Activities to advance, build, and deliver remote-sensing supported species distribution and species abundance EBVs. 18-GEOBON-0025.

Walter Jetz
Yale University

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Co-I	**Robert Guralnick**	University of Florida, Gainesville
Co-I	**William McShea**	Smithsonian Institution
Co-I	**Cory Merow**	Yale University
Co-I	**Adam Wilson**	SUNY, Buffalo
Collaborator	**Melodie McGeoch**	Monash University, Australia
Collaborator	**Jorge Ahumanda**	Conservation International
Collaborator	**Roland Kays**	NC State University
Collaborator	**Carsten Meyer**	iDiv, Leipzig
Collaborator	**Tim Robertson**	Global Biodiversity Information Facility, Denmark
Collaborator	**David Thau**	Google; WWF
Collaborator	**Martin Wikelski**	Max Planck Society, Germany

GEO BON
Group on Earth Observations
Biodiversity Observation Network

MOL
MAP OF LIFE

Walter Jetz
Yale University

Activities to advance, build, and deliver remote-sensing supported species distribution and species abundance EBVs.

1. Integrate data types for Species Population EBV Development

Definition, Concept

Camera trapping data

Movement data

2. Advance new methods for improved species population EBVs

Model-based integration of different data types

Joint distribution models applied to Cape biota

3. Regional and global EBV implementations

Expert lateral and elevation constraints in species distribution predictions

4. Indicator Products

EBV driven biodiversity indices supported in Map if Life

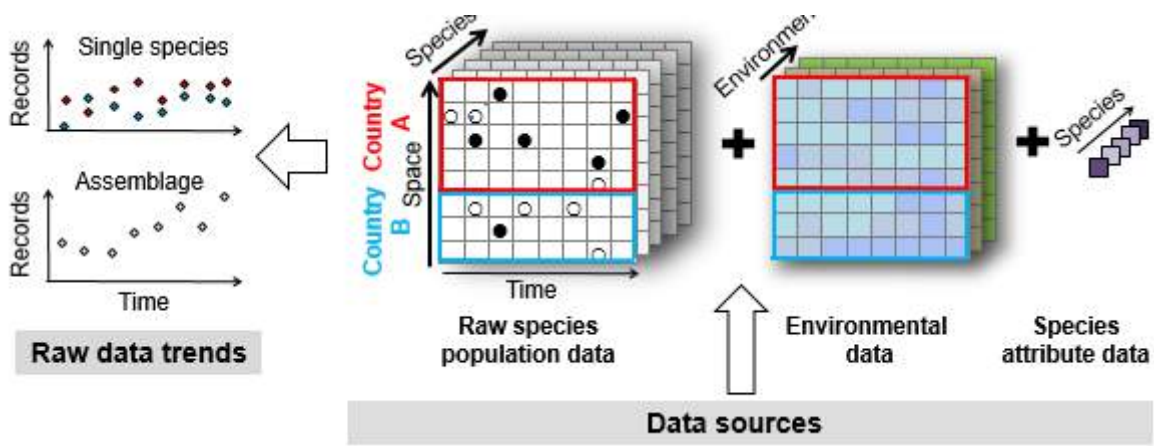
Models, data workflows and infrastructure supporting invasion monitoring

1. Integrate data types for Species Population EBV Development

Species Populations Working Group

Walter Jetz[1], Melodie A. McGeoch[2], Robert Guralnick[3], Simon Ferrier[4], Jan Beck[5], Mark J. Costello[6], Miguel Fernandez [7,8] , Gary N. Geller[9], Petr Keil[10], Cory Merow[1], Carsten Meyer[10,11], Frank E. Muller-Karger[12], Henrique M. Pereira[10,13,14], Eugenie C. Regan[15], Dirk S. Schmeller[16,17], Eren Turak[18,19]

Nature Ecology & Evolution 2019



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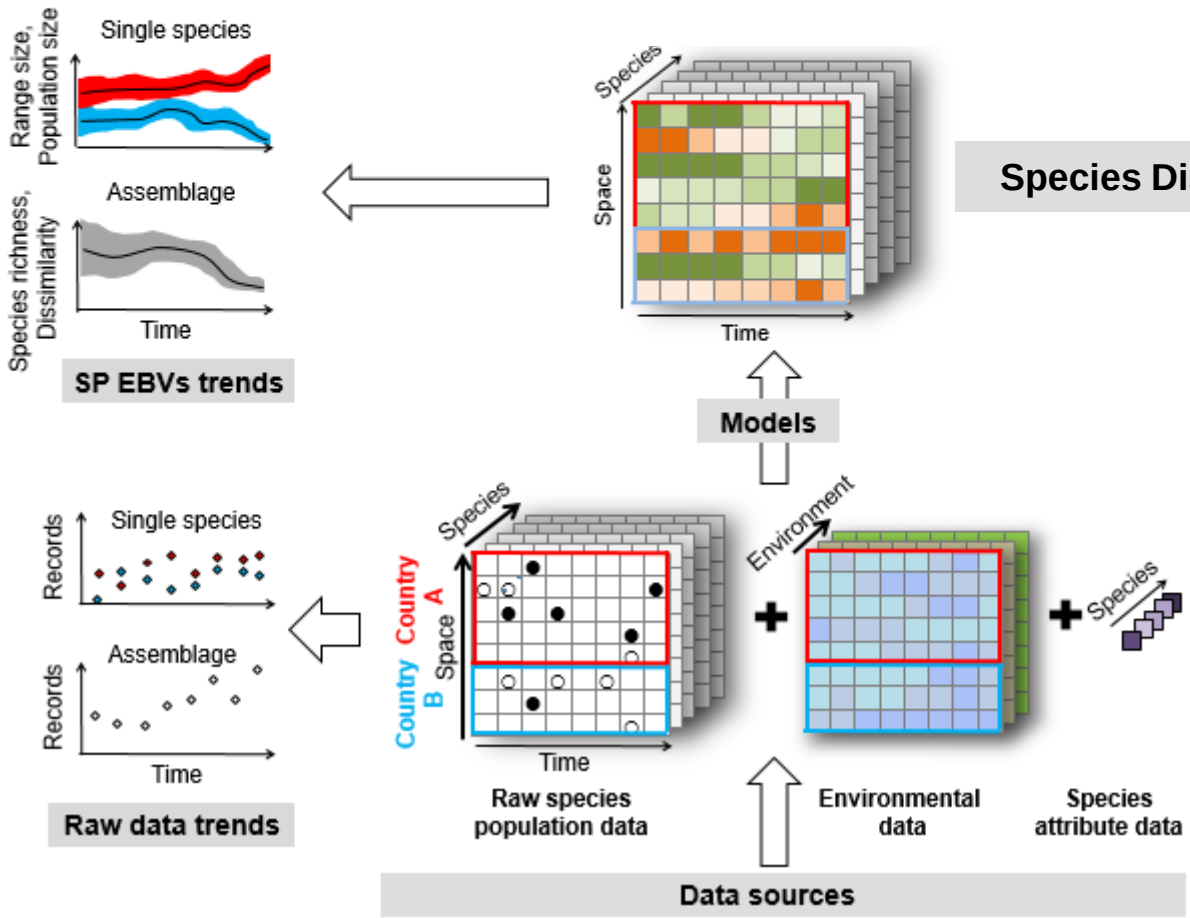

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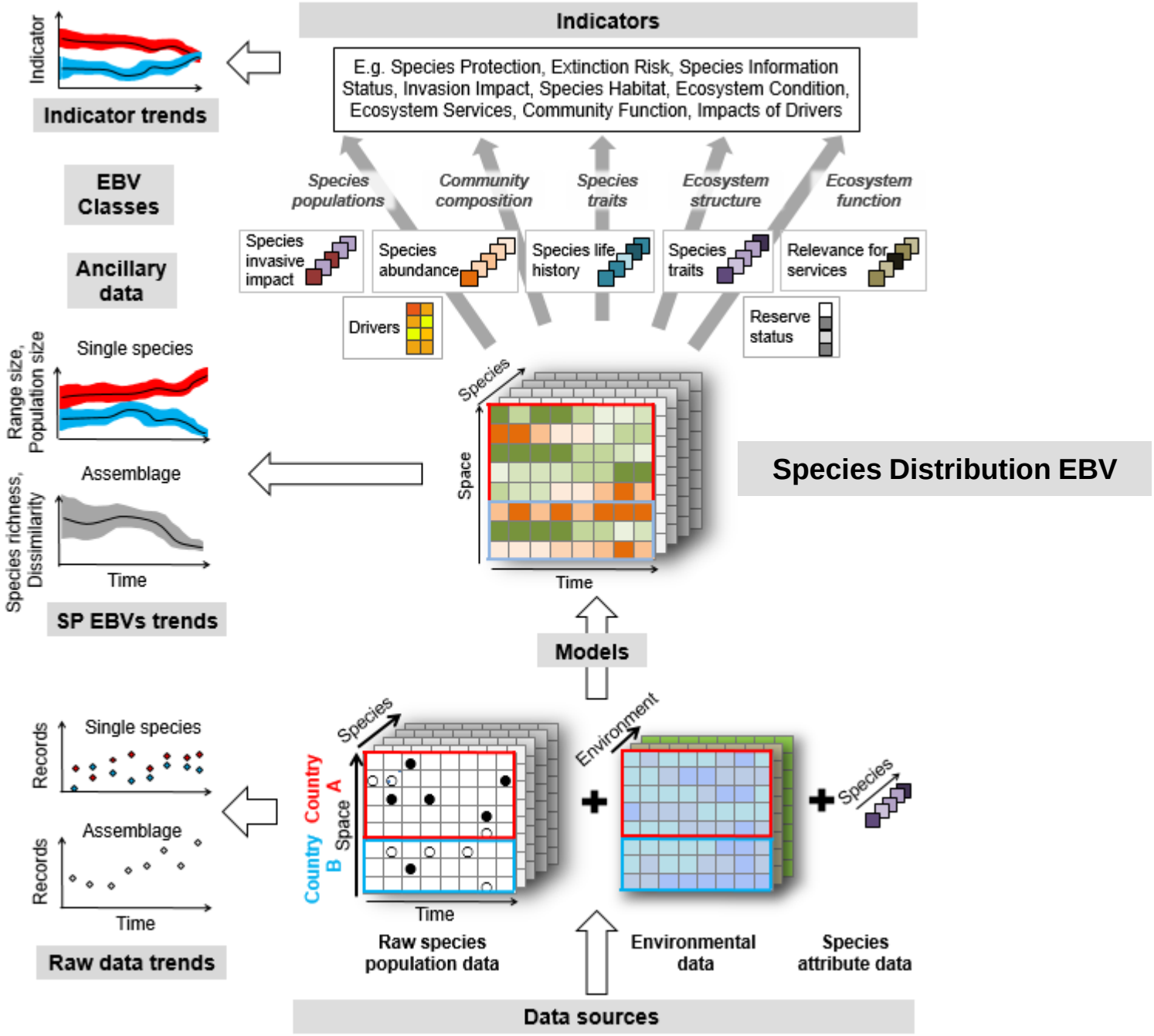

