

Original Article

# A Study on the Agricultural and Livestock Farming Method Using the Crying Sound of Top Predators

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Received: 09 August 2024

Revised: 13 January 2025

Accepted: 16 January 2025

Published: 31 January 2025

**Abstract** - Top predators are carnivores at the top of the food chain, and tigers and lions are representative examples. It has been empirically suggested that the roars of lions and tigers contain sounds with special frequencies that scare lower-level animals and, thus, effectively drive them away. Accordingly, this researcher studied the roars of lions and tigers, which are top predators, to establish a foundation for using the roars of top predators as a farming method to prevent damage caused by animals in rural areas where crops are frequently damaged by various wild animals. For this study, we analyzed three types of crying sounds of tigers and lions, including roaring sounds, warning sounds, and attack sounds, and made suggestions for more effective use in farming.

**Keywords** - Top predator, Crying sound of lion, Crying sound of tiger, Roar sound, Warning sound, Attack sound.

## 1. Introduction

In many countries around the world, there are many farmlands made up of forests, so various wild animals frequently appear and cause crop damage, causing farmers to suffer. Farmers try to prevent damage from wild animals by setting traps or building fences, but it is difficult to block them completely. Each country tried to reduce the number of wild animals by granting hunting permits to hunters, but it was not the best method. In particular, since they were helpless at night, they had no choice but to give up their farmland to the animals. Even if they stood guard and patrolled, they could not stop the animals that instinctively and quickly evaded. Since these various methods did not work, they had no choice but to try various methods. Among them, a method to chase wild animals was adopted based on research that shows that the cries of top predators have a frequency that scares lower-level animals that could become prey. Since the powerful top predators we know of include lions and tigers, this study studied the cries of these two animals in detail. The purpose of this study was to prove that the crying sounds of lions and tigers pose a serious threat to lower-order animals by categorizing them into roaring sounds, warning sounds, and attack sounds. As a research method, the crying sounds of lions and tigers were extracted, scientific acoustic analysis tools were used to analyze them acoustically, and a system was established to apply them more systematically to agricultural methods for exterminating wild animals. The roars of lions and tigers, the top predators, were collected using high-quality data for broadcasting. The sound data for broadcasting was extracted from worldwide records, and the

sounds were studied by dividing them into three sounds. In order to analyze the roars of lions and tigers, the top predators, Adobe's Audition 3.0 program was used. The sound analysis was based on the three sound elements in terms of acoustics, and the sensory analysis was conducted using the MOS Test. [1]

## 2. Study on the Crying Sound of Top Predators, Lions and Tigers

Lions and tigers are top predators at the top of the food chain. Their habitats are different and do not overlap, but they sometimes meet in the border areas of mountains and jungles. Tigers are adapted to mountainous terrain, while lions are mainly adapted to jungles. Regarding lifestyle, tigers are mostly independent, while lions live in family groups. Currently, top predators such as lions and tigers have disappeared from the villages where people live, so lower-level animals such as foxes, wild dogs, and wild boars frequently appear in people's homes. These lower-level animals eat or damage crops. These animals react sensitively to the cries of top predators. This paper will analyze the characteristics of the cries of lions and tigers and determine whether the cries of top predators are worth using in farming. In order to analyze the roars of the top predators, tigers and lions, the roars of the two animals were classified into roaring roars, warning roars, and attack roars, and they were studied. The characteristics of the sounds were analyzed using Adobe's Audition program. The acoustical characteristics of the sounds were analyzed using time domain analysis, spectrogram analysis, and spectrum analysis. [2]



**2.1. The Analysis of Tiger Crying Sound**

Tigers have a long and large body, a thick neck, a large and wide tongue, and sharp teeth, so they use their wide vocal tract and strong vocal cords to produce strong low-frequency sounds. They also have strong and flexible muscles as a predator and strong and large-capacity lungs. These body structures and characteristics produce a tiger-like, charismatic cry. In particular, tigers can produce a unique growling sound because, unlike other felines, which have a hard hyoid bone, they have an elastic cartilaginous hyoid bone.

