



A wide-angle photograph of a savanna landscape. In the foreground, a herd of elephants is grazing in a field of tall, golden-brown grass. The middle ground shows a flat expanse of grass leading to a distant horizon. The sky is a vibrant blue, filled with scattered, fluffy white clouds. The overall scene is bright and clear, suggesting a sunny day.

AI and Resilience

From a Conservation Perspective

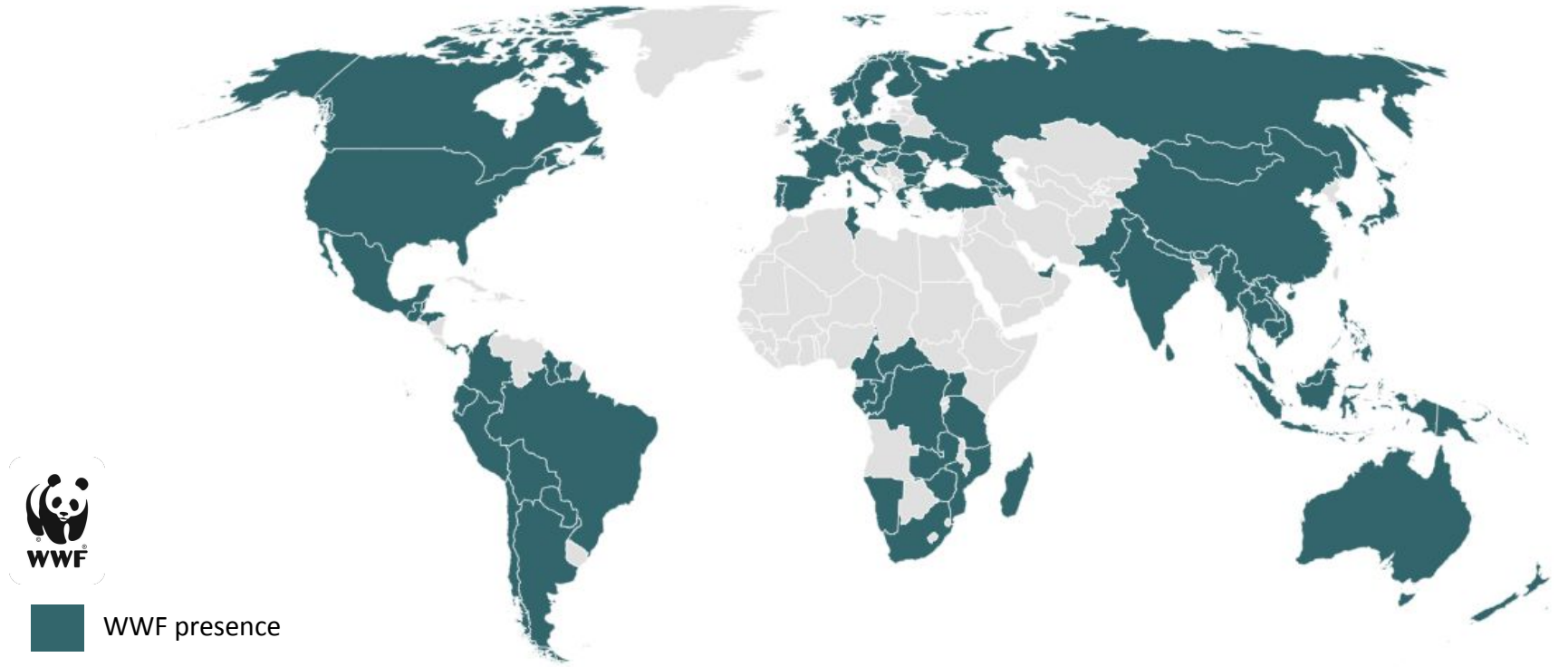
Dave Thau
Global Data and Technology Lead Scientist - World Wildlife Fund
APEC Climate Symposium, September 16, 2022



WWF's mission

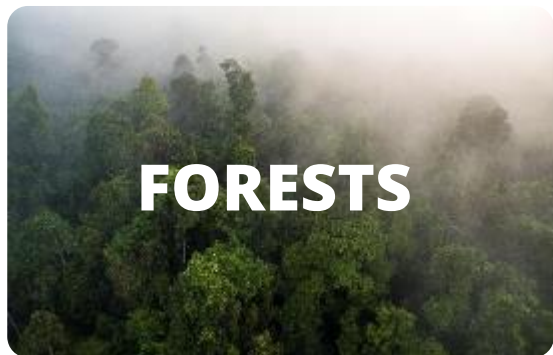
To conserve nature and reduce
the most pressing threats to the
diversity of life on Earth

Where we work



➤ *WWF is one of the world's largest global conservation organizations. We have a presence in nearly 100 countries around the world.*