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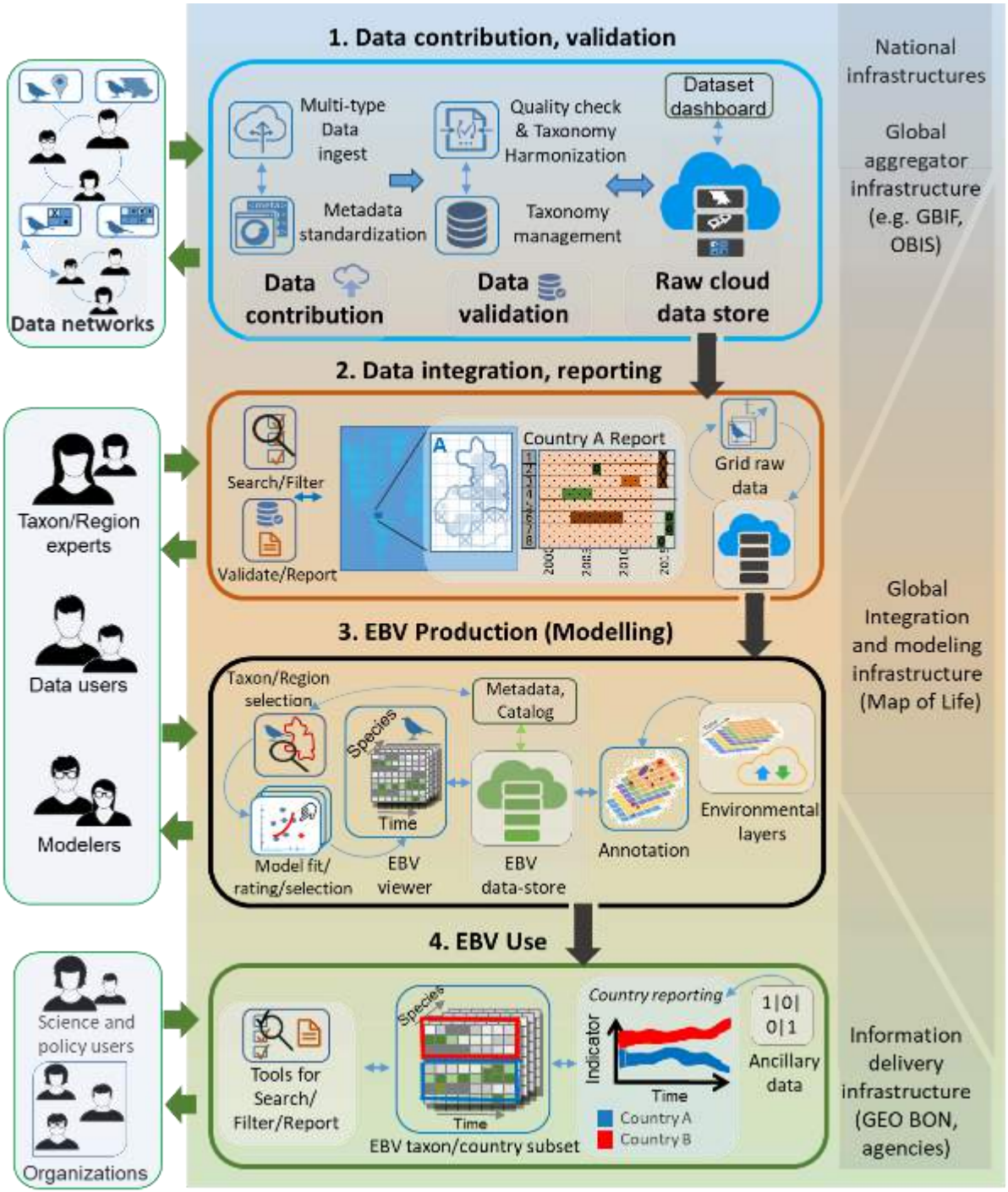
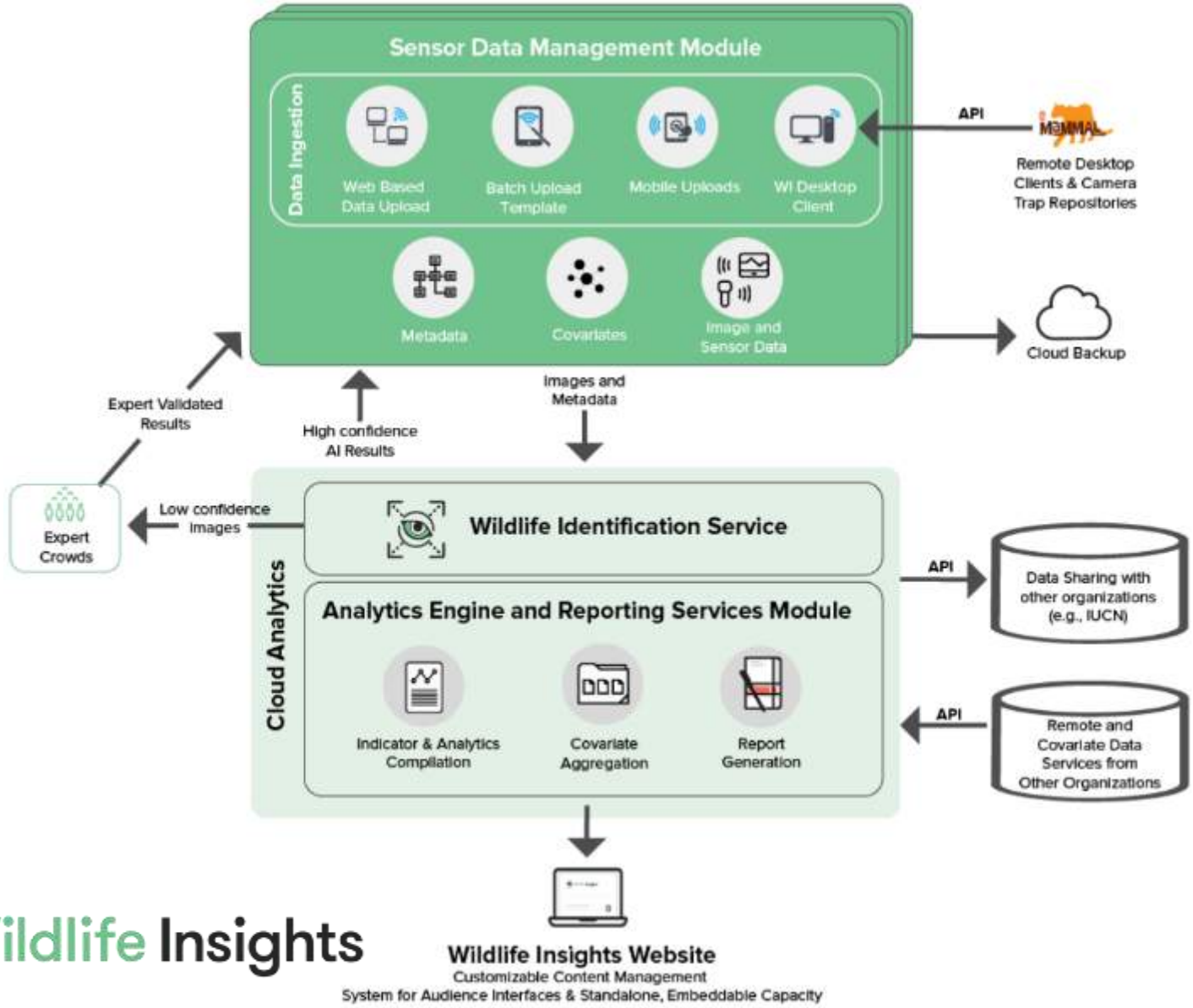


