
WWF

AI and Resilience

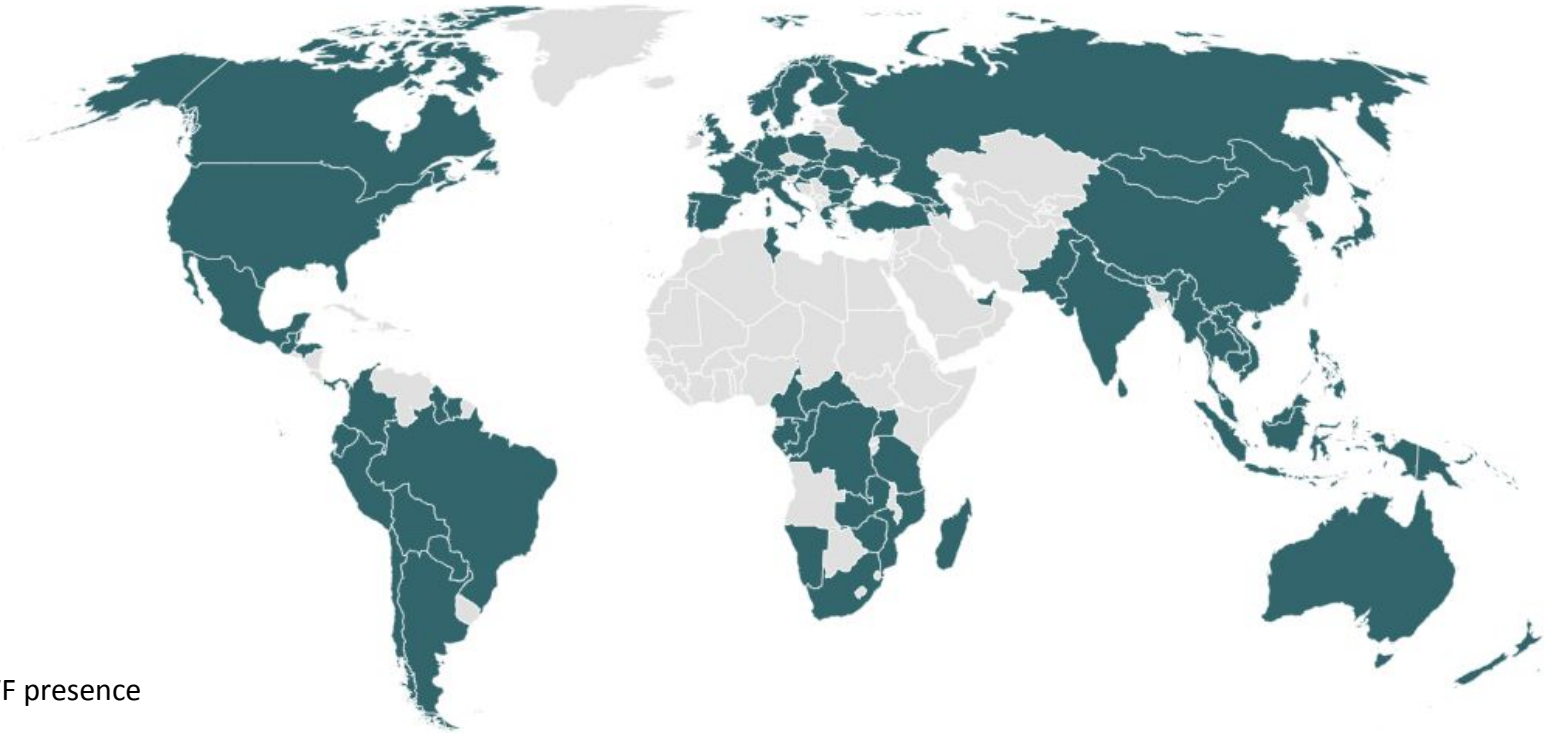
From a Conservation Perspective

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

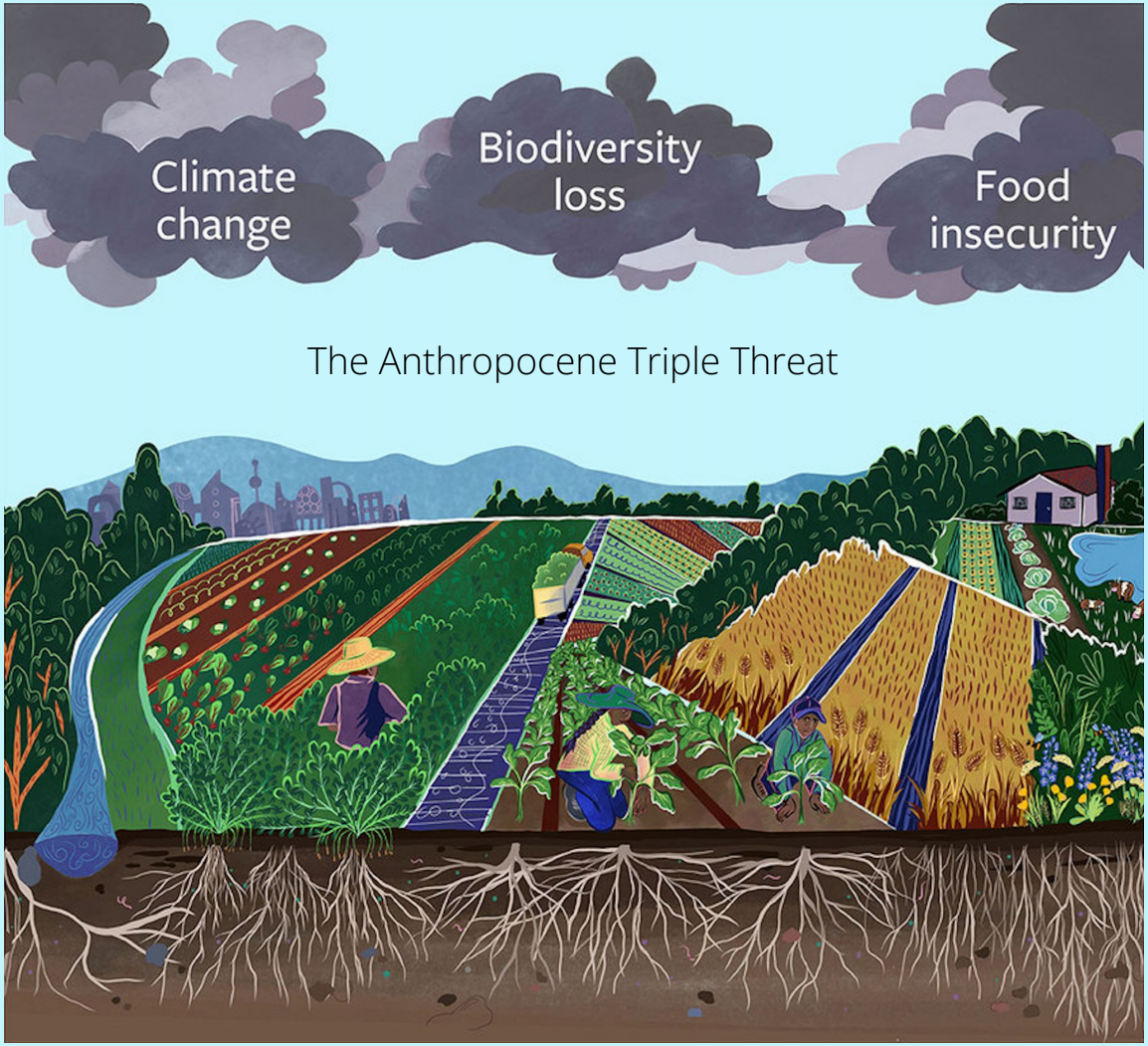
Where we work



WWF presence

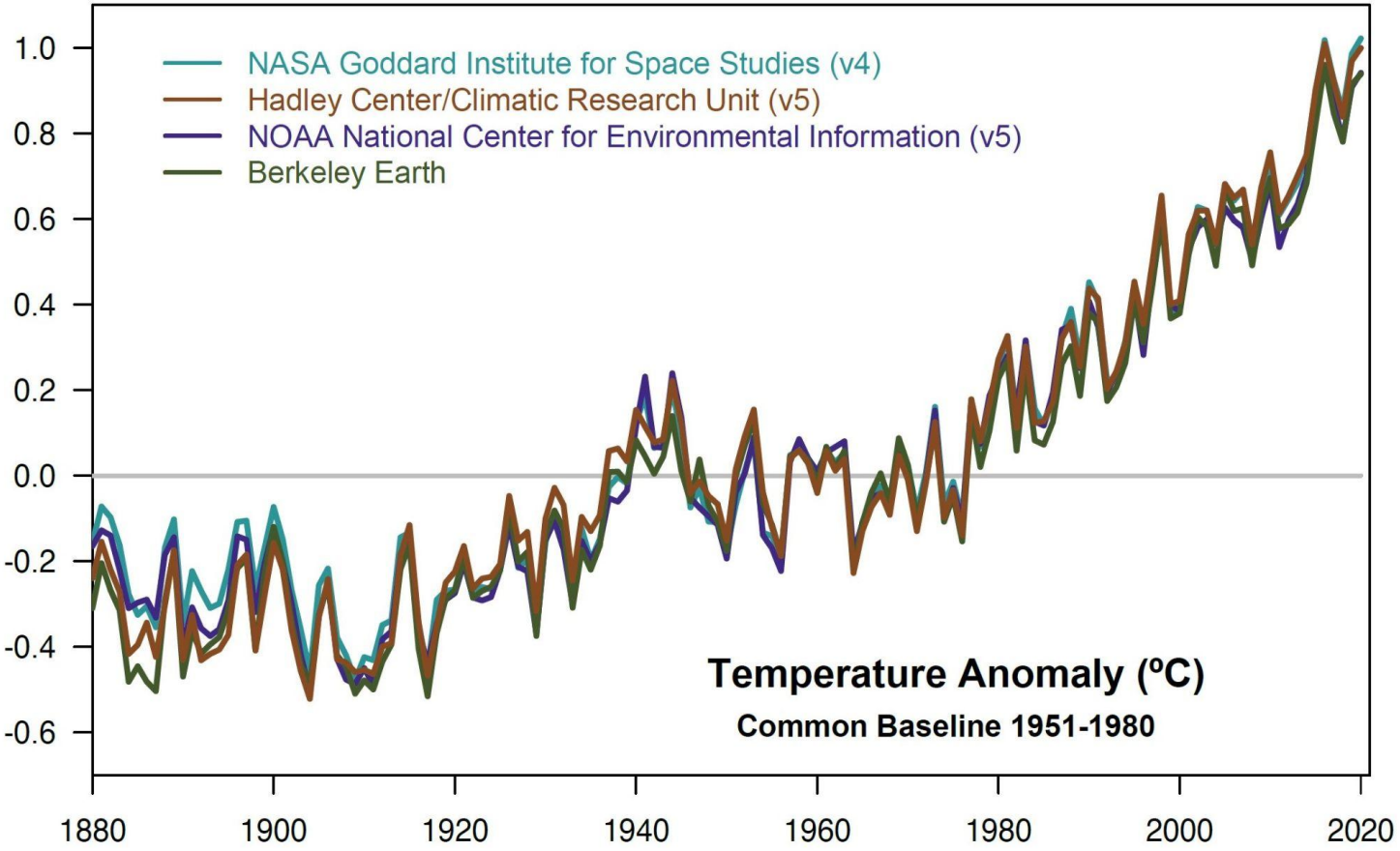
WWF is one of the world's largest global conservation organizations. We have a presence in nearly 100 countries around the world.

WWF’s work aligns around 6 areas of focus