WWF's work aligns around 6 areas of focus



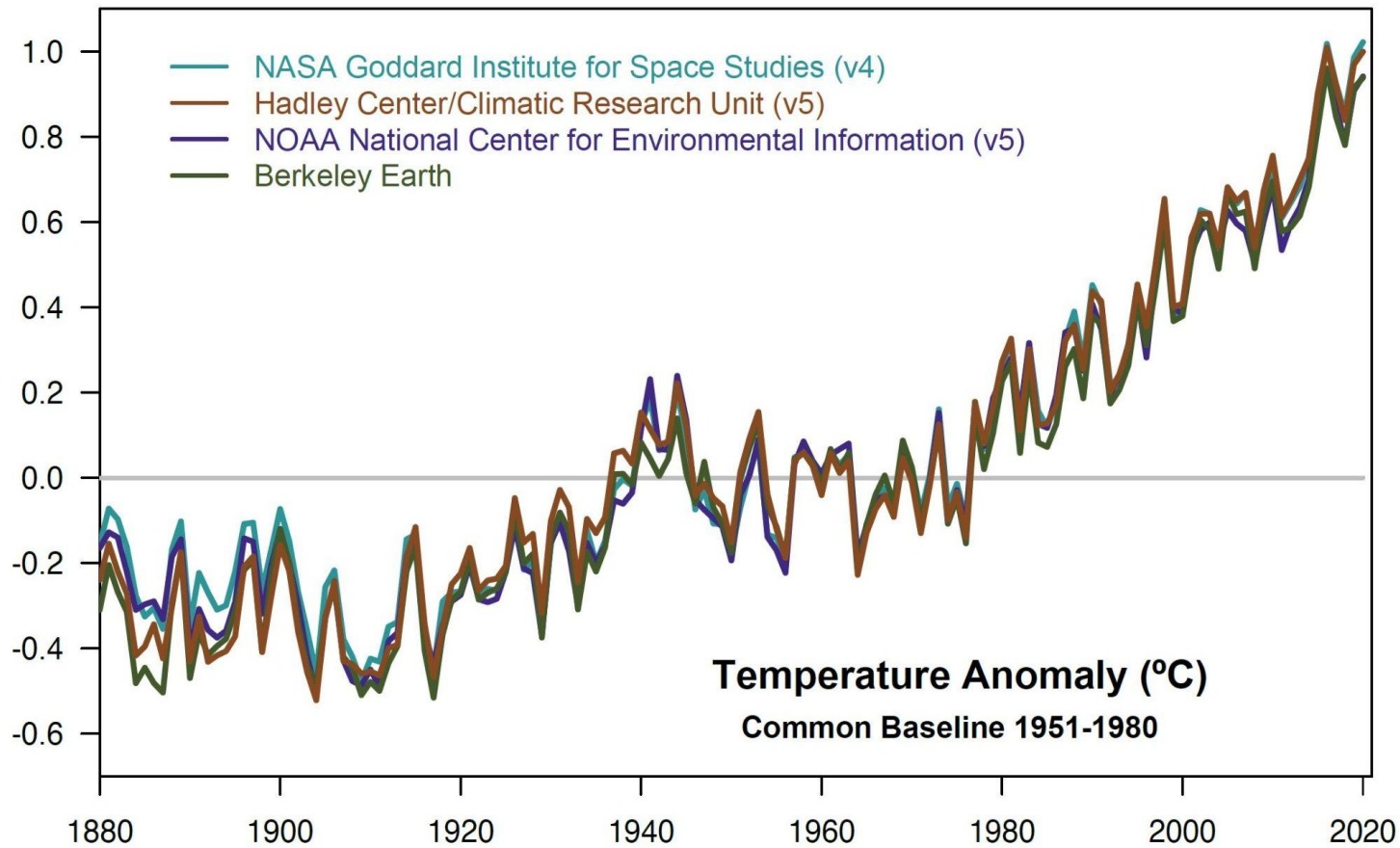
Climate
change

Biodiversity
loss

Food
insecurity

The Anthropocene Triple Threat





Germanwatch Global Climate Risk Index

CRI 2000-2019 (1999-2018)	Country	CRI score	Fatalities	Fatalities per 100 000 inhabitants	Losses in million US\$ PPP	Losses per unit GDP in %	Number of events (2000-2019)
1 (1)	Puerto Rico	7.17	149.85	4.12	4 149.98	3.66	24
2 (2)	Myanmar	10.00	7 056.45	14.35	1 512.11	0.80	57
3 (3)	Haiti	13.67	274.05	2.78	392.54	2.30	80
4 (4)	Philippines	18.17	859.35	0.93	3 179.12	0.54	317
5 (14)	Mozambique	25.83	125.40	0.52	303.03	1.33	57
6 (20)	The Bahamas	27.67	5.35	1.56	426.88	3.81	13
7 (7)	Bangladesh	28.33	572.50	0.38	1 860.04	0.41	185
8 (5)	Pakistan	29.00	502.45	0.30	3 771.91	0.52	173
9 (8)	Thailand	29.83	137.75	0.21	7 719.15	0.82	146
10 (9)	Nepal	31.33	217.15	0.82	233.06	0.39	191

Climate Change 2022

Impacts, Adaptation and Vulnerability

Summary for Policymakers



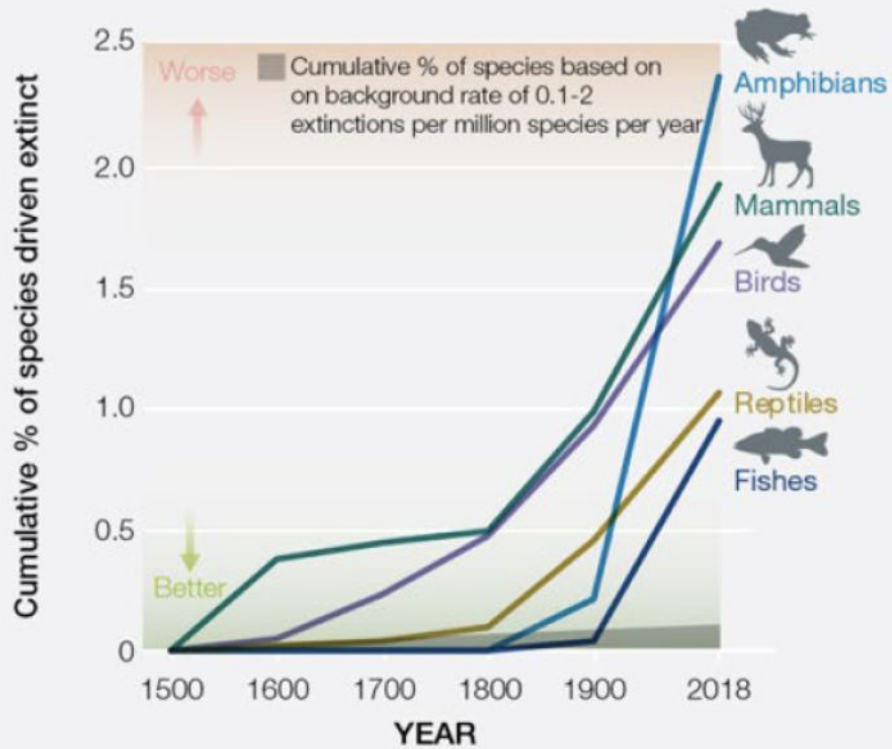
- [Climate Change 2022: Impacts, Adaptation and Vulnerability](#)
 - Summary for Policymakers (35 pages)
 - Technical Summary (96 pages)
 - Full Report (3,675 pages)
- Working Group II contribution to the IPCC Sixth Assessment Report (AR6)
- Examines how climate change impacts on people and nature now, risks in the future, and possible pathways for climate resilient development
- Published 28 Feb 2022

Takeaways III: Climate resilient development

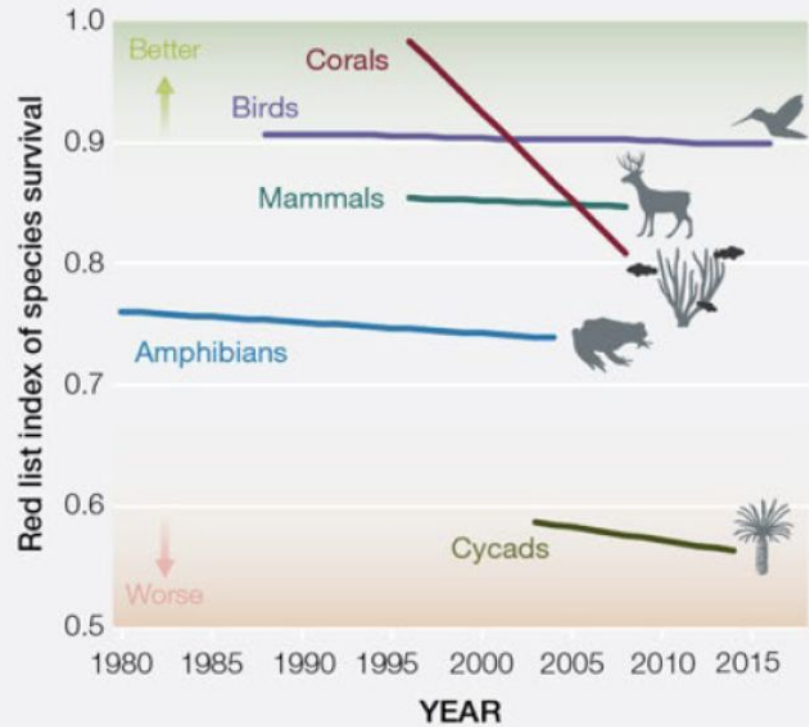


- **The report highlights the urgency for Climate Resilient Development**, which integrates adaptation measures with mitigation to advance sustainable development.
- **There is a rapidly narrowing window of opportunity** to enable climate resilient development, as pathways are constrained by every increment of warming. **This is a critical decade for action.**
- **Although adaptation solutions exist** - it is clear that this is not without rapid, deep and sustained emission cuts + enablers such as finance.
- **Urban systems are critical**, interconnected sites for enabling climate resilient development, especially at the coast.
- **Safeguarding biodiversity and ecosystems is fundamental to climate resilient development.** Maintaining ecosystem services & resilience of biodiversity globally will depend on effective conservation of 30-50% of Earth's land, freshwater and ocean areas