New sensors

Wildlife Insights

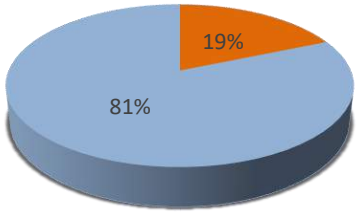
New sensors

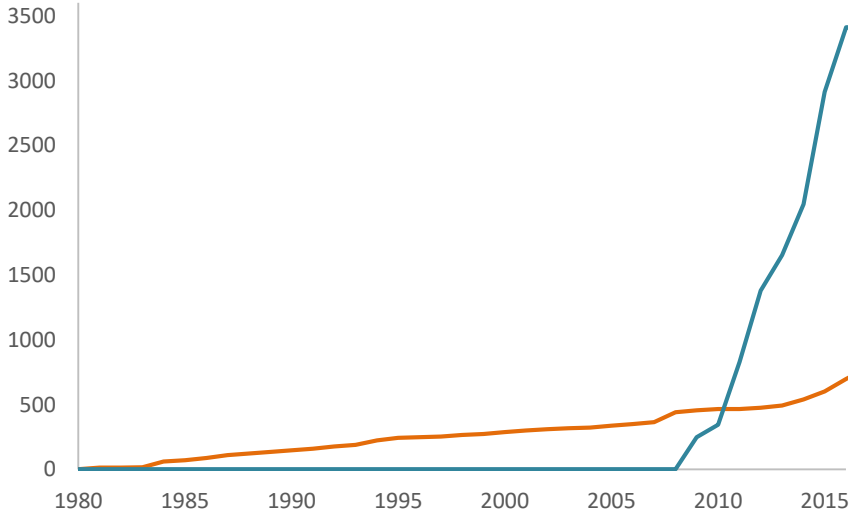

Sensor Data Management Module
Data Ingestion
Web Based Data Upload
Batch Upload Template
Mobile Uploads
WI Desktop Client
Metadata
Covariates
Image and Sensor Data
API
Remote Desktop Clients & Camera Trap Repositories
Cloud Backup
Expert Validated Results
High confidence AI Results
Images and Metadata
Expert Crowds
Low confidence Images
Cloud Analytics
Wildlife Identification Service
Analytics Engine and Reporting Services Module
Indicator & Analytics Compilation
Covariate Aggregation
Report Generation
API
Data Sharing with other organizations (e.g., IUCN)
API
Remote and Covariate Data Services from Other Organizations
Wildlife Insights
Wildlife Insights Website
Customizable Content Management
System for Audience Interfaces & Standalone, Embeddable Capacity

Jaguar

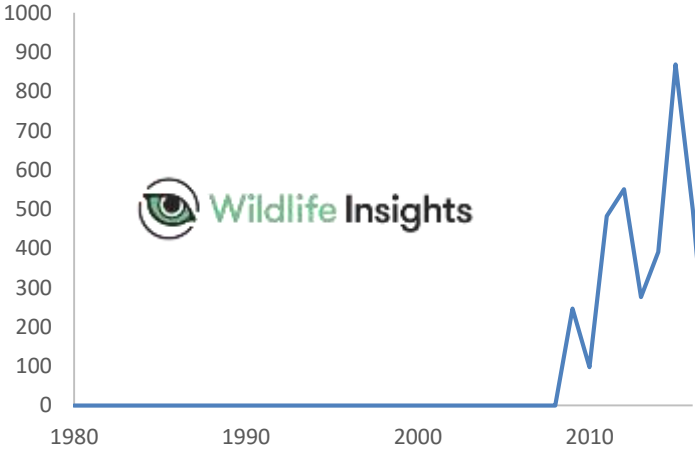
New sensors

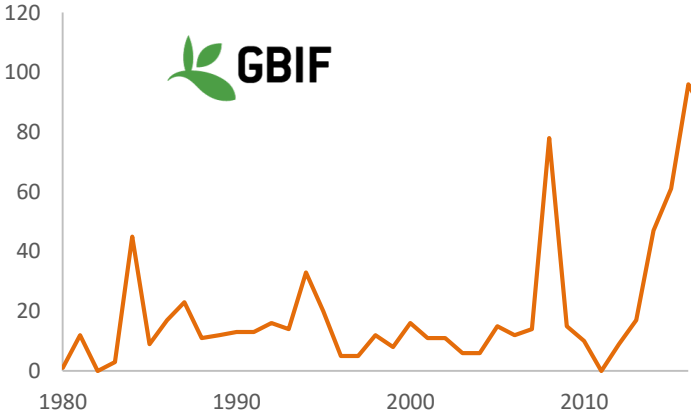
Cumulative total records





Annual records





New sensors

GPS Tracking Data

Linking Individual Behavior to Community Responses in Changing Landscapes

8:45 am WELCOME RECEPTION (COFFEE)

9:00 am Tracking Biodiversity Movement

Walter Jetz (Yale, MPYC): *From individual movements to species and community ecology*

Martin Wikelski (MPIO, MPYC): *The Internet of Animals: a global collective of intelligent sensors for Planet Earth*

9:45 am Multi-Species Movement Ecology

Meg Crofoot (UC Davis)

Roland Kays (North Carolina State): *Comparative tracking of four frugivores*

Katherine Mertes (Smithsonian): *Animal movements reveal the spatial scale of the ecological niche*

10:45 am COFFEE BREAK

11:00 am Integrating Multi-Individual Behavior

Dan Rubenstein (Princeton): *Wild Equid Movements: The Importance of Habitat Quality, Predation Pressure and Leadership*

Blair Costelloe (MPIO): *Quantitative field studies of collective behavior: an approach using drones and computer vision*

Damien Farine (MPIO): *High-resolution GPS tracking of individual movement, collective movement, and population-level social structure*

12:15 pm LUNCH BREAK

1:15 pm From Individual Movement to Species Ecology

Dustin Rubenstein (Columbia): *How environmental variation in time and space affects group structure and dynamics in social species*

Raul Costa-Pereira (McMaster): *Individual niche variation in interacting species*

Brett Jesmer (Yale, MPYC): *Causes and consequences of individual niche variation*

Remington Moll (Michigan State): *Challenges and opportunities in modeling mammal communities across space and time*

2:30 pm COFFEE BREAK

3:00 pm Movement Informed by Remote Sensing

Doris Klein (Earth Observation Center): *Remote Sensing for landscape characterization*

Ryan Pavlick (NASA): Integrating animal tracking with the next generation of ecosystem remote sensing

3:45 pm Movement Ecology, Conservation, and Global Change

Mathew Mutinda (Kenya Wildlife Service): *Motivation to move in savanna ecosystems: communities and wildlife past and present*

Jared Stabach (Smithsonian): *Wildebeest as Sentinels of Habitat Change and Connectivity*

Vanessa Ezenwa (Georgia): *Linking individual behavior to community responses: is there a role for parasites?*

Tyler Kartzinel (Brown): *Connecting earth observations with ecological networks*

5:00 pm DRINKS RECEPTION

MAX-PLANCK-GESELLSCHAFT

Yale

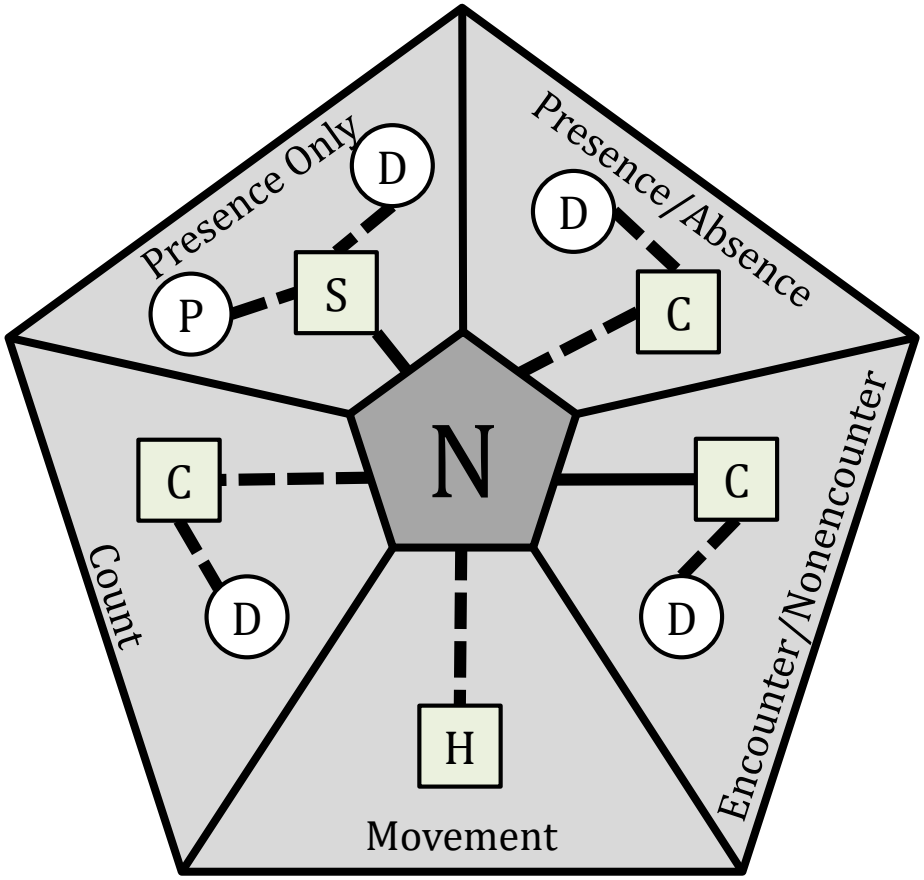
2. Advance methods for improved species population EBVs

"Linking biodiversity sensors with data and models to predict global biodiversity change"

May 2018: 2-day workshop at Yale:

Global, representative species population EBVs require careful integration of different data types

Integrating data types in a single modelling framework



Merow et al., in prep.

