

Songlike vocalizations from the Sumatran Rhinoceros (*Dicerorhinus sumatrensis*)

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Abstract: There are only 200 to 300 Sumatran rhinos (*Dicerorhinus sumatrensis*) left in the world. Sumatran rhinos are solitary, and their native habitat is dense tropical forest and mountain moss forest. Three Sumatran rhinos, housed at the Cincinnati Zoo, were recorded using Sthatham Radio microphones and Sony TCD-D8 DAT recorders. Sumatran rhinos produce sounds described as eeps, 70 Hz - 4 kHz (57 - 92 dB); whales, 100 Hz - 3.2 kHz (87 dB); and whistle-blows, 17 Hz - 8 kHz (100 dB). The whistle-blows contain high level infrasound that would be advantageous for use in the rhino's forest habitat. Some Sumatran rhino vocalizations resemble humpback whale signals.

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1. Introduction

The Sumatran rhinoceros is the smallest living rhino, standing 0.9 - 1.5 m tall, and weighing in at 600 - 950 kg. Sumatran rhinos are covered in coarse, reddish-brown hair, and they are considered the oldest living species of rhino. The Sumatran rhino has an estimated population of between 200 to 300 individuals, found in Indonesia, Burma, and Malaysia. Little is understood about the behavior of these creatures, and most information has been passed down from hunters and captive preserves. Within the last ten years the size of the Sumatran rhino population has dropped 50%, and this species is severely endangered.¹

Currently there are only four rhinos in captivity in the United States. Three are housed at the Cincinnati Zoo, two adults and a one-year-old captive born. This is the first Sumatran rhino born in captivity in 112 years, and the Cincinnati female recorded in this research was pregnant with this male during the study. The fourth rhino is housed at the Bronx Zoo in New York.

These small reclusive rhinos have been described as solitary, although males and females are sometimes seen together during courtship. In the wild, individuals spend much of the day and night wallowing in mud pools or concealed. Their native habitat is dense forest in which they create tunnels or passageways to travel through. They emerge from thorny foliage

in the early evening and again during the morning. The Sumatran rhino browses on twigs, leaves, bamboo shoots, and fruits, and are dexterous enough to climb near vertical cliffs.² They have the most varied calls of any rhino species, including squeaks, snorts, grunts, blows, and plaintive songs.² Sumatran vocalizations contain infrasonic properties like the other three captive species of rhino; white, black and Indian.^{3,4} Besides casual observation and an infrasound study, the authors are unaware of any research describing the Sumatran's vocalizations. There has been no long term research into their behavior, so it can only be speculated on as to how their vocalizations are used. It is hypothesized that they would use vocalizations to convey biological states such as danger, sexual readiness, or location, as other ungulates do.⁵

2. Methods

Three Sumatran rhinos, one male and two females housed at the Cincinnati Zoo, in Cincinnati, Ohio were recorded in March of 2001. One rhinoceros from the Bronx Zoo was residing at Cincinnati for a captive breeding program. The Cincinnati female was pregnant. The rhinos were recorded using Statham Radio's LIZ microphone (1.5 Hz to 22 kHz +/- 3 dB, sensitivity 19.6 mV/Pa.) with an AT8410A Audio Technica shock mount, which has an attenuation of 8 - 10 dB and two Sony digital audio recorders, AT TCD-D8 (7 Hz to 22 kHz +/- 3 dB). Calibration of the microphones is performed at Statham Radio every 6 months, using a Bruel and Kjaer 2608 measurement amplifier, a Bruel and Kjaer 4231 calibrator, an Audio Precision System 1, and an Electrovoice 1821 compression driver for measurements below 40 Hz. Calibration of the recording system in the field from the microphone through the analysis system to insure accurate levels during recording and analysis was performed using a Bruel and Kjaer 4226 multifunction acoustic calibrator. The 4226 generates accurate and stable signals ranging from 31.5 Hz to 16 kHz in octave steps, at 94, 104, and 114 dB.

Recordings were made of the empty barn to determine levels of ambient noise. The rhinos were then recorded from as close as 1 to 3 meters for 20-minute intervals inside the barn during the morning, midday, and early evening. The rhinos were recorded for a total of 6 hours. Analysis was performed onsite at the Cincinnati Zoo and also in the lab at Fauna Communications Research Institute using a National Instruments DAQ 1200 PCMCIA card, portable computer, and Polynesia, a LabView-based digital signal analysis program.