The Anthropocene Triple Threat

Image created by Aidee Guzman

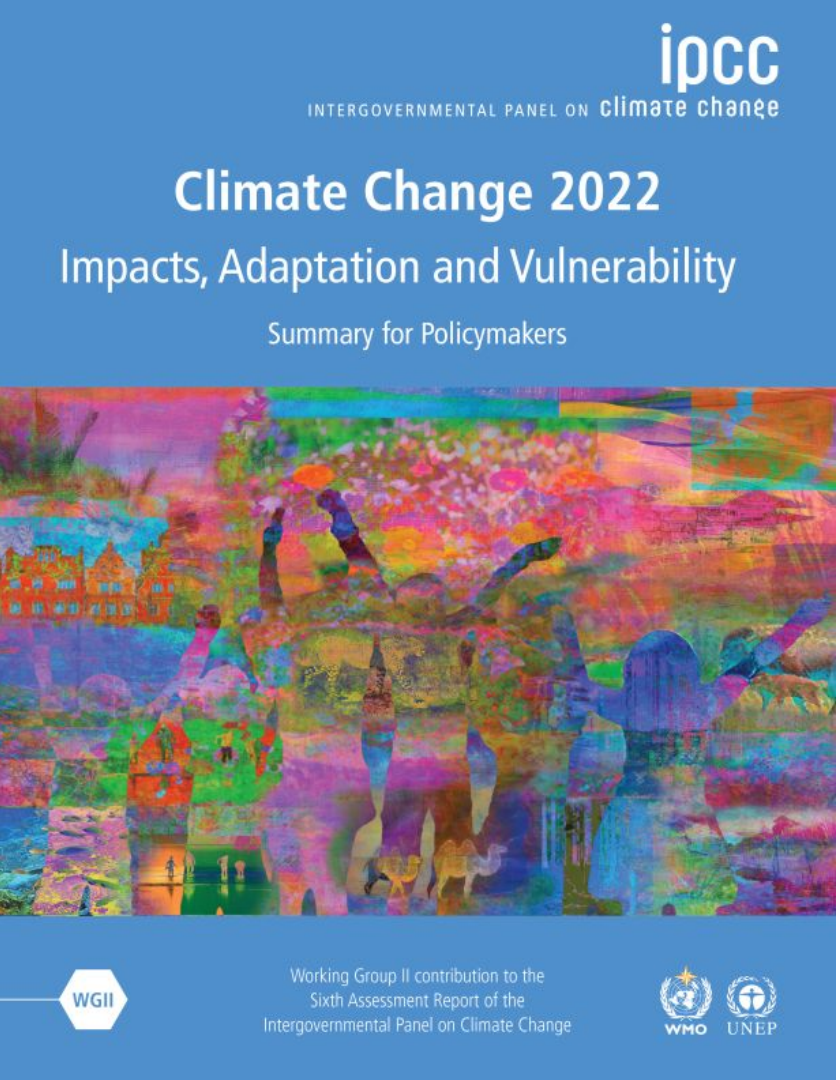

NASA Goddard Institute for Space Studies (v4)
Hadley Center/Climatic Research Unit (v5)
NOAA National Center for Environmental Information (v5)
Berkeley Earth
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
1880
1900
1920
1940
1960
1980
2000
2020
Temperature Anomaly (ºC)
Common Baseline 1951-1980