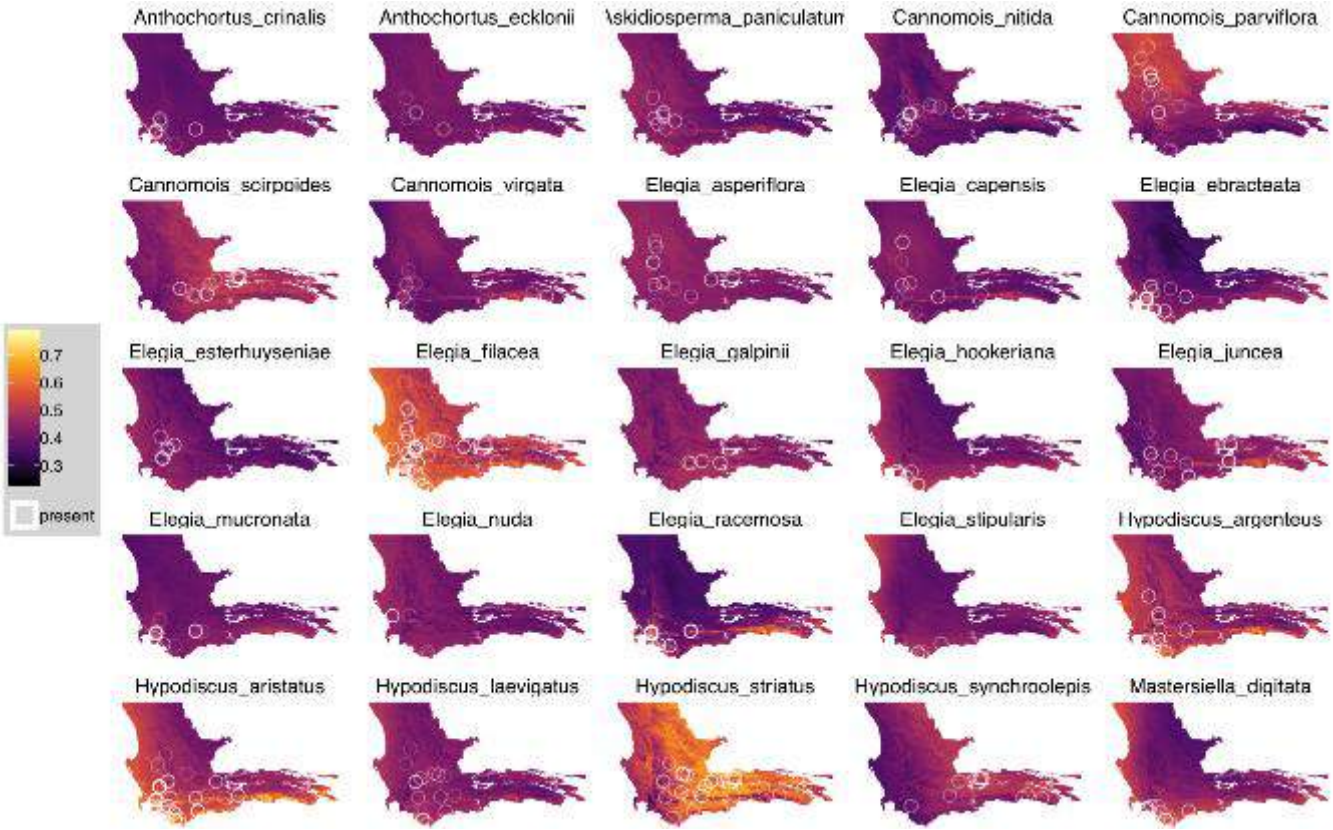
Joint distribution models applied to Cape biota

Restionaceae of South Africa

~1000 plots

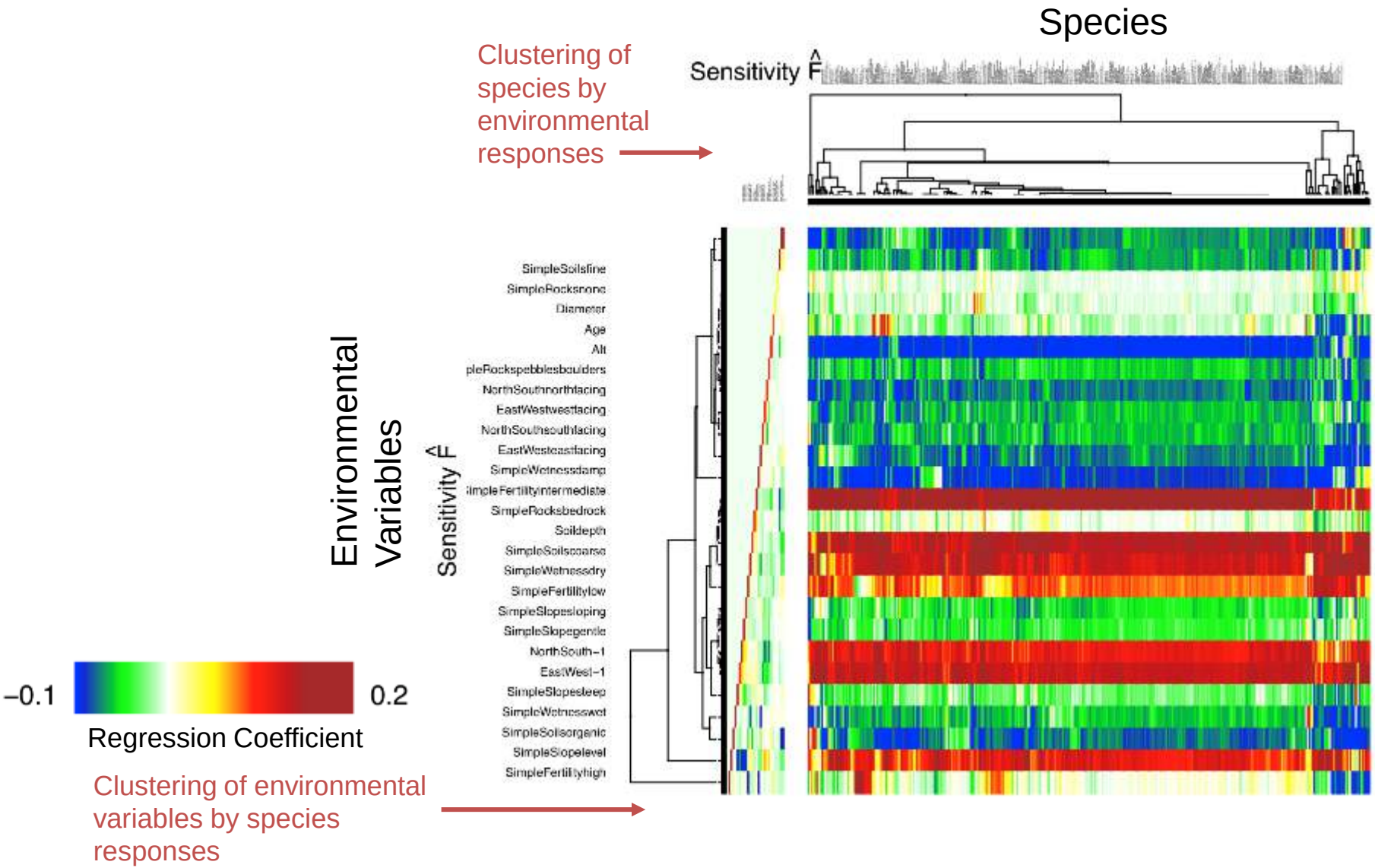
~ 325 Species

Photo from J Born, HP Linder - Austral ecology, 2018



Probability of presence estimated with a Joint Species Distribution Model (GJAM)
Covariates: Topography, Tree Cover + Precipitation & Temperature (Mean & Seasonality)

Joint distribution models applied to Cape biota



3. Regional and global EBV implementations

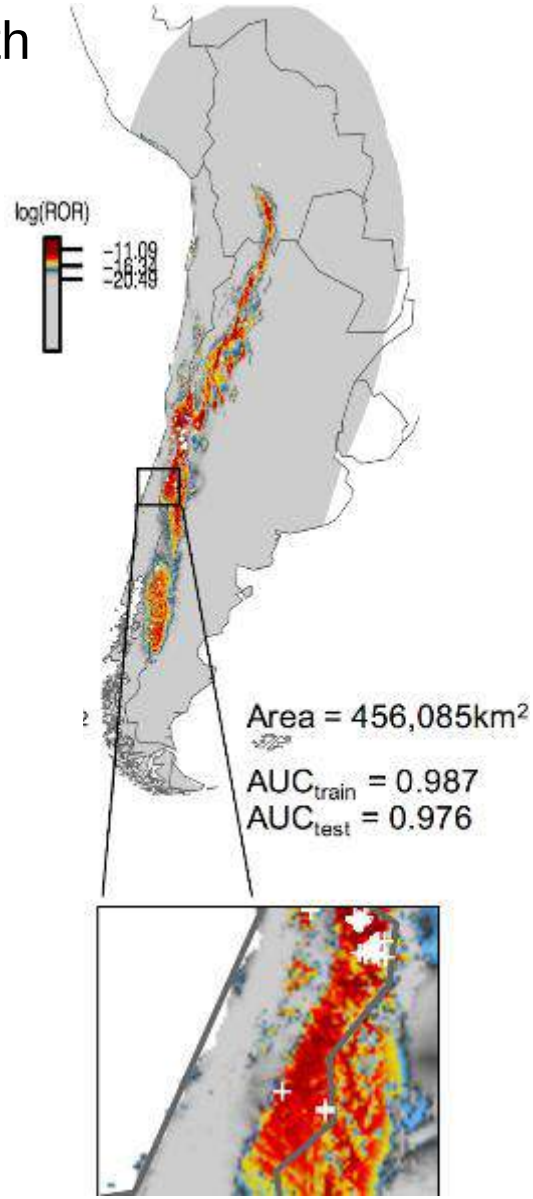
Expert prior on lateral and vertical range extent

