AI for Earth Grantee Profile
African Parks
Creating smart, connected parks with cloud and AI

Summary

Managing vast territories with dispersed endangered animal populations is a logistical feat, especially in regions with political instability and poaching. For two decades, the nonprofit African Parks has served as steward for parks across Africa that would otherwise lack the resources to protect vulnerable animal populations. Cloud connectivity has transformed African Parks' management approach from ad hoc interventions by roving rangers into a centralized command center from which the park manager can coordinate operations. African Parks uses Microsoft cloud and AI tools to track elephants, detect threats to them, and coordinate an effective ranger response to protect the animals from poaching or illegal hunting. With machine learning, park managers also hope to better understand and even predict elephant behavior. As low Earth orbit satellite constellations bring internet connectivity to the most remote regions, African Parks is poised to create smart, connected parks that are true sanctuaries for vulnerable endangered species like elephants, tigers, hyenas, and Kordofan giraffes.

Protecting vulnerable wildlife with real-time insights

Africa is experiencing a conservation crisis. Wildlife populations have been decimated by decades of poaching, overhunting, and habitat destruction. The African Wildlife Foundation reports near eradication of the black rhino, with a population loss of 97.6 percent since 1960; 43 percent of lions lost in the past 21 years; as many as 35,000 African elephants killed each year; and just a thousand mountain gorillas and 2,000 Grévy's zebras remaining. The elephant population has plummeted 90 percent, from 10 million about a hundred years ago to an estimated 350,000 across the continent today, according to African Parks.

Factors in this devastating loss of wildlife range from poaching and illegal hunting to habitat destruction. Wildlife crime is a $23 billion trade, according to the World Economic Forum. Raw ivory from elephant tusks reached a per-kilo dollar price of $2,100 in 2014 according to conservation organization Save the Elephants. Rhinoceros horn can fetch about $60,000 per kilogram on the Asian black market (per the African Wildlife Foundation), making it more valuable by weight than gold, diamonds, or cocaine. "A rhino walks around with $300,000 on the end of its nose," notes

Geoff Clinning, Technology Development Manager for African Parks. The trade is dominated by organized crime syndicates, who use military-style weaponry and high-powered technology to stalk and kill many animals at once.

At the same time, wildlife habitats—forests, woodlands, savannahs, and wetlands—are also in decline from the pressure of a growing human population. Habitat destruction is the primary cause of animal extinction worldwide, reports the [World Animal Foundation](). Causes range from urbanization to agriculture and mining to climate change and the ravages of war among armed militias.

Coordinating conservation efforts to restore ecosystems

Nonprofit conservation organization African Parks was founded in 2000 in response to a dramatic decline in protected regions in Africa due to inadequate funding and political instability. In partnership with local communities and governments, the nonprofit assumes responsibility for the law enforcement and daily management of protected parks across Africa. As of 2020, African Parks manages 19 parks in 11 countries, covering 14.2 million hectares of some of the world's most precious ecosystems. This represents the largest and most ecologically diverse portfolio of parks under management by any one NGO on the continent. By 2030, African Parks hopes to expand its portfolio to 30 parks.

"Working at this scale across Africa's diverse landscape requires holistic and adaptable management." —Geoff Clinning, Technology Development Manager, African Parks

Garamba National Park in Democratic Republic of Congo (DRC) is one of African Parks' success stories. Home to one of the largest populations of elephants and the last remaining Kordofan giraffes, Garamba reached a crisis point in 2016, according to the [IUCN World Heritage Outlook](). The park had lost all of its northern white rhinos, for which it had gained World Heritage Status in 1980; 95 percent of its elephants, from 22,000 to 1,200 remaining; most of its Kordofan giraffes; and an estimated 80 to 90 percent of other large mammals. In the several years since assuming the reins, African Parks has restored security to the park. Anti-poaching efforts have reduced elephant losses 97 percent, with only eight carcasses taken by poachers in 2019.

African Parks has achieved successes such as these with a ranger force of only 1,000 for 14.2 million hectares. Ground patrols are an important part of the job—African Parks rangers conducted 113,159 days' worth of foot patrols in 2017 alone—but technology is critical to coordinating rangers and deploying them strategically. "Working at this scale across Africa's diverse landscape requires holistic and adaptable management," says

Clinning. African Parks uses animal collars equipped with tracking sensors, geographic information system (GIS) software for location intelligence, data visualization software to map the movement of tracked assets in real time, predictive analytics, and cloud services for efficient management of the data collected and the business operations of the parks. Armed with this array of technologies, Clinning aims to "create a technologically smart park."

Combining tracking and data visualization

Tracking sensors are fundamental to African Parks' connected conservation—sensors on animals, sensors on rangers, sensors on vehicles, sensors on critical infrastructure like bridges and roads. Clinning says, "When we were rugged rangers in the bush down in South Africa we would talk about the day when we'd sit behind our desks and manage the park from behind a computer screen. And that is exactly what happened." In the past, park managers used a paper map with pins and penciled notes with details. Or they might have had an operation room with multiple screens for different data that they could monitor separately. It was impossible to detect patterns between different data sets in separate views. Now, African Parks uses EarthRanger, a data visualization software built on Microsoft Azure and developed by Paul Allen's Vulcan Inc., to bring together these sensor data streams and display them as moving icons on a map, together with other data from the park such as ranger reports and spatial data.

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EarthRanger's real-time cloud system integrates disparate data streams with satellite mapping services like Esri ArcGIS to show park managers how human, animal, and physical assets are moving in relation to one another and the environment. The data is stored in a secure cloud platform and readily accessible to visualize on a satellite map through the EarthRanger web app or to be downloaded for further analysis within GIS software. Evan Trotzuk, African Parks' Research and Monitoring Coordinator, explains: "EarthRanger and Esri allow for us

to track movements of a wide range of animals, including animals in near real time. That's a massive advantage for us and has opened a much wider variety of solutions and responses."