Source: NASA

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

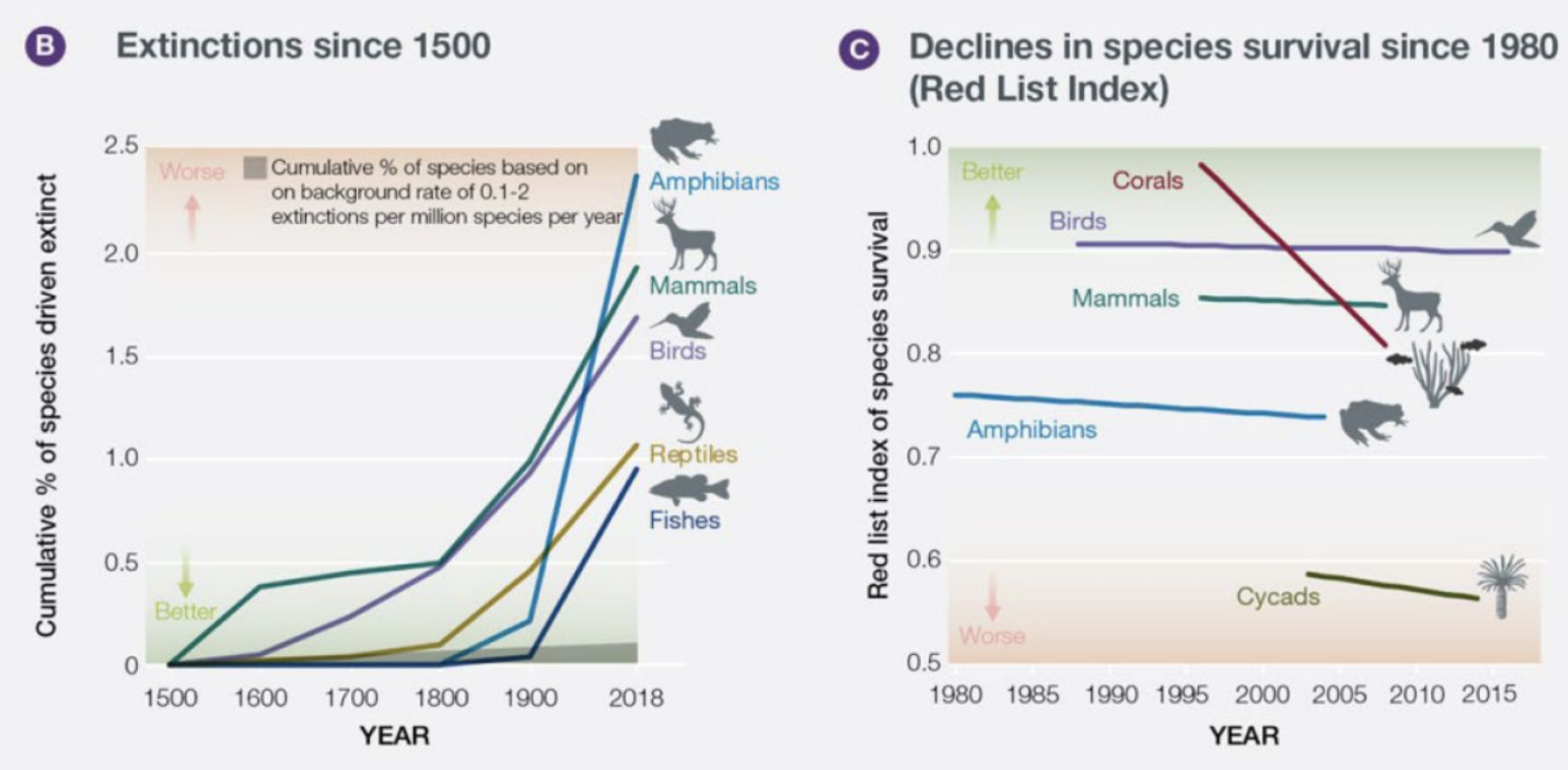
https://www.germanwatch.org/en/19777



- 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

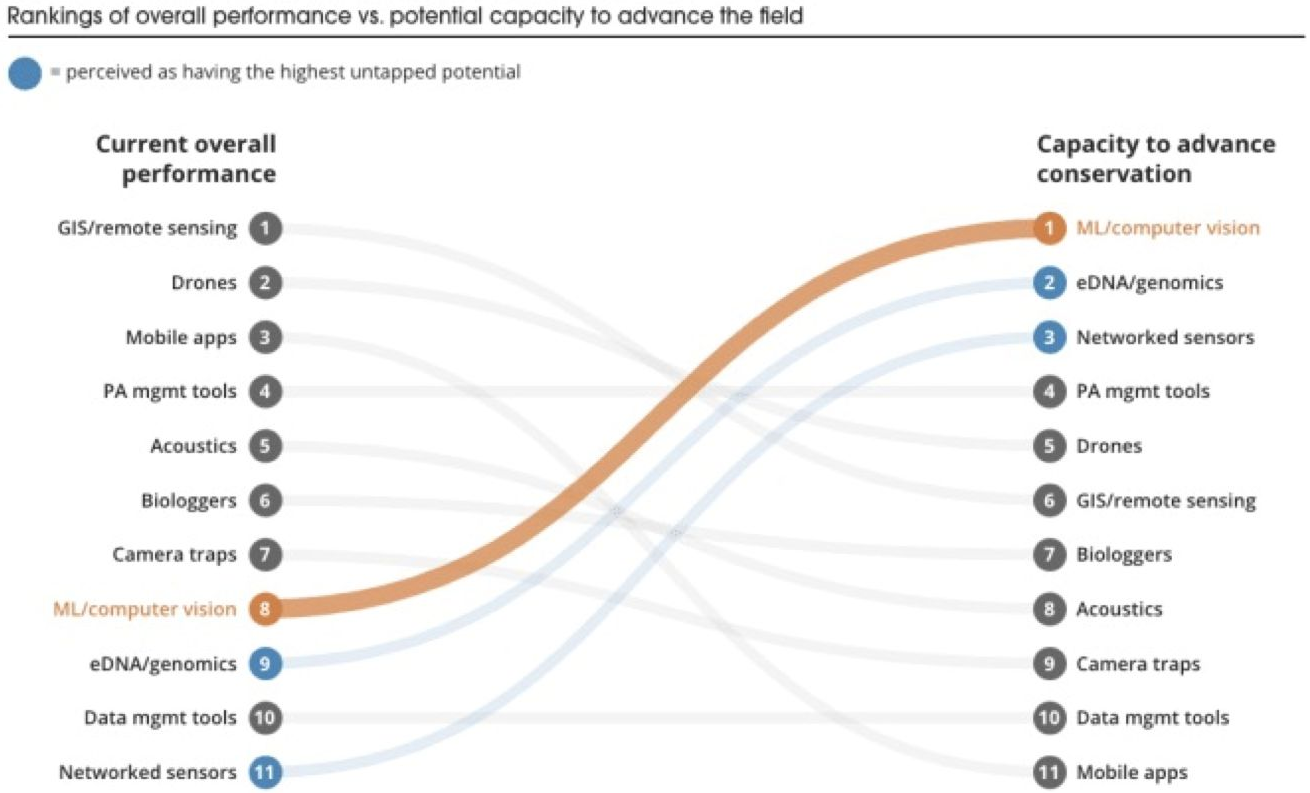
Takeaways III: Climate resilient development

- **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



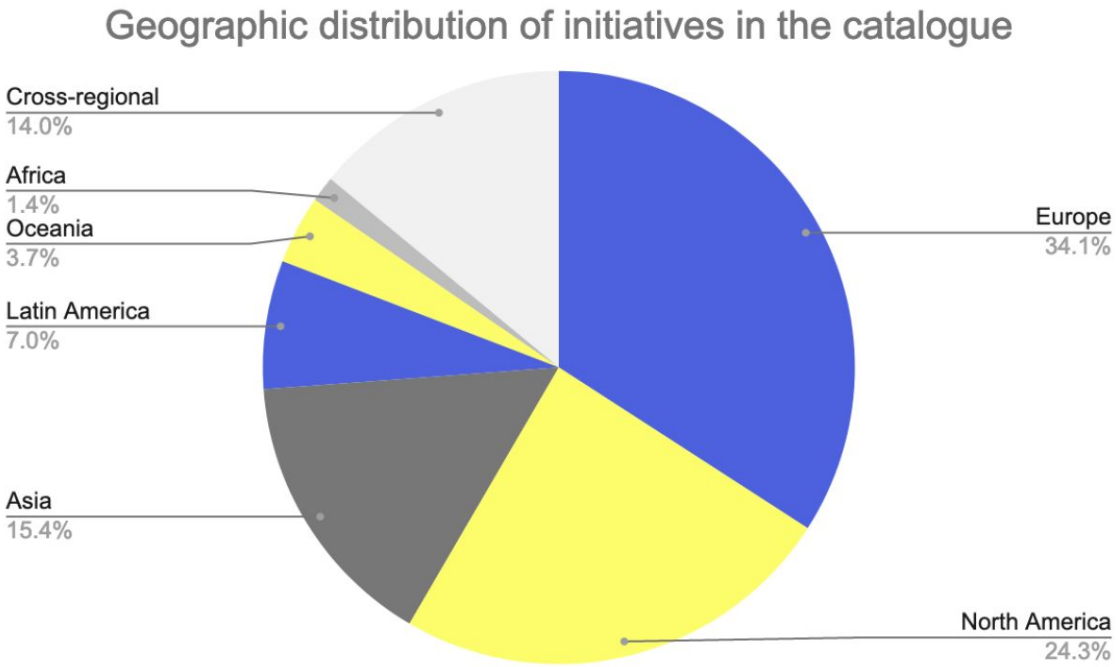
Source: Intergovernmental Science-Policy Platform on Biodiversity And Ecosystem Services (IPBES) Global Assessment

