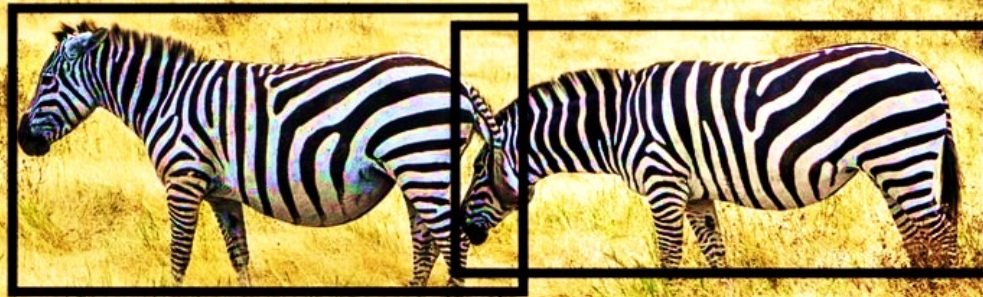
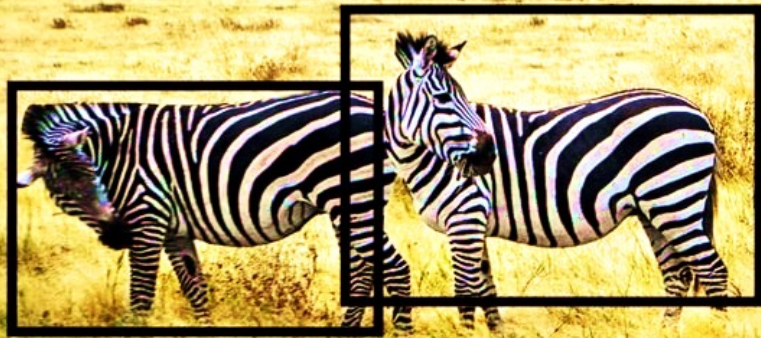


Community Engaged Trustworthy AI for Wildlife Conservation

Tanya Berger-Wolf

Director, Translational Data Analytics Institute
Professor, The Ohio State University
Director, NSF HDR Imageomics Institute
Director and Co-Founder, Wildbook at WildMe.org





UN News



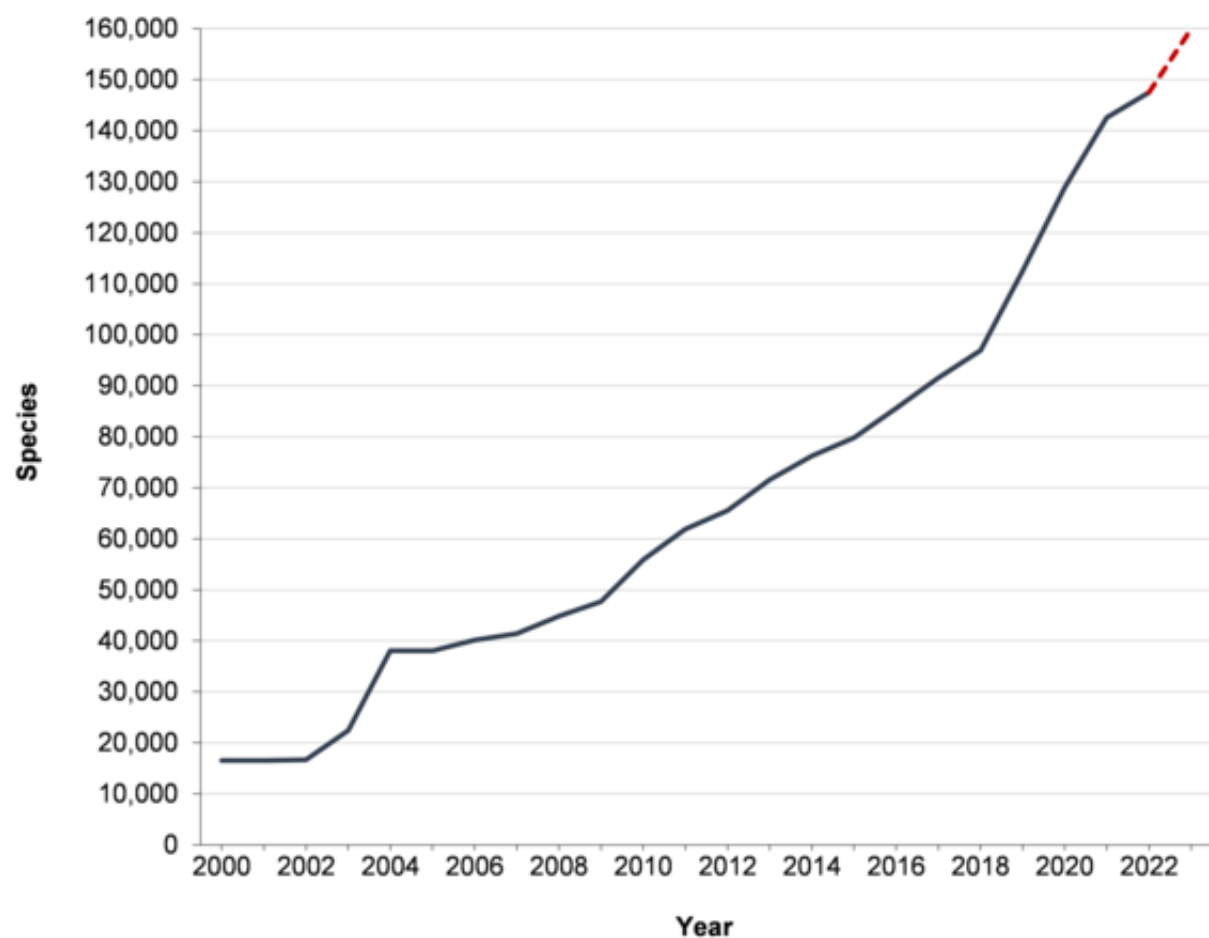
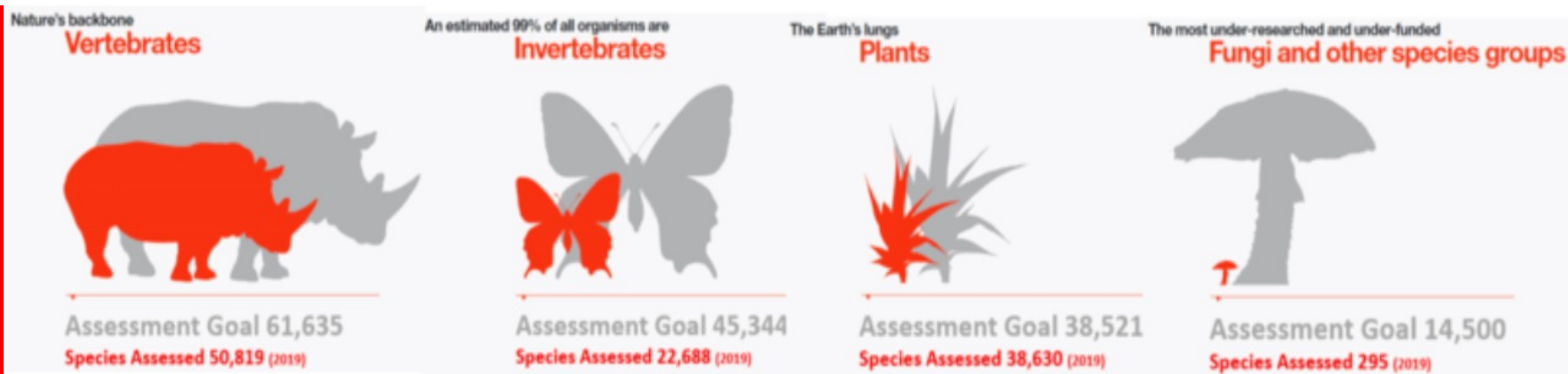
Global perspective
Human stories



[Advanced Search](#)

World is 'on notice' as major UN report shows one million species face extinction



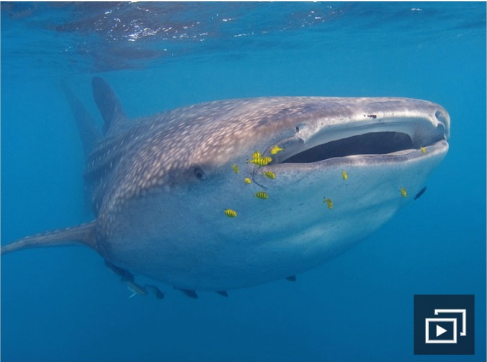


▼ Red List Category

- ☐ EX - Extinct (902)
- ☐ EW - Extinct In The Wild (82)
- ☐ RE - Regionally Extinct (regional category) (0)
- ☐ CR - Critically Endangered (9065)
- ☐ EN - Endangered (16094)
- ☐ VU - Vulnerable (16300)
- ☐ LR/cd - Lower Risk: Conservation Dependent (158)
- ☐ NT or LR/nt - Near Threatened (8714)
- ☐ LC or LR/lc - Least Concern (75733)
- ☐ DD - Data Deficient (20469)



[Back to search results](#)



Whale Shark

Rhincodon typus

CITATION

Pierce, S.J. & Norman, B. 2016. *Rhincodon typus*. *The IUCN Red List of Threatened Species* 2016. e.T19488A2365291. <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T19488A2365291> on 09 January 2019.

The most under-researched and under-funded
Fungi and other species groups



al 38,521
30 (2019)

Assessment Goal 14,500
Species Assessed 295 (2019)



NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	< ENDANGERED >	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
NE	DD	LC	NT	VU	EN	CR	EW	EX

C., Lunn, N., Obbard, M., Regehr, E. & Thiemann, G. 2015. *Ursus*
red Species 2015: e.T22823A14871490.
-4.RLTS.T22823A14871490.en. Downloaded on 09 January 2019.



