

TrailGuard AI Deployment in the Kanha-Pench Landscape in Madhya Pradesh, India

*And Insights for Protecting
Tigers across Their Range*

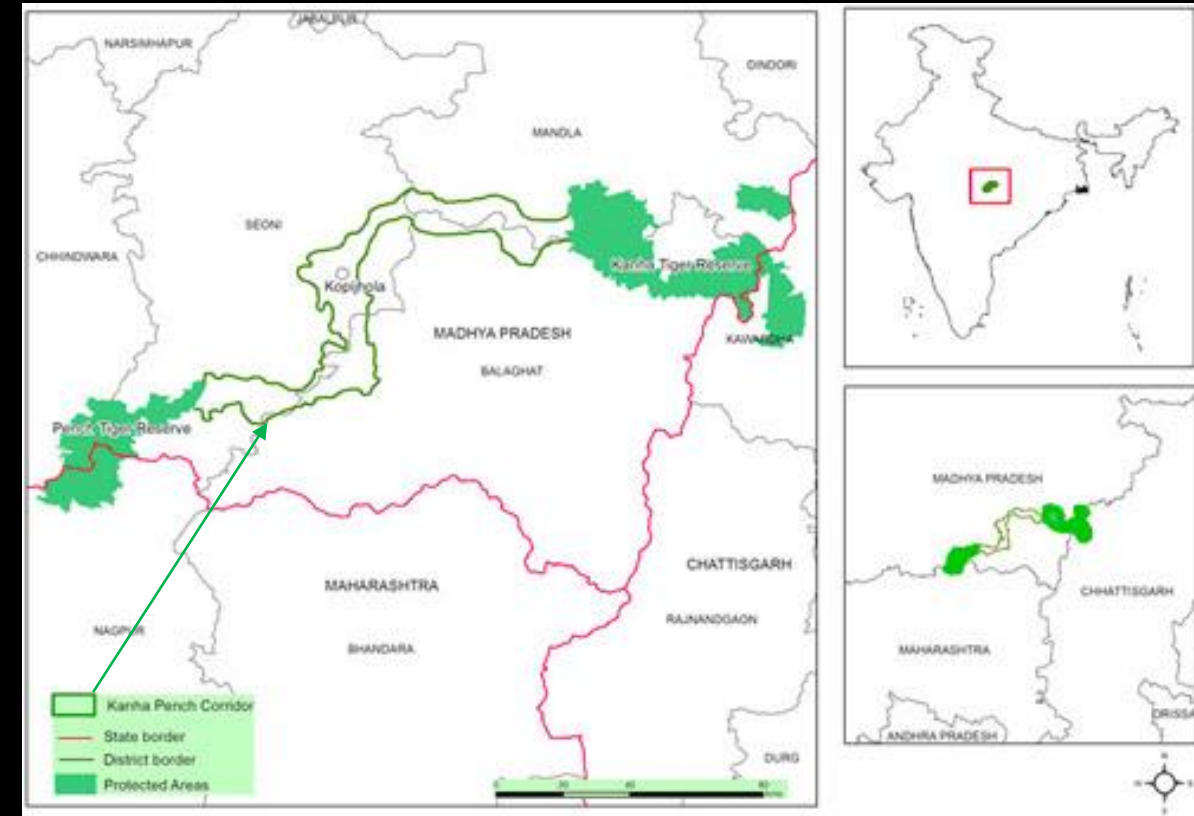
RESOLVE

WildTech



The Kanha-Pench Tiger Corridor: A Globally Important Tiger Conservation Landscape

- India's Kanha-Pench Landscape represents perhaps the most important of the 76 Tiger Conservation Landscapes delineated across the range¹. Over 500 adult tigers occur in Kanha and Pench National Parks, adjacent buffer zones, and in over 100 km of linked corridors, representing the largest population in the world.
- RESOLVE has piloted TrailGuard AI in Kanha-Pench to monitor reserve habitats, buffer zones, and the major corridor connecting the two National Parks.
- We have achieved spectacular results during the pilot period: detecting humans, vehicles, tigers and other endangered wildlife and transmitting images in real-time.
- After this successful pilot, the National Tiger Conservation Authority is engaging with RESOLVE to scale TrailGuard AI across India's 52 tiger reserves and other protected areas.