B Extinctions since 1500




C Declines in species survival since 1980 (Red List Index)

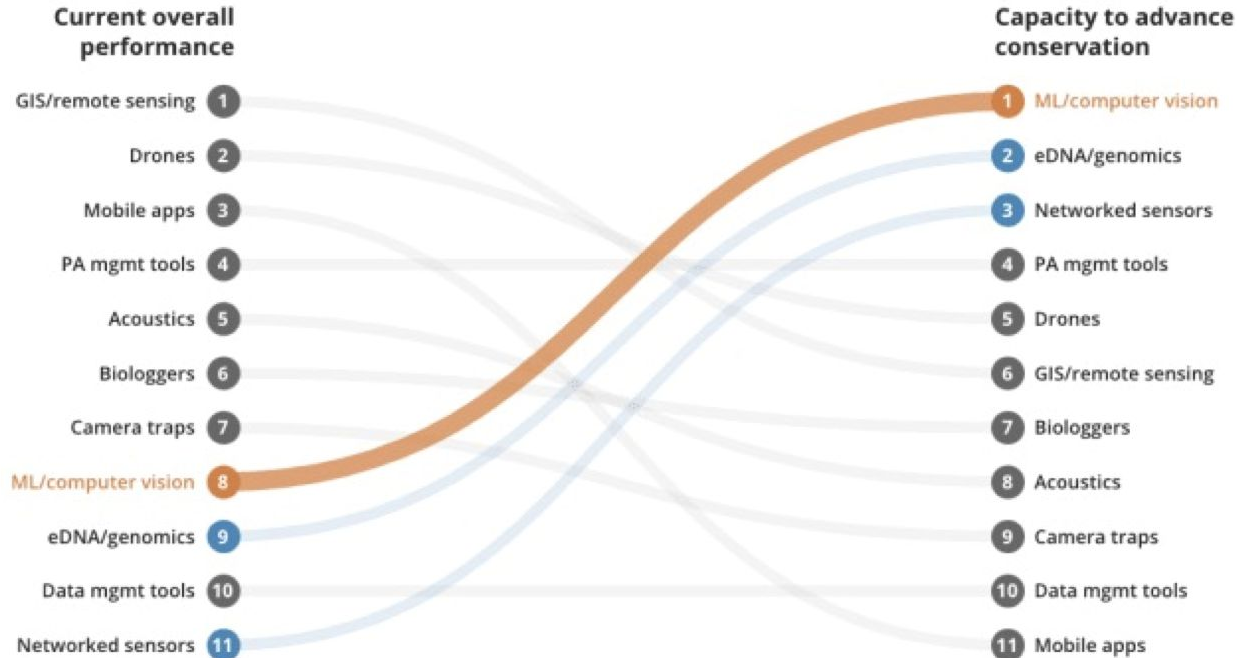


The “State of Conservation Technology”



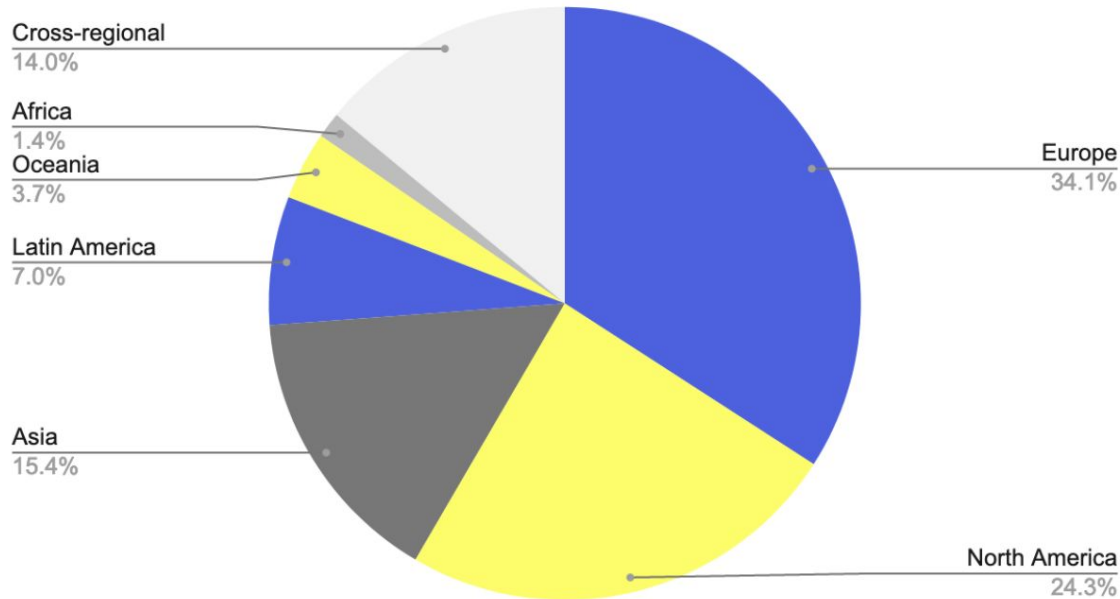
Rankings of overall performance vs. potential capacity to advance the field

 = perceived as having the highest untapped potential



AI for Social Good : Global Partnership on AI

Geographic distribution of initiatives in the catalogue



Reference: [Future Society Paper](#), [GPAI Catalogue](#)



Forest Foresight

An early warning system to
predict and prevent
deforestation

Deforestation threatens the earth's species and climate



90,000 km²

Each year an area the size of Portugal is deforested. Deforestation decimates habitats for 100,000+ species, among which are the forest elephant, gorilla, orangutan and rhino



6.7 billion tonne CO₂

The annual greenhouse gas emissions of deforestation-related activities account for 15% of global emissions, equivalent to the emissions of the entire USA



Disrupting livelihoods

Deforestation can change precipitation patterns, induce erosion and cause floods, thereby disrupting livelihoods of millions of people

Source: WWF Living forest report



More than 1.6 billion people depend on forests directly for their livelihoods, and many more rely on forests for their food, water and clean air ([WWF](#), [UN environment programme](#) & [United Nations](#)).



Forest degradation and destruction account for up to 20% of global carbon emissions – more than that of the entire global transport sector ([Environmental Defence Fund](#)).

Forests are home to 80% of land-based wildlife, housing incredibly complex and unique ecosystems ([WWF](#)).