The “State of Conservation Technology”



Speaker et al 2021 Con Bio

AI for Social Good : Global Partnership on AI



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 km^2

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 CO_2

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).

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

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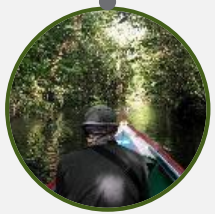
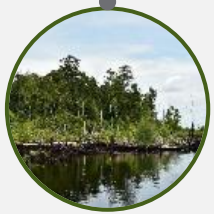


Pristine forest

1

Road & canal development

2



Illegal logging

3

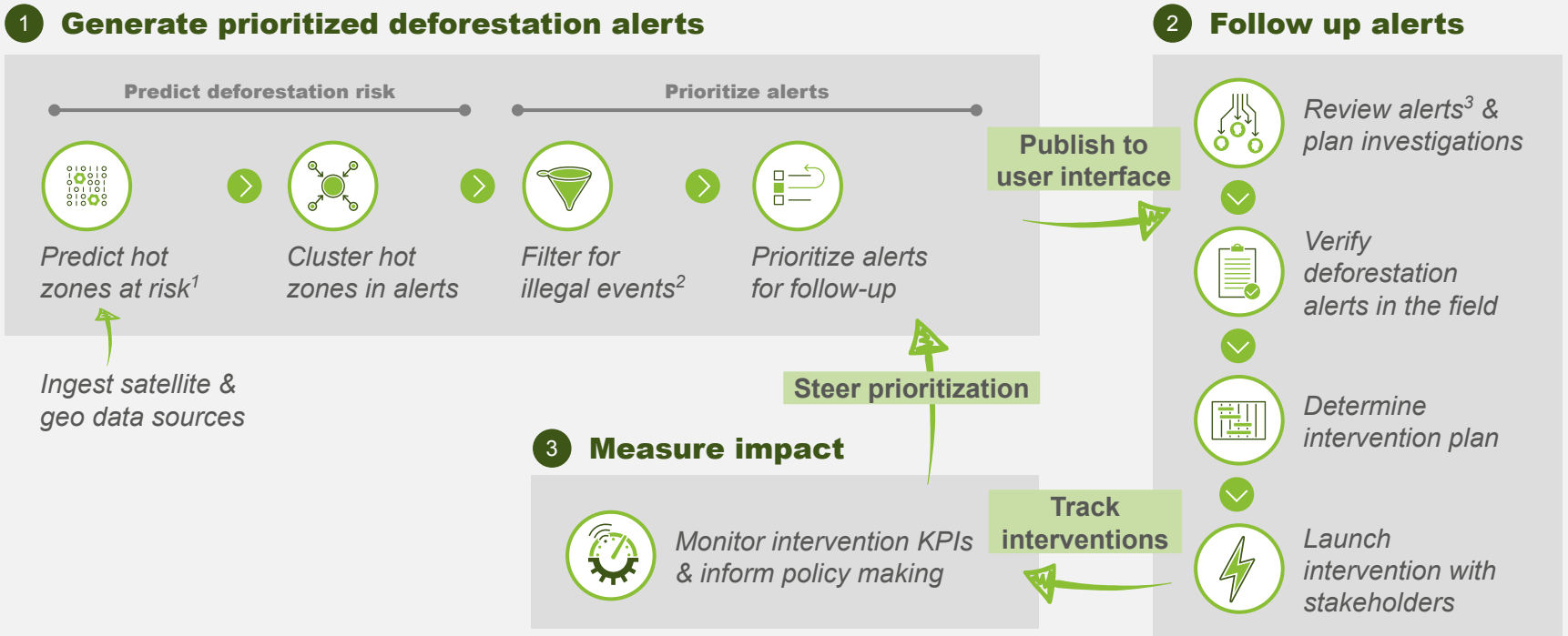
Land clearing and conversion

Source: Photos were taken near the Sebangau National Park border (Central-Kalimantan)

Existing forest monitoring systems

Existing forest monitoring systems

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



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

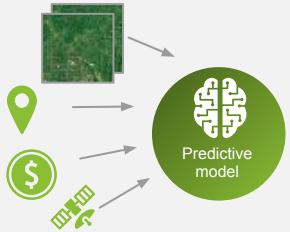
Predict hot zones at risk

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

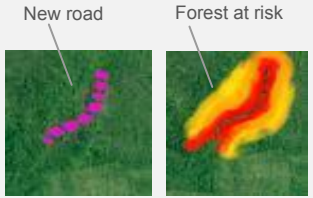
2. Collect input data and generate data set with static and dynamic indicators