338 known species

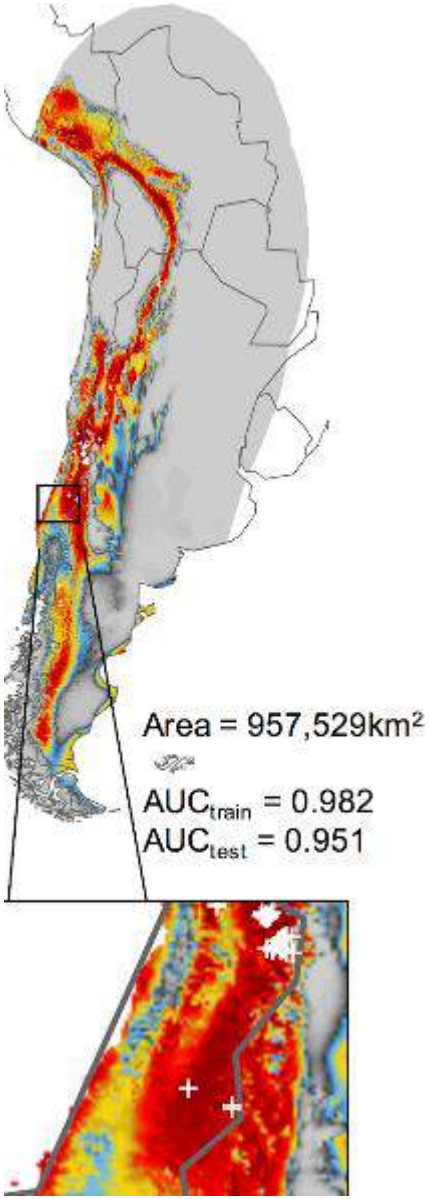
El Soto et al, manuscript

Expert prior on lateral and vertical range extent

With



Without



Speckled
Hummingbird

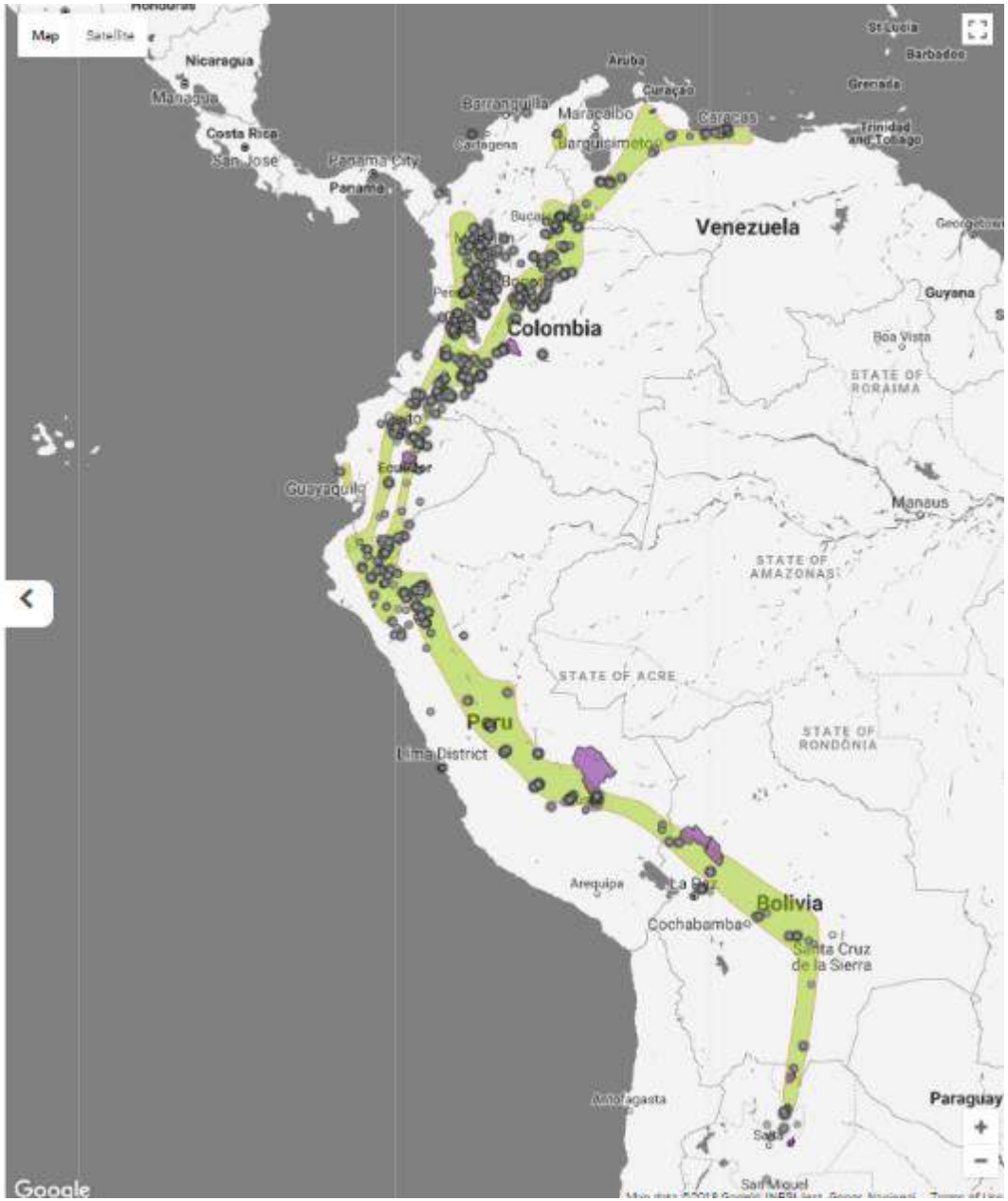
Adelomyia melanogenys

| Hummingbirds

Least Concern (IUCN 2016)

Sources

- [x] Local inventories — 19
- [x] Expert range maps — 2
  - [ ] MOL grid of BirdLife
  - [x] Ietz et al. (2012)
- [x] Point observations — 12,489
- [ ] Regional checklists — 51



Speckled
Hummingbird

Adelomyia melanogenys

| Hummingbirds

Least Concern (IUCN 2016)

Sources

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Expert range maps	2	
MOL grid of BirdLife		
Jetz et al. (2012)		
Point observations	12,489	
Regional checklists	51	
src_sdm	1	

SDM Filters

1.327e-7 2.441e-7

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Hummingbird

Adelomyia melanogenys

| Hummingbirds

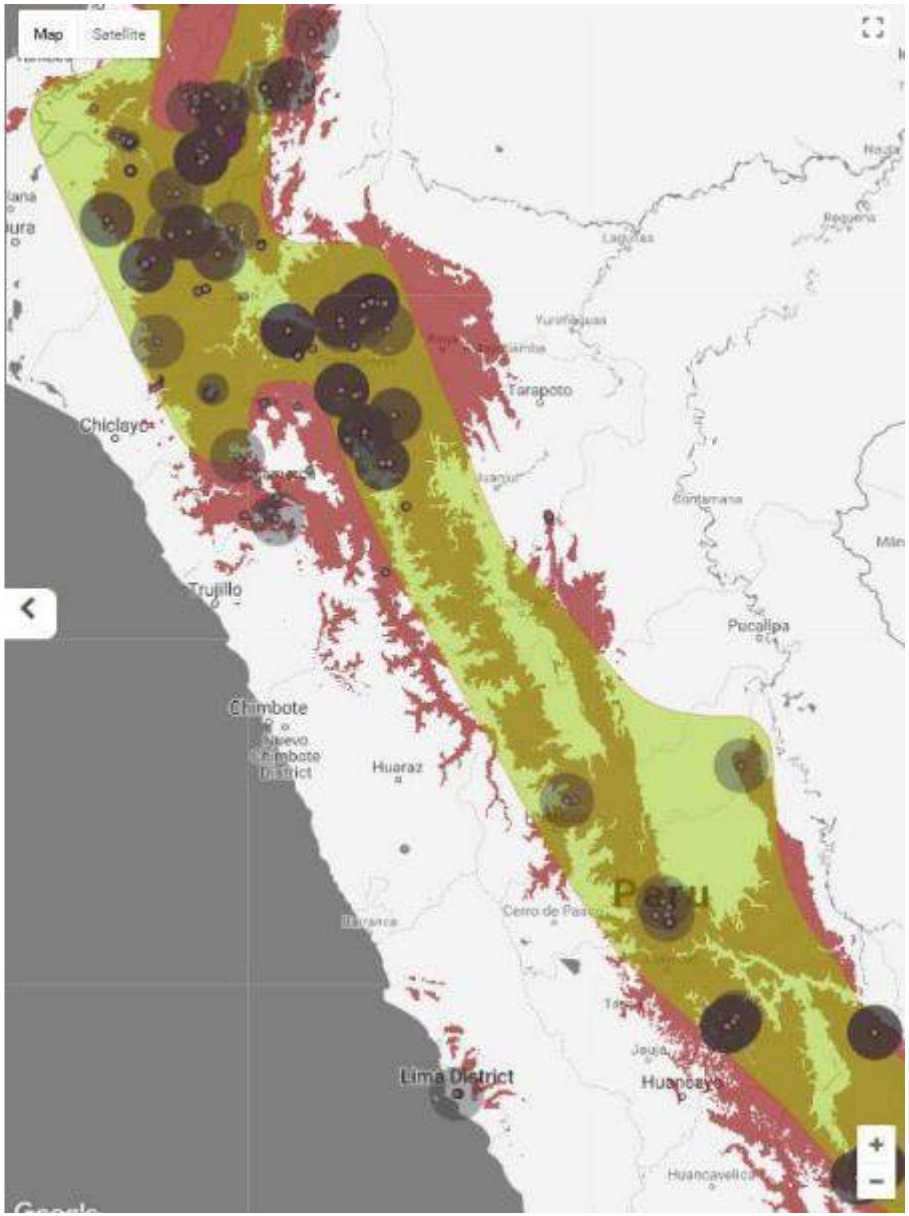
Least Concern (IUCN 2016)