The power of prediction: enabling earlier interventions for forest conservation

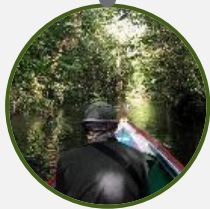
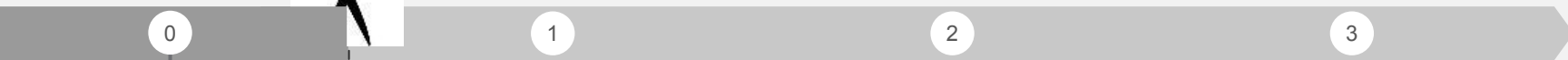


Prediction and early detection models enable faster forest conservation

Prediction and early detection enable **earlier interventions**, cutting short the deforestation chain



Currently, **interventions are often too late**, due to long lead times and lack of proper follow-up



Pristine forest



Road & canal development


















Illegal logging



Land clearing and conversion

Existing forest monitoring systems

Scope deforestation	Time horizon				
	 Forecasting model >1 year before start of deforestation	 Medium term forecasting EWS 6-12 months before start of deforestation	 Short-term preventive EWS 1-4 weeks before start of deforestation	 Reactive EWS 1-4 weeks after start of deforestation	 Event warning model > 1 month after start of deforestation
Global				   	  
Local				  	  

Existing forest monitoring systems



Introducing FF: We designed a holistic approach from data to interventions and built tools to support rollout

1 Generate prioritized deforestation alerts



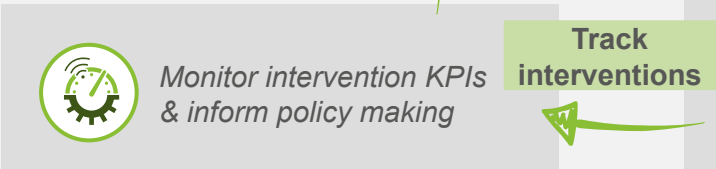
Ingest satellite & geo data sources

Steer prioritization

2 Follow up alerts

-  Review alerts³ & plan investigations
- 
-  Verify deforestation alerts in the field
- 
-  Determine intervention plan
- 
-  Launch intervention with stakeholders

3 Measure impact



1. Predictions on 15x15m, followed by down-sampling to 480x480m, 2. Exclude deforestation with permits, forest fires etc., 3. Includes desktop research to verify permits, area mgmt. plan etc.

Technical foundation underlying FF



Predict hot zones at risk

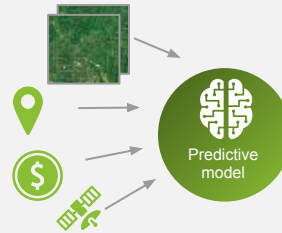
- 1 Collect historic satellite images, analyze and label changes in forest cover



- 2 Collect input data and generate data set with static and dynamic indicators



- 3 Train machine learning models based on historical data, using static and dynamic inputs



- 4 Use machine learning model to generate a map of forest cover at risk and validate on historic data



Dynamic indicators

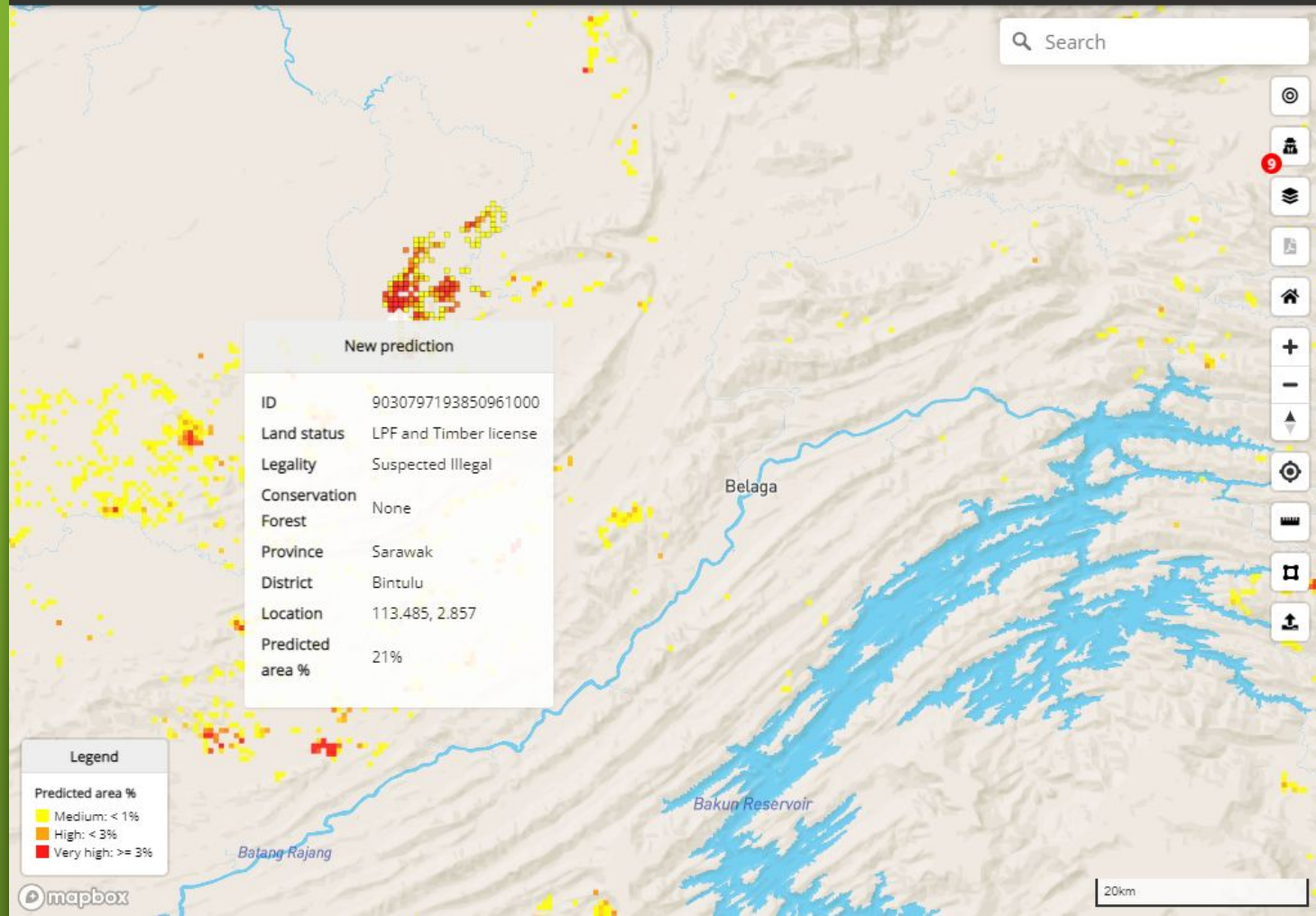
- Distance to degradation
- Distance to deforestation
- Landscape heterogeneity metrics
- ...



