SAF-ADAPT
South Africa / Flanders
Climate Adaptation
Research and Training
Partnership

RESEARCH BRIEF
July 2024

Wildlife Monitoring Through Remote Sensing in Tembe Elephant Park

Hubert Claes

Wildlife monitoring is essential for the conservation and management of wildlife populations and their habitats. The increasing anthropogenic impacts on wildlife necessitate the development of efficient and cost-effective monitoring methods. This research focuses on using drone technology combined with deep learning models to monitor wildlife in Tembe Elephant Park, South Africa. The aim is to develop an automated system for detecting and counting animals, particularly elephants, to aid in conservation efforts.

PROBLEM STATEMENT AND OBJECTIVES

African parks need to know the status of their animal populations in order to take conservation measures. To achieve this, Tembe Park now uses a helicopter, with a pilot, and two specialists who count the animals they observe. This technique works, but it's expensive, time-consuming and subject to the error of the counting specialists. EZEMVELO is keen on finding another, reliable and cheap way of counting its animal populations.

The objectives of this project are:

- determine an effective and efficient method for wildlife monitoring, and more especially wildlife counting
- test an object detection model for aerial image of the Tembe park, that works on non-homogeneous backgrounds
- test the impact of the resolution of the images and the vegetation types on the accuracy of the model

PROJECT SUMMARY

This study explores the use of a deep learning model, specifically a Region-Based Convolutional Neural Network (RCNN), to identify elephants in aerial images taken with drones in Tembe Park. The study identifies image resolution and background vegetation as key factors affecting the model's accuracy.

KEY FINDINDS

- **Effective training of the RCNN model requires an extensive dataset**, necessitating longer field campaigns or higher drone flight heights, which are currently limited in South Africa.
- Elephant identification accuracy **improves with higher image resolution**, performing best at 5.3 cm/pixel to 10-20 cm/pixel, with current satellite imagery resolutions reaching 15-30 cm/pixel and expected improvements to 10 cm/pixel by 2025.
- The **accuracy of animal detection decreases with increasing vegetation diversity and cover**, and animals under dense vegetation cannot be detected. A coefficient is needed to estimate populations based on historical count comparisons.
- High-resolution satellite imagery is **recommended for more efficient and regular wildlife censuses**, overcoming the limitations posed by drone operations.

KEY FINDINGS AND DISCUSSION

A deep learning model, a sub-branch of artificial intelligence in the field of programming, was carried out for the park, more specifically a region-based convolutional neural network (known as a RCNN), was tested to identify objects. This model identifies regions in the images, which can then be trained to increase accuracy. To train it, you need to give it images in which objects are identified. Here, the objects recognized are elephants on aerial images taken in Tembe Park with a drone.

It was found that this technique could be effective, but requires a rather large training data set. This would require or a longer field campaign (> 8 weeks) or a higher flight height with the drone. The flight height for drones in South Africa is limited to 100 m, which also limits the area that can be covered in a 15' flight. This rather low flight height also scares away quite some animals. From that perspective the purchase of high-resolution satellite images such as those offered by Maxar, Airbus or Planet looks more promising. to carry out censuses more regularly, more easily and more cheaply. Two limitations were identified to assess wildlife populations: image resolution and the presence of background vegetation.

As far as resolution is concerned, the elephant identification accuracy depends directly on the resolution of the images used. The model performedbetter on images with a resolution of 5.3 cm/pixel to 10 - 20 cm/pixel, but deteriorated with a lower resolution. The resolution of today's commercial satellite imagery has reached 15-30cm/pixel and still improving. In 2025, Albedo Space is due to release a new satellite offering images of 10cm/pixel.

As far as vegetation is concerned, this is one of the major challenges facing the Tembe park. Most studies carried out so far for the detection of animals on aerial images were carried out with a rather homogeneous background.. Accuracy decreases with increasing vegetation diversity and cove. It was not possible to detect animals under the vegetation cover. We therefore need to approximate them with a coefficient that can be defined by comparing the results of previous counts with satellite image counts for the same past years.

KEY RECOMMENDATIONS

Further research in wildlife monitoring using drones and deep learning should focus on several key areas:

1 Improving detection in dense vegetation is crucial, as current models struggle in such environments like Tembe Elephant Park. Enhancing these models and developing methods to estimate animals hidden under vegetation, possibly by comparing detected numbers with historical data to create correction coefficients, will be essential.

2 Determining the optimal image resolution needed for reliable detection of various species is important. Since high-resolution images are costly, research should identify the minimum resolution necessary. Testing more powerful models on drone images before investing in satellite imagery can ensure cost-effectiveness and accuracy.

3 Effective wildlife monitoring requires significant computing power. Future research should explore affordable and scalable computing solutions, such as online platforms like Google COLAB, to process large datasets and run complex models efficiently. Addressing these areas will improve the accuracy and feasibility of using drone and deep learning technologies for wildlife monitoring in environments with dense vegetation.

CONCLUSION

Wildlife monitoring is increasingly important, especially in the face of shrinking and changing habitats. Effective and efficient animal counting methods are crucial for parks in Africa. This research demonstrates the potential of using satellite imagery and deep learning models for wildlife monitoring. By successfully identifying elephants in drone images, the study highlights the numerous advantages of this technique, including regular monitoring and minimal disturbance to animals.

The study shows that it is possible to identify Tembe Park's elephants using images with a resolution of 30cm/pixel, a quality offered by companies like Maxar, Airbus, and Planet. Although the accuracy is affected by vegetation cover and resolution, linking these findings with historical census data can help achieve more precise estimates. However, significant progress is still needed to develop powerful, accurate models capable of counting various species across large areas like Tembe Park.

The SAF-ADAPT project is funded by the Government of Flanders, and is a 4.5-year collaborative project between University of Cape Town, University of Fort Hare, and University of Venda, KLIMOS Interuniversity Platform, and the South African Adaptation Network. This work was co-funded by VLIR-UOS, the Flemish University Council for University Development Cooperation through the ReSider project..

All opinions, interpretations and conclusions expressed are entirely those of the authors and do not reflect the views of the funder, the Government of Flanders and VLIR-UOS.

Published by the SAF-ADAPT project - www.saf-adapt.org

Corresponding author: Hubert Claes (hubert.claes@student.kuleuven.be) or **READ THE FULL THESIS HERE**

Flanders State of the Art

SAF-ADAPT
South Africa / Flanders
Climate Adaptation
Research and Training
Partnership

University of Fort Hare
Together in Excellence

University of Venda
Creating Future Leaders

KU LEUVEN

vliruos
SHARING MINDS, CHANGING LIVES