Sources

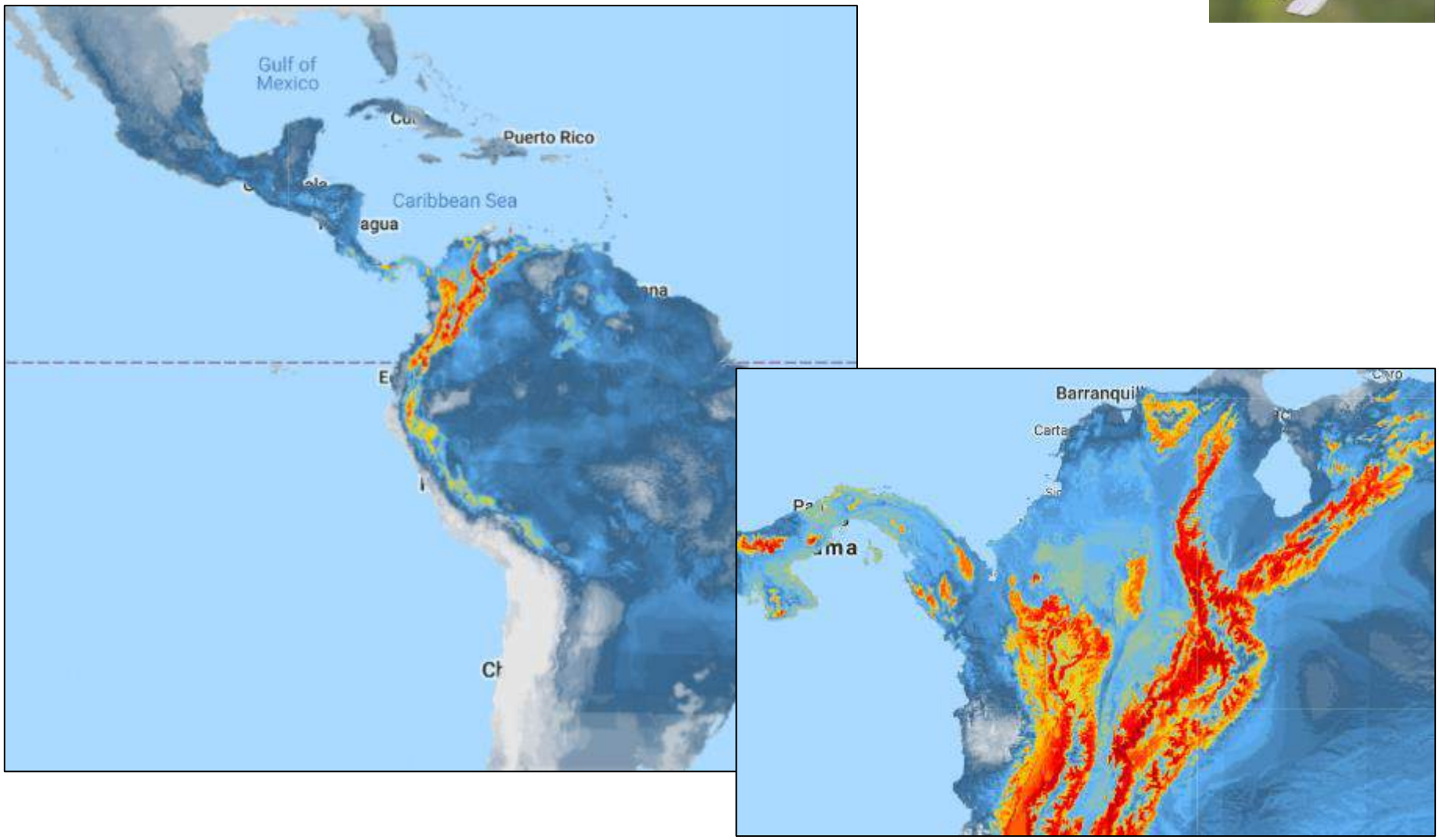
- Local inventories — 19
  - Angulo Pratolongo et al. (2... — 1
  - Cantú-Salazar & Gaston (2... — 13
  - Meese (2005) — 4
  - Walker et al. (2006) — 1
- Expert range maps — 2
  - MOL grid of BirdLife
  - Jetz et al. (2012)
- Point observations — 12,489
  - eBird (2017) — 11,769*
  - GBIF.org (2017) — 720
- Regional checklists — 51
- src_sdm — 1
  - Best predicted SDM — 1

SDM Filters

1.327e-7 2.441e-7



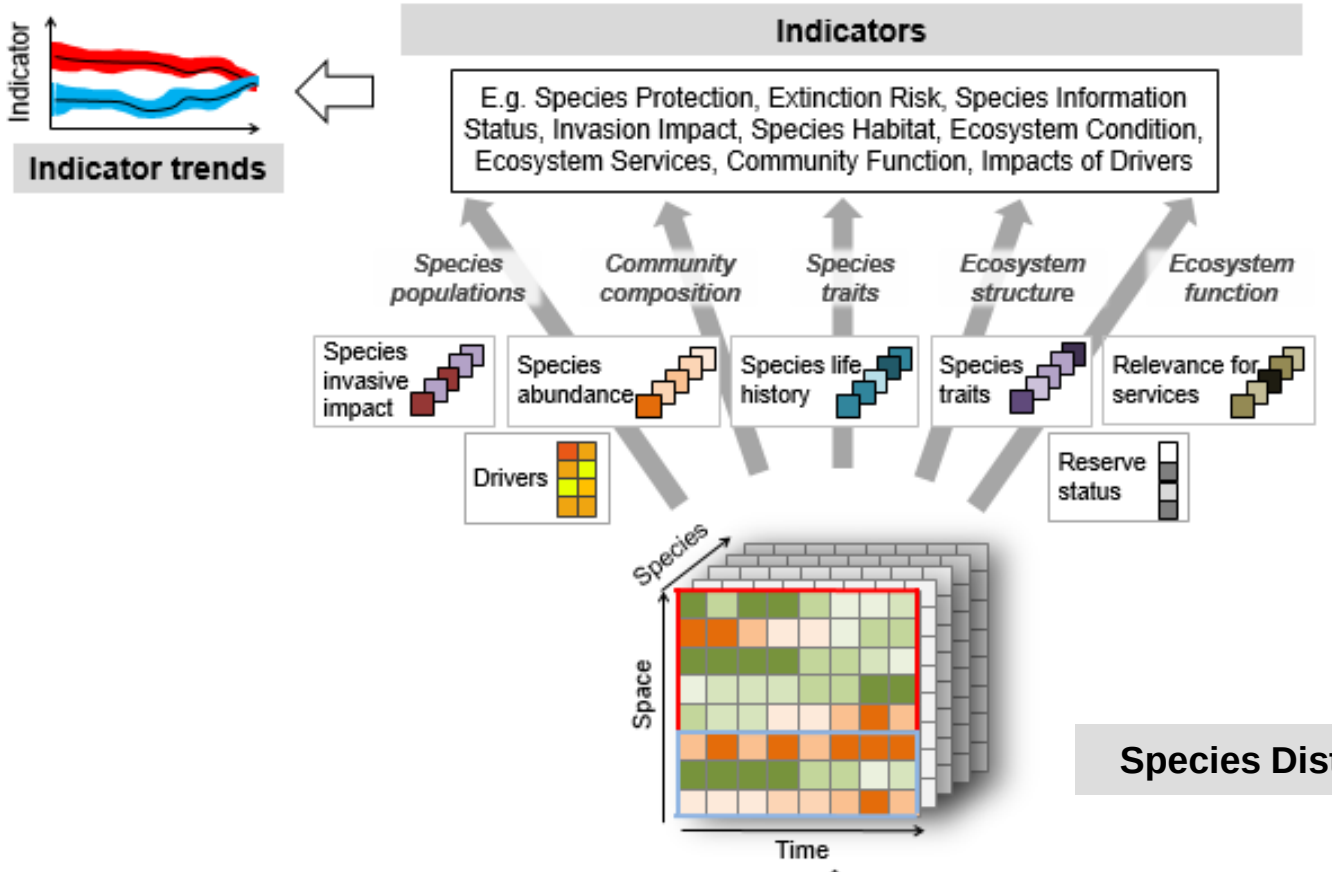
Hummingbird 1km Species Richness



Species range rarity (endemism)

(338 species)

