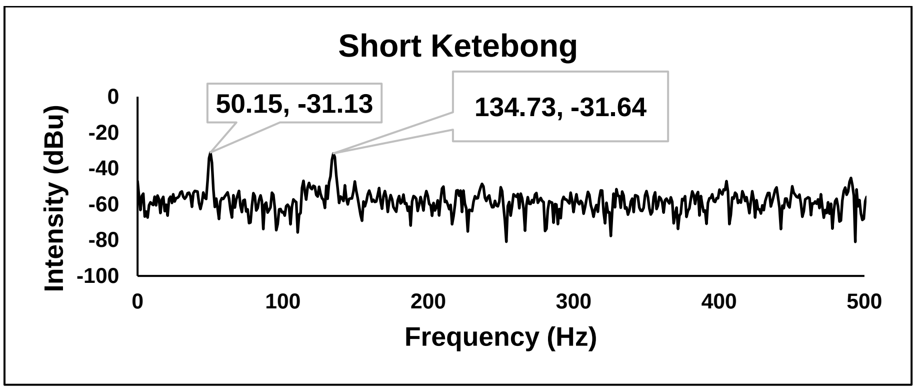

Fig. 7c. A typical intensity *vs* frequency for the short ketebong

Table 1. The First and Second Partial (Hz) of the Long, Medium, and Short Ketebong

	First Partial (Hz)	Second Partial (Hz)
Long Ketebong	50.15	299.94
Medium Ketebong	50.15	106.20
Short Ketebong	50.15	134.73

The importance of the coconut palm in the ketebong producing process lies in the integration of craftsmanship, acoustic expertise, and ecological principles. When considering the mass production of this ketebong, it is essential to assess not just the material's hardness but also factors such as cost, availability, and durability. The high level of hardness of Menggris (Ser 1981) may increase manufacturing costs by necessitating specialized tools and expertise, therefore diminishing cost-effectiveness despite its advantages for some applications. The availability of menggris wood may be limited, thereby impacting its applicability for large-scale manufacturing. Menggris wood's robustness provides resistance to wear and decay, (Ser 1981) hence extending the lifespan of items. When choosing between menggris wood and nibong palm with coconut palm for ketebong manufacture in Malaysia, it is crucial to consider a balanced blend of acoustic characteristics, cost-effectiveness, availability, and durability. A thorough process is crucial for selecting the suitable wood species for various applications in Malaysia's wood industry.

Figure 8 shows the spectrogram for the long, medium, and short ketebong. The spectrogram for the long ketebong is brighter than the medium ketebong. The medium ketebong is brighter than the short ketebong. Although the fundamental frequency of all the ketebong is similar, the spectrogram displayed all the ketebong with unique brightness. It indicates that a longer ketebong produces brighter sound from the air column.