- Topological data
- Socio-economic data
- Satellite data and land cover data

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



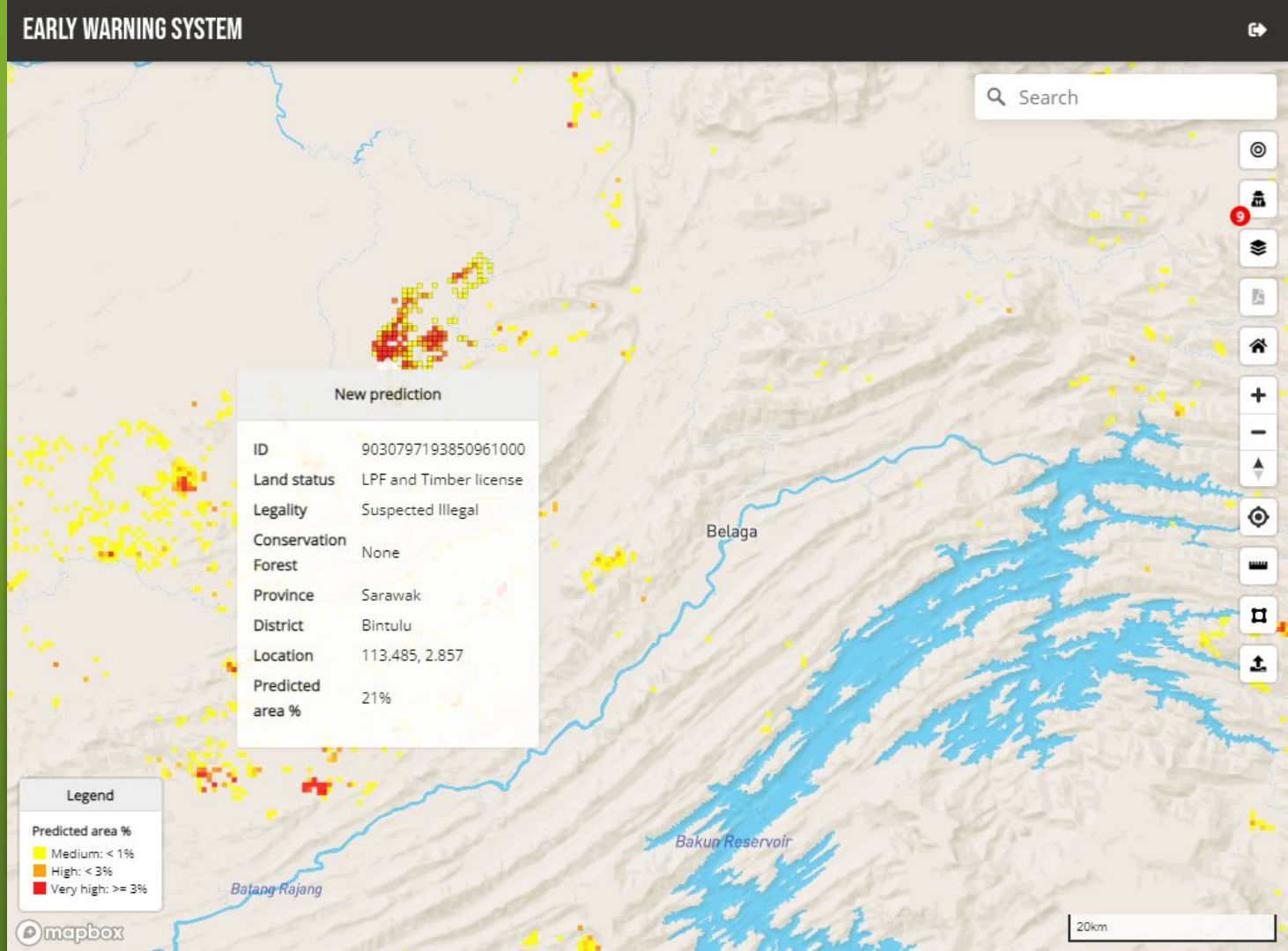
Dynamic indicators

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

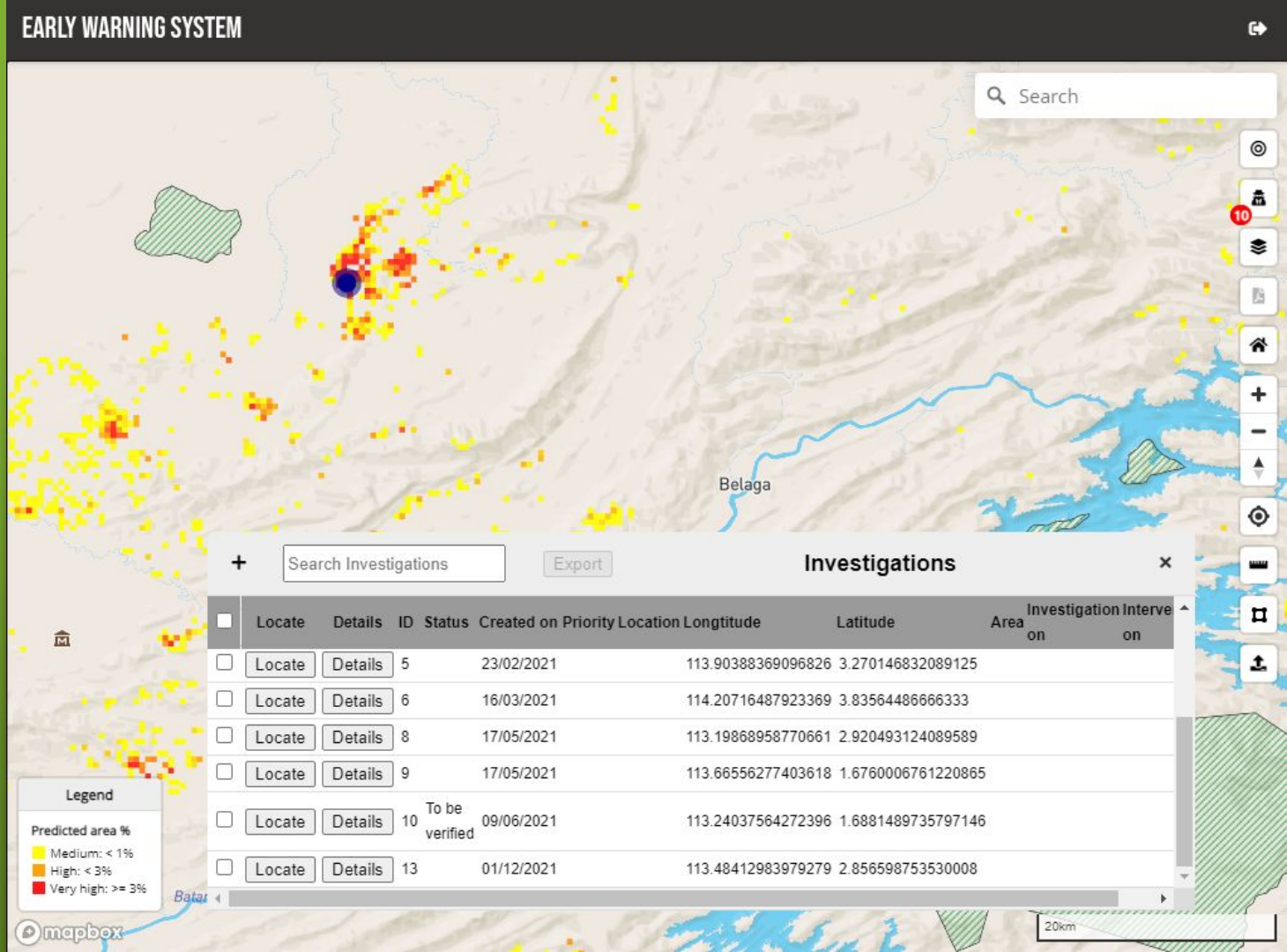
Static indicators

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

Dashboard visualizes predictions of 'deforestation hot zones'