Kanha-Pench Corridor

¹ Dinerstein, Eric, et al. "The fate of wild tigers." *BioScience* 57.6 (2007): 508-514.

Introducing TrailGuard AI to the Kanha-Pench Landscape

RESOLVE provides training and technical support to local management teams



Piyush Yadav, RESOLVE's Conservation Technology Engineer, teaches Indian Forest Service staff how to utilize the TrailGuard AI camera-based alert system in Pench National Park



Piyush Yadav trains a Clemson researcher and an Indian forest ranger how to install TrailGuard AI prior to camouflaging the unit.



P = 0.99



P = 0.99



P = 0.99



P = 0.97



P = 0.98



P = 0.99



P = 1.00



P = 0.96



P = 0.95

Humans Detected by TrailGuard AI during a Demonstration for Senior Wildlife Officials in the Kanha-Pench Landscape. The tiny TrailGuard AI cameras were hidden in vegetation along the trail. As the rangers walked by, images were transmitted over the cell network to Piyush Yadav's mobile phone within 30 seconds. Piyush showed them the images on his phone, demonstrating how TrailGuard AI acts as a burglar alarm system to prevent poaching and illegal logging. These images show the high accuracy of the Human Detector in both daytime and nighttime conditions, and the ability to detect multiple people within the same image. All P values are over 0.95 (100% accuracy is 1.0),



A Historic Accomplishment: First Ever Example of Tigers Detected in a Reserve and the Images Transmitted in Real-time. TrailGuard AI accurately detected tigers and transmitted images to designated parties in under 30 seconds. Tigers were first detected by CVEDIA's Tiger Detector on the TrailGuard AI camera, then transmitted to the TrailGuard server where the images were run through a second detector, before sending on to the end user. The Detector is very accurate in day and night; most P values are greater than 0.90 (1.00 is 100% probability).

Testimonials from Users Involved in the Kanha-Pench Pilot

“The test was fabulously successful. For the first time ever, tigers in the wild were detected by running inference on the edge and the images sent in real-time.”

— Dr. Rob Baldwin, Clemson University and Science Advisor to Tigers United

“You have a great product that can protect tigers and other wildlife from poachers.”

— Keshav Varma, Director of the Global Tiger Initiative, advisor to the Global Tiger Forum, and PM Modi’s office

‘It was very exciting when that first tiger image popped up in my email. Hopefully this new technology will help prevent future conflict between humans and tigers.’

— Dr. Jeremy Dertien, Clemson University





Other Mammals Were Also Detected in the Kanha-Pench Landscape. In our pilot in Kanha-Pench, we used a detector running on the edge (i.e., in the camera). Edge detection effectively filtered out most false triggers from moving vegetation and only transmitted images of mammals (e.g. leopard, sloth bear, sambar, barking deer) to the server. We then ran a more powerful classifier on the server – trained specifically to identify South Asian mammals of interest – to correctly identify the species in the image.

TrailGuard AI makes History as the First Technology to Transmit Images of Wild Tigers in Real-Time

This technology can revolutionize Wildlife Monitoring and Play a Pivotal Role in Improving Human Wildlife Coexistence



Wildlife Monitoring

TrailGuard AI's real-time image alerts, in a version we call WildEyes AI, revolutionizes monitoring of endangered species. Researchers no longer have to wait several months to retrieve camera traps from the field and comb through thousands of images to know if a tiger (or other species of interest) passed by; WildEyes AI sends a photo to their cell phone or to the dashboard within 30 seconds.