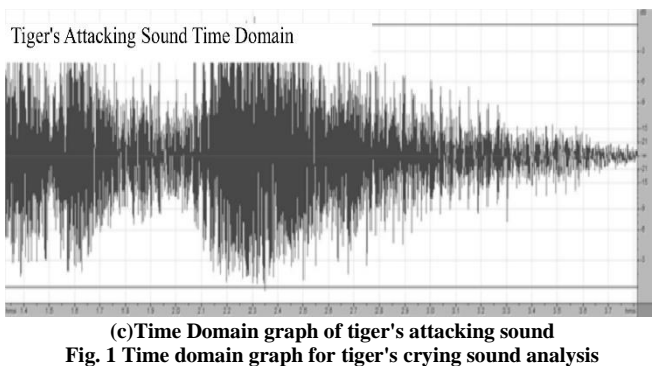
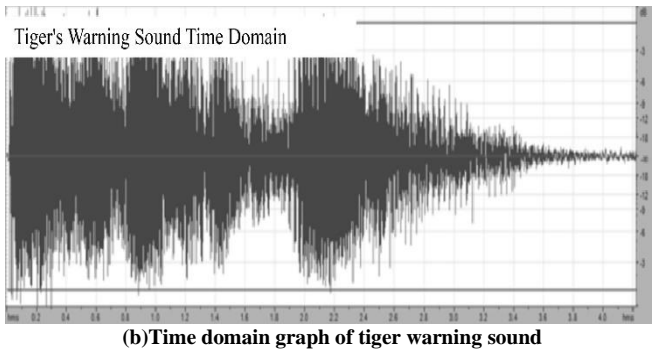
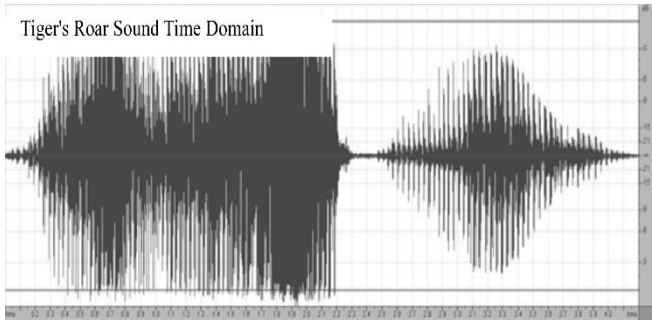
**2.1.1. Time domain Analysis of Tiger crying sound**

The frequency change of a tiger's crying sound over time can be analyzed in the time domain. By dividing the tiger's crying sound into a roar of a tiger, a warning roar, and an attack roar and identifying the degree of amplitude, the shape of the sound wave, and the change in volume through a time domain graph, the characteristics of the tiger's roar can be analyzed.[3, 4]

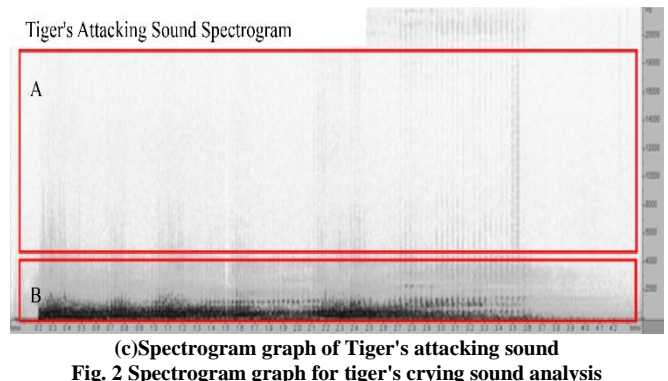
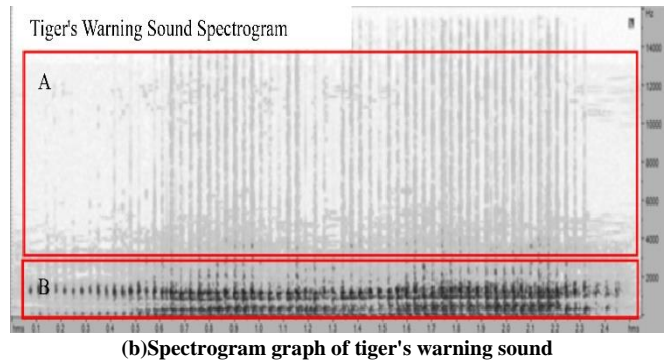
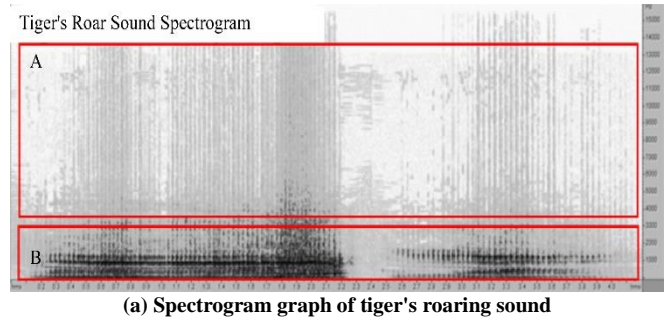
- a) Looking at the time-domain graph of a tiger's roar sound, we can see that it starts off strong and long. Then, it lets out a short lingering sound.
- b) Looking at the time-domain graph of a tiger's warning sound, we can see that it expresses a wide range of sounds, from low-frequency to high-frequency sounds, and uses time strongly and for a long time.
- c) Looking at the time-domain graph of a tiger's attack sound, it appears to be a strong and threatening sound.[5, 6]

