

# Informing UN-assisted National Biodiversity Strategy Action Plans with Earth Observations: Application to Forest Integrity and Connectivity

## Forest Integrity for Sustainable Development Planning



Photo: UNDP

NASA Ecological Forecasting Meeting, May 24, 2017, Washington DC



# Key Issue: Loss of Ecological Integrity of Wildlands



Grand Canyon National Park, US

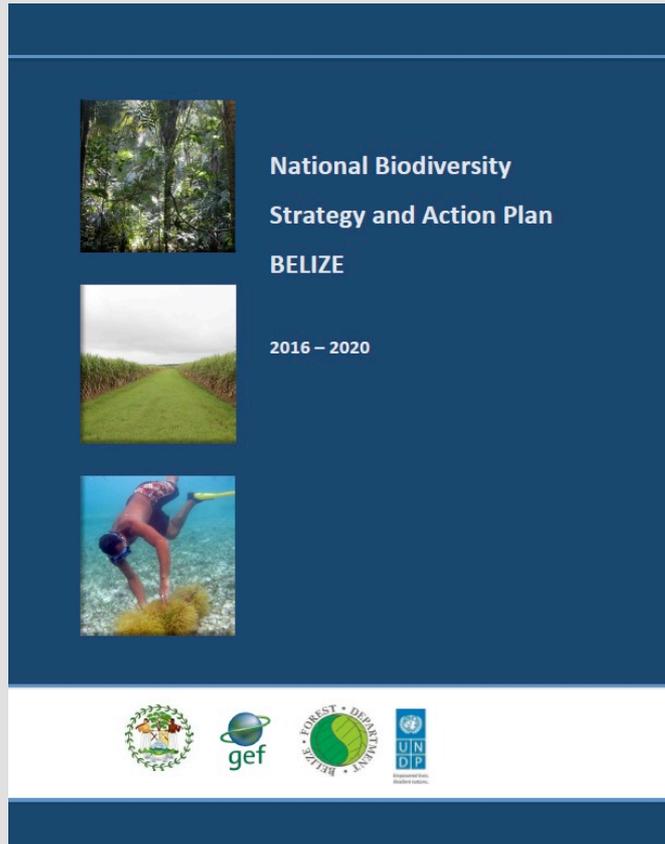


Near Tanjung Puting National Park, Indonesia



Watson et al  
2016

# Potential Solution: International Biodiversity Conservation



- ## Convention on Biodiversity (2010) Targets for 2020
- Target 5 - fragmentation
  - Target 11 - connectivity
  - Target 17 - National Biodiversity Strategy Action Plans

**The UNDP's Global Programme on Nature for Development is working with 135 countries to implement NBSAPs.**

# Project Purpose

## Goal:

**Develop credible and consistent global satellite-based products and analysis methods to inform connectivity implementation of forest integrity in NBSAPs**

## Objectives:

- 1. Develop satellite-based products mapping forest condition, human pressure, and forest integrity, and assessing habitat fragmentation and connectivity.**
- 2. Use the products to inform a biodiversity Decision Support System (DSS).**
- 3. Incorporate the DSS into the UN Pulse Lab and demonstrate its use by countries implementing NBSAPs**