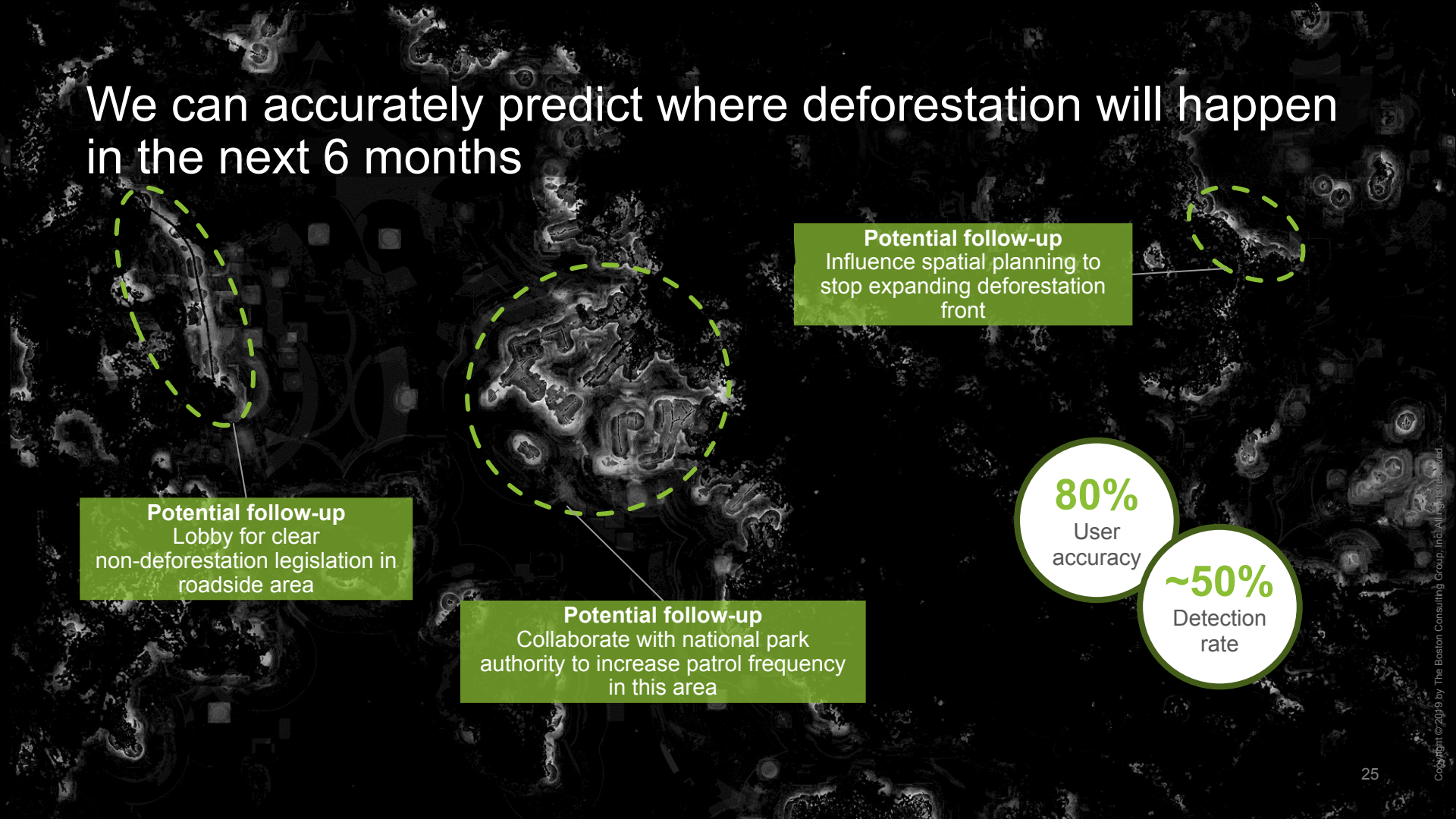


When potentially illegal deforestation is spotted, users can create investigations to follow up the alert



… which are then followed up through in-field investigations

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



Potential follow-up
Influence spatial planning to stop expanding deforestation front

Potential follow-up
Lobby for clear non-deforestation legislation in roadside area

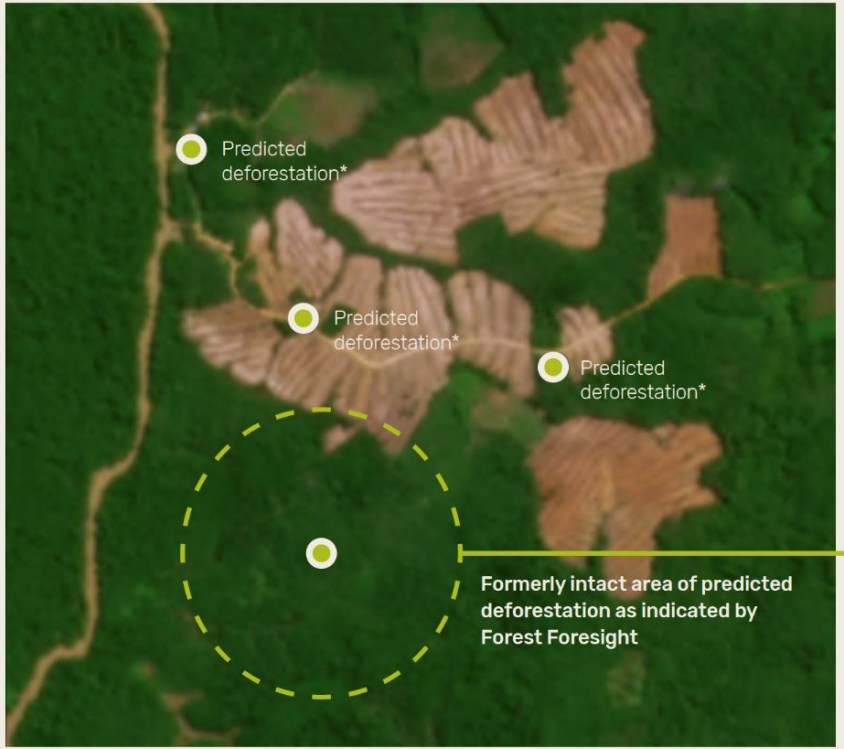
Potential follow-up
Collaborate with national park authority to increase patrol frequency in this area

80%
User accuracy

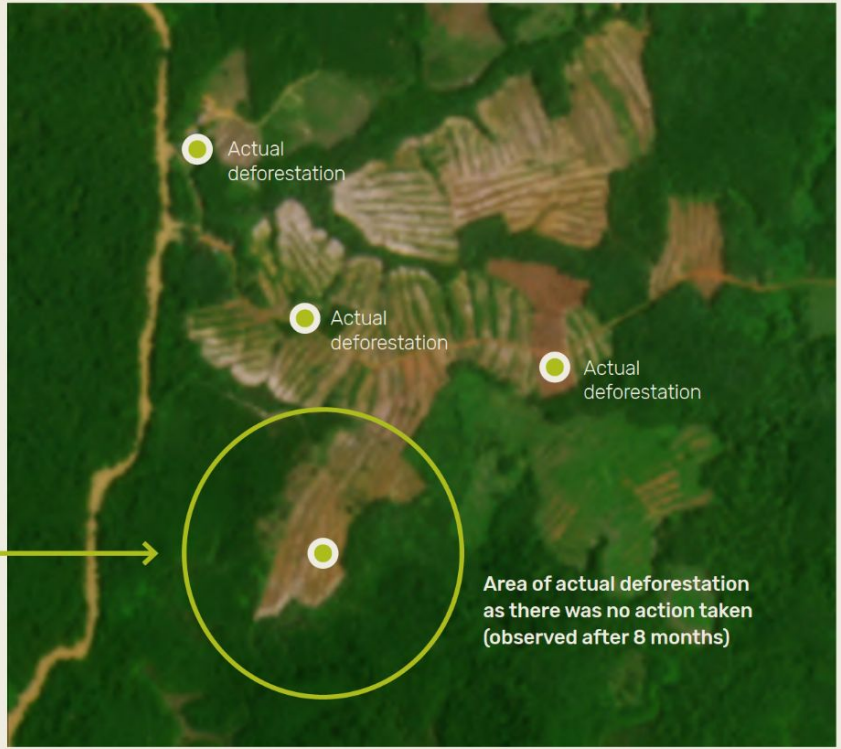
~50%
Detection rate

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)

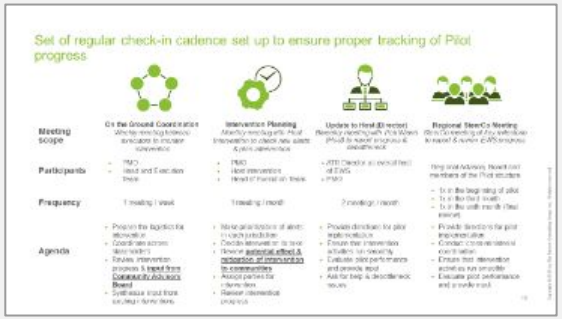
* for illustrative purposes this is a simplification of predicted hotzone representation

Setup of local governance critical to FF success

Designed roles & responsibilities for relevant stakeholders

Set up team to coordinate stakeholders, organize trainings…

Organize regular meeting cadence for each phase



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

FF global team

+ Future partnerships

FF local (Kalimantan)