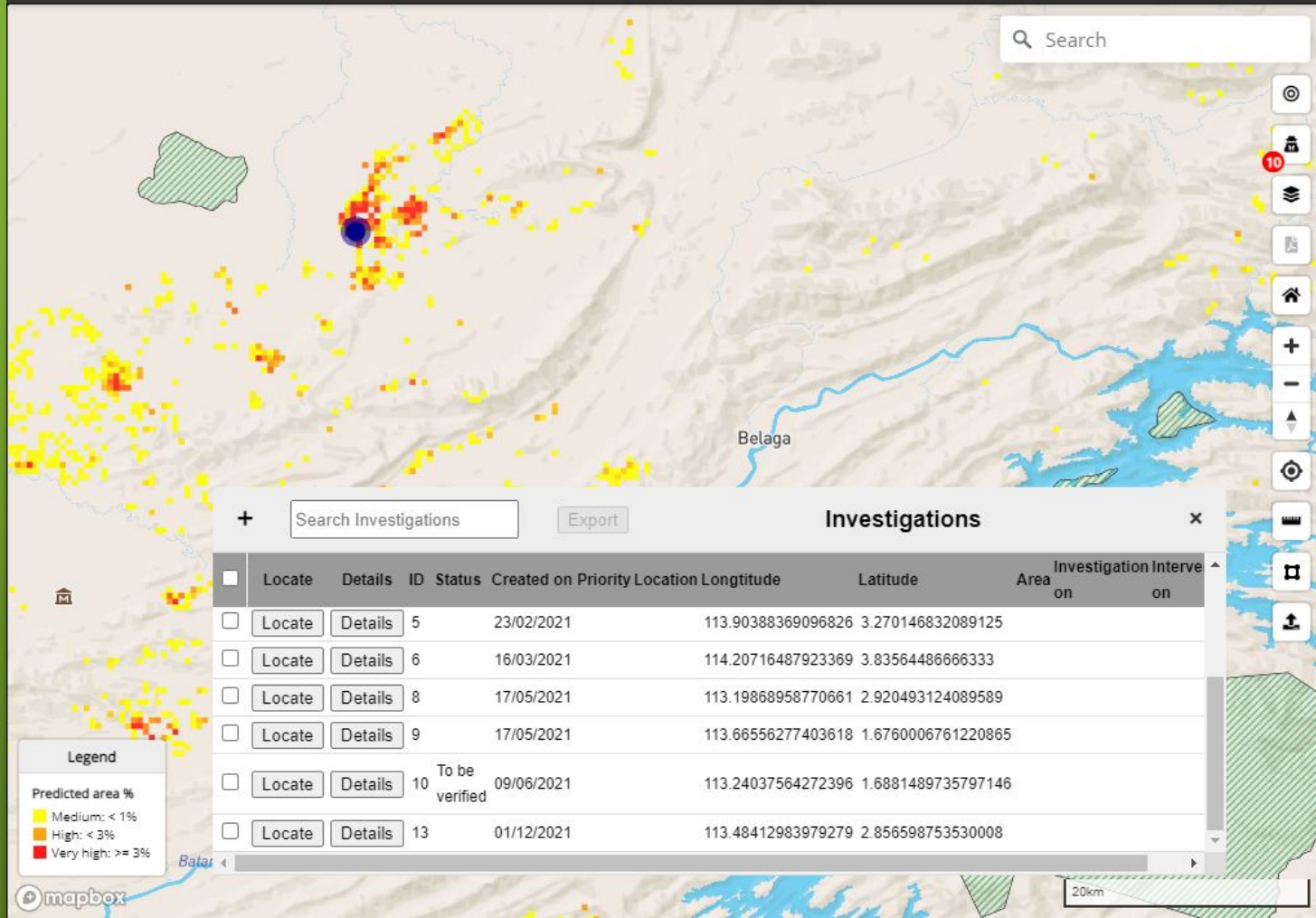
Static indicators

- Population density
- Distance to population center
- Distance to roads
- ...

Dashboard visualizes predictions of 'deforestation hot zones'



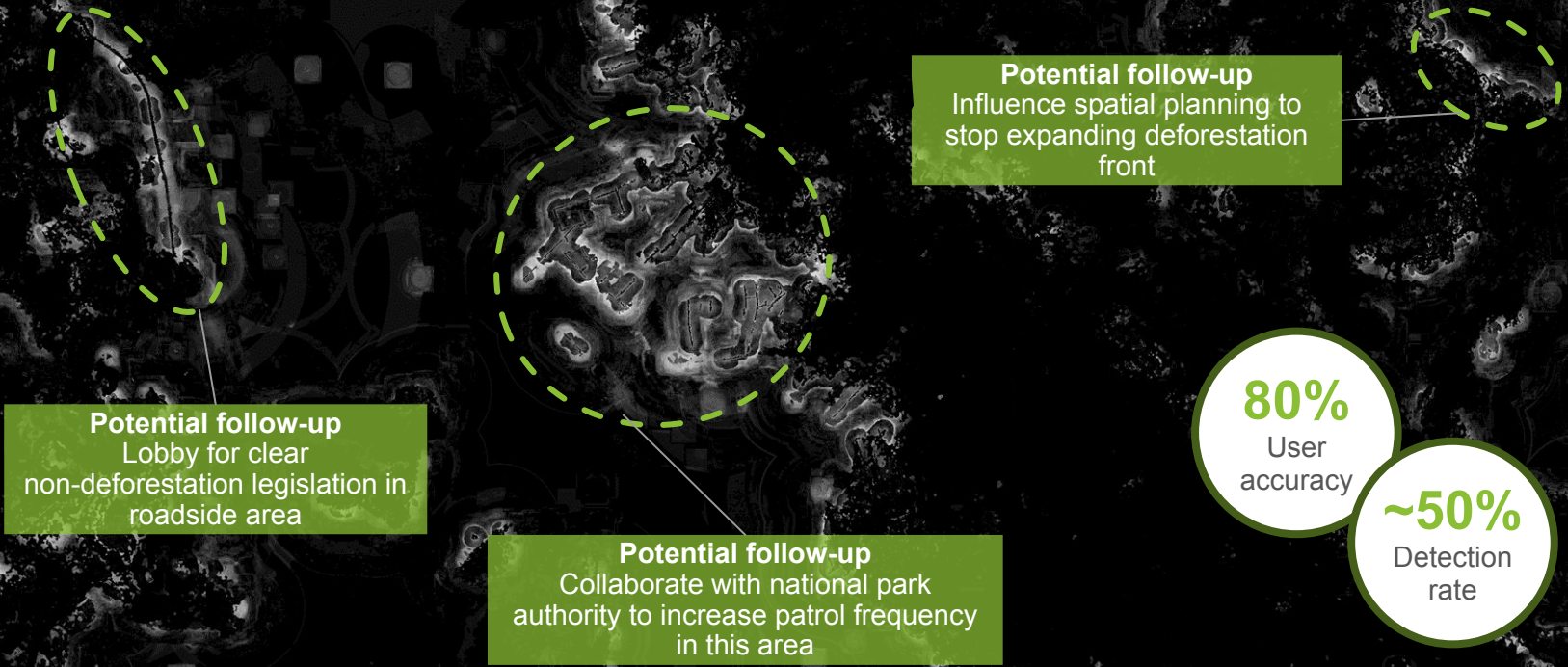
When potentially illegal deforestation is spotted, users can create investigations to follow up the alert