Preventing Human-Wildlife Conflict

As wildlife populations recover, human-wildlife conflict is certain to increase. WildEyes AI can be applied to detect predators or elephants approaching community areas and alert rangers or villagers. This prevents livestock losses, crop damage, and harm to humans, and ultimately reduces the risk of retaliation killings. When livestock losses are reported, TrailGuard AI can also be used to monitor the carcass to ensure that people do not return and try to poison it.

TrailGuard AI Transmitted Alerts from Areas Lacking Cell Connectivity

- TrailGuard AI's camera-alert system is the only technology able to transmit 20 KB JPEG images—rather than just text messages—from remote areas using a long-range radio (LoRa) connection.
- We can extend range of transmission from a camera location lacking cell connectivity to another gateway in cell range directly or via a repeater unit.
- Shown on the right are images transmitted from camera locations in Kanha-Pench lacking cell connectivity. In these scenarios, a text alert was sent to designated parties over LoRa within 80-90 seconds and the image alert arrived several minutes later.



(Top) TrailGuard AI image of Piyush at night, transmitted from a small LoRa-GSM gateway, then on to the Internet, and ultimately received by designated parties as email alerts within 3 minutes.



(Bottom) TrailGuard AI Image of Piyush on a motorcycle, transmitted with a range-extending hop (repeater) unit from a site lacking cell connectivity between the camera transmitter and gateway.

Automatic Image Enhancements Now Run on The TrailGuard AI Server

The TrailGuard AI server can automatically enhance images before transmitting them to the end user.

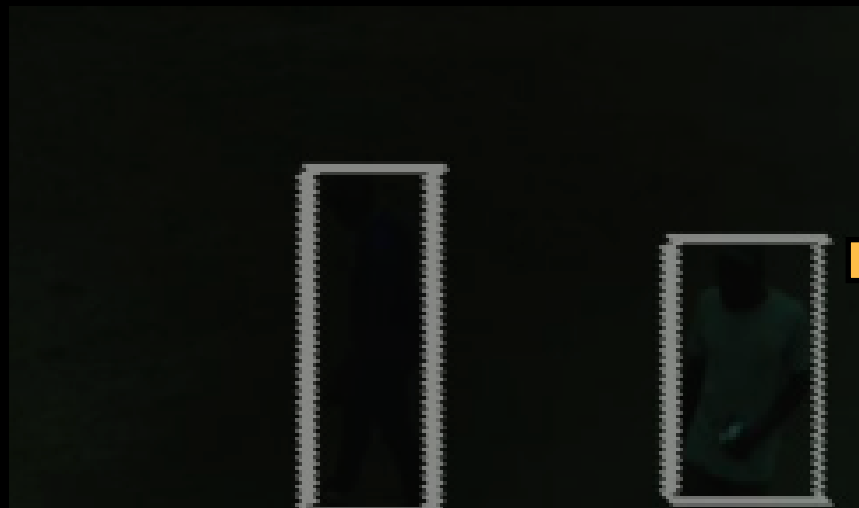
In daytime, the enhanced images provide users with a more vivid photo, such as this leopard detected in Kanha-Pench.

The AI detects objects better than the human eye in low-light conditions. Automatic image enhancement on the server can provide more information to managers reviewing the alerts. As shown here, it is much easier to discern the intruders' clothing in the enhanced image.