4. Indicator Products



Species Distribution EBV

SHI **Species Habitat Indices**

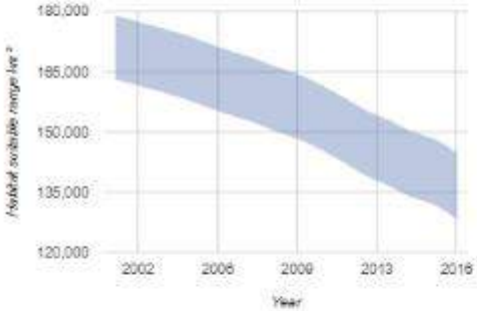
MOL MAP OF LIFE

Solitary Tinamou

Tinamus solitarius

Map overlay Expert range within suitab ▼

Legend

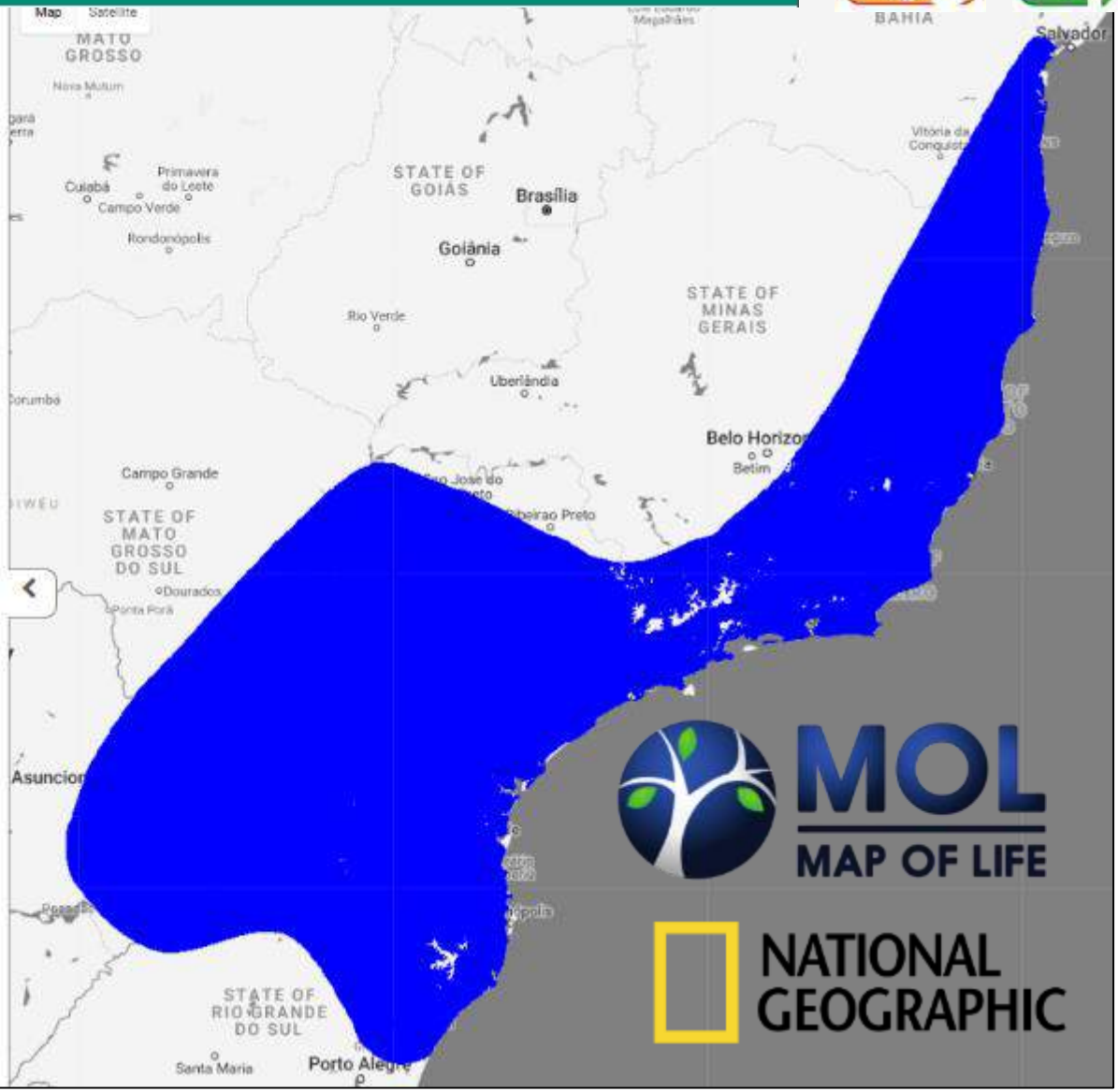


View Download

Suitable elevation: -500 to 1300 meters

Suitable tree cover: 75 to 100%

Toggle land cover suitability ›



SHI Species Habitat Indices

MOL MAP OF LIFE

Solitary Tinamou

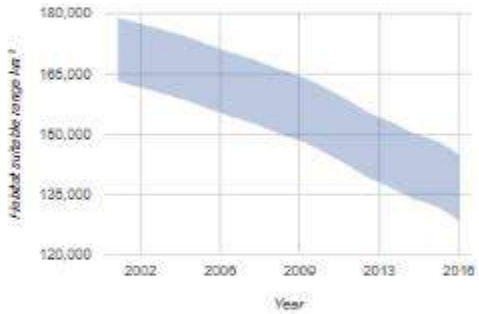
Tinamus solitarius

Map overlay 1km ESA land cover and Tr

Legend

% initial habitat suitability

Loss — No-change — Gain



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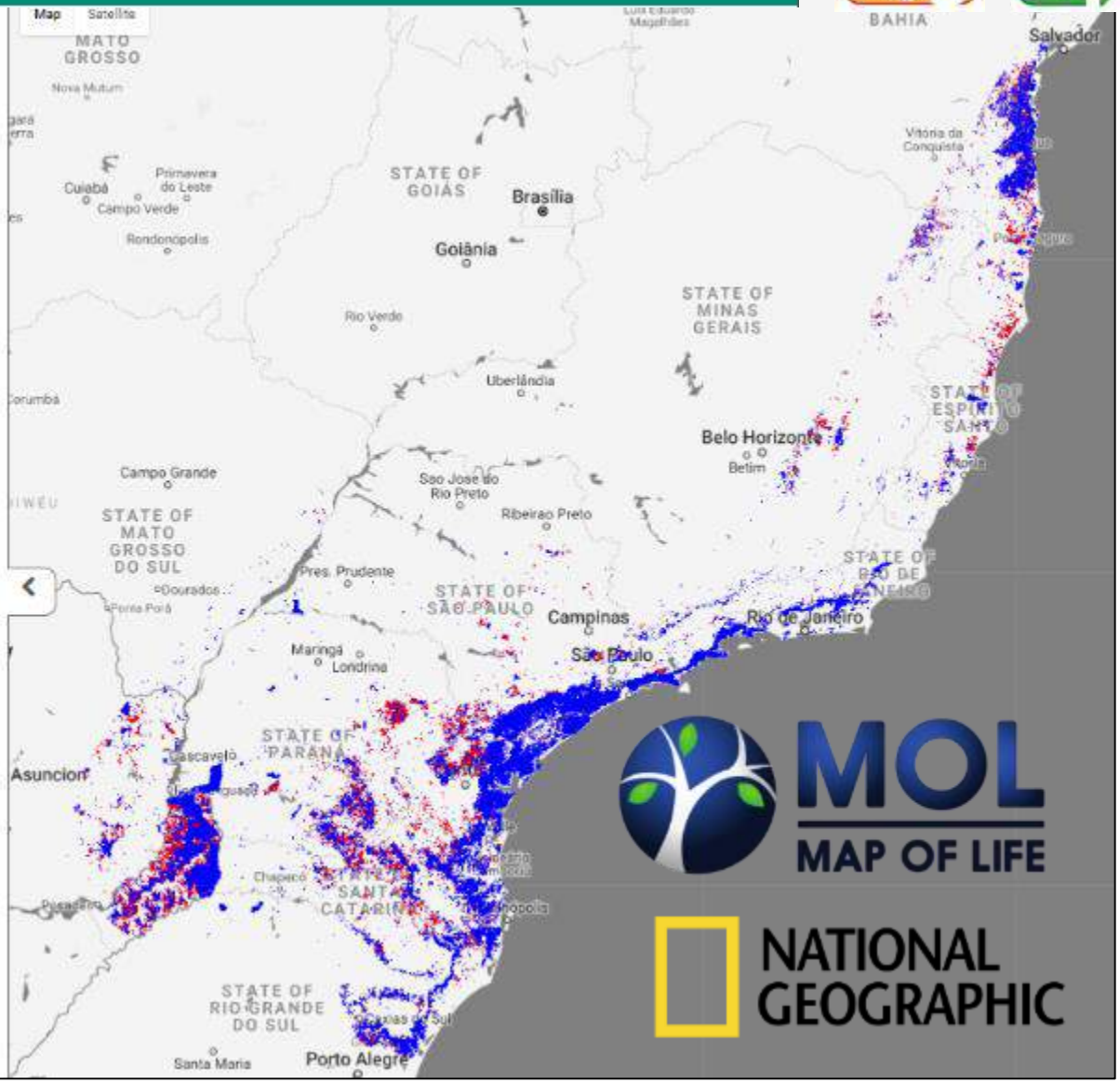
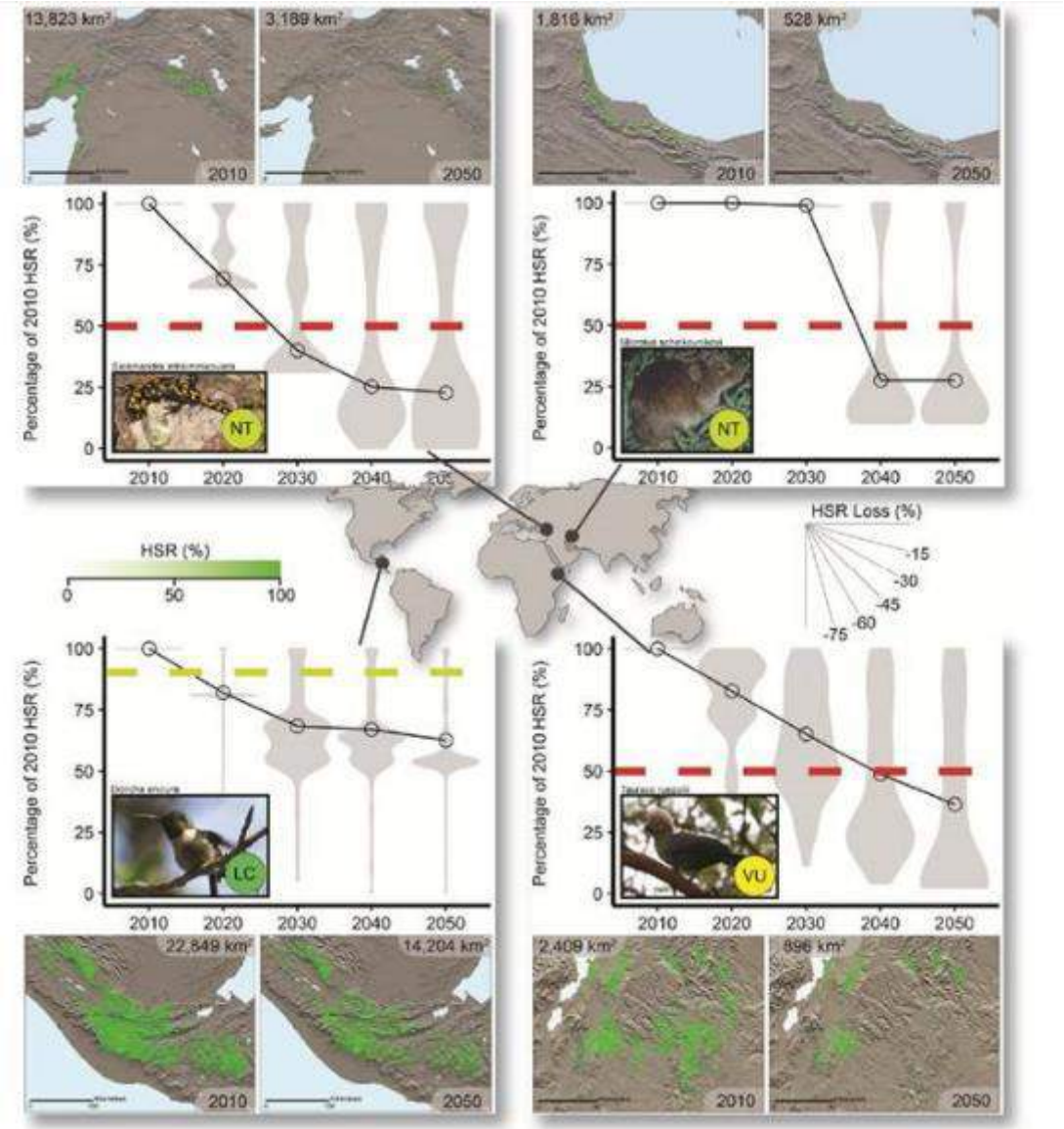