... which are then followed up through in-field investigations

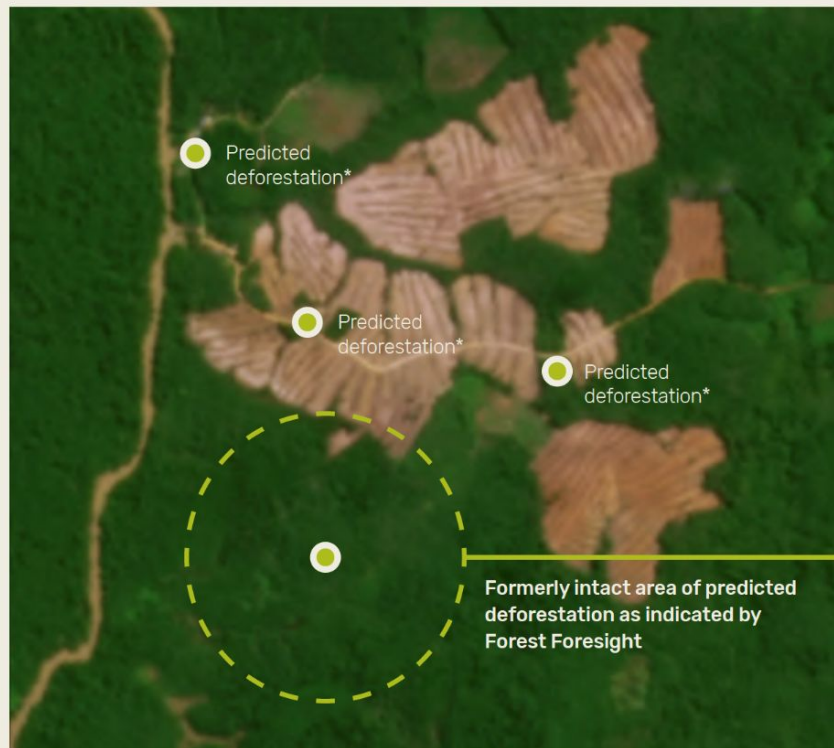


We can accurately predict where deforestation will happen in the next 6 months

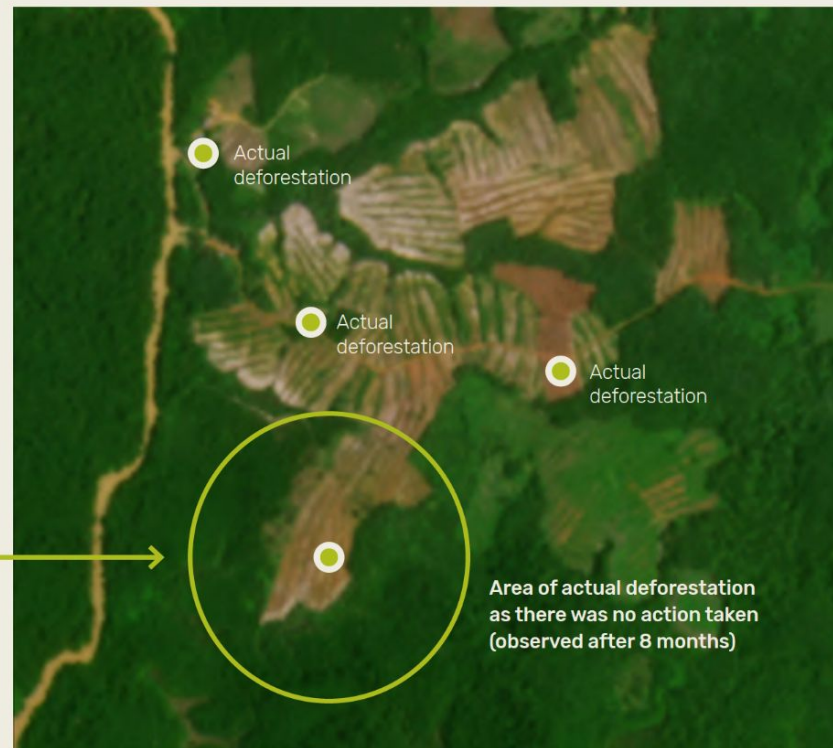


How the prediction model corresponds with actual deforestation

These images show an example of a prediction that was made by our Forest Foresight program, which unfortunately came true. The image on the right shows that deforestation has taken place.



Before - June 2021 Central Kalimantan (Indonesia)



After - February 2022 Central Kalimantan (Indonesia)

* for illustrative purposes this is a simplification of predicted hotzone representation

Designed roles & responsibilities for relevant stakeholders

6 Key Roles and the relevant agencies identified to be involved in EWS local governance

Training Core-Team	<ul style="list-style-type: none"> Responsible for the overall implementation and monitoring of EWS across 100 hours, 6 months Monitor progress on a regular basis and coordinate all cross-agency activities Support the implementation of the training and ensure it is delivered to all agencies Ensure the training is delivered in a timely and effective manner
Steering Panel	<ul style="list-style-type: none"> Responsible for the overall implementation and monitoring of EWS across 100 hours, 6 months Monitor progress on a regular basis and coordinate all cross-agency activities Support the implementation of the training and ensure it is delivered to all agencies Ensure the training is delivered in a timely and effective manner
Data Centre	<ul style="list-style-type: none"> Full operations of the Data Centre from business hours until the end of the day Support the implementation of the training and ensure it is delivered to all agencies Ensure the training is delivered in a timely and effective manner
User Board	<ul style="list-style-type: none"> The user board will represent the users of the EWS It will be responsible for the overall implementation and monitoring of EWS Support the implementation of the training and ensure it is delivered to all agencies Ensure the training is delivered in a timely and effective manner
Management Team	<ul style="list-style-type: none"> Responsible for the overall implementation and monitoring of EWS across 100 hours, 6 months Monitor progress on a regular basis and coordinate all cross-agency activities Support the implementation of the training and ensure it is delivered to all agencies Ensure the training is delivered in a timely and effective manner
Training Panel	<ul style="list-style-type: none"> Responsible for the overall implementation and monitoring of EWS across 100 hours, 6 months Monitor progress on a regular basis and coordinate all cross-agency activities Support the implementation of the training and ensure it is delivered to all agencies Ensure the training is delivered in a timely and effective manner

Setup of local governance critical to FF success

Organize regular meeting cadence for each phase

Set of regular check-in cadence set up to ensure proper tracking of Pilot progress

Meeting Scope	On the Ground Coordination Weekly meeting to ensure coordination to ensure governance	Intervention Planning Monthly meetings with PMO, Intervention to check on progress	Update to Head of Forest Monthly meetings with PMO, Intervention to check on progress	Regional Steering Meeting Quarterly meetings with PMO, Intervention to check on progress
Participants	PMO, Head and Decision team	PMO, Head, Intervention, Head of Forest on track	PMO, Head, Intervention, Head of Forest on track	PMO, Head, Intervention, Head of Forest on track
Frequency	1 meeting/week	1 meeting/month	1 meeting/month	1 meeting/quarter
Agenda	<ul style="list-style-type: none"> Review the progress of the pilot Coordinate across agencies Review intervention progress & need from Community/Advisors Board Review progress from the pilot 	<ul style="list-style-type: none"> Review progress of the pilot Review intervention progress & need from Community/Advisors Board Review progress from the pilot 	<ul style="list-style-type: none"> Review progress of the pilot Review intervention progress & need from Community/Advisors Board Review progress from the pilot 	<ul style="list-style-type: none"> Review progress of the pilot Review intervention progress & need from Community/Advisors Board Review progress from the pilot

Set up team to coordinate stakeholders, organize trainings...

Pilot: These are the names of PMO¹ Team who will guide the EWS pilot process

Footnote:

¹ PMO = Project Management Office - responsible for the overall implementation and monitoring of EWS across 100 hours, 6 months

Align governance scheme and set up steering, user board etc.