3. Results

The Sumatran rhinos proved to be exceptionally vocal, producing signals even when they were eating. The female from the Bronx Zoo produced the most signals over time, although all rhinos vocalized constantly throughout the recording sessions. Results indicate that there are three main types of vocalizations, strung together to form a constant "song." The three distinct calls are described as eeps, whales, and whistle-blows. On average, during a 20-minute recording session, the rhinos produced 421 eeps, 180 whales, and 60 whistle-blows. The eeps are a simple signal and the most common vocalization. Eeps are short in duration, about a second in length. Whales, so named because they sound similar to humpback whale song, tended to vary greatly, some being 4 seconds in duration and others up to 7 seconds. Whale vocalizations were not observed to be produced by the male. Whistle-blows, so named because a whistle is followed immediately by a burst of air, were loud, approximately 2 seconds in duration, and had a strong infrasonic content, which make the 7-inch in diameter iron bars surrounding the stall resonate. The rhinos appeared to produce the low frequency whistle-blows more often when the male rhino urine-sprayed the wall. The eeps are occasionally interspersed with whales, and every 30 seconds to one minute, a whistle blow was produced. The second female from Cincinnati vocalized less than the Bronx Zoo female, which may be because she was pregnant. The male vocalized the least of the three, and did

not produce a whale during the study. Fig. 1a shows a Fast Fourier Transform of the most common vocalization, the eep, which had frequencies between 70 Hz - 4 kHz at 57 - 92 dB re 20 uPa at 1m. Average duration of an eep is one to two seconds. Fig. 1b shows an eep in spectrographic form, and Mm. 1 is a sound file of an eep.

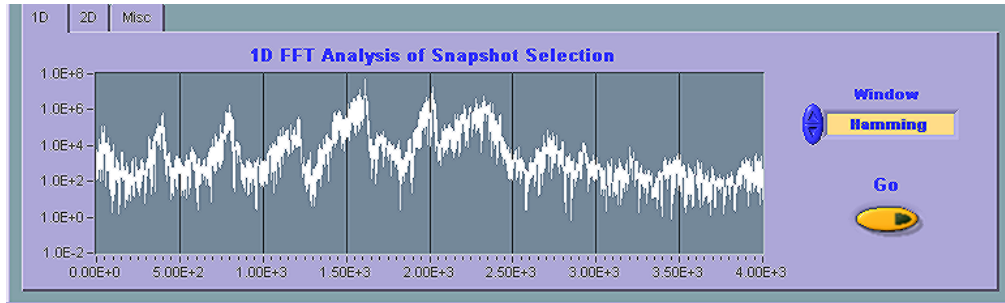


Fig. 1a. FFT of an eep, 7 Hz - 4 kHz.

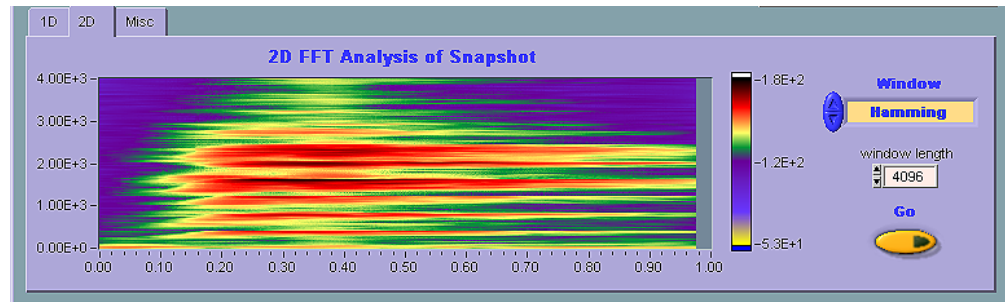


Fig.1b. Spectrograph of an eep, 7 Hz - 4 kHz.



Mm.1. Male rhino producing an eep (80 Kb)

The second most common vocalizations are whales, 100 Hz - 3.2 kHz at 87 dB re 20 uPa at 1m. Average duration of the whales are 4 to 6 seconds. Fig. 2a is an FFT of a whale, and fig. 2b is a spectrograph of a whale. Mm. 2 is a sound file of a whale.