**2.1.2. The spectrogram Analysis of Tiger crying sound**

The frequency-specific energy changes of a tiger's crying sound can be identified through spectrogram analysis. By dividing the tiger's sound into a roaring sound, a warning sound, and an attack sound and identifying the changes in the degree of energy condensation in each low-frequency band through a spectrogram graph, the unique energy characteristics of a tiger's crying sound can be analyzed.



**Fig. 1 Time domain graph for tiger's crying sound analysis**



**Fig. 2 Spectrogram graph for tiger's crying sound analysis**

- Looking at the spectrogram graph of a tiger's roar sound, we can see that very strong energy is concentrated in the low-frequency range from the beginning, and strong energy is also distributed in the high-frequency range.
- Looking at the spectrogram graph of a tiger's warning sound, we can see that it gradually generates low-frequency sounds and overall frequency sounds and continuously generates alert sounds.
- Looking at the spectrogram graph of a tiger's attacking sound, we can see that it focuses on low-frequency sounds and expresses a roar with continuous consistency.

### 2.1.3. The Spectrum Analysis of Tiger Crying Sound

In order to identify the frequency band characteristics of tiger cries, spectrum graphs were analyzed. In order to identify the frequency characteristics of tiger crying sounds, such as roaring sound, warning sound, and attack sound, frequency domain components were compared in the spectrum graphs and each characteristic was analyzed.[7]

Tigers make various cries depending on the situation, whether to their fellow tigers or other animals. Figure 3 is a spectrum graph analyzing the characteristics of a. roar sound, b. warning sound, and c. attacking sound among tiger crying sounds using an acoustic analysis tool. a. Roar sound is a strong low-frequency sound below 100 Hz generated across a wide bandwidth. b. the warning sound is a sound that is created by the vocal cords vibrating strongly and the hyoid bone acting as a flexible cushion as if rolling in the oral cavity. It strongly generates low-frequency sounds below 100 Hz and mid-frequency and high-frequency ranges above 100 Hz. c. Attacking sound forms a wide bandwidth centered around 1,000 Hz. Although the low-frequency energy is weak, it evenly generates husky vocalization across the entire band, threatening the opponent with an energy similar to the white noise phenomenon. In order to build a system to repel wild animals using tiger roars, various roars must be used alternately.

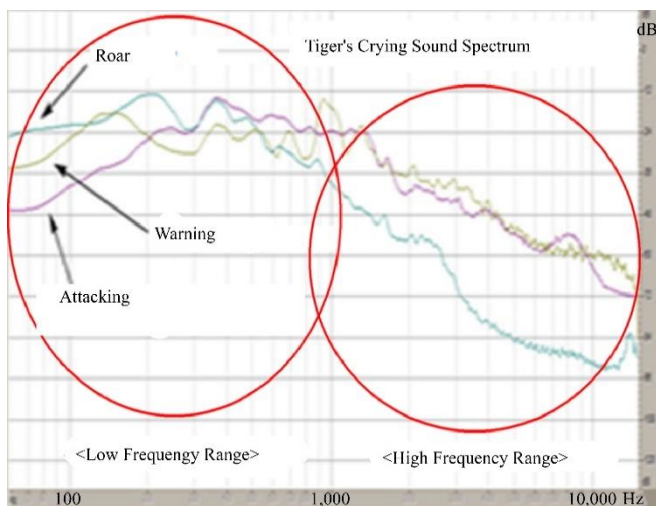


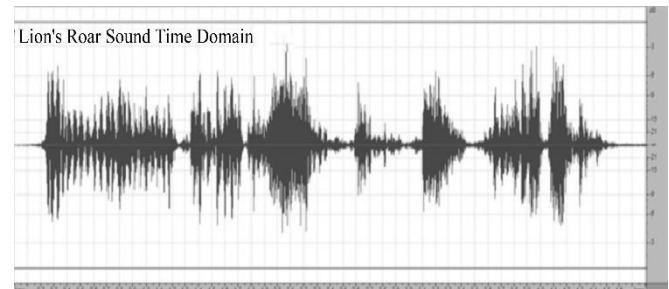
Fig. 3 Spectrum graph for tiger's crying sound analysis