Proposed Hybrid governance: Ensure rightful authority owns intervention in their jurisdiction?

Footnote:

¹ PMO = Project Management Office - responsible for the overall implementation and monitoring of EWS across 100 hours, 6 months

FF global team



+ Future partnerships

FF local (Kalimantan)





MOTION DETECTING CAMERAS AND AI



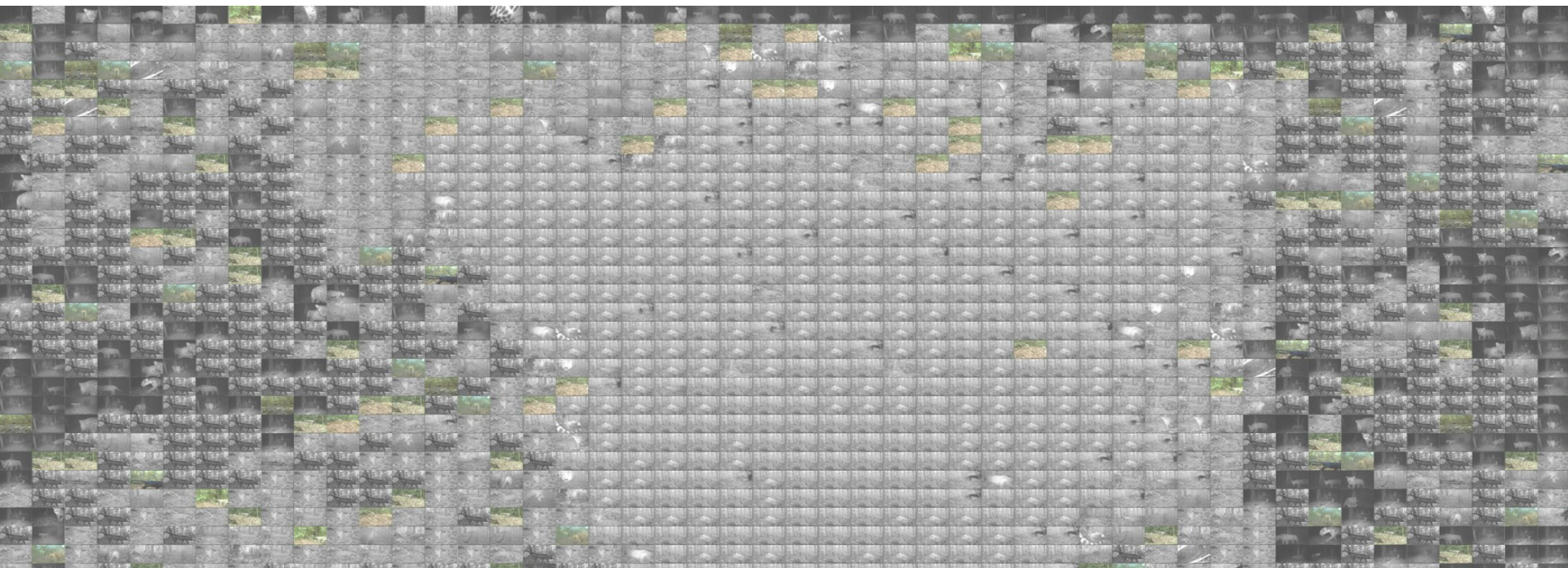
Motion sensitive cameras are everywhere

1,000s of projects

100,000s of cameras

Many 10,000,000s of images

Steenweg et al. 2017



A big challenge in wildlife conservation

Camera traps can provide the necessary data about
wildlife populations

Millions of images are taken around the world every day

Yet most of these images and data are not effectively shared or
analyzed, leaving valuable insights just out of our reach



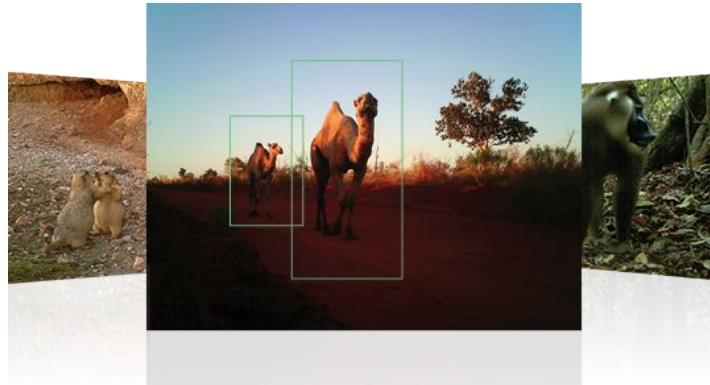
In development

Upload



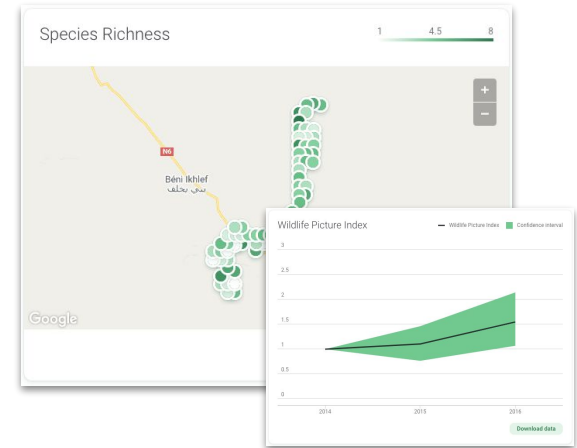
**Images and metadata
are uploaded to the
Google Cloud.**

Identify



**AI helps to identify
what's in the image.**

Analyze



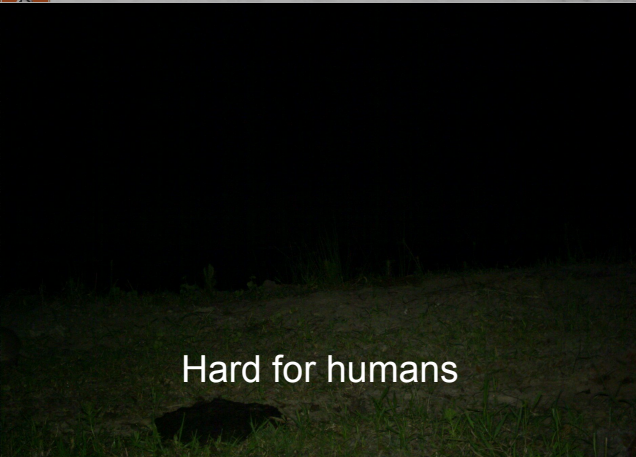
**Analyses are calculated
automatically.**






The AI models in Wildlife Insights
catch **79%** of blank images
with an **error rate of less than 12%**.

Cameras present lots of challenges for the AI models



A photograph of a dense forest floor, likely a tropical or subtropical environment. The ground is covered with a thick layer of dry, brown leaves and twigs. In the background, there are numerous green plants, including what appears to be a palm tree on the right and various other leafy plants. The lighting is somewhat dim, suggesting a shaded forest interior. A semi-transparent dark overlay is present across the center of the image, where white text is displayed.

For ~100 species Wildlife Insights AI models are able to catch
between **80% and 98.6%** correctly.

A dark bird, possibly a frigatebird, is shown in a natural setting with dry leaves and twigs on the ground. The bird is positioned in the lower right quadrant of the frame, facing left. Its body is dark, and its legs are visible. The background is slightly blurred, showing more of the ground and some green foliage in the distance.