MOTION DETECTING CAMERAS AND AI

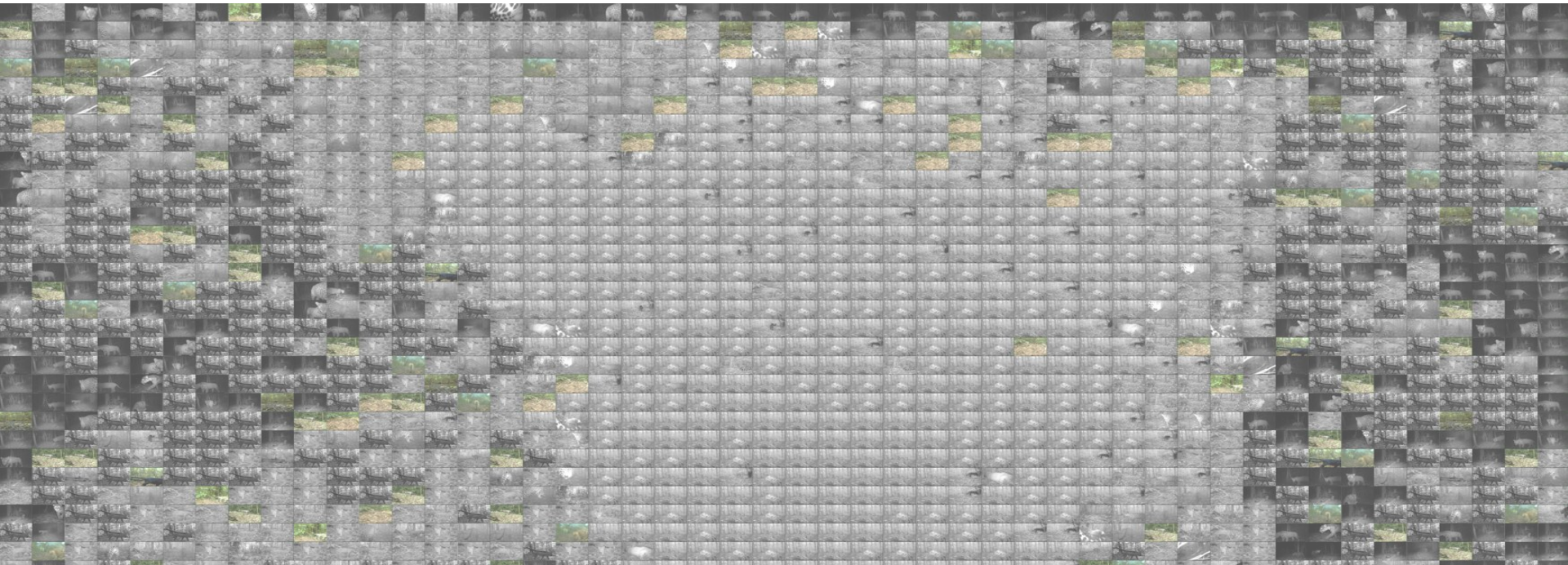
Motion sensitive cameras are everywhere

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

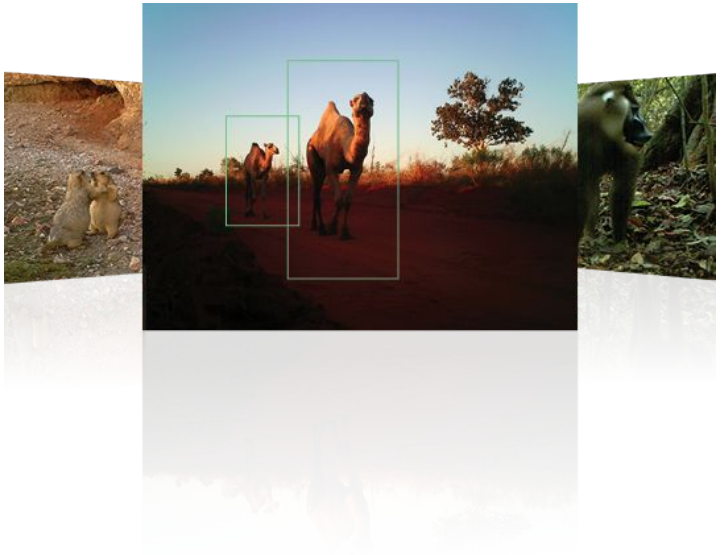
Wildlife Insights

In development

Upload

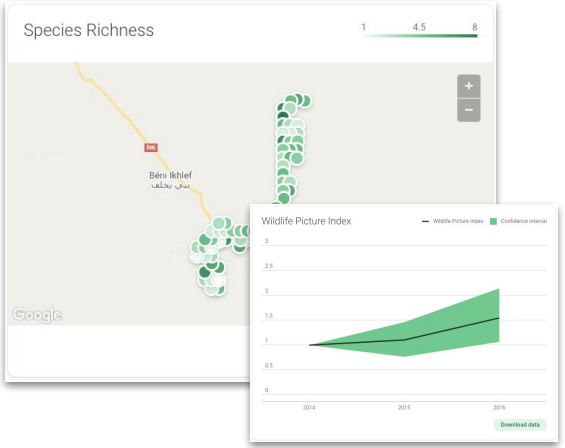
Images and metadata are uploaded to the Google Cloud.

Identify

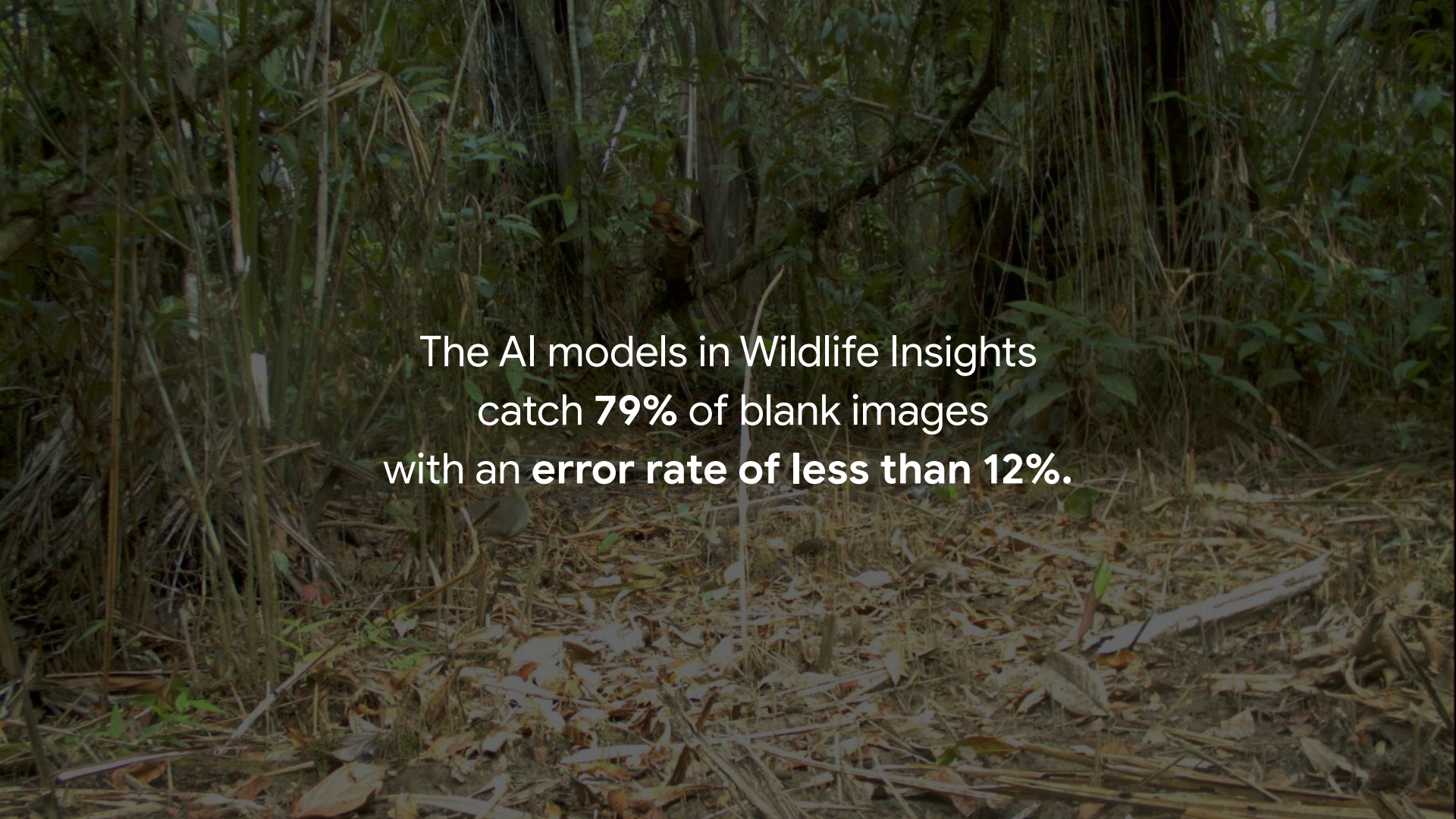


AI helps to identify what's in the image.