## 2.2. The Analysis of Lion Crying Sound

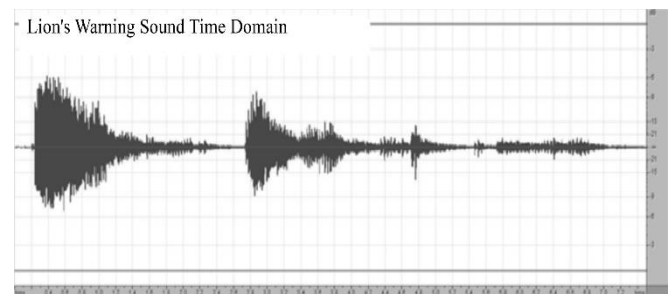
The lion's crying sound is similar to that of a tiger because, although it is slightly smaller than a tiger, it has a large body, thick neck, large and wide tongue, and sharp teeth, as befitting a top predator. Its wide vocal tract and strong vocal cords are also similar in size to those of a tiger, so it can produce strong low-frequency sounds and various high-frequency sounds without difficulty. In addition, as a top predator, it has strong and flexible muscles and strong and large-capacity lungs similar in size to those of a tiger. Male and female lions have slightly different structures, with the difference that males have manes on their necks and are larger than females. Due to these body structures and characteristics, male lions can produce more majestic and strong roars than females. However, this does not mean that female lions' roars are weak. Although female lions' roars are less charismatic than those of male lions and tigers, the roars that can be produced due to the body structure unique to top predators can sufficiently tremble and chase away lower animals.[8]

### 2.2.1. Time Domain Analysis of Lion Crying Sound

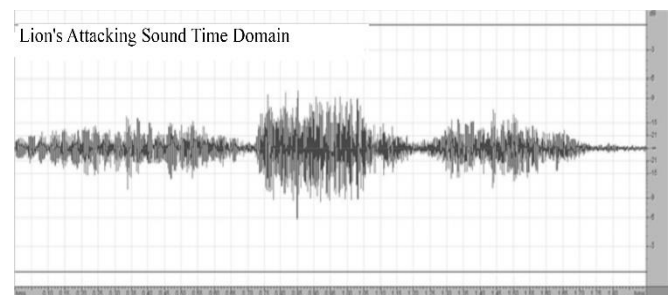
The frequency change of a lion's crying sound over time can be analyzed in the time domain.



(a) Time domain graph of lion's roaring sound



(b) Time domain graph of lion's warning sound



(c) Time Domain graph of lion's attacking sound

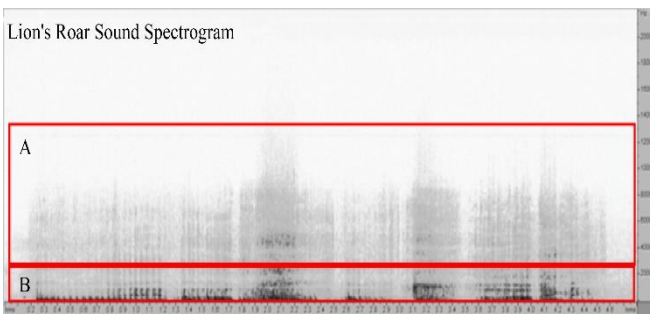
Fig. 4 Time domain graph for lion's crying sound analysis

Lion's crying sound can also be divided into roar sound, warning sound, and attacking sound, and the characteristics of lion roars can be analyzed by identifying the degree of amplitude, the shape of the sound wave, and the change in volume through a time domain graph.