Original Image



Auto-Enhanced Image on the Server



 **Intruder Alert** [View all alerts](#)

09/03/2022 07:08:10 – #031 Event 35

09/01/2022 13:22:30 – #034 Event 04

08/29/2022 08:21:16 – #014 Event 45

08/29/2022 07:13:23 – #014 Event 44

08/16/2022 20:19:45 – #024 Event 05

08/16/2022 18:20:33 – #024 Event 04



 **Key Species Sightings** [View all](#)



09/03/2022 07:13:10 – #002 Tiger

09/01/2022 14:28:15 – #131 Sambar

09/01/2022 12:08:10 – #101 C. leopard

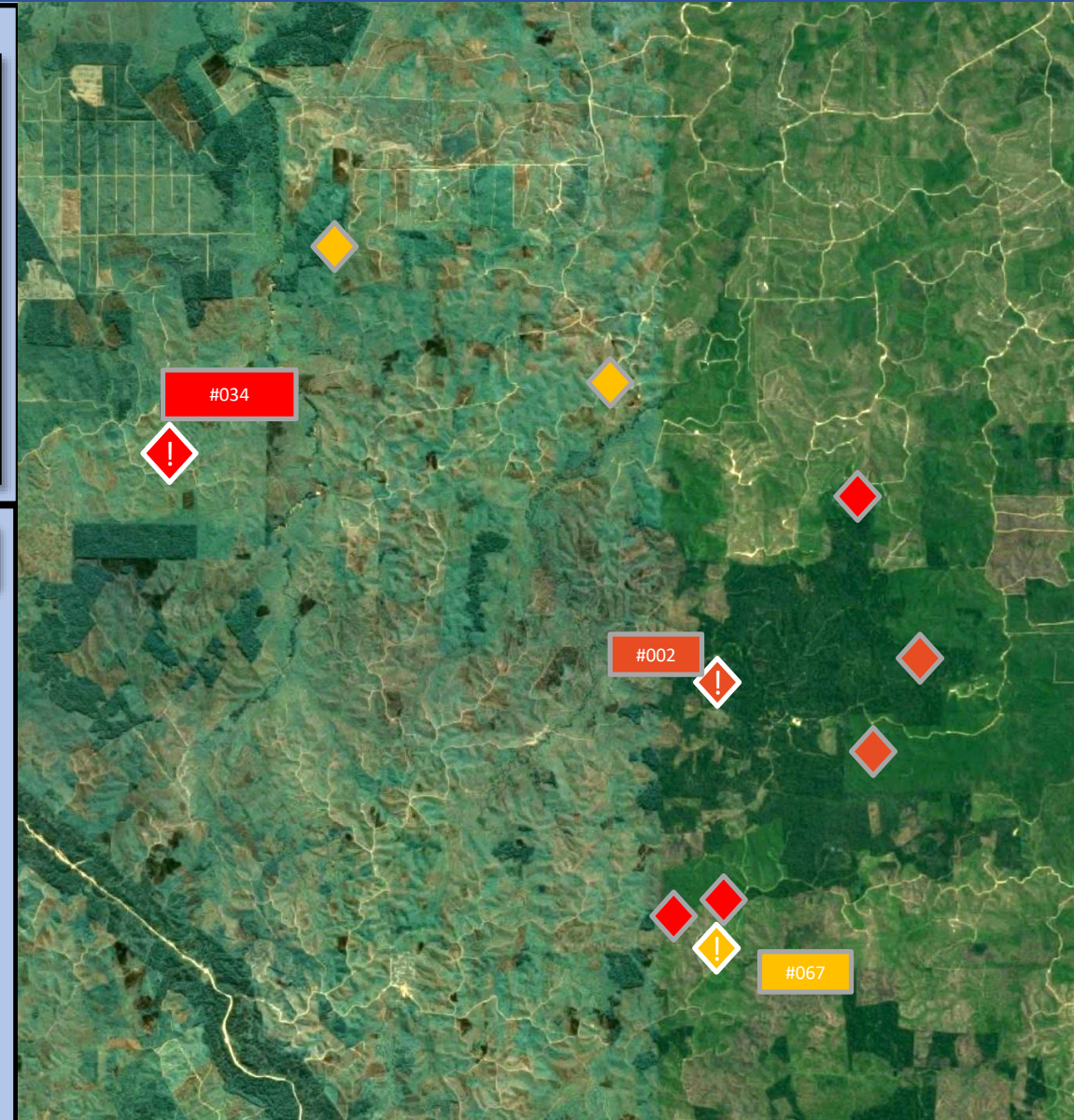
08/30/2022 17:01:32 – #003 Rhino

 **Sensor Alert** [View all alerts](#)

07/16/2022 04:23:12 – #067 Smoke

07/13/2022 17:13:01 – #074 Chainsaw

07/10/2022 12:10:04 – #014 Smoke

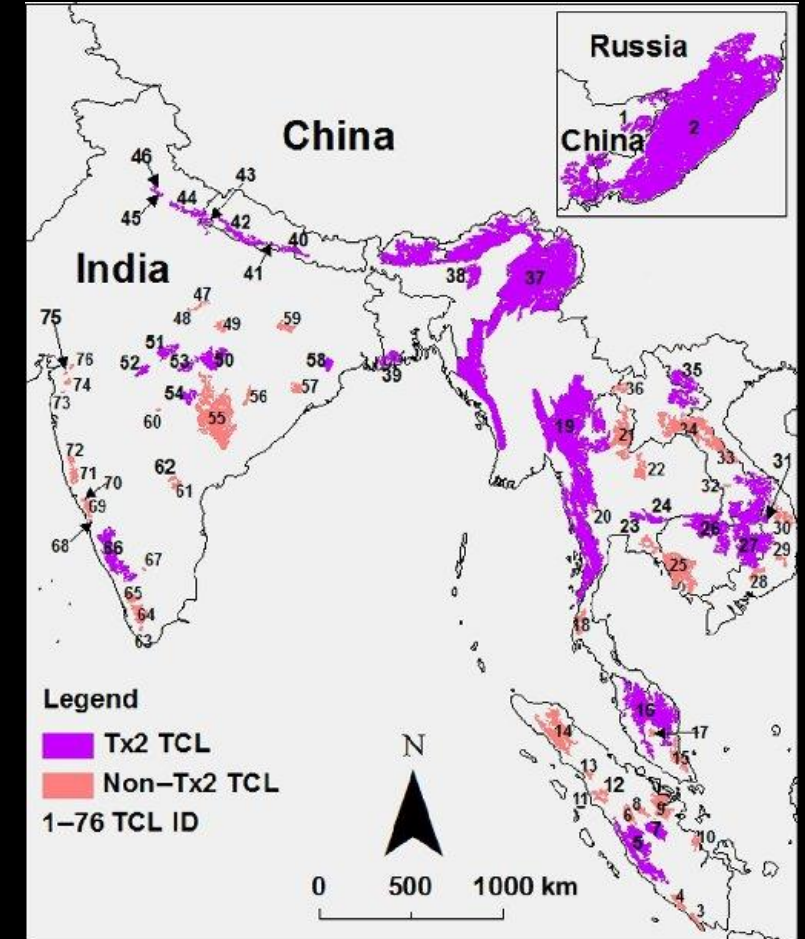
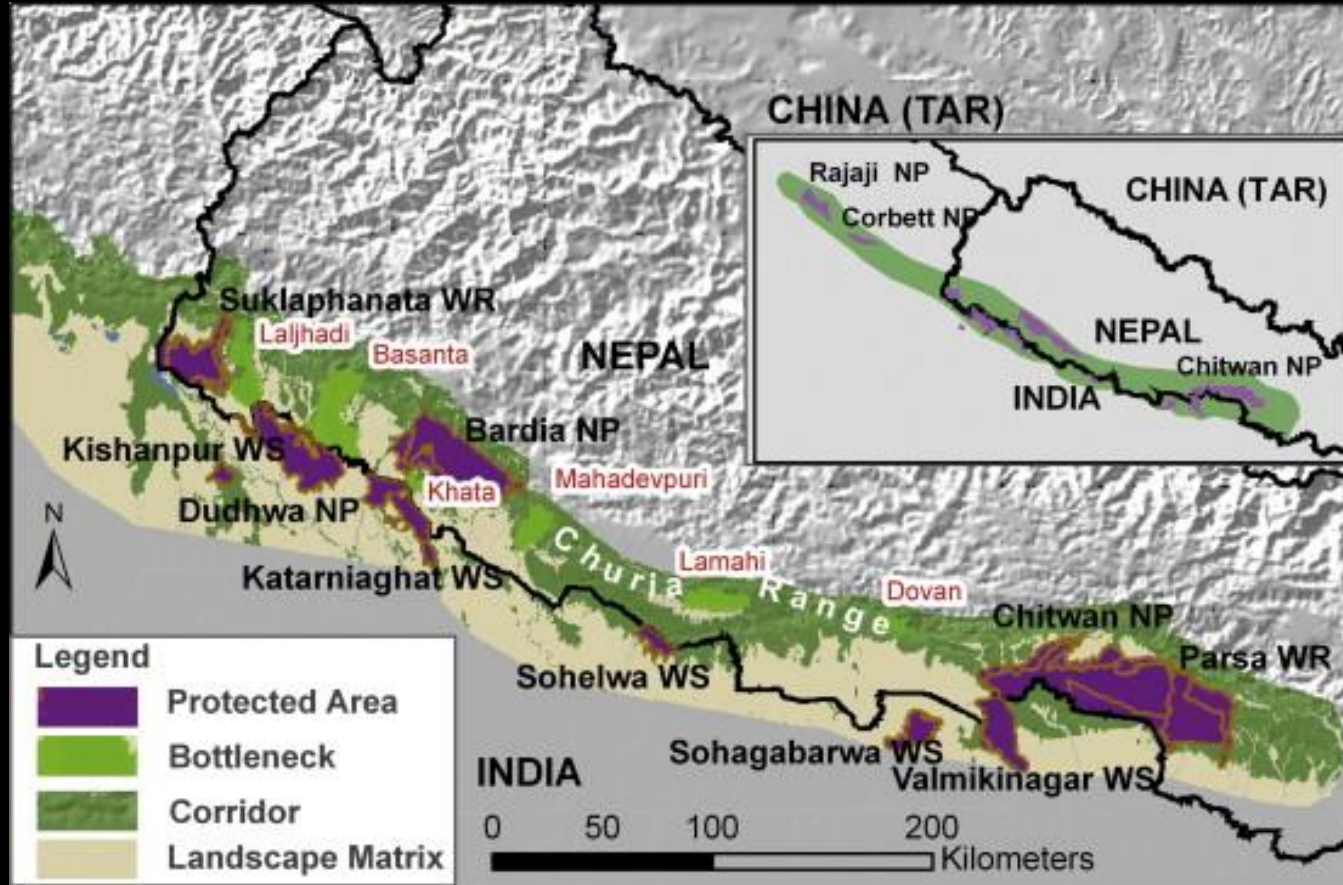