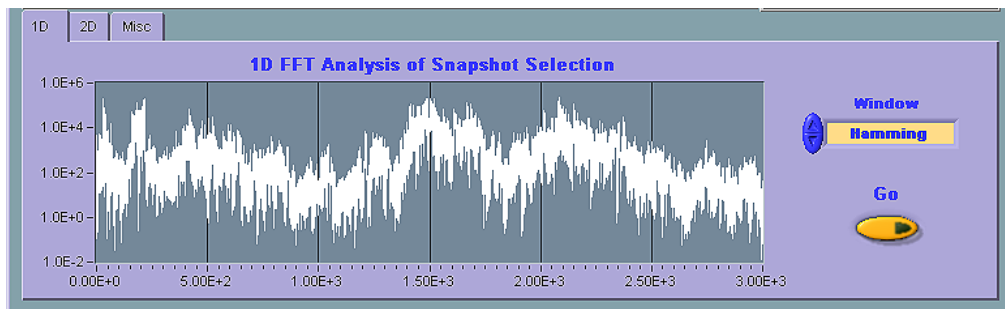


Fig. 2a. FFT of a whale, 10 Hz - 3 kHz.

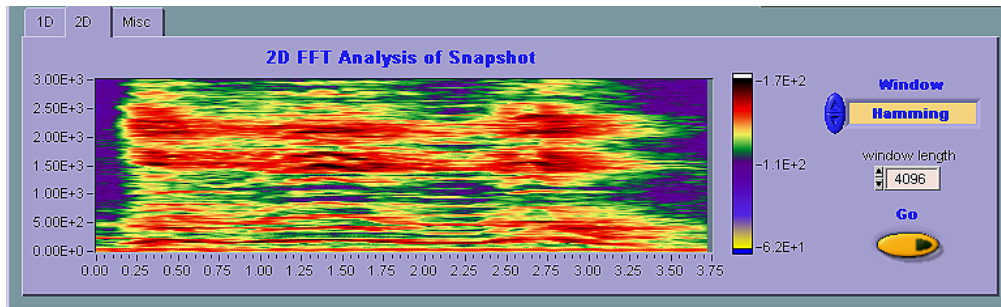


Fig. 2b. A spectrograph of a whale, 7 Hz - 3 kHz.



Mm. 2. Female rhino producing a whale (370 Kb)

The least common vocalizations are whistle-blows, 17 Hz - 8 kHz at 100 dB re 20 uPa at 1m. Average duration of the whistle-blows are 2 to 2.5 seconds. Fig. 3a shows an FFT of a whistle-blow, and fig. 3b shows a spectrograph of a whistle-blow. Fig 3c shows the low frequencies components of the whistle-blow. Mm. 3 is a sound file of a whistle-blow.

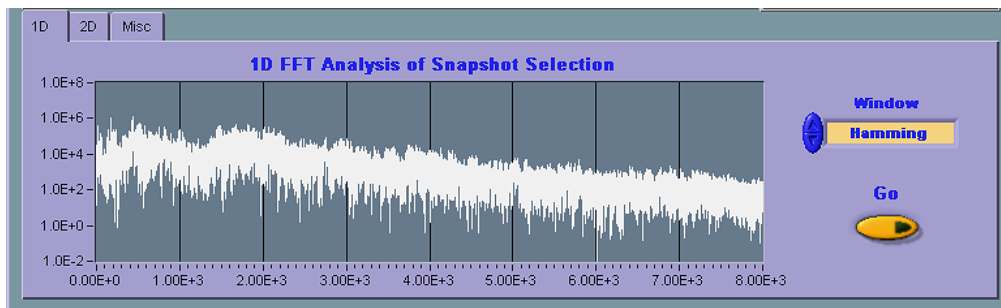


Fig. 3a. FFT of a whistle-blow from a female Sumatran rhino, 7 Hz - 8 kHz.