Human experts can label between
300-1000 images per hour.

A single machine can identify 18,000 images per hour, and when we
parallelize across hundreds or thousands of GPUs,
AI can save biologists a lot of time.

Impact

2400+

approved users

43+

million images

140+

protected areas

993

species in AI model

15

million images in
training set

12%

Error rate on blanks

Showing 43,070,623 camera trap records taken in the whole world between 1990-01-02 and 2022-08-07.

[See filters and statistics](#)

Exploring data



wildlifeinsights.org

Eyes on Recovery

Using Wildlife Insights to measure the impact of the 2019-20 summer bushfires on Australia's wildlife



© Kangaroo Island Land for Wildlife



Abby Hehmeyer & Arno Lyet (WWF US), Emma Spencer (WWF AUS)

The Problem

Summer 2019-20 bushfires in Australia burned **19 million hectares** (about the size of Cambodia)

3 billion animals impacted

Unclear whether **priority species** were recovering...



The Solution

Convince dozens of organizations to join forces under a **single monitoring initiative**

Use **Wildlife Insights** to manage and analyze CT data

Better understand the **population trends of target species** post fire



By the Numbers

18 partners including Universities, natural resource managers, NGOs, and four state government agencies (SA, NSW, VIC and QLD)

1,146 cameras deployed across **15 projects**;
generating almost **3M images**

126 Wildlife Insights users

9 target & 123 non-target species detected across our monitoring sites

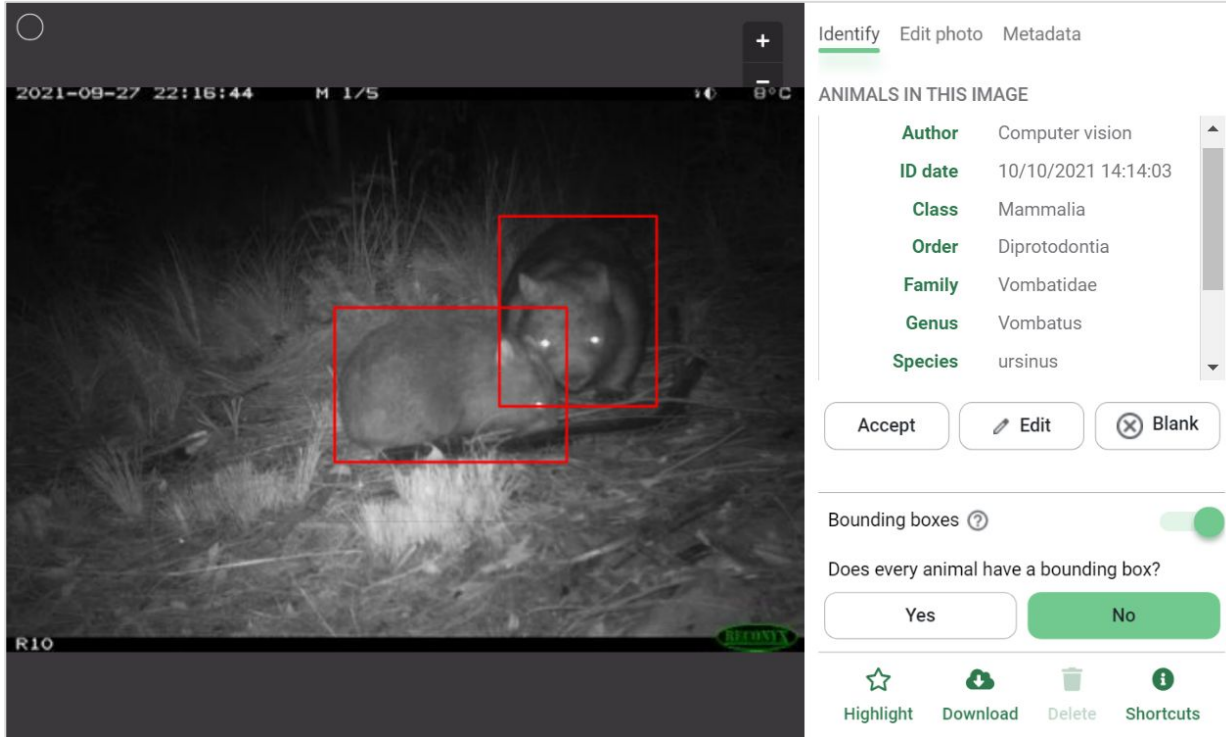
13 management actions identified to date to facilitate recovery



Here are some of the amazing animals we have captured on camera



Data processed in Wildlife Insights



2021-09-27 22:16:44 M 1/5 10 8°C

Identify Edit photo Metadata

ANIMALS IN THIS IMAGE

Author	Computer vision
ID date	10/10/2021 14:14:03
Class	Mammalia
Order	Diprotodontia
Family	Vombatidae
Genus	Vombatus
Species	ursinus

Accept Edit Blank

Bounding boxes

Does every animal have a bounding box?

Yes No

Highlight Download Delete Shortcuts

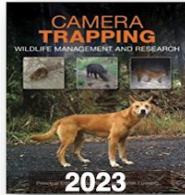
2.5 million images used to train WI computer vision model

Excellent feedback from AUS users: **5x increase in image processing speed**

~500 hours of staff time saved per project site location

WildObs – streamlining Australia's camera trap data pipeline

1 Standardise & secure images streams



Deployment manual



App for field metadata

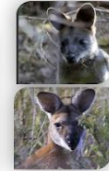


Images secured on Australian servers

2 Efficiently process images into datasets



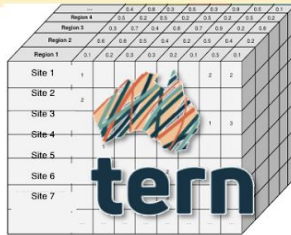
Remove blanks →
Object detection →
Segmentation →
Classification



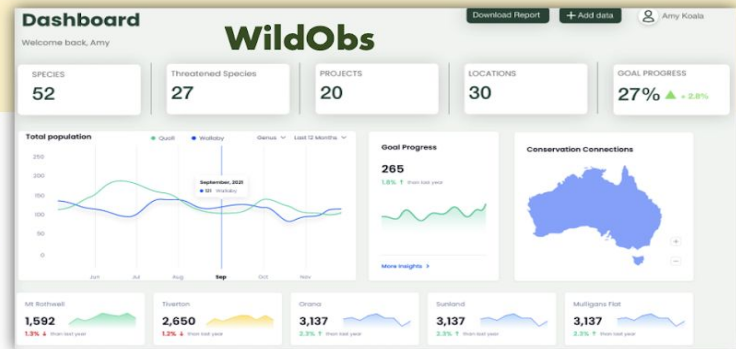
Computer vision AI classifies >95% images

Human oversight

3 Collate, curate, and share the national database



Interactive dashboard for exploring projects & data downloads



Big Outstanding Challenges

- Social Metrics (e.g. poverty, climate resilience)
- Data privacy and sovereignty versus FAIR principles
- Connecting Global and Local (See GLASSNET for example)
- Digital Sustainability (See the Coalition for Digital Environmental Sustainability - CODES)
- The big one - Impacts, both measuring and attaining



Thanks!



WWF