The Kanha-Pench Deployment Lays the Foundation for Protecting and Monitoring Tigers Across their Range

The success from our field monitoring project in the Kanha-Pench Tiger Conservation Landscape is the beginning of plans to scale our technology across Tiger Conservation Landscapes. Below are some key accomplishments that will benefit tigers across their range:

- **Proof of concept monitoring humans, vehicles, and key wildlife species** in reserve habitats, buffer zones, and a critical corridor connecting the reserves;
- **Successful technology transfer and training of local reserve staff** to implement the TrailGuard AI camera-alert system for protection and monitoring;
- **Real-time image transmissions of wild tigers and other endangered wildlife, a first in conservation.** This advance has tremendous implications for revolutionizing monitoring efforts and preventing human-wildlife conflict; and
- Innovations such as **image enhancements implemented on the server**, and **running a secondary Classifier on the server** to reduce false positives and increase accuracy of species detection.

The Kanha-Pench Deployment Lays the Foundation for Protecting and Monitoring Tigers in Other Parts of Their Range



RESOLVE has received a grant to deploy TrailGuard AI to protect and monitor wildlife in five parks in the Terai-Arc Landscape; three in Nepal and two in India. We are also in discussions with the National Tiger Conservation Authority about scaling TrailGuard AI across India's tiger reserves.

We plan to scale TrailGuard AI across many of the 76 Tiger Conservation Landscapes