AI for Earth Grantee Profile
Tanzania Conservation Resource Centre
Reducing human-wildlife conflicts through machine learning

Summary

Understanding where human and wildlife populations intersect is critical to the conservation of wildlife in Africa. The Tanzania Conservation Resource Centre (TZCRC), in conjunction with Development Seed and other partners including the Tanzania Wildlife Research Institute, is developing an AI-assisted methodology to increase the speed of counting wildlife and human activities following an aerial survey and to produce a heatmap of potential conflict areas between the two in survey zones.

Protecting biodiversity with AI

The growing human population, combined with climate change, is causing conflicts where humans and wildlife compete for land, food, and other natural resources. Human-wildlife conflict leads to thousands of deaths each year in both human and wildlife populations. Identifying areas of possible conflict can lead to proactive mitigation and understanding where wildlife and human populations overlap can protect both.

One of the most common ways to understand wildlife populations is through systematic reconnaissance flights—aerial surveys in straight-line patterns across zones, with two human observers in a light airplane counting wildlife and other targets as the aircraft flies over wildlife areas and the boundaries of settlements. These surveys can help detect declines in populations from threats such as poaching or responses to environmental changes and are used in various areas around the world. Though widely adopted in wildlife conservation, this method has some significant drawbacks. The survey flights take days or weeks to cover smaller sample areas of very large ecosystems. The observers can face fatigue, which limits daily mission times, and their performance can be highly variable. In addition, game counts often occur only in three to five-year intervals due to high logistical costs and the difficulty in fielding teams in remote locations.

Automated cameras and digital imaging for data capture have been shown to be consistent and accurate and could reduce the financial and logistical costs of flights, but this solution has its own drawbacks. The use of automated cameras in surveys results in tens of thousands of images, requiring a labor-intensive sorting process and increasing the time to review the data from days to months due to the volume and difficulty counting complex images. Though digital imaging provides at least as accurate results as just the human observers in the standard flights, typically less than 2 percent of images have any wildlife, livestock, or other

targets in them. Now, through a Microsoft AI for Earth grant, the Tanzania Conservation Resource Centre and Development Seed are exploring how to expedite the photo analysis by using AI to review the images.

Analyzing aerial imagery using machine learning

Tanzania's wildlife is one of its greatest natural resources and protecting it is vital to protecting the health of the ecosystems that are a major driver of its economy. Working in partnership with Development Seed and the Tanzania Wildlife Research Institute (TAWIRI), the Tanzania Conservation Resource Centre (TZCRC) is developing an AI-assisted photographic review system to help reduce the burden of data collection to track and analyze changes to wildlife species, population counts, and human influence.

Howard Frederick, the technical lead for the project, is the principal investigator for the Tech for Aerial Wildlife Survey (TAWS) at TAWIRI. The TAWIRI team will annotate its huge library of aerial survey imagery as training data for the AI system. Development Seed machine learning engineers will work side by side with Frederick to build multi-labeled image classification and object detection models and model deployment on the Microsoft

An annotated aerial survey image. [photo courtesy Tanzania Conservation Resource Centre]

Azure Machine Learning platform. Machine learning models will review the massive amounts of photographs and then direct mappers and analysts to areas where they provide the most value to sort images, track and count wildlife, and identify human settlements and other objects of interest as they appear in images. The model detection work will produce a risk map that will illustrate possible human settlement expansion and wildlife migration conflict within protected areas in critical Tanzanian ecosystems.

This new process can reduce the cost and time of the aerial census and speed up human annotators' workflow with AI-assisted wildlife and human settlement detection. In addition, this project will build capacity for others across Africa, particularly in wildlife conservation communities, to use Microsoft Azure Machine Learning and training datasets to monitor potential conflicts. The process will produce species as well as group-level predictions quantitatively for wildlife and human settlements and can train deep learning object detection models to target and fine tune for each separately. It will allow conservation and development partners to

The new workflow could improve accuracy while reducing survey costs by 40 percent, enabling more frequent surveys.

further inform decision-making and investment for conservation purposes. Finally, this project will allow conservation organizations without in-house AI capacity to take advantage of the broader AI community and resources for community support to iterate on the models and workflow. The new end-to-end workflow, including machine learning classifier and object detection, could improve accuracy while reducing survey costs by 40 percent, enabling more frequent surveys.

Looking forward

TZCRC and Development Seed are also developing a visualization tool for an interactive early warning heatmap of human-wildlife conflict. When a user selects a conflict hotspot and hovers over a particular point of interest, the associated aerial images will show up with the detected wildlife species and human settlements, and numbers of each. Conservation teams will be able to use the methods developed here to explore ways of mitigating human-wildlife conflict and reducing the decline in wildlife populations. The use of AI systems for classifying photos and managing vast datasets opens the possibility to use unmanned aerial vehicles (UAVs) in place of manned aircraft in the future, further saving on costs and reducing risk.

About Howard Frederick

Howard Frederick is the principal investigator for the Tech for Wildlife Survey project at the Tanzania Wildlife Research Institute (TAWIRI), which is developing and accessing methods for improvement of aerial survey techniques. Frederick is a conservation biologist with 20 years of experience in carrying out aerial surveys of wildlife in 10 countries in Africa as well as Central Asia. TAWIRI is working to be the lead in development of new aerial survey methods for wildlife assessment.

About the Tanzania Conservation Resource Centre

The Tanzania Conservation Resource Centre is a 501(c)3 nonprofit that supports Tanzanian conservation research and activities by local and international researchers and students and conservation projects. TZCRC has a small annotation lab at its office in Arusha, working with images from Tanzania Wildlife Research Institute (TAWIRI), Wildlife Conservation Society and other partner agencies. It partners with the Tech for Aerial Wildlife Survey (TAWS) project at TAWIRI for development of survey methods.

About Development Seed

Development Seed builds tools that bring modern Earth science to the cloud by making large geospatial datasets more accessible and pioneers the development of cloud-native geospatial software. The company's clients span data creators (NASA, ESA, USGS) to data consumers (World Bank, World Resources Institute). Development Seed partners with these groups by producing products and imagery processing pipelines that manage petabyte-scale data in the cloud at the speed of the web, and by building impactful data products that empower decision-makers and operators with the insight they need, where and when they need it. Development Seed is actively developing open-source machine learning tools and libraries that can be adopted and executed on multiple cloud computing platforms, such as Microsoft Azure, AWS, and GCP. The machine learning tools and libraries are specifically designed for analyzing earth observation imagery faster and more effectively. These tools reduce the amount of time spent doing the boring bits of running deep learning pipelines, allowing engineers and scientists to focus more of their time optimizing science and application. These tools are built in the open, which allows the team to quickly and cheaply build and iterate deep learning processes at massive scale. Development Seed's machine learning team is applying deep learning to real problems at organizations like the World Bank, UNICEF, WRI, and NASA. In this project, Development Seed will work closely with TZCRC with technical support from the Microsoft AI for Earth team to execute and deploy the open source tools and workflow successfully to the Azure Machine Learning platform.

The Development Seed Data Team creates, curates, and validates highly accurate maps and geographic data. The team regularly contributes to humanitarian mapping campaigns around the world and validates contributions on OpenStreetMap to make sure disaster responders and emergency preparedness workers are working with a high-quality map. They have mapped disasters ranging from the Nepal and Mexico earthquakes to Zambia's malaria outbreak. They will ensure the machine learning models are trained on a curated and good-quality dataset for the coming wildlife species and human settlement detection and counting under this project.

Resources

Websites
Tanzania Conservation Resource Centre (TZCRC) main site
TZCRC Facebook page
Development Seed main site
Howard Frederick's page on LinkedIn
Tanzania Wildlife Research Institute main site