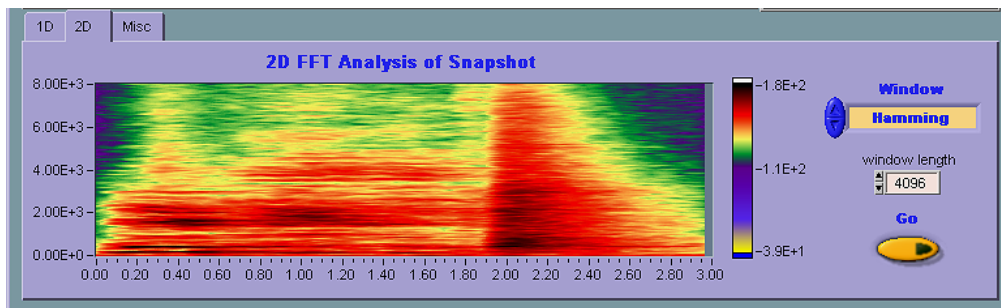


Fig. 3b. Spectrograph of a whistle-blow, 7 Hz - 8 kHz.

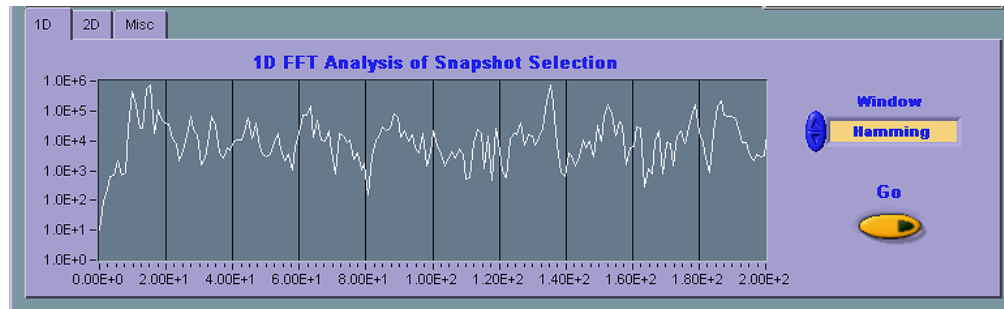


Fig. 3c. Low frequency and infrasonic components of the whistle-blow, 7 Hz - 200 Hz.



Mm. 3. Whistle-blow from a female rhino, (240 Kb)

4. Conclusions

The Sumatran rhino produces more signals over time than any other species of rhinoceros. The Sumatrans produce vocalizations consistently, which the other species do not.^{3,4} Because of the small sample of rhinos recorded, it is impossible to determine if there is a gender difference in the amount of signals or types produced.

A copy of humpback whale song was obtained from marine biologist Jim Darling, and compared to Sumatran signals. The eeps and the whales from the Sumatran rhino sound nearly identical to the vocalizations that the humpback whale makes. It would be of benefit to determine whether the rhinos are actually performing a true song. Although an arbitrary term, bioacousticians frequently consider the definition of a song to be repetitive over time, and/or linked to breeding behaviors.



Mm. 4. Humpback whale followed by Sumatran rhino eeps, (650 Kb)



Mm. 5. Humpback whale vocalization followed by Sumatran whale vocalization, (690 Kb)

The Sumatran's whistle-blows would carry quite far even in the rhino's native habitat of dense brush. Elephants can communicate with each other over a distance of 9.8 km.⁷ It is possible that the Sumatran rhino's whistle-blow which at 17 Hz is within +/- 2 Hz from the average elephant rumble, may carry at least as far.

It would be interesting to determine if there are behaviors associated with particular vocalizations. Perhaps a large study encompassing many wild rhinos, over several years, could be performed using remote video and audio recorders.

Morphological and genetic data indicate that whales may be a sister group to the rhinoceros.^{8,9} Perhaps their vocalizations are similar because the Sumatran, as the oldest rhino in evolutionary terms is more representative of rhino genetic heritage. A comprehensive investigation into this phenomenon would be valuable.

The rhino barn was consistently filled with amazing sounds from the continuous "song" of the Sumatrans. The actions of some first-time observers, which included crying, indicate that, like the humpback whale, Sumatran rhinos touch something very deep emotionally in the human. It is hoped that with more research, these beautiful "songs" will yield insight into the behavior of this fascinating and lovely creature before they become extinct.



Acknowledgments

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