Wild Elephant Conservation Using Sound Waves to Obstruct Them from Plantations: a Case Study at Kui Buri District, Thailand

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Abstract: A trial of the 2,300-2,800 Hz band of frequency in sound waves were made more intense in decibels (dB), similar to a firecracker or firecracker ball was made for use of the local people to dislodge and/or obstruct wild elephants from agricultural areas (pineapple plantations) within Kui Buri District, Prachuap Khiri Khan Province, Thailand. The 3 point source was checked between 10 -50 meters, sound sources to the elephants in distances and loudness are as discussed later; firecracker balls were 151, 142, 138, 128, 119 decibels (dB), firecrackers were 99, 95, 91, 85, 72 dB, and the frequency of the sound waves (2,800 Hz) were 85, 80, 74, 70, 62 dB, respectively. The results can be analyzed through the laboratory and fundamentals of sound wave, anatomy and physiology of mammals, including comparisons to the standard sound intensities of the Acoustical Society of America (ASA). The energy and pressure of firecracker ball is strong and were transferred into some auditory mechanisms and behaviors of wild elephants. As a consequence, the elephant's auditory mechanism has been affected from the energy and pressure; at least 1 individual of wild elephant had shown sensorineural hearing loss in the case study, their behavior became more aggressive and more easily angered.

Keywords: Wild Elephant, Conservation, Sound Wave, Kui Buri District, Thailand

Introduction

Sound is a kind of energy and has been divided in loudness (decibel=dB) and frequency (hertz=Hz). Porges (1977) has explained a frequency of sound wave is very important to hearing and each frequency makes a different sound, pitch and usually loudness is produced from a lower frequency of sound wave but there is more energy, power and pressure. Whilemiddle and higher frequencies of sound wave have produced lower amounts of loudness, power, pressure / energy (Semal, 1964 and Beiser, 1964). Each vertebrate is different in its ability to hear, but regularity hears best at about 2,000 – 3,000 Hz and some vertebrates can receive both infrasonic, less than 30 Hz and ultrasonic, more than 18,000 Hz (Donail, 2001) bands of frequencies.

The ear as a sensory organ is more complex than other sensory organs. The sensory cells (hair cell) are located in the cochlea, but the cochlea not only serves to convert sound into a code of neural impulses in the auditory nerve, it also performs the first analysis of sounds that prepares sounds for further analyses in the auditory nervous system. The cochlea also compresses the amplitudes of sound, which makes it possible to code sounds within the very large range of sound intensities that is covered by normal hearing. Without such amplitude compression, the ear could not detect and analyze sounds in the intensity range of normal hearing (Moller, 2000).

In Kui Buri District, there are substantial pineapple plantations and they adjoin National Park areas. Thus, wild elephants roam from National Park into plantation for their food. All farmers, day after day, protect their farms by making noise from firecracker balls and firecrackers for obstruction and/or dislodgment. The study focus on the 2 purposes of studying consist of a confirming and monitoring some sound wave frequency by a functional generator and accessories (an instrument that produces a frequency of sound wave, 21 – 28 KHz) connected to a 60 Watt of amplifier from DC 12 volt battery connected to a loudspeaker to obstruct or dislodge a wild elephant from coming into the

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pineapple plantations and also to show the effect from 2 sound sources of loudness at each distance to show some auditory mechanism and behavioral reactions of wild elephants. Sound frequencies created by the machine can protect the hearing by lessening the effect of hearing loss in comparison to the firecracker and firecracker ball.

Materials and Methods

This study was conducted in a pineapple plantation in the vicinity of Pa-Yang Check-Point in Kui Buri National Park in Ban Ruam-Thai, Kui Buri District, Prachup Khiri Khan Province Thailand, 12° 8' 24.56" N 99° 38' 54.72" E (Figure1).

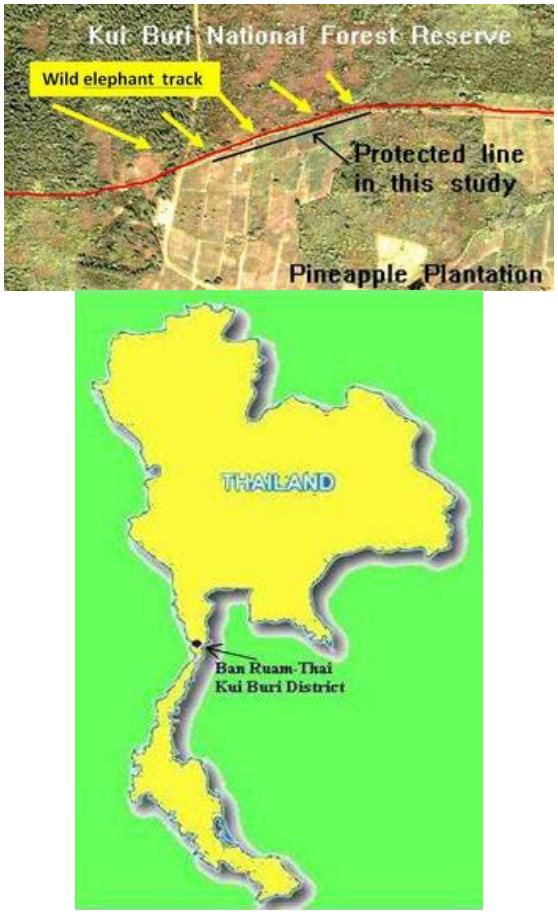

Figure 1. Shows the site and wild elephants track from Kui Buri National Park area adjoin the pineapple plantation and between them were obstructed by electric fence but were destroyed by wild elephants.