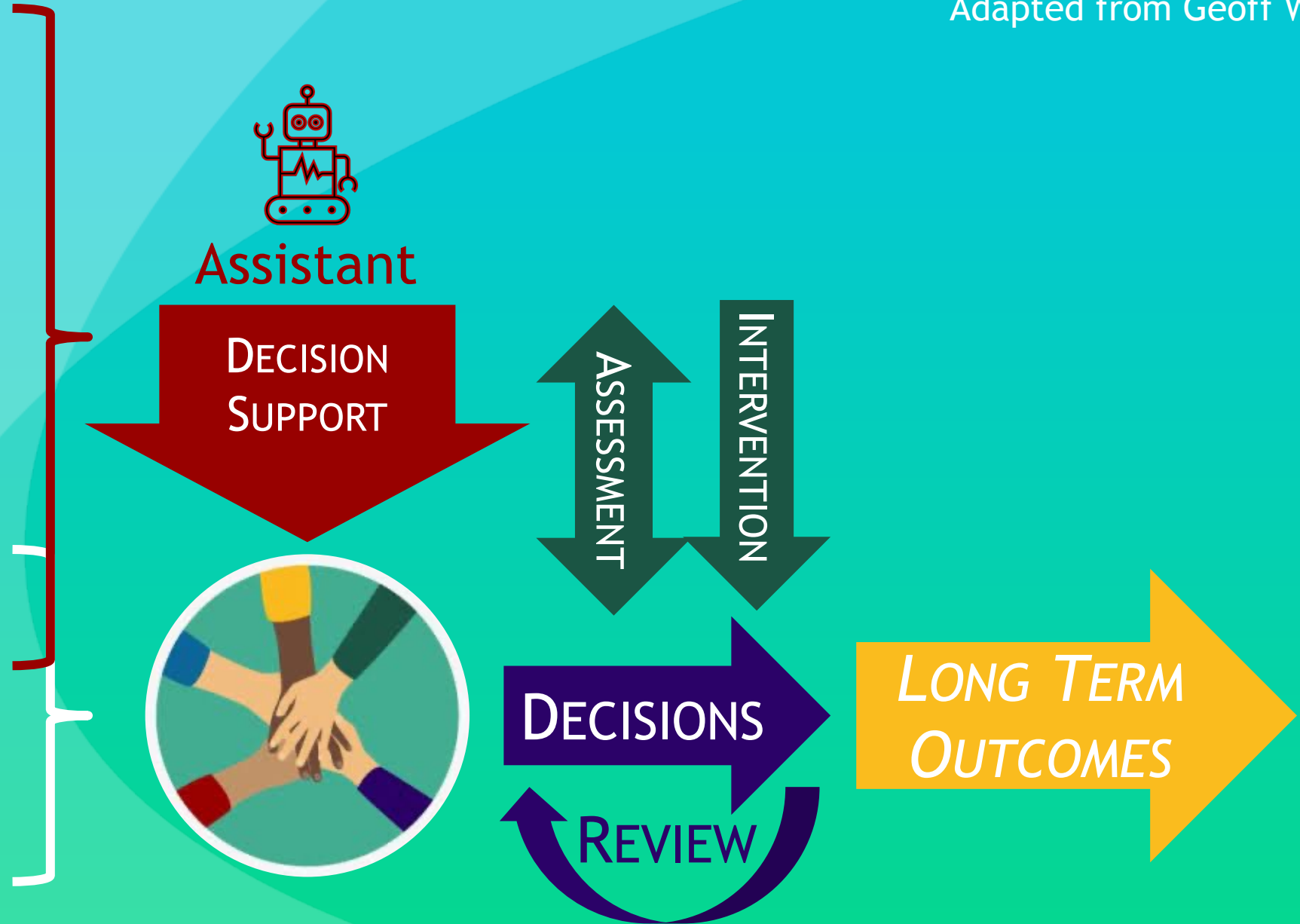
Two global-scale genetic studies on Whale Sharks have estimated genetic effective population size – the number of breeding adults – albeit based on small sample sizes of 70 (Castro *et al.* 2007) and 68 sharks (Schmidt *et al.* 2009), respectively. Castro *et al.* (2007) used mitochondrial DNA to estimate current genetic effective population size to be 119,000–238,000 sharks. Schmidt *et al.* (2009) estimated genetic effective population size to be 103,572, with a standard error of 27,401–179,794, based on microsatellite analysis. However, lack of knowledge on species-specific mutation rates mean these estimates should not be used for management purposes (J. Schmidt pers. comm., T. Vignaud and S. Planes pers. comm).

LY RED	EXTINCT IN THE WILD	EXTINCT
	EW	EX

Evidence-based conservation needs monitoring



ALL OTHER DATA
POPULATION
SURVEYS



How do we engender trust (by design)?

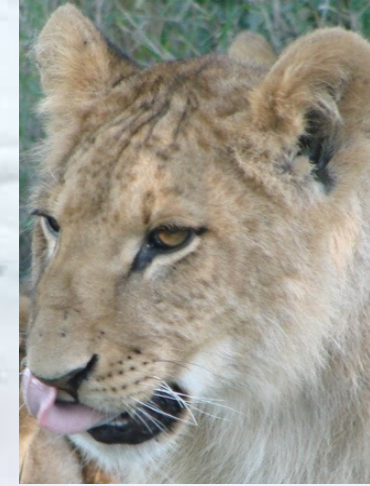
- **Inclusive, collaborative partnership**
 - Change how the solutions are created: **with** whom they benefit, not for them
 - Change **who** creates the solutions: diversity of AI
 - Build **global** AI capacity
- **Transparency, accountability**
 - **Open** source, open process, **interpretability** (possibly explainability)
 - Clear **assumptions**, uncertainty, limits
 - **Responsibility** for the outcomes, monitoring and changing over time
- **Safety**
 - **Do no harm**: improvement on existing, including the cost (environmental too)
 - Data **governance** (protection, security, privacy)
 - **Fairness** and bias



Flukebook.org/Wildbook.org



WWF Finland/Wildbook.org



Snow Leopard Conservancy



WWF International/Wildbook.org

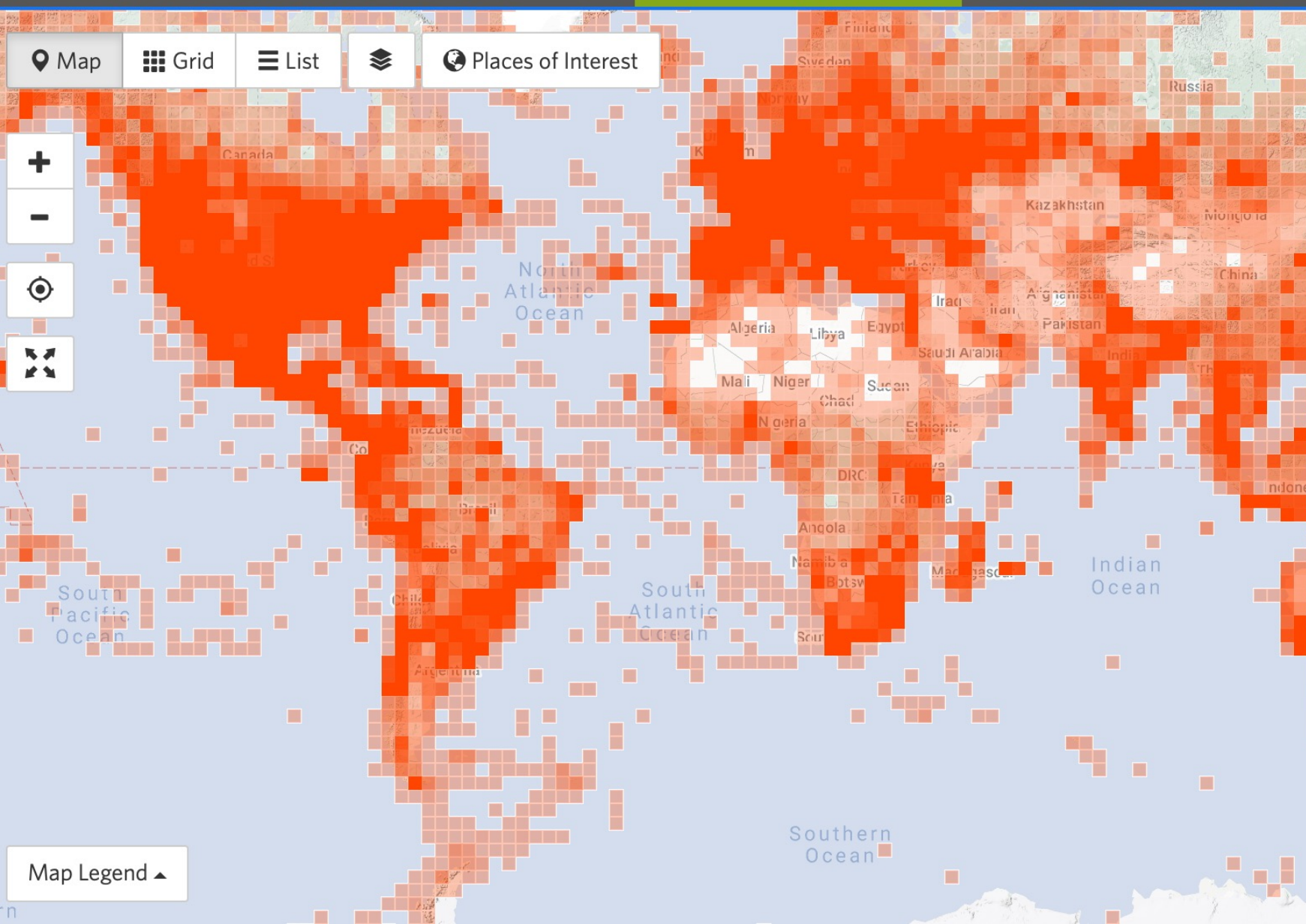


110,612,511
OBSERVATIONS

389,594
SPECIES

264,984
IDENTIFIERS

2,311,532
OBSERVERS



Unknown

Gilpin, Colorado,... • Yesterday



Unknown

Gilpin, Colorado,... • Yesterday



Brittlegills

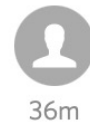
(Genus *Russula*)