# Project Team

Montana State University



**Andrew Hansen**



**Linda Phillips**

Northern Arizona University



**Scott Goetz**



**Patrick Jantz**

Univ of Queensland and Univ of N. British Columbia



**James Watson**



**Oscar Venter**

University of Maryland



**Matt Hansen**

United Nations Development Programme



**Jamison Ervin**



**Christina Supples**



**Anne Vernig**



**Heena Ahmed**

UN PULSE Lab Kampala



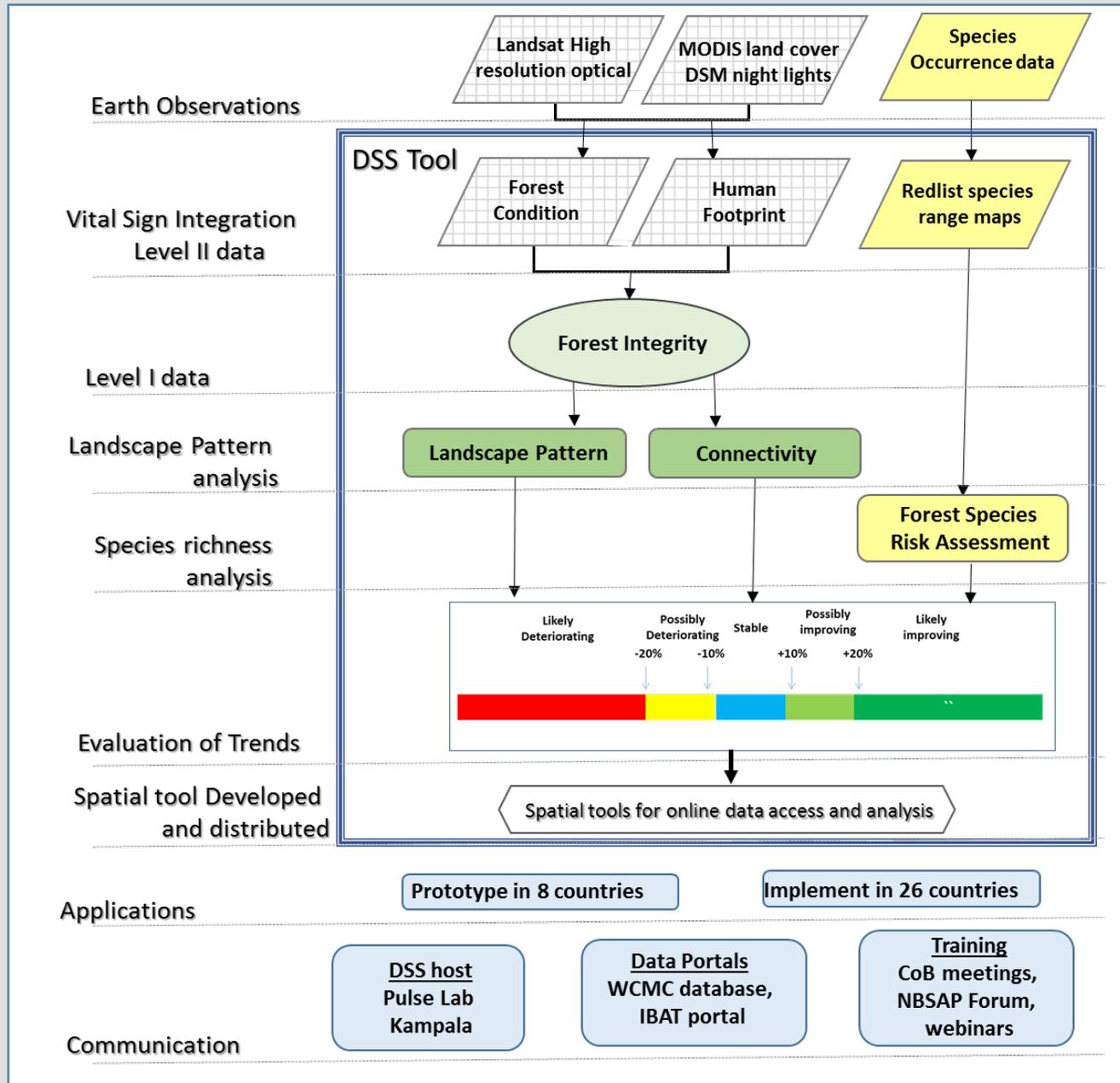
**Paula Hidalgo-Sanchis**

NASA Applied Sciences Program



**Cindy Schmidt**

# Project Flow



# Countries for Piloting

## Selection Criteria

