Activities to advance, build, and deliver remote-sensing supported species distribution and species abundance EBVs. 18-GEOBON-0025.
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<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Institution/Position</th>
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<tbody>
<tr>
<td>Co-I</td>
<td>Robert Guralnick</td>
<td>University of Florida, Gainesville</td>
</tr>
<tr>
<td>Co-I</td>
<td>William McShea</td>
<td>Smithsonian Institution</td>
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<tr>
<td>Co-I</td>
<td>Cory Merow</td>
<td>Yale University</td>
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<tr>
<td>Co-I</td>
<td>Adam Wilson</td>
<td>SUNY, Buffalo</td>
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<tr>
<td>Collaborator</td>
<td>Melodie McGeoch</td>
<td>Monash University, Australia</td>
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<tr>
<td>Collaborator</td>
<td>Jorge Ahumanda</td>
<td>Conservation International</td>
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<tr>
<td>Collaborator</td>
<td>Roland Kays</td>
<td>NC State University</td>
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<tr>
<td>Collaborator</td>
<td>Carsten Meyer</td>
<td>iDiv, Leipzig</td>
</tr>
<tr>
<td>Collaborator</td>
<td>Tim Robertson</td>
<td>Global Biodiversity Information Facility, Denmark</td>
</tr>
<tr>
<td>Collaborator</td>
<td>David Thau</td>
<td>Google; WWF</td>
</tr>
<tr>
<td>Collaborator</td>
<td>Martin Wikelski</td>
<td>Max Planck Society, Germany</td>
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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**
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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 Jetz¹, Melodie A. McGeoch², Robert Guralnick³, Simon Ferrier⁴, Jan Beck⁵, Mark J. Costello⁶, Miguel Fernandez⁷,⁸ Gary N. Geller⁹, Petr Keil¹⁰, Cory Merow¹, Carsten Meyer¹⁰,¹¹, Frank E. Muller-Karger¹², Henrique M. Pereira¹³,¹⁴, Eugenie C. Regan¹⁵, Dirk S. Schmeller¹⁶,¹⁷, Eren Turak¹⁸,¹⁹

Nature Ecology & Evolution 2019
Species Populations Working Group

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Nature Ecology & Evolution 2019
New sensors
New sensors
New sensors

Jaguar

Cumulative total records

- GBIF
- Wildlife Insights

Annual records

Wildlife Insights

GBIF
Linking Individual Behavior to Community Responses in Changing Landscapes

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:45 am</td>
<td>WELCOME RECEPTION (COFFEE)</td>
<td></td>
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</table>
| 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 frogivores  
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 |
| 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 Kartzinell (Brown): Connecting earth observations with ecological networks |
| 5:00 pm  | DRINKS RECEPTION                                |                                                                            |
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

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

Clustering of environmental variables by species responses

Clustering of species by environmental responses

Regression Coefficient

-0.1 to 0.2

Environmental Variables

Species
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

Area = 456,085 km²
AUC_{train} = 0.987
AUC_{test} = 0.976

Without

Area = 957,529 km²
AUC_{train} = 0.982
AUC_{test} = 0.951
Speckled Hummingbird
Adelomyia melanogenys

Least Concern (IUCN 2016)

Sources
- Local inventories
- Expert range maps
  - Mid-east grid of birdlife
  - Axt et al. (2012)
- Point observations
- Regional checklists
Hummingbird 1km Species Richness

Species range rarity (endemism) (338 species)
4. Indicator Products

- E.g. Species Protection, Extinction Risk, Species Information Status, Invasion Impact, Species Habitat, Ecosystem Condition, Ecosystem Services, Community Function, Impacts of Drivers

Species Distribution EBV
Solitary Tinamou

Tinamus solitarius

Map overlay
Expert range vs. suitable

Legend

Suitable elevation: ~500 to 1300 meters
Suitable tree cover: 75 to 100%
Solitary Tinamou
Tinamus solitarius

Suitable elevation: 500 to 1300 meters
Suitable tree cover: 75 to 100%

Map overlay: 1km ESA land cover and Tr

Legend:
- Loss
- No-change
- Gain

Graph:
- X-axis: Year (2002 to 2018)
- Y-axis: Habitat suitable range km²

View, Download

Map of Life:
- MOL
- SHI

National Geographic
Forecasting

SSP 2
Forecasting
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?
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