Gilpin, Colorado,... • Yesterday



Unknown

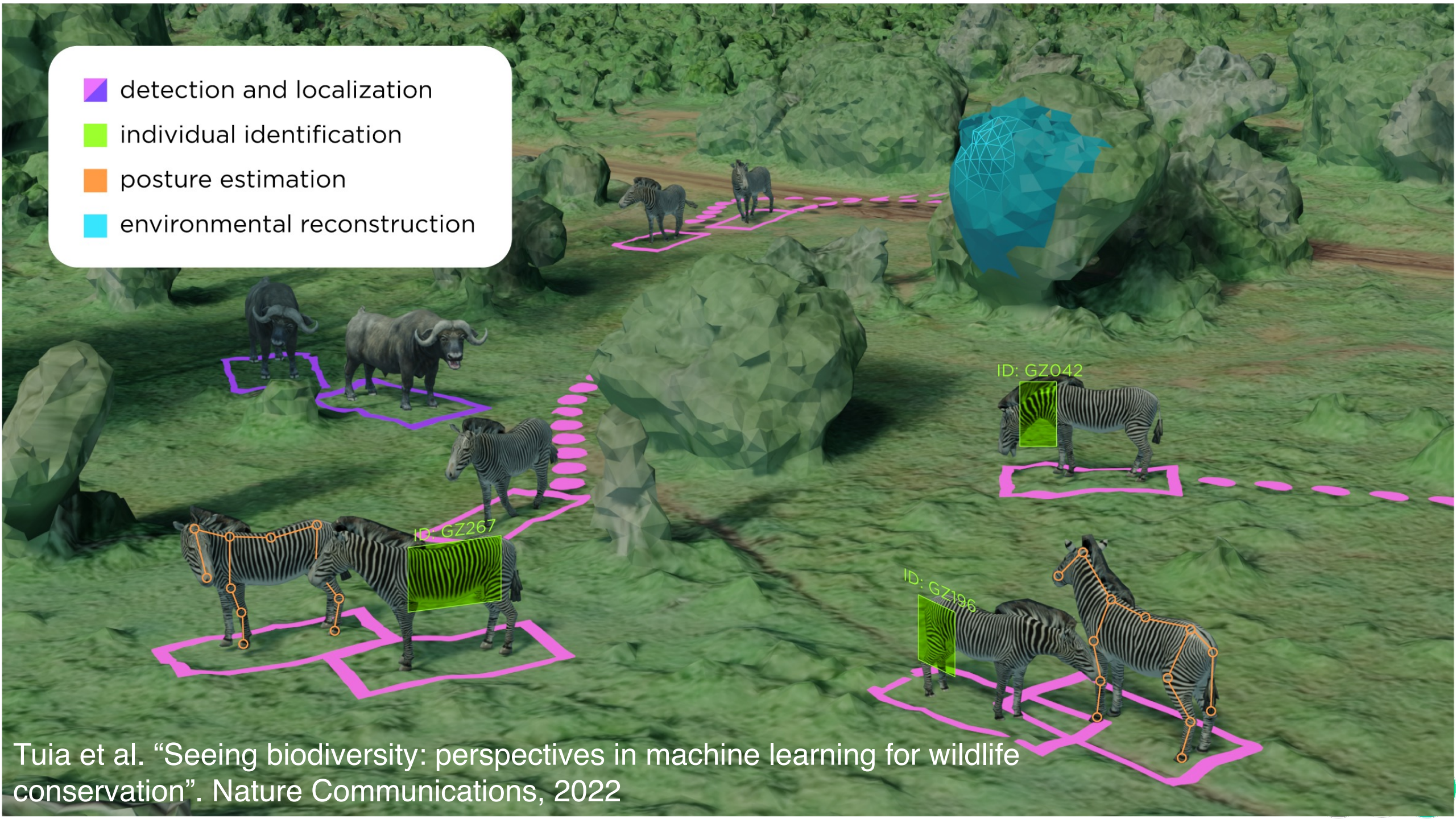
Gilpin, Colorado,... • Yesterday



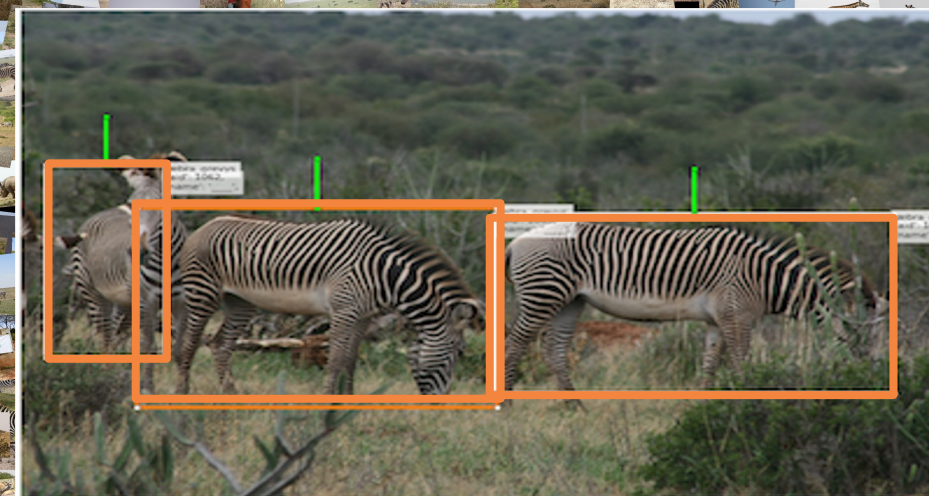
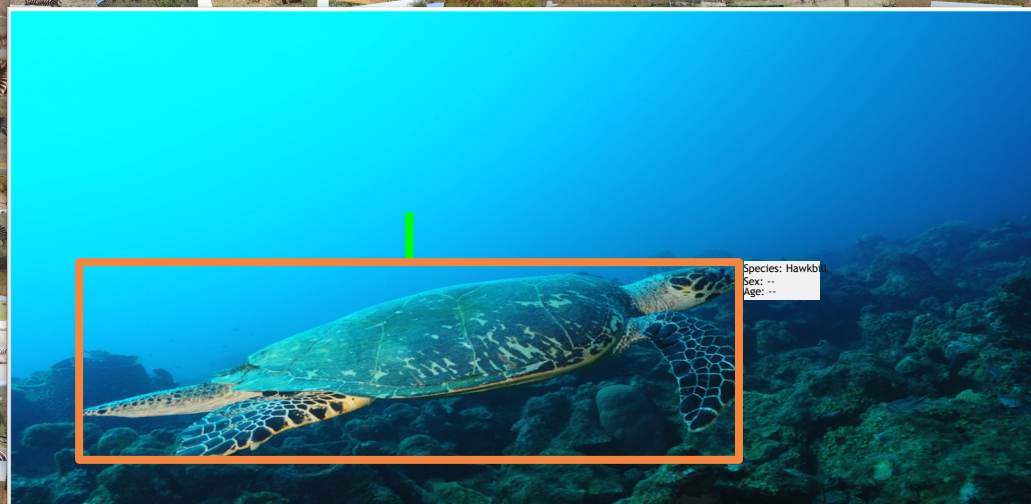
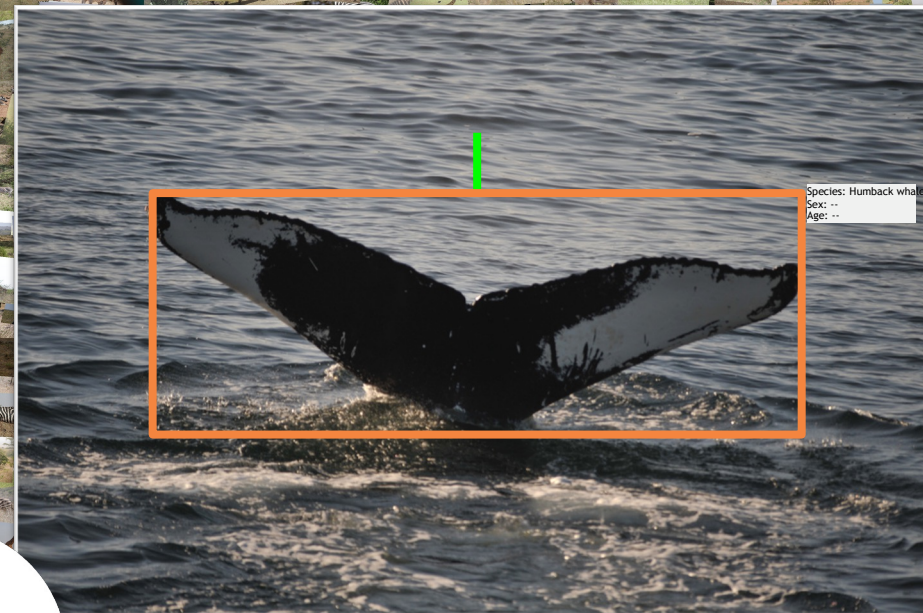
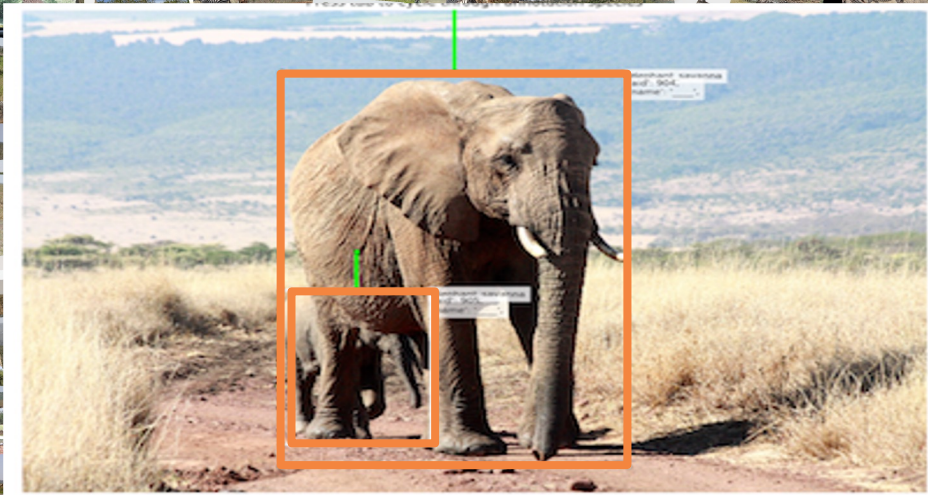
Lemon Yellow