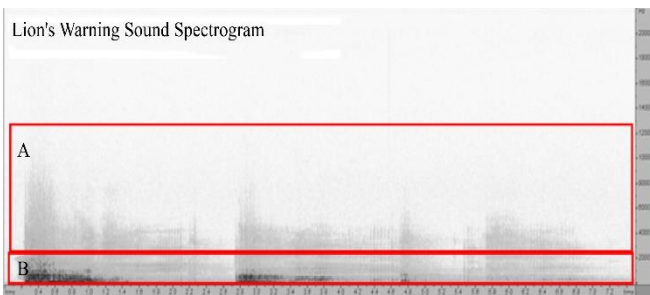
- a) Looking at the time-domain graph of the lion's crying sound, you can see that although the sound is lower in amplitude than the tiger's crying sound, it is common for it to start strong and long and to roar loudly, and in addition, it uses a variety of roars.
- b) Looking at the time-domain graph of a lion's warning sound, you can see that it is expressed by dividing it into several strong and short sounds and utilizing the entire frequency band.
- c) Looking at the time-domain graph of a lion's attacking sound, it appears to be a rough, long, and charismatic roar.

2.2.2. The Spectrogram Analysis of Lion Crying Sound

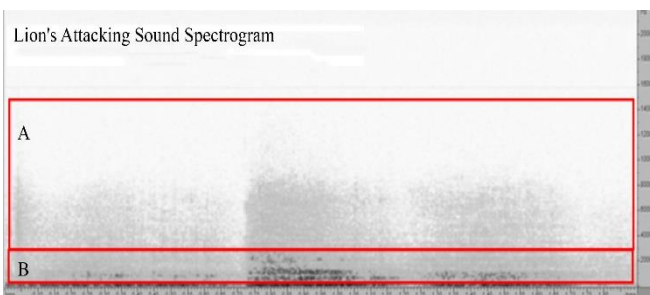
The frequency-specific energy changes of the Lion's crying sound can be identified through spectrogram analysis.



(a) Spectrogram graph of lion's roar sound



(b) Spectrogram graph of lion's warning sound



(c) Spectrogram graph of lion's attacking sound

Fig. 5 Spectrogram graph for Lion's crying sound Analysis

Lion's crying sound can also be divided into roaring roars, warning roars, and attack roars, and the changes in the degree of energy condensation in each low-frequency band can be identified through spectrogram graphs to analyze the unique energy characteristics of the Lion's crying sound.[9]

- a) Looking at the spectrogram graph of a lion's roar sound, It can be seen that the energy of the basic low-frequency range is maintained strongly overall, and the energy is distributed in a way that changes using the mid-frequency and high-frequency bands.
- b) Looking at the spectrogram graph of a lion's warning sound, we can see that short and strong energy is expressed multiple times to generate a warning sound.
- c) Looking at the spectrogram graph of the Lion's attacking sound, we can see that the sound of the entire frequency range is evenly used and expressed by maintaining it for a long time.

2.2.3. The spectrum Analysis of the Lion Crying Sound

In order to identify the frequency band characteristics of the Lion's crying sound, the spectrum graph was analyzed. As with the analysis of the tiger's roar sound, the frequency domain components of the Lion's roar were compared in the spectrum graph to identify the frequency characteristics of the roar sound, warning sound, and attacking sound, and each characteristic was analyzed.[10]

Since Lions live in prides, communication between members occurs more frequently than with solitary tigers, and therefore their roars are expressed in a variety of ways.

Figure 6 is a spectrum graph analyzing the characteristics of a. roar sound, b. warning sound, and c. attacking sound among lion's sound using an acoustic analysis tool.

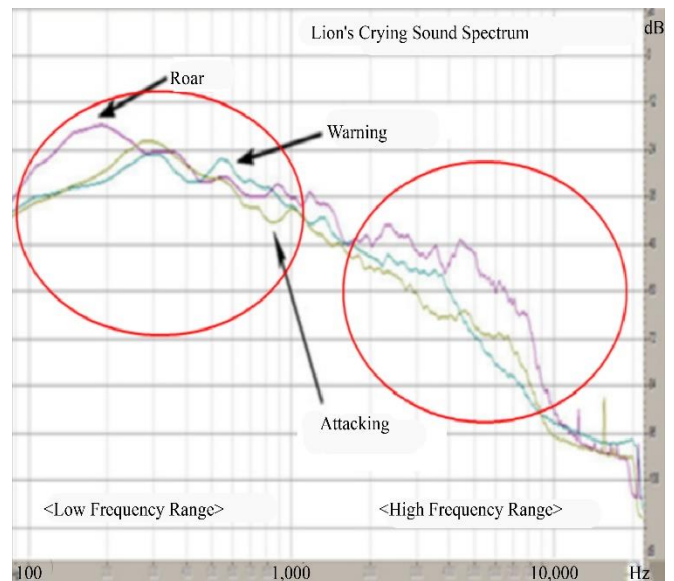


Fig. 6 Spectrum graph for lion's crying sound analysis

**Table 1. Comparison of lions and tigers**

Type	Classification	Habitat type	Appearance	Lifestyle	Hunting	Crying characteristics
Lion	Feline	Field	Yellow fur, males have manes.	Group life	Cooperation	Low frequency band is wide, and the high frequency band is strong.
Tiger	Feline	Mountain	Both males and females are brown with black stripes.	Solitary	Ambush	Low frequency band is narrow, and the high-frequency band is weak

- a) Roar sound generates a strong low-frequency sound band that forms a hill from the 100 Hz range to the 300 Hz range.
- b) warning sound creates a variety of roars across the entire band from the 300 Hz range to the mid-frequency and high-frequency range and strongly generates a warning sound.
- c) Attacking sound is weaker than the roar of a tiger when it attacks, but it forms a wide frequency band unique to lions and expresses a strong roar.

### 3. Research on Livestock Farming Methods Using Top Predator Crying Sound

Top predators, such as lions and tigers, control the number of lower predators or herbivores and play a role in maintaining the balance of the ecosystem. In order to perform this role well, lions and tigers make unique roars. Although the roars of lions and tigers are somewhat different, they have unique low-frequency sounds that share a common similarity as top predators. Their unique low-frequency sounds have the ability to warn lower animals away or scare them into not moving. Since lions' habitats are mainly plain fields or jungle areas, lions' roars can be used to prevent damage from wild animals in fields such as sugarcane fields and corn fields. Tigers' habitats are caves in the forests on mountain slopes or crevices in rock cliffs. Since they are nocturnal animals, they become active after the sun sets and hunt for prey at high altitudes in the mountains. These characteristics of tiger habitats allow farmers in mountain villages to use tiger roars to prevent damage from wild animals. Farming methods using the unique cries of top predators stimulate the instinctive defense mechanisms of lower-level animals, preventing them from approaching farmland. However, if the same cries are repeated repeatedly and the source of the cries is not revealed, wild animals will return to farmland due to the learning effect. In order to prevent the learning effect, it is necessary to discover and extract various cries of top predators and model them, as well as study and install various moving sculptures that can be used as visual warnings.[11, 12]

#### 3.1. Farming and Livestock Methods Using Tiger Crying Sound

Farmland on the mountainside is frequently damaged by wild animals. There have been cases where tigers' roars have been used effectively to prevent crop damage caused by wild animals. These cases have raised the need to specifically study the use of tigers' roars to prevent damage to farmland in mountain villages caused by wild animals. The farming

method using tigers' roars is based on the principle of paralyzing the minds of lower-order animals with the unique ultra-low frequency sound of tigers' roars and preventing wild animals from approaching by giving them various changes such as warning sounds and attack sounds. In order to further increase the effect, a life-size tiger model should be installed on a wheeled cart with rails laid around the farmland and moved left and right repeatedly while playing various tiger roars to create a three-dimensional and active system. As part of this system construction, installing speakers in the resonance chamber to enhance the resonance characteristics so that it sounds like a tiger roaring in its den can also increase the effect. [13, 14]

#### 3.2. Farming and Livestock Methods Using Lion Crying Sound

The agricultural products cultivated in the fields are large in scale. Sugarcane farms, corn farms, and the various roars made by lions produce unique low-frequency sounds as well as a variety of sounds across the entire frequency range, so they are sufficient to act as warning sounds to threaten wild animals. In addition, in order to prevent inefficiencies due to the learning effect of wild animals, it is necessary to continuously discover and extract various lion roars, and additionally, visual effects should be provided.

### 4. Conclusion

The roars of lions and tigers contain mysterious and unique ultra-low frequency sounds that humans cannot hear but cause fear in lower animals. Therefore, even animals that have never seen a lion or tiger before will be unable to move or run away when they hear the roars of lions and tigers. This paper conducted a study to utilize the phenomenon of responding to the unique roars of top predators in agricultural methods. For the study, we scientifically analyzed the roars of lions and tigers to investigate whether the roars of top predators are worth using in agricultural methods. As a result, This paper confirmed that the roars of top predators are sufficient to drive away not only lower carnivores but also herbivores, in addition to what has been proven in various previous studies. Since lions have roaring characteristics that can spread widely in fields due to their habitat characteristics, they are likely to be used in field cultivation, and tigers live in the mountains, so they are likely to be used in mountainous farming. In order for the wild animal extermination system using the cries of top predators to be more effective, the system must be built by creating a model of the top predator and its surrounding environment in addition to various cries.

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