Whenever a wild elephant was heard or observed at approximately 30 - 50 meters of distances, suddenly the functional generator was opened. While standing by, wild elephants would be observed, the pattern of farmers and rangers to deter a wild elephant from the National Park to agricultural areas, and their pattern will be checked and recorded for loudness, energy and pressure in each distances, along with wild elephants' behavior.

Results

The 108 individuals from 44 times during on 06:00 pm to 05:00 am of a wild elephants were found through from the forest of National park nearby the study area on approximately 30-50 meter of distances. Their behavior was observed by a binocular and eye sign included listening. All of them were obstructed by the frequency of sound waves at 2,100-2,800 Hz (best on 2,600-2,800 Hz) and their reaction was to break and then break away far from study site. In the morning the distances were measured for rechecking and the sound source to wild elephants' vestige.

In observation of other methods to deter wild elephants there has been found proceeding by a farmers and a ranger of Kui Buri National Park and all are loudness making for detonating from firecracker ball, about 5 balls per a time and firecracker, more than 5 pieces per a time on 5-50 meter of distances from sound source to the wild elephants by catapult.

Figure 1 shows the site and wild elephants track from Kui Buri National Park area adjoin the pineapple plantation and between them were obstructed by electric fence but were destroyed by wild elephants.

The next step was that the different volumes of loudness were checked in electronic laboratory and their results were as follows on Table 1 and 2. Both of the tables show effects in the levels of sound source, maximum to minimum from firecracker balls, firecrackers, and the frequency of sound waves, respectively. Each loudness levels of the sound are released differently in energy, power, pressure, and they were transferred into the tympanic membrane to the middle ear and lastly to the internal ear. The internal ear consists of a series of cavities in the petrous part of the temporal bone but the cavity concerned with hearing is a cochlea and it is a very important organ because it contains a hair cells. The hair cell is a receptor of a power, energy, pressure, and frequency of sound and transfers this information to the auditory cortex of cerebellum and changes it into sound.

Loudness from detonating firecracker balls were powerfully transferred strong energy, power and pressure, shock waves to the tympanic membrane passed on to middle ear and hair cells in inner ear; thus, consequential impact of hearing loss is an action potential as a spatial summation.

Table 1. Loudness of sound sources, firecracker ball (Fb), firecracker (F) and frequency of sound wave were differentially compared at each distance.

Distances(m.)	Decibel = dB (A)									
	Fb	F	Frequency of Sound wave (KHz)							
			21	22	23	24	25	26	27	28
10	151	99	90	89	87	89	87	87	86	85
20	142	95	86	85	82	84	82	82	81	80
30	138	91	80	75	75	76	77	76	75	74
40	128	85	72	71	68	75	70	71	71	70
50	119	72	64	61	58	67	64	63	62	62

Table 2. Pressure (Newton), energy/power (Watt) were made from each loudness.

Pressure (N / m^2)	Power / Energy (W / m^2)	Loudness (dBA)
2×10^{-5}	1×10^{-12}	0
2×10^{-4}	1×10^{-10}	20
2×10^{-3}	1×10^{-8}	40
2×10^{-2}	1×10^{-6}	60
2×10^{-1}	1×10^{-4}	80
2	1×10^{-2}	100
20	1×10^{1}	120
200	1×10^{2}	140

Eventually, wild elephant had hearing loss or deafness because sensorineural and conductive hearing loss caused by the tympanic membrane being ripped, hair cells and basilar membranes being destroyed. These probable factors or circumstances that the wild elephants had received daily or over several occasions, resulted in their changed behavior, becoming aggressive and becoming easily angry. Thilosakulchai (2005) described conductive hearing loss is an impact from sensorinural hearing loss, caused by hair cells being destroyed. A powerful loudness of 100 dB or more can build and transfer a strong energy pressure, like shock waves, destroying

tympanic, basilar membranes and hair cells. Moreover, lower sound wave frequencies can build strong energy pressure and also can also travel more distant than middle or higher sound wave frequencies. Therefore, the strong energy can spread to all hair cells on cochlea and transfer the energy to the cerebellum, all resulting in bringing about different behavior.

Conversely, frequencies of sound waves created artificially were of a lower loudness than firecracker balls and firecrackers but obstructed and/or dislodged the wild elephants throughout the conduct of this study. This is because the frequencies stimulate the hair cell, little by little, making a disturbance. Furthermore, all important organs of auditory mechanism receive the effect less than the loudness and also all wild elephants never shown as an aggressive or angry. At least, 1 individual on 3 times of wild elephant in this study were found never move or frighten loudness from all sound source but suddenly move whenever it got a flashlight ,therefor likely to describe the wild elephant is unusually hearing and perhaps deaf.

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