MOL MAP OF LIFE

NATIONAL GEOGRAPHIC

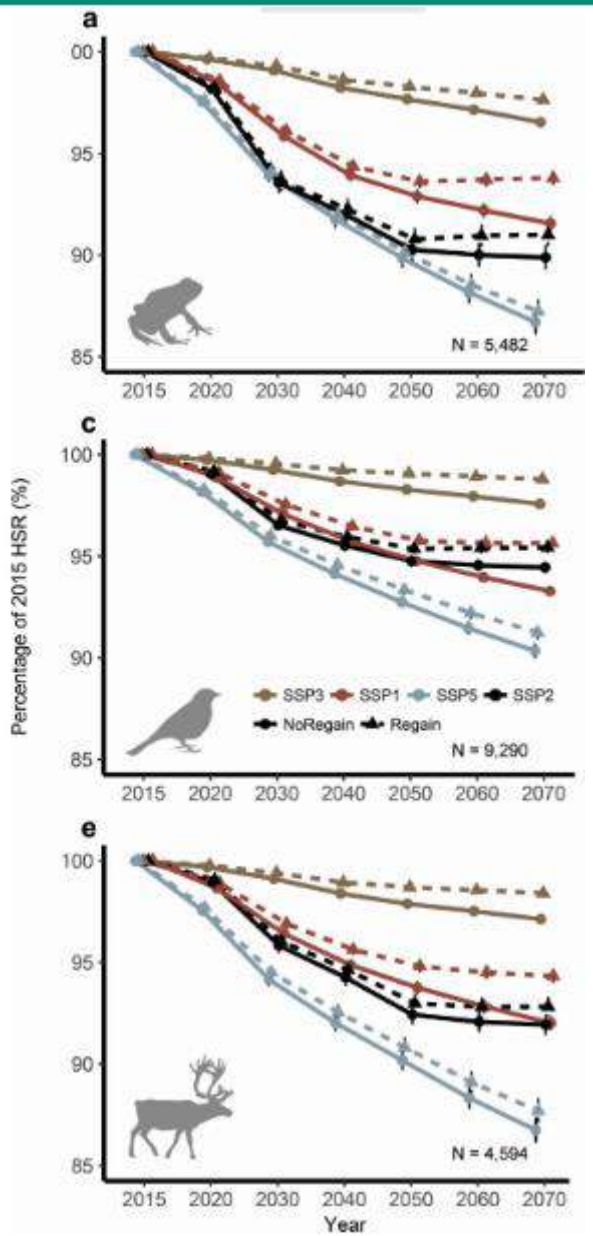
Forecasting



SSP 2

Powers & Jetz
Nature Climate
Change 2019

Forecasting



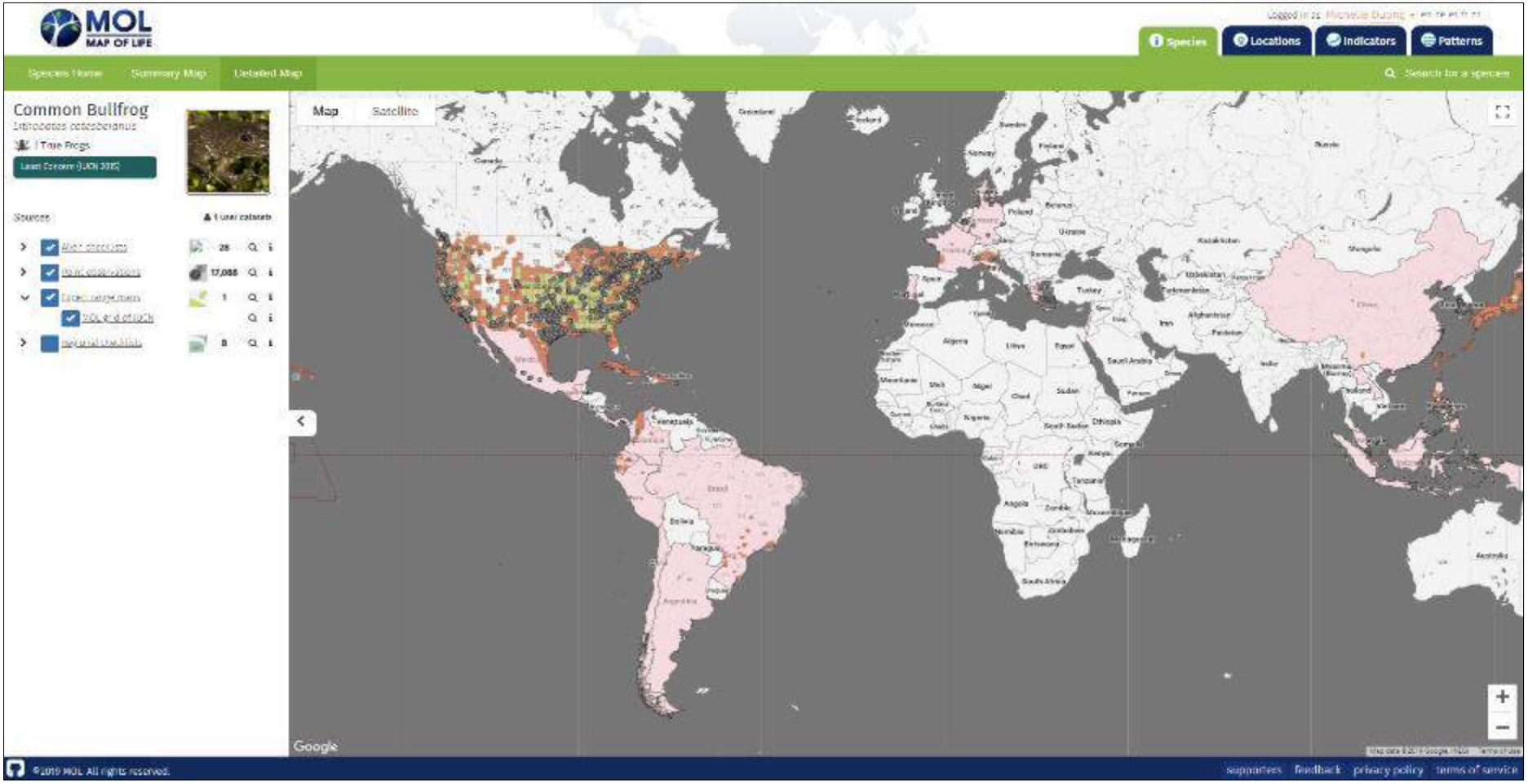
Powers & Jetz

sTWIST – Theory and Workflows for Alien and Invasive Species Tracking

1. What is the theoretically/methodologically sound indicator/s?
2. What is needed to achieve this?
3. Are enough data currently available for a sensible 1st global picture?
4. What are the question/s it answers? How are these answers useful for supporting policy/decision making?

iDiv

sTWIST – Theory and Workflows for Alien and Invasive Species Tracking



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