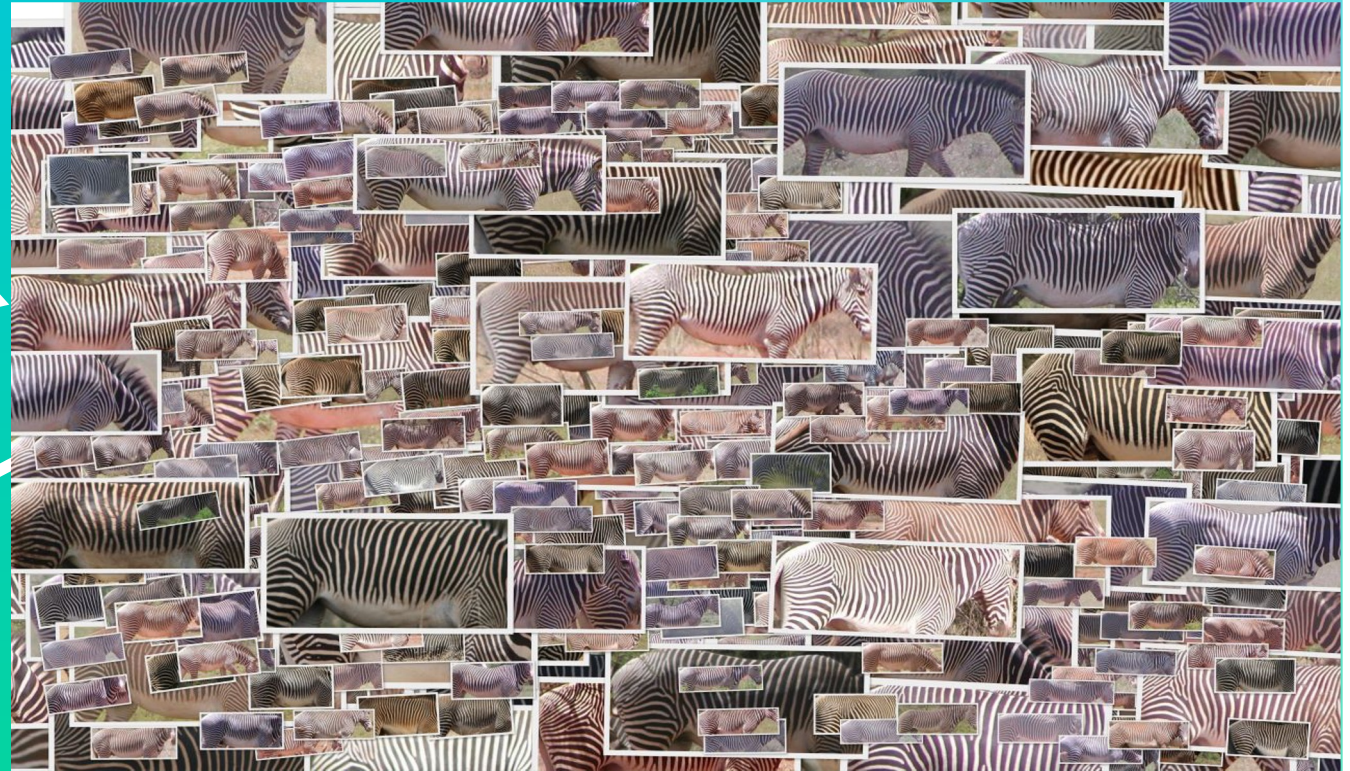


- detection and localization
- individual identification
- posture estimation
- environmental reconstruction



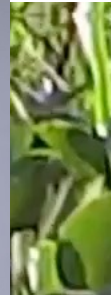
Tuia et al. "Seeing biodiversity: perspectives in machine learning for wildlife conservation". Nature Communications, 2022







Video courtesy NVIDIA
I am AI Docuseries, Episode 6: Running Wild for Nature Conservation - Wildbook



J. Crall et al.
WACV 13

H. Weideman et al.
ICCV 17 x 2

J. Parham et al.
WACV 18

R. Bogucki et al.
Cons Bio '18

O. Moskvayak et al.
2019

D. Mishkin et al.
Kaggle '19

J. Thompson et al.
2019



Video courtesy Microsoft, AI for Earth program
Fighting extinction with Microsoft AI and citizen science

Pinchy

Edit



Marked Individual 5560

Nickname: Pinchy

Sex: female

Taxonomy: *Physeter macrocephalus*

Date of Birth

Date of Death:

Alternate ID: PIN,AET:3146,IFAW:20029



View all images...

Encounter(s) (not all may be currently visible) & Biological Samples

637 Encounter(s) (not all may be currently visible)

Biological Samples

Date	Location	Data Types	Alternate ID	Sex	Occurring With	Behavior
1995-01-08	Dominica			unknown		
1995-01-08	Dominica					
1995-01-13	Dominica			unknown		
1995-01-13	Dominica			unknown		
1995-01-13	Dominica					
1995-01-14	Dominica					
1995-01-15	Dominica			unknown		

Reset Filters

Zoom In

Zoom Out

Hide Legend

Male

Female

Unknown Gender

Alpha

Unknown Role

Select Family

Filter Family

Male Sex

Female Sex

Unknown Sex

Alpha Role

Organism

Paternal Relationship

Maternal Relationship

Familial Relationship

Member Relationship





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Learn ▾

Individuals ▾

Sightings ▾

Encounters ▾

Search ▾

Administer ▾

A.I. for Cetacean Research

2M+

photos

324172

reported sightings

67740

identified whales and dolphins

Continual (Evidence) Curation Problem



C. Stewart et al. 2021

Given: **stream** of images from an **open set** of animal identities

Goal: **continuously** maintain the id of animals in the images,
allowing for human decisions



Whale Shark Diving Cancun July 2017



Wild Me 3 years ago

At 2m46s into the video, you can see whale shark MXA-700. We have been tracking it since 2006. This is the first sighting of 2017! Here's everything we know about it:

<https://www.whaleshark.org/individuals.jsp?number=MXA-700>

REPLY

Hide 6 replies



Kevin Burke 3 years ago

Wild Me whoah

REPLY



Kevin Burke 3 years ago

Wild Me what should I do to help I care about animals should I send videos and pictures to the website

REPLY

Sharkbook
Wildbook for Sharks

nickname, id, site, encou

LOGIN USER WIKI

Submit Learn Individuals Sightings Encounters Search Administer

Marked Individual MXA-700

Nickname Me!

MXA-700

Sex: male

Taxonomy: *Rhincodon typus*

Date of Birth:

Date of Death:

Alternate ID:

View all images...

Date	Location	Data Types	Alternate ID	Sex	Occurring With	Behavior
2018-07-26	Isla Mujeres, Mexico			male		
2017-08-02	Isla Mujeres			male		
2017-07-27	Isla Mujeres			male		
2017-07	cancun			unknown	MXA-1151, MXA-1186	
2016-07-29	North east Isla Mujeres, Mexico			unknown		
2015-07-15	Isla Mujeres, Mexico			unknown		

Map data ©2019 Google, INEGI Terms of Use

Adopt Me

Collaborating Researchers

Deni Ramirez

Affiliation: Tiburon Ballena Mexico (Whale Shark Mexico)

Web Site: www.whalesharkmexico.com

Rafael de la Parra

Affiliation: Ch'ooj Ajauil AC, Mexico

Research Project: Monitoreo Ecológico de Pellylgicos Marinos

Web Site: <http://www.choojaijauil.org.mx/>

Michael Pfundt

Affiliation: Marine Megafauna Foundation

Wildbook A.I.

Affiliation: Wild Me

"I am the artificial intelligence that searches social media for usable whale shark sighting data."

Alina Riesenma



You can help study whale sharks!

Report your sightings



Adopt a shark



17148

identified sharks

92779

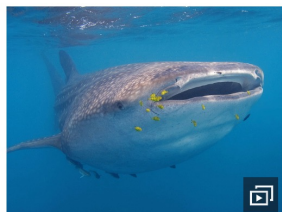
reported sightings

9303

citizen scientists

310

researchers and volunteers

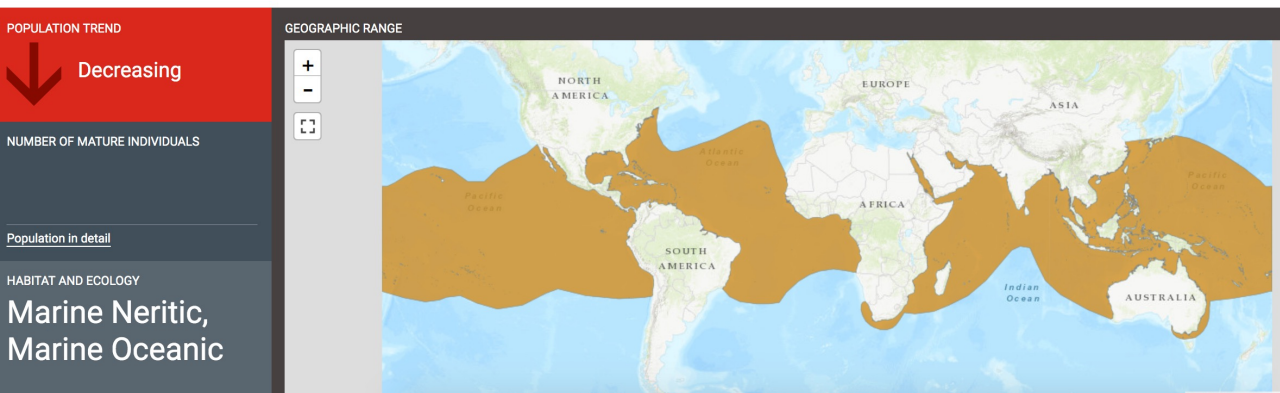
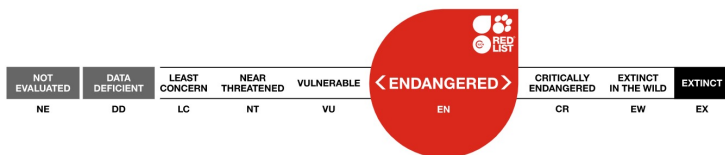


Whale Shark

Rhincodon typus

CITATION

Pierce, S.J. & Norman, B. 2016. *Rhincodon typus*. *The IUCN Red List of Threatened Species* 2016: e.T19488A2365291. <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T19488A2365291.en>. Downloaded on 18 May 2019.



Global population size

Whale Sharks are individually identifiable based on their characteristic spot patterns (Taylor 1994, Arzoumanian *et al.* 2005, Marshall and Pierce 2012). A global database of Whale Shark sightings, comprising submitted photographs from both researchers and the public, is hosted online at Wildbook for Whale Sharks Sharkbook.ai (Wild Me 2016, Norman *et al.* submitted). As of February 2016, there were 1,011 individual sharks on this database, identified from images submitted between 1964 and 2016. However, 70% of sexed individuals (n = 3,420) were male, with the majority of these likely to be immature based on length estimates (Norman and Stevens 2007, Ramírez-Macías *et al.* 2012, Rohner *et al.* 2015). This dataset is assumed to not fully represent female, small juvenile or adult sharks (Norman *et al.* submitted). Therefore, the total represents a minimum number of sharks alive over this period.

BioScience

EDITOR'S CHOICE

Undersea Constellations: The Global Biology of an Endangered Marine Megavertebrate Further Informed through Citizen Science ^{FREE}

Bradley M. Norman, Jason A. Holmberg, Zaven Arzoumanian, Samantha D. Reynolds, Rory P. Wilson, Dani Rob, Simon J. Pierce, Adrian C. Gleiss, Rafael de la Parra, Beatriz Galvan Deni Ramirez-Macias, David Robinson, Steve Fox, Rachel Graham, David Rowat, Matthew Potenski, Marie Levine, Jennifer A. McKinney, Eric Hoffmayer, Alistair D. M. Dove, Robert Hueter, Alessandro Ponzo, Gonzalo Araujo, Elson Aca, David David, Richard Rees, Alan Duncan, Christoph A. Rohner, Clare E. M. Prebble, Alex Hearn, David Acuna, Michael L. Berumen, Abraham Vázquez, Jonathan Green, Steffen S. Bach, Jennifer V. Schmidt, Stephen J. Beatty, David L. Morgan

BioScience, Volume 67, Issue 12, 1 December 2017, Pages 1029–1043,



frontiers

Frontiers in Marine Science

TYPE Original Research

PUBLISHED 28 July 2022

DOI 10.3389/fmars.2022.775691

Improving sightings-derived residency estimation for whale shark aggregations: A novel metric applied to a global data set

Araujo G, Agustines A, Bach SS, Cochran JEM, Parra-Galva' n Edl, Parra-Venegas Rdl, Diamant S, Dove A, Fox S, Graham RT, Green SM, Green JR, Hardenstine RS, Hearn A, Himawan MR, Hobbs R, Holmberg J, Shameel I, Jaidah MY, Labaja J, Leblond S, Legaspi CG, Maguiño R, Magson K, Marcoux SD, Marcoux TM, Marley SA, Matalobos M, Mendoza A, Miranda JA, Norman BM, Perry CT, Pierce SJ, Ponzo A, Prebble CEM, Ram' irez-Mac' ias D, Rees R, Reeve-Arnold KE, Reynolds SD, Robinson DP, Rohner CA, Rowat D, Snow S, Va' zquez-Haikin A and Watts AM



Flukebook
203,772 sightings



whaleshark.org
75,191 sightings



MantaMatcher
36,287 sightings



GiraffeSpotter
20,379 sightings



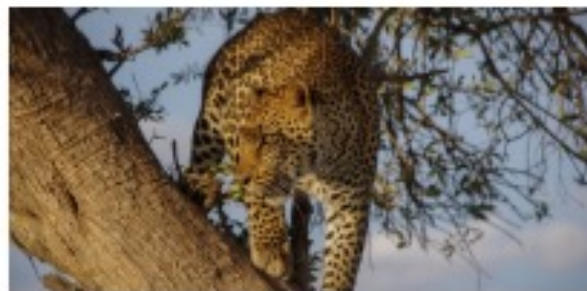
Spot a Shark
7,290 sightings



African Carnivores
21,466 sightings



Spot a Shark USA
1,404 sightings



Wildbook for Jaguars
925 sightings



Internet of Turtles
37,149 sightings



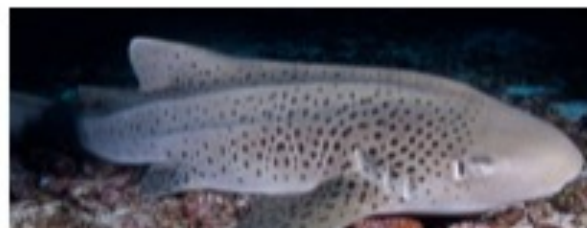
Wildbook for Zebras
28,520 sightings



Wildbook for Lynx
22,479 sightings



Giant Sea Bass
607 sightings



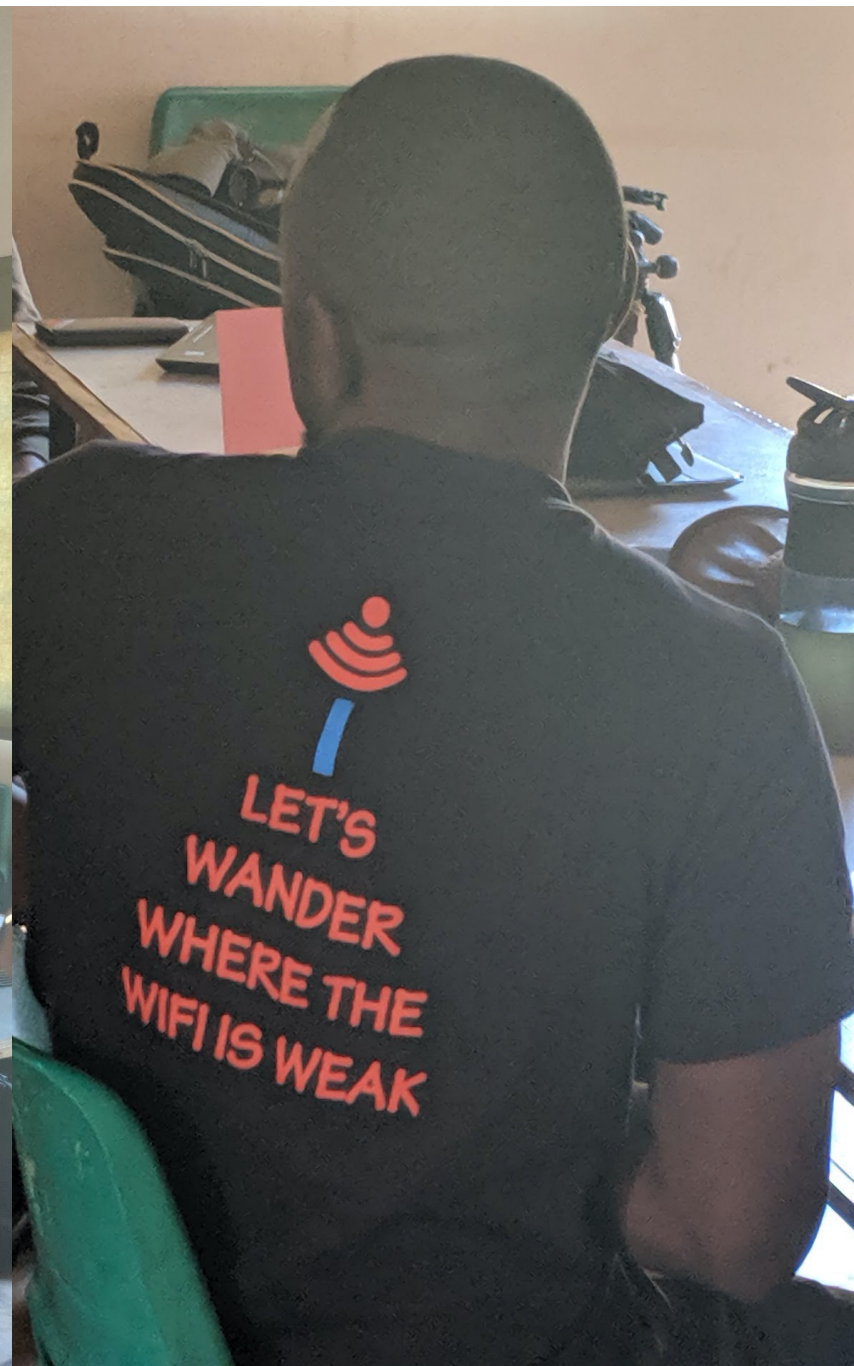


The next edition of the Great Grevy's Rally will be held on the 25 - 26 of January 2020.

Join us in Laikipia, Isiolo, Samburu and Marsabit to participate in the national census of Grevy's

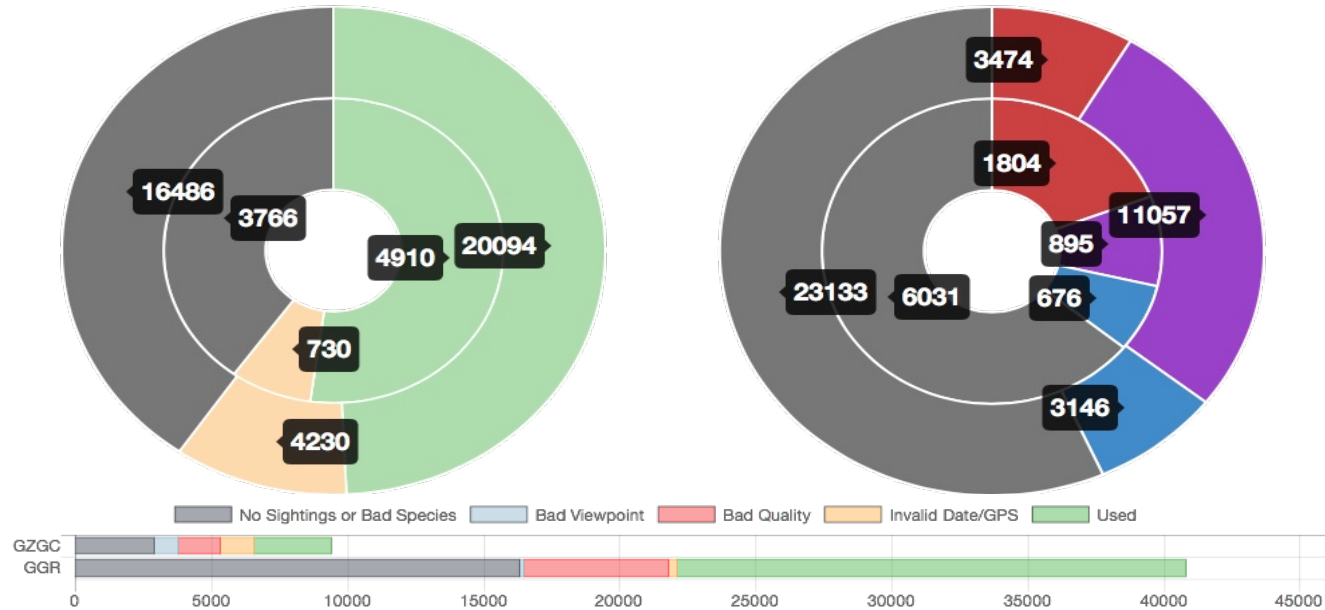




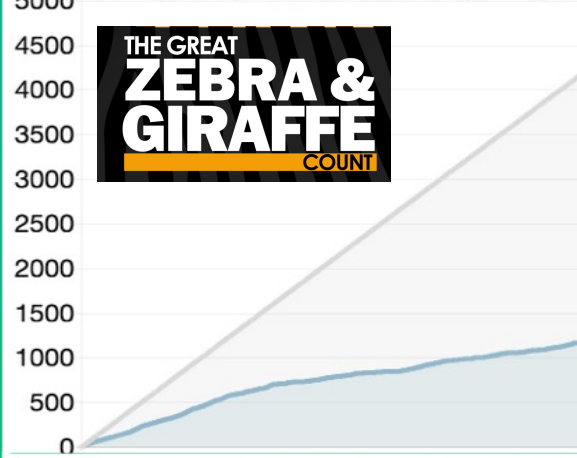


Can we count using photos?

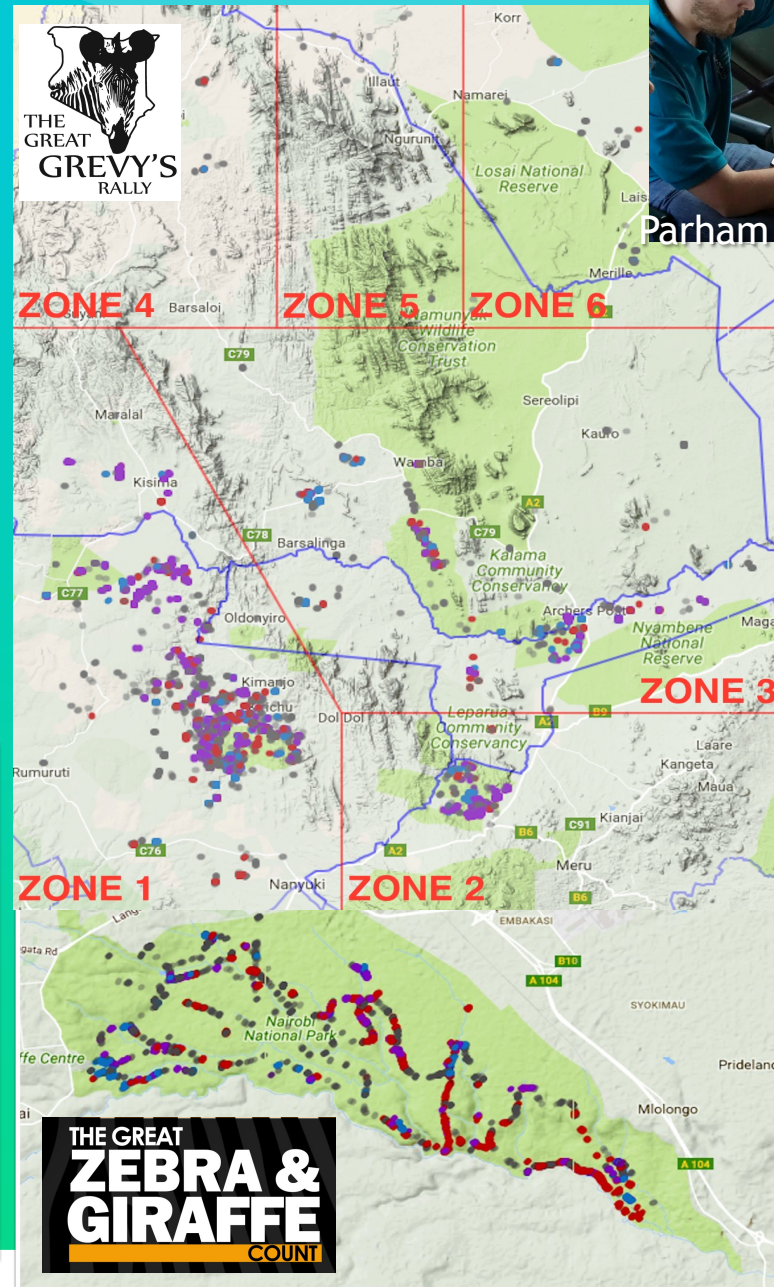
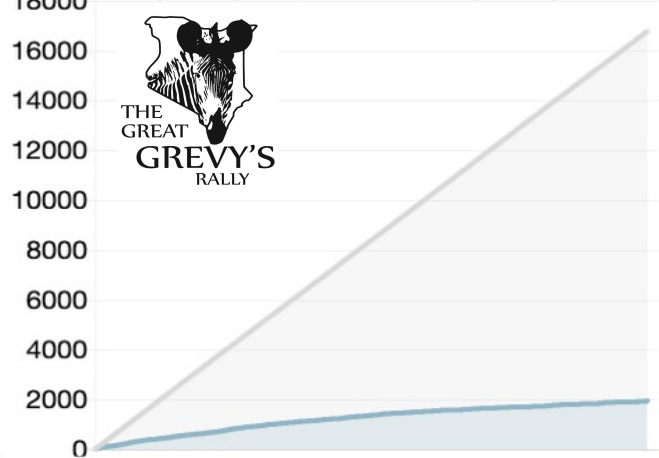
■ Correct Viewpoint ■ Day 1 Only ■ Resightings
■ +/- 45 Viewpoint ■ Unused ■ Day 2 Only ■ Unused



■ Sightings ■ Unique Sightings

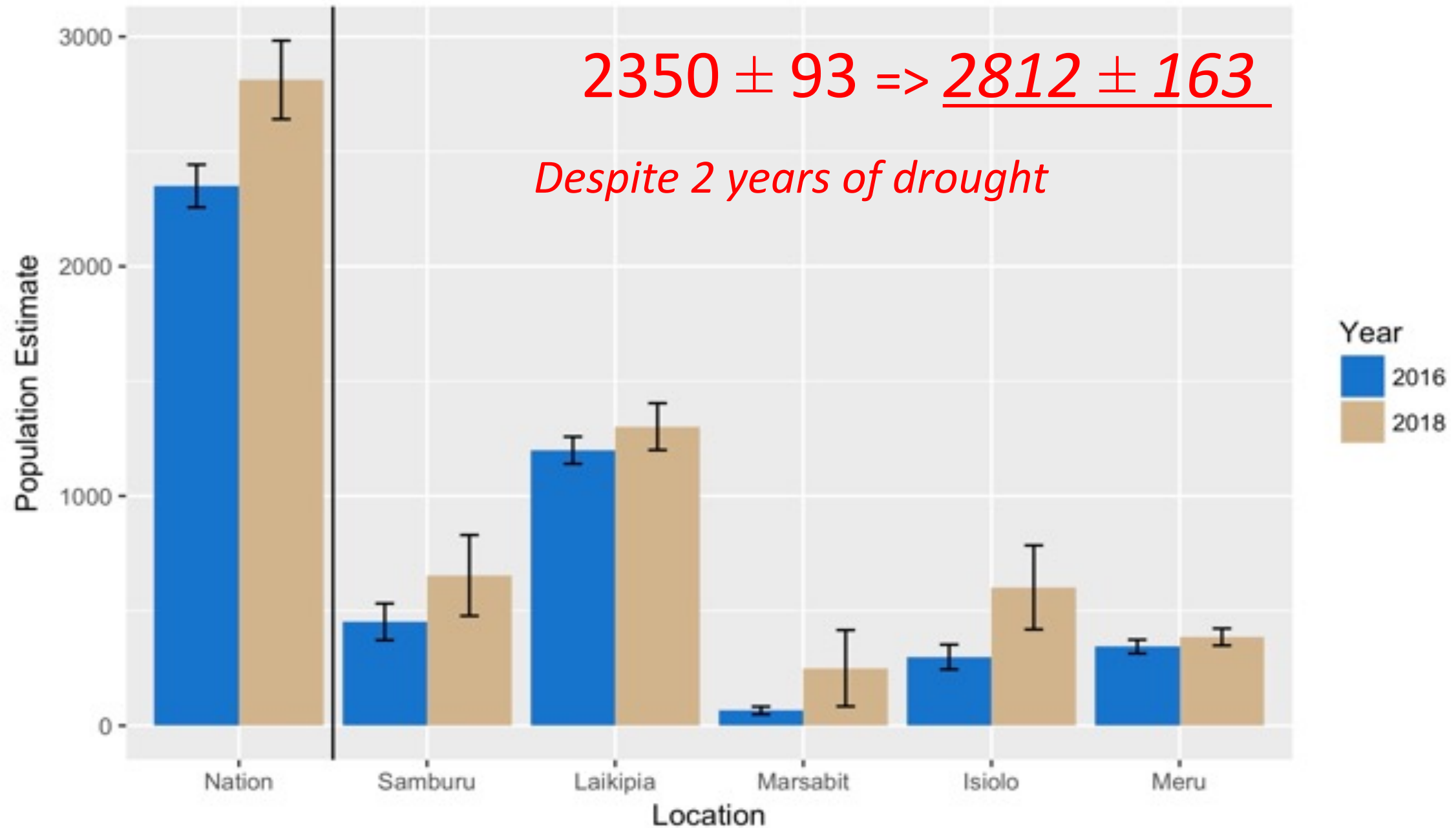


■ Sightings ■ Unique Sightings

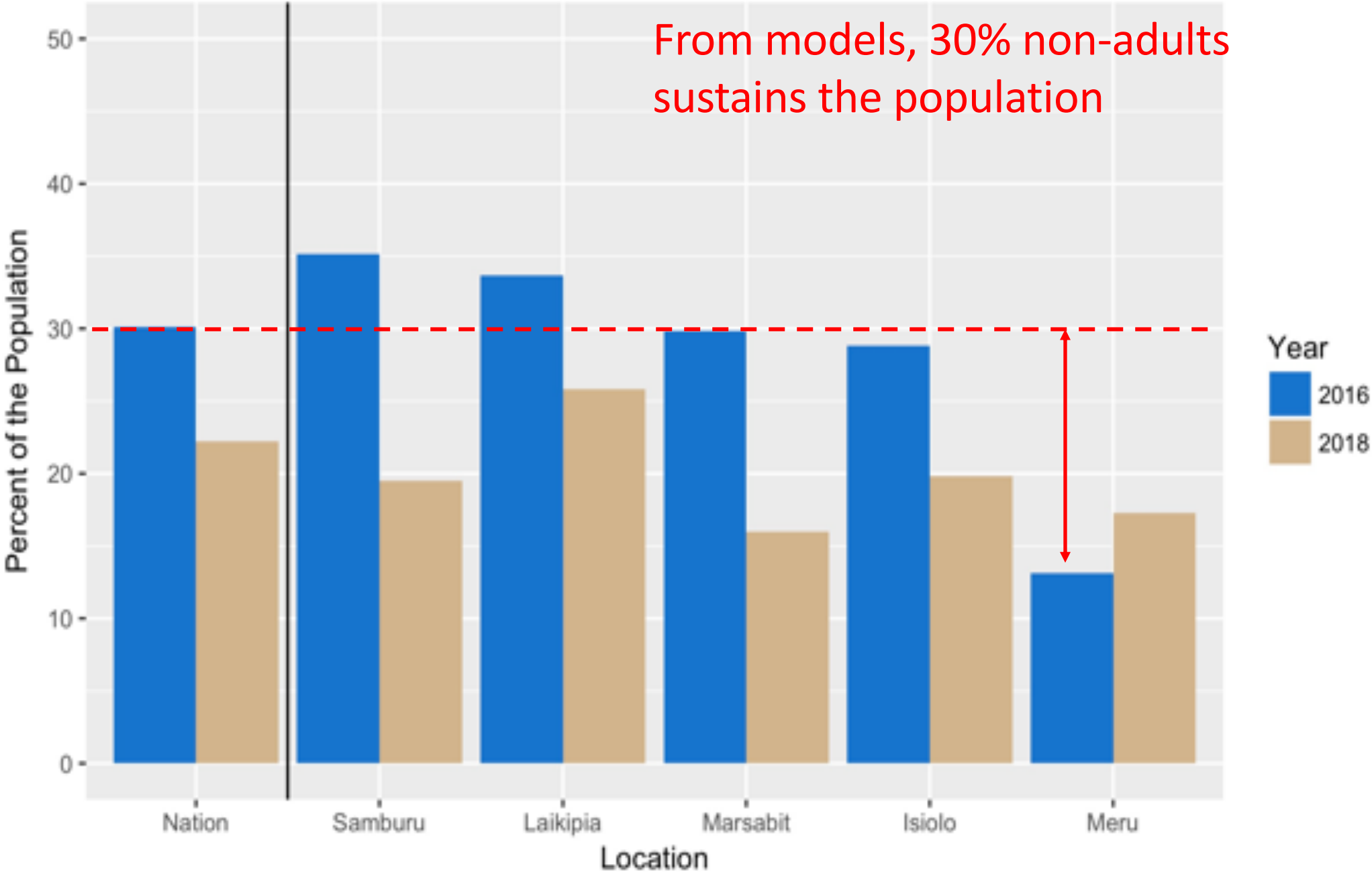


Parham et al. '17

Grevy's Zebra Population Estimates in 2016 & 2018



Grevy's Zebra Recruits in 2016 and 2018



From models, 30% non-adults sustains the population



PROCLAMATION

We, the Governors of the six counties where Grevy's zebras live, acknowledge that collectively our people are the custodians of Kenya's 2,350 Grevy's zebras. This represents over 95% of the world's population. Kenya's Grevy's zebras have undergone a massive decline of over 80% during the last 35 years and although most populations are now stable and sustaining themselves, more must be done to increase the populations to healthy levels.

County	Number of Grevy's Zebras
Laikipia	1,206
Isiolo	286
Marsabit	75
Meru	332
Taita Taveta/Tsavo	45
Samburu	429

On behalf of our Counties and all Kenyans, we as Governors accept the national and global responsibility to conserve this endangered species. We pledge that our counties will take the following critical actions to change the status of our Grevy's zebra populations to 'increasing' by the year 2020:

- 1) Ensure that county development plans take account of the needs of this endangered Kenyan iconic species and do not further endanger this species;
- 2) Proactively and intentionally develop local capacity to protect the Grevy's zebra;
- 3) Commit funds, people and resources towards improving habitat, water access and security that will foster population growth of Grevy's zebras;
- 4) Collaborate with one another, the Kenya Wildlife Service, conservation and researcher groups to promote data sharing, conservation science and improved understanding of the behavior and ecology of Grevy's zebra; and
- 5) Promote greater engagement of citizens in the monitoring of the Grevy's zebra and conservation actions, and commit to implementing a public awareness campaign to protect the Grevy's zebra and other wildlife species.

Governor Ukur Yattani
Marsabit County

Governor Peter Munya
Meru County

Governor Moses Lenolkula
Samburu County

Governor Joshua Irungu
Laikipia County

Governor Godana Doyo
Isiolo County

Governor John Mruttu
Taita-Taveta County



Kenya Wildlife Service (KWS) Assistant
Director in charge of Mountain Conservation
Area Simon Gitau:

"This shows the power of citizen science and
machine learning for conservation"



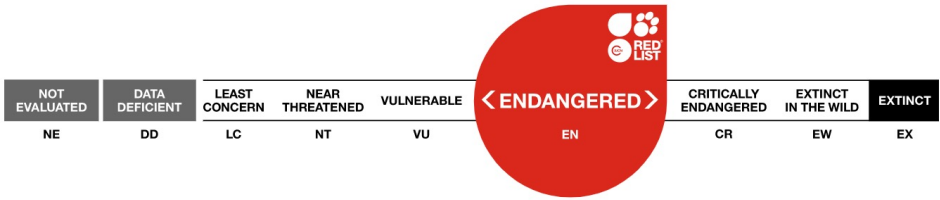


Grevy's Zebra

Equus grevyi

CITATION

Rubenstein, D., Low Mackey, B., Davidson, ZD, Kebede, F. & King, S.R.B. 2016. *Equus grevyi*. *The IUCN Red List of Threatened Species* 2016: e.T7950A89624491. <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLT-S.T7950A89624491.en>. Downloaded on 18 May 2019.



POPULATION TREND

Stable

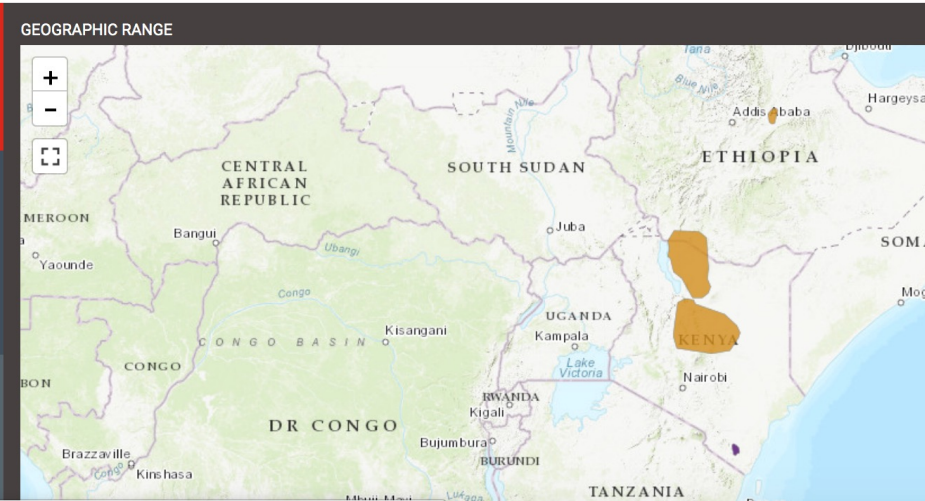
NUMBER OF MATURE INDIVIDUALS

1,956

Population in detail

HABITAT AND ECOLOGY

Grassland, Shrubland



In Kenya, the Grevy's Zebra population declined from around 13,700 in 1977 (Dirschl and Wetmore 1978) to 4,300 in 1988 (KREMU 1989). They then declined further to 2,400-2,700 in 2000 (Nelson and Williams 2003) and 1,570-1,980 in 2004 (KWS 2012), to an estimated population size of 1,470-2,140 in 2006 (B. Low pers. comm. 2007); a decline of 85-90% over 29 years. In 2008, the population was estimated to consist of 2,400 individuals, indicating that either counting techniques had improved or that the population had stabilized or even increased, or a combination of the two (Mwasi and Mwangi 2007, KWS 2012). An assessment of all existing counts carried out by Kenya's Grevy's Zebra Technical Committee in 2012 estimated that by 2011 the population in Kenya was approximately 2,500. **In January 2016 a comprehensive census of Grevy's zebra in five counties in Kenya was conducted ("The Great Grevy's Rally")**. The census comprised of 350 people (members of the public, conservancy members, rangers and scouts from conservancies and National Parks and Reserves, and scientists) driving over 25,000 km² recording Grevy's zebras using GPS enabled cameras. Over 40,000 photos of Grevy's Zebra were taken. The photographs were sent to the US-based IBEIS team to process the images, identifying unique individuals seen on days 1 and 2 as well as the number seen on day 1 that were re-sighted on day 2. From these three values population size estimates could be computed. In the future, such analyses will be performed by Kenyan scientists once the software is made publicly available. From the sight-resight analysis the population was estimated **to be 2,250 individuals (95% CI of +/- 93; KWS 2016)**. For the first time, Laikipia county has the highest number of Grevy's Zebras (supporting over half of Kenya's Grevy's Zebra population), surpassing Samburu and Isiolo counties, the traditional heartland of the species. An additional 80-100 animals were estimated in Tsavo, Oserian, Meru National Park, and the Laisamas area - areas that were too dangerous or inaccessible to survey during the census period (KWS 2016). The total Kenya population in 2016 is therefore estimated to be ~2,350 individuals. The population will be re-censused in August 2017.

Selfie-taking tourists are putting endangered species at risk with poachers, experts say

Poachers can track wildlife based on a phone's geolocator

By Liezl Thom

2 January 2020, 11:44 • 4 min read



Poachers use tourists' safari pictures to track endangered animals

Safari tourists are being urged to stop taking photos of animals. STOCK PHOTO/Getty Images

DURBAN, SOUTH AFRICA — Poachers are using tourists' photos of their rare wildlife plants and animals to track them down, experts say.

YaleEnvironment360

Published at the Yale School of Forestry & Environmental Studies

Explore Search About E360



ILLUSTRATION BY ERIC NYQUIST

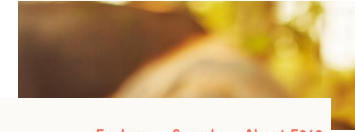
Unnatural Surveillance: How Online Data Is Putting Species at Risk



usenix

THE ADVANCED
COMPUTING SYSTEMS
ASSOCIATION

Technology is the new word for wildlife



Forbes

Deadly Virtual Postcards Lead Poachers To Rare, Endangered Trophy Animals



Michael Patrick Shiels Contributor @
When the settings are the stars, I take you there.

EXPLORE TRAVEL+LEISURE

How Your Instagram Geotag Might Be Putting Wild Animals and Natural Areas at Risk Around the World

TRACY LEASCA | MARCH 22, 2019



PHOTO: KLAUS VEDFELT/GETTY IMAGES

Privacy for Tigers

Ross Anderson, Tanya Berger-Wolf

TRAVEL PULSE

Geotagging Harmful to Natural

TRAVEL TECHNOLOGY | ALE

f 759

t 759

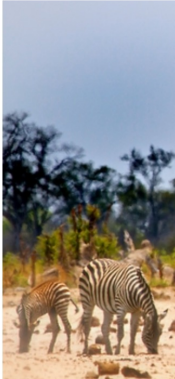
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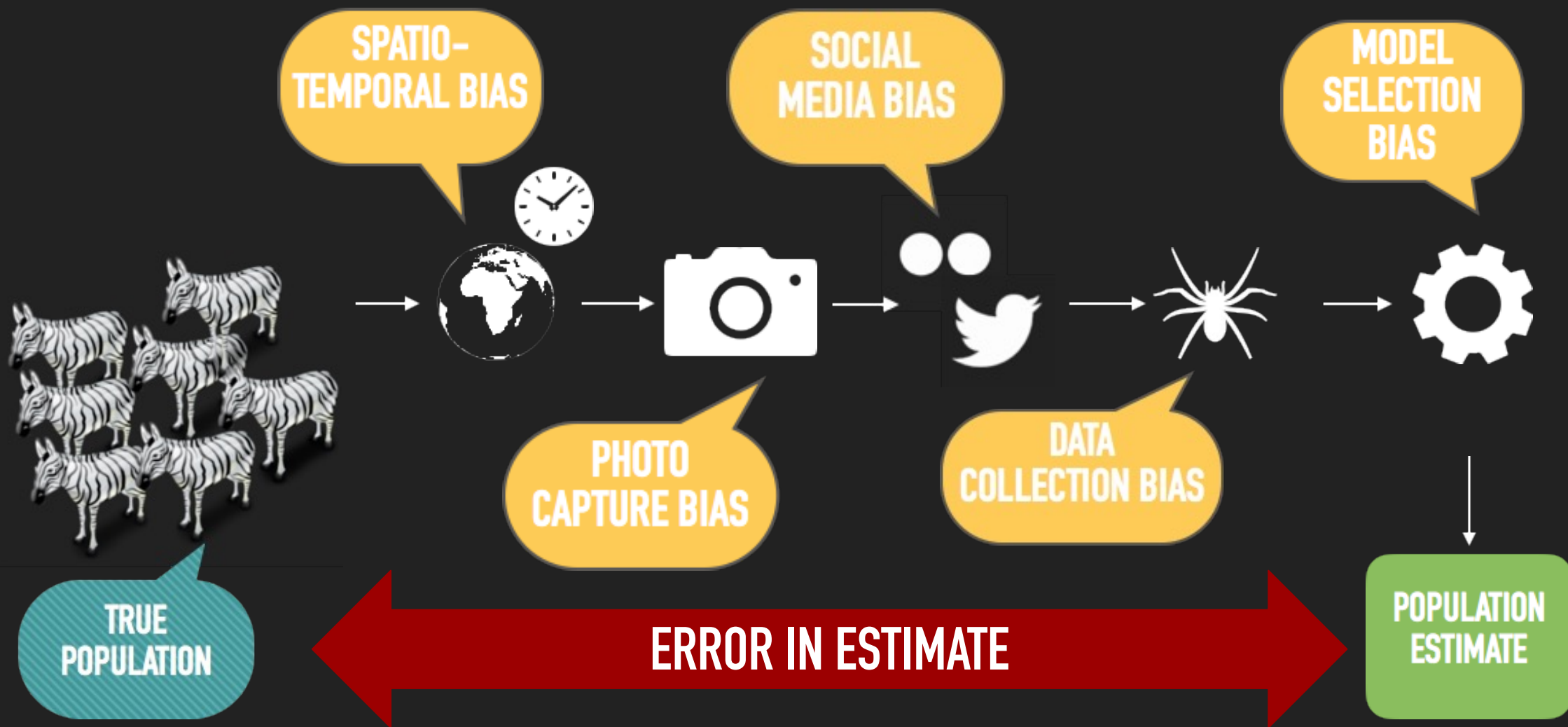
f

+

771

SHARES





AI and Data Science enable

Science, Conservation
Public engagement

by bringing communities together
and working in partnership
to provide solutions
that people **trust**



WILDLIFEDIRECT



JASON
HOLMBERG



CHUCK
STEWART



DAN
RUBENSTEIN



ZAVEN
ARZOUMANIAN



ALEX
DEHGAN



TANYA
STERE



JASON
PARHAM



JON
VAN OAST



COLIN
KINGEN



DREW
BLOUNT



MARK
FISHER



BEN
SCHEINER

Discussion?