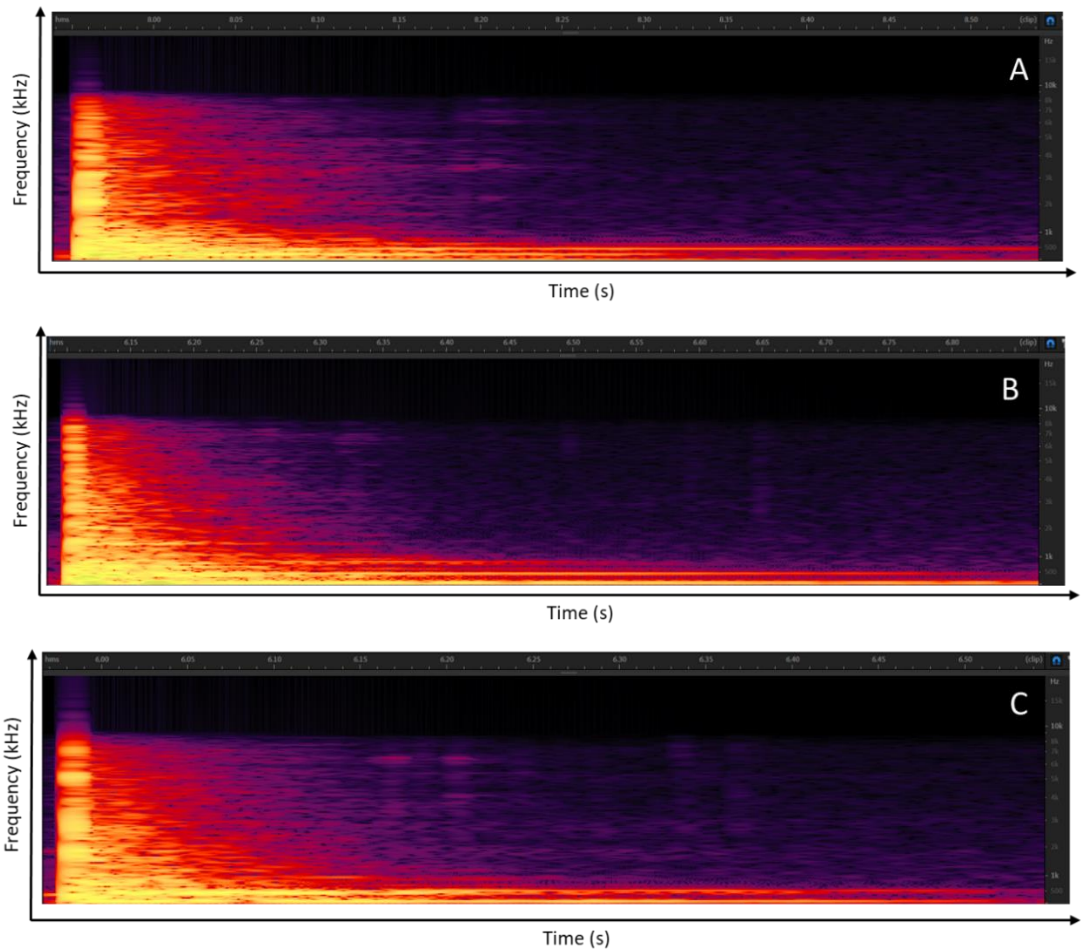

Fig. 8. Spectrogram for the long (A), medium (B), and short (C) ketebong

The Repertoire

The rhythmic patterns for GP were transcribed based on the performance on video (Bada 2022). The performance was performed by the 'Persatuan Gendang Pampat sereta Main Asal Iban Kuching' (PGPMAIK). The GP performed by Gendang Pampat Kampung Bangkong Baru, Lachau, Pantu, Sri Aman, Sarawak and can be viewed online (Bolkiah 2018). Bada (2022) claims that the rhythms frequently played are 'taubindau', 'kukuk manuk', 'pepitu', and 'lengain', in which each drummer must strike out a unique pattern. Each drummer should also be proficient at playing at least two other rhythms so that, if the rhythm he is playing becomes monotonous, he can transform to a different rhythm. Rhythmic patterns transcribed according to the sequence beating are shown in Fig. 9. The 1st GP will indicate the tempo and create the 1st pattern. In drum notation, the ">" symbol indicates an accented note. When placed above or below a note, it signifies that the note should be played with emphasis or more forcefully compared to the surrounding notes.

Fig. 9. Rhythmic patterns transcribed according to the sequence beating video uploaded by Bada (2022)

CONCLUSIONS

1. The analysis using the Picoscope signal extraction process provided useful insights into the coconut tree and its utilization in ketebong production. This finding confirms the manufacturer's claim that the prolonged signal of ketebong is a result of its length and demonstrates its ability to preserve high-quality sound.
2. The maker chose materials based not just on structural considerations but also due to the challenge of sourcing nibong palm and menggris wood, without considering their acoustic properties, which they assessed only through hearing.
3. The Picoscope data validates the acoustic precision of their choice. The meticulous and precise techniques employed by the maker in ketebong production are crucial for safeguarding Sarawak's intangible heritage. This ensures that the knowledge and customs can be effectively passed on to future generations.

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