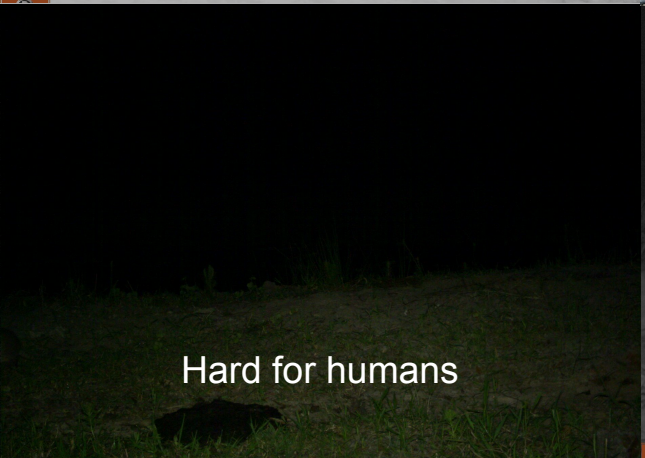
Analyze

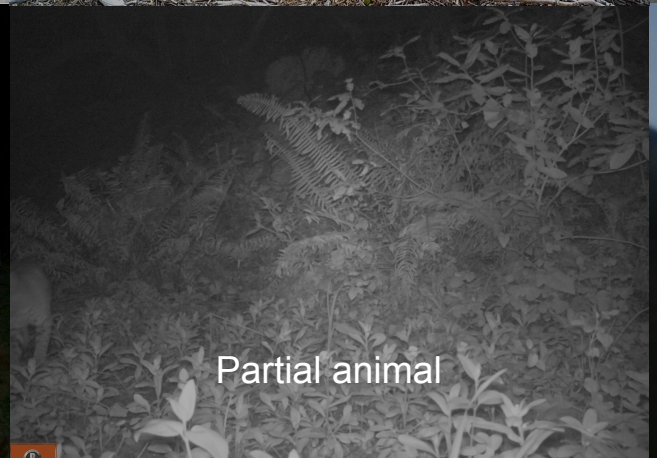


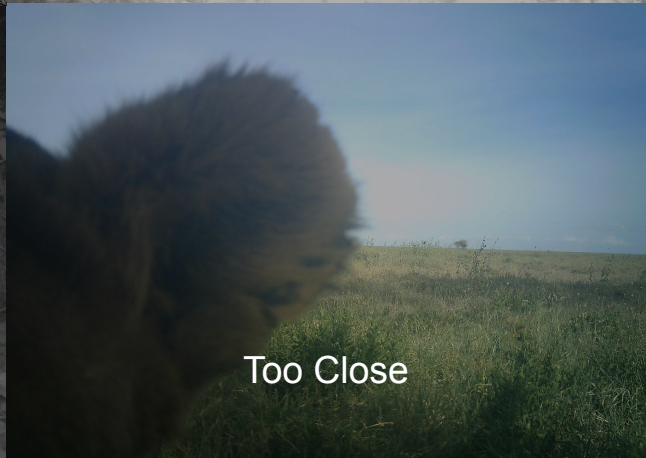
Analyzes are calculated automatically.


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








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

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

993
species in AI model

43+
million images

15
million images in training set

140+
protected areas

12%
Error rate on blanks

Exploring data

wildlifeinsights.org

Eyes on Recovery

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

Google

WWF

CONSERVATION INTERNATIONAL

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

Installing sensor cameras on Kangaroo Island for Eyes on Recovery © WWF-Australia / Slavica Miskovich

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**

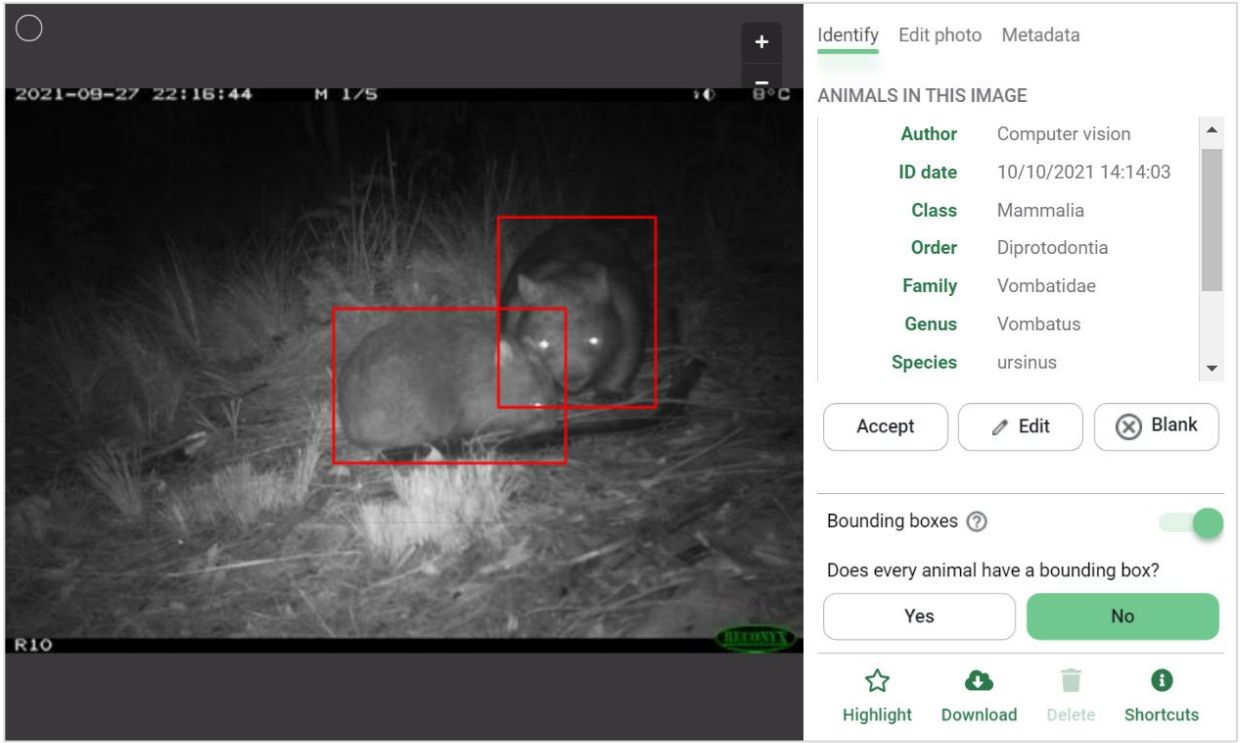
126 Wildlife Insights users

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



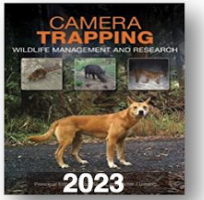
2.5 million images used to train WI computer vision model

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

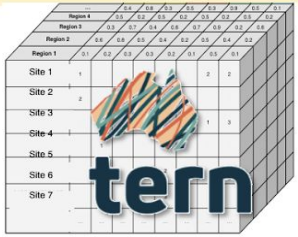
Wildlife Insights

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 for Digital Environmental Sustainability - CODES)
- The big one - Impacts, both measuring and attaining


WWF
Thanks!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