Managing Human-Elephant Cohabitation: Strategies for Mitigating Conflict and Encouraging Coexistence

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Abstract. Human-elephant cohabitation is becoming increasingly common in many parts of the world, particularly in areas where human populations are expanding into traditional elephant habitats. While this coexistence can have benefits for both humans and elephants, it can also lead to conflict and negative outcomes for both parties. This paper explores strategies for managing human-elephant cohabitation, with a focus on mitigating conflict and encouraging coexistence. The paper first examines the factors that contribute to conflict between humans and elephants, including competition for resources, property damage, and human safety concerns. It then reviews current approaches to mitigating conflicts, such as elephant-proof fencing, crop protection methods, and elephant relocation programs. Next, this work explores strategies for encouraging coexistence between humans and elephants. These include approaches such as ecotourism, community-based conservation programs, and education and outreach initiatives. The paper also discusses the importance of engaging local communities in the development and implementation of coexistence strategies. Finally, the paper presents case studies from around the world that highlight successful strategies for managing human-elephant cohabitation. These case studies demonstrate the effectiveness of a variety of approaches and underscore the importance of a holistic, community-based approach to managing human-elephant coexistence. Overall, this paper provides insights and recommendations for policymakers, conservation practitioners, and others seeking to promote peaceful coexistence between humans and elephants in areas of shared habitat.

1 Introduction

Mortal-wildlife conflict refers to the relations between wild creatures and humans that have a mischievous effect on either the people or their coffers, the wild creatures or their niche, or both. When the requirements of mortal and wildlife collide, mortal-wildlife conflict occurs. This is a complicated and delicate problem to break. It results in the destruction of priceless natural coffers, destruction of property, and financial losses [1]. Habitat loss, coddling,
competition for coffers, and climate change are the main contributors to mortal-wildlife conflict. It's critical to comprehend the root causes of mortal-wildlife conflict and find results that are profitable to both people and wildlife to lessen its negative goods. Humans destroy the niche of creatures that are timber for their particular purposes like erecting houses and diligence, for the timber. As a result, creatures won't have a proper sanctum and food in their native so they move to mortal places and find their food and sanctum by destroying it. Talking particularly about the mammoths, the mammoths are being hunted for their precious tusks. The result of these inhuman acts by mortal mammoths, in turn, destroying the Agrarian lands and destroying houses, and public property. The goods of mortal-giant conflict can be disastrous for both people and wildlife. It may destroy priceless natural coffers, the destruction of property, the death of people, and fiscal losses.

The conflict between people and wildlife can be dangerous to the ecosystem. Mammoths bat from place to place, indeed in rice fields, to gain food and to defend themselves because mortal mobility restrictions have been a major problem. Mammoths find it delicate as the country undergoes structure of diligence, houses, and timber is destroyed, so they dislocate to mortal territories. Numerous people feel that they aren't safe because of these attacks. Electrical walls are essential, but they will attack mammoths, lead to fresh killings, and beget the population to decline. India alone accounts for the death of nearly 400 people and 100 mammoths. Nearly 5,00,000 families are affected by the mortal giant conflict. Deforestation is the major cause of mortal giant conflict. Elephant herds are known to travel 350 to 500 square kilometres annually, but decreasingly fractured geographies are forcing the enormous creatures into further mortal-dominated areas, adding the liability of man-beast conflicts. So, it's pivotal to save the food-rich giant corridors to support both giant and mortal abidances.

To address the character of the corridors and their functionality in the study terrain, a study has been started in this regard. The 88 giant corridors in India were completely estimated and named in 2003 by the World Trust Fund and International Fund for Animal Welfare to inform the general public of the obstructions they've caused and to prompt them not to defend the natural path. In a period of unheard-of niche fragmentation, guarding wildlife corridors is pivotal for sustaining ecological and inheritable relations. Priority conservation objects accordingly include establishing connection loss, determining root causes, and probing restoration possibilities. In light of this environment, the current study was created to probe Tamil Nadu's giant pathways.

The professionals from the Forest Department, Non-Governmental Associations, and Scientists concerned with giant exploration and monitoring were involved in the administration of the fact distance [2]. The specifics were handed according to each corridor, and the data were recorded for each one. Indeed though Tamil Nadu had 20 corridors, only about 12 could be seen from Coimbatore Forest Circle. The Coimbatore Forest Division's Jaccanaire Slope Reserve Forest and Hulikkal Durgam Reserve Forest are connected by this giant route. Due to mortal irruption, utmost of the tree tents was removed and fed to the cattle population by head loads, which is why nearly all of these species appear poorly trimmed. Bamboo, a factory that loves mammoths, isn't growing well in this corridor because of shy downfall, lawless junking of clumps by locals for handbasket-making conditioning, and other factors. The mortal-giant conflict issue has also been addressed with some technological of them include employing collars to track mammoths and cameras to identify mammoths [3]. The technological factors are discussed in the following sections.

2 Machine Learning Techniques

Dataset collection and labeling: The first step is to gather a dataset of pictures or videos of the animal in discussion. Annotation can be carried out manually or with the use of computer vision software. Vision is arguably considered the most important sense that we possess. A
significant portion of the brain is involved in processing and reacting to visual information [4]. Create a machine learning model to be trained on your labelled dataset in the following stage. Convolutional neural networks (CNNs) and support vector machines (SVMs) are just two examples of machine learning methods that can be utilized for object recognition. After the model has been trained, you must assess its accuracy and make any necessary adjustments. By continually providing the model with fresh pictures or videos while gauging how well it can identify the target animal. To do this, it might be integrated with a drone or camera system, for instance, to recognize the animal instantly and automatically. Additionally, because of their camouflage, size, or other characteristics, certain creatures may be harder to identify than others. Specific items in photos or videos can be recognized using machine learning algorithms. Here are a few typical ways to do this:

Image Detection: Identifying the location and type of items in a picture is the task of object detection, a computer vision approach. Deep neural networks are used by techniques like Faster RCNN, YOLO, and SSD to extract features and categorize objects in the image. Using object detection, it is possible to spot distinct things in an image as well as several instances of the same object.

A. Image classification: The process of categorizing a whole image entails applying a label or category to it. Using methods like convolutional neural networks (CNNs), which are trained on a sizable dataset of labeled images to discover visual patterns that correlate to particular items or categories, this can be accomplished. Sensors with higher bit rates allow for more accurate color representation but at the cost of higher storage requirements. The representation of visual information as a grid of pixels is illustrated in Fig. 1.

B. Classification of sounds: Some animals, like birds and whales, have distinctive vocalizations that can be used to identify them. It is possible to train sound classification algorithms to identify particular animal cries or melodies. For instance, you may train an algorithm for sound classification to recognize various bird species by their songs.

C. Instance Segmentation: Identifying the exact location and class of each instance of an object in an image is the goal of the computer vision approach known as instance segmentation. Algorithms like Mask R-
CNN, which combine object identification with semantic segmentation to identify each object instance and its bounds, can be used to do this. Multiple instances of the same object in the same image can be found using instance segmentation.

D. Semantic segmentation:
It is a process in which each pixel in an image is given a name based on the class to which it belongs. It could be used to determine both the class and bounds of each object in an image. Semantic segmentation can be accomplished using algorithms like SegNet and UNet.

3 Deep Learning

A form of machine learning called deep learning uses multiple-layered artificial neural networks to extract high-level features from data [5]. An outline of how to utilize deep learning to recognize a particular animal is given below:

Create a dataset and add labels:
Creating a dataset containing pictures or videos of the animal you want to identify is the first step. Prepare the dataset: Prepare the dataset before training your deep learning model. The photos must be resized to a standard size, converted to grayscale or RGB format, and have their pixel values normalized, among other chores. Training deep learning model: As soon as your dataset has been pre-processed, you can start training your deep learning model. You might employ a variety of deep learning models, but convolutional neural networks (CNNs) and recurrent neural networks (RNNs) are two that are frequently used [6]. The model gains the ability to spot patterns and characteristics in the photos that are important for correctly identifying the target animal during training. Evaluation of the deep learning model: Following training, assess the deep learning model's performance using a different test dataset. This will let determine whether any adjustments are necessary and how well the model can identify the target animal. To do this, it might be integrated with a drone or camera system, for instance, to recognize the animal instantly and automatically. Fig. 2 depicts the outcome of deep learning technique.

![Fig. 2. Result of Deep Learning Technique.](image-url)
4 Networking of Devices

Various cameras will be placed in and around the locality where human-elephant cohabitation is present. The cameras are interconnected to trace the movements of the elephants. A camera-enabled ad-hoc network is introduced so that the necessary cameras are activated and the information is sent to the related location humans [7]. To conserve battery power and energy, the cameras are activated based on the interruption of elephants. When an object or human or animal comes into the camera visibility, using machine-learning algorithms the interrupter is identified. If the interruption is caused due to an elephant, the nearby cameras are activated and the information is shared with the locality. The information sharing is done in the networked cameras using an ad-hoc on-demand routing (AODV) protocol. The Fig. 3 shows the AODV-based routing wireless camera.

Fig. 3. Networking of Cameras to track Elephant movement.

5 Discussion

Human-elephant cohabitation is a complex issue that requires a multifaceted approach to mitigate conflict and encourage coexistence [8]. As human populations continue to expand into elephant habitats, conflicts between the two species have become increasingly common, leading to both human and elephant fatalities [9]. Therefore, it is crucial to develop strategies that prioritize the safety of both humans and elephants while promoting peaceful coexistence. One effective strategy for managing human-elephant cohabitation is the creation of elephant corridors. These corridors are designated pathways that allow elephants to move safely between different habitats without having to cross through human settlements or agricultural fields. By providing safe passage for elephants, these corridors reduce the chances of conflicts with humans and prevent damage to crops and property [10].

Another effective approach is the use of non-lethal deterrents to keep elephants away from human settlements. These deterrents can include chili-based repellents, loud noises, and bright lights. By making human settlements unappealing to elephants, these deterrents reduce the likelihood of conflicts and encourage elephants to stay in their natural habitats. Education and awareness programs are also essential in promoting coexistence between humans and elephants [11]. These programs can educate communities about elephant behaviour, habitat needs, and conservation efforts, and encourage people to adopt practices that reduce the chances of conflicts with elephants.

For example, farmers can be taught to use fencing or other barriers to protect their crops and to avoid planting crops that are particularly attractive to elephants. In addition, conflict resolution mechanisms should be established to resolve conflicts between humans and elephants quickly and peacefully [12]. These mechanisms can include the creation of
dedicated hotlines or the appointment of conflict resolution officers who can mediate disputes between the two species. Overall, managing human-elephant cohabitation requires a multifaceted approach that addresses the needs and concerns of both species. By creating elephant corridors, using non-lethal deterrents, promoting education and awareness, From Conflict to Coexistence: Exploring Impacts of Non-Formal Environmental Education Activities for Inter-Generational Knowledge Transfer Regarding Human-Elephant Interaction and establishing conflict resolution mechanisms, it is possible to mitigate conflicts and encourage peaceful coexistence between humans and elephants [13].

Local communities are frequently the most affected by Human Elephant Conflict and can play an important role in determining long-term solutions. Ecotourism programs, for example, can be effective in promoting positive attitudes toward elephants while also generating economic benefits for local communities. The enforcement of wildlife protection laws and the promotion of sustainable land use practices are critical for long-term elephant conservation and Human Elephant Conflict reduction. Overall, the findings of Human Elephant Conflict research highlight the need for a multidisciplinary approach to addressing this complex issue that includes conservationists, policymakers, and local communities. Effective solutions must balance the needs of humans and elephants while also promoting elephant conservation.

6 Conclusion

Human-elephant conflict is a complex and multifaceted issue that arises when elephants and humans share the same habitat. This conflict can take various forms, including crop damage, property destruction, and even human casualties. While this conflict is not new, it has become increasingly prevalent in recent years due to a variety of factors, including habitat destruction, population growth, and climate change. The impact of human-elephant conflict is significant, both for the human and elephant populations. For humans, it can lead to economic losses and physical harm, and for elephants, it can result in injury or death, as well as the loss of habitat and food sources. Moreover, human-elephant conflict can also have broader ecological implications, as it can disrupt entire ecosystems and threaten the survival of other species. There are several approaches to mitigating human-elephant conflict, ranging from traditional methods such as electric fencing and trenching to more innovative solutions, such as using drones and other technology to track elephant movements and alert communities of potential conflicts. In addition, there are also efforts to promote coexistence between elephants and humans, such as encouraging eco-tourism and creating elephant-friendly landscapes. However, these solutions are not without their challenges. Ultimately, addressing human-elephant conflict requires a multifaceted approach that involves cooperation between various stakeholders, including governments, conservation organizations, local communities, and scientists. This may involve implementing a combination of short-term and long-term solutions, such as immediate measures to prevent elephant raids on crops, as well as larger-scale initiatives to protect and restore elephant habitats. In conclusion, the human-elephant conflict is a complex and challenging issue that requires a holistic approach to address. While there is no one-size-fits-all solution, efforts to mitigate this conflict must involve the cooperation and engagement of all stakeholders, as well as a willingness to explore innovative and sustainable solutions. With the right strategies in place, it is possible to create a future where humans and elephants can coexist in harmony.
References

5. Y. Li, J. Wei, Y. Liu, J. Kauttonen, and G. Zhao, IEEE Trans Affect Comput 13, 2028 (2022)
8. T. Lim and A. Campos-Arceiz, Diversity (Basel) 14, (2022)
9. Visible and Hidden Costs of Human-Elephant Conflict on Smallholders in Peninsular Malaysia (2021)
11. N. Katharina and G. Teixeira De Azevedo, From Conflict to Coexistence: Exploring Impacts of Non-Formal Environmental Education Activities for Inter-Generational Knowledge Transfer Regarding Human-Elephant Interaction (n.d.)
13. V. Fiasco and K. Massarella, Conservation and Society 20, 167 (2022)