Using machine learning to predict elephant behavior

Tracking and data visualization are critical to conservation. Together, these context-based information systems create a nervous system of sorts, with sensory input, analysis, and intelligent response. Rangers use this cloud- and satellite-based technology to gain a unified view of the territories they manage, for the sake of both understanding the animals and protecting them. "Tracking for us is a very important part of my job, because we can't protect things if we don't know where they are, and we also can't provide a safe working environment for our rangers," says Clinning. Elephants, for example, tend to clump together when they feel insecure due to, say, local gunfire. Managers can now see when this pattern emerges and deploy law enforcement immediately to intervene. With tracking sensors, explains Trotzuk, "we were able to make informed decisions in the short term… we were able to understand that when a elephant runs 10 kilometers an hour, there's probably something quite wrong to which we should respond."

With the support of a Microsoft AI for Earth grant, African Parks has been able to extract more insights from its elephant tracking data using machine learning and other AI tools. "We started looking into the possibility of machine learning in order to help longer-term prediction," explains Trotzuk, who implemented Azure and AI tools in Garamba National Park. "We went from looking at a few points over time to hundreds of thousands if not millions of data points over years." With about 100 tracking sensors logging hourly data since 2016, African Parks relies on Microsoft Azure to store and manage this data.

Armed with this historical data, park managers use several machine learning techniques to predict and understand elephant behavior. In addition to remote sensing, the Garamba team used geographically weighted regressions to understand the factors responsible for longer-term variations in elephant movements and range size. They also used hidden Markov models in order to understand the movements that different social groups were making. These machine learning tools have helped park managers to better understand the animals they protect. Elephants in the more secure south of Garamba National Park spent more time resting or foraging, while those in the north spent more time moving and traveling; over time, this behavior makes a
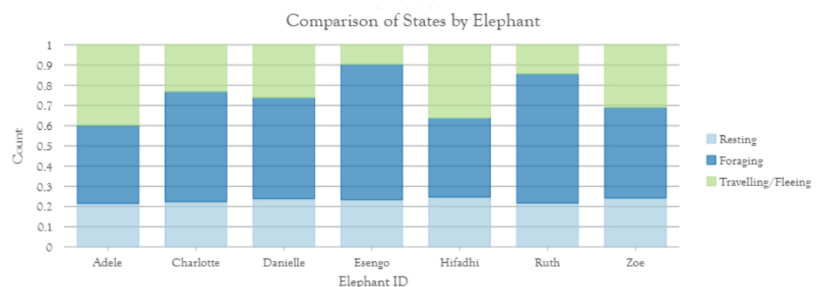

Figure 2: A comparison of the proportions of different behavioral states of certain elephants. While all animals spent similar time resting (20%, in light blue), individuals like Ruth and Esengo, who are further S and have smaller HRs, spent more time foraging (dark blue) relative to Hifadhi and Adele, who range throughout N GNP. These behavioral differences likely have significant downstream effects that might influence the population's reproductive potential.

difference in the long-term viability of the population. "Machine learning yielded a useful insight into the fact that elephants in different areas end up behaving differently and that behavior could have long-term

implications on discrete communities' populations," explains Trotzuk. AI tools are helping park managers better understand elephant behavior, which in turn aids in decision making to promote the animals' well-being.

Building toward the cloud-connected future of conservation

The AI-enabled management of Garamba National Park's elephant population fits into a larger picture of cloud-connected conservation across African Parks' territory. Reliable data management is critical to park management on this scale. "Microsoft has been an unbelievable help to us," says Clinning. "Every day we thank our lucky stars that we have cloud systems. On site, we would have had multiple broken servers in parks. It was an endless nightmare." AI for Earth's Azure credits also help support African Parks' cloud computing infrastructure, including business operations such as HR, finance, messaging services, and database services. The nonprofit's migration to the cloud, as internet connectivity permits, is helping African Parks to scale its operation to more parks.

With low Earth orbit satellite internet connectivity on the horizon, African Parks sees an opportunity to extend its use of cloud services and AI tools across its park management portfolio. This will help the park expand its tracking into more areas and do so more affordably and reliably, in near-real time. In turn, these advances will help further the conservation work of park technologists like Trotzuk, who envisions using neural networks and other AI analytics tools to better predict the behavior of elephant groups. In both broad and focused applications, cloud technology is helping African Parks conserve some of Earth's most precious ecosystems.

About African Parks

African Parks is a non-profit conservation organization that takes on direct responsibility for the rehabilitation and long-term management of protected areas in partnership with governments and local communities. The organization currently manages 19 national parks and protected areas in 11 countries covering over 14.7 million hectares in: Angola, Benin, Central African Republic, Chad, the Democratic Republic of Congo, Malawi, Mozambique, the Republic of Congo, Rwanda, Zambia and Zimbabwe. African Parks utilizes a clear business approach to conserving Africa's wildlife and remaining wild areas, securing vast landscapes, and carrying out the necessary activities needed to protect the parks and their wildlife. The organization maintains a strong focus on economic development and poverty alleviation of surrounding communities to ensure that each park is ecologically, socially, and financially sustainable in the long term. African Parks pioneered the Public-Private Partnership (PPP) model for protected area management, whereby African Parks maintains the full responsibility and execution of all management functions and is accountable to the government, who is the owner and who determines the policy. This is achieved through three approaches: long-term agreements (mandates); putting in place funding solutions (money); and establishing good governance and management, by creating separate legal entities registered in the host country, with a Board representing key stakeholders (management).

Resources

Website

African Parks, https://www.africanparks.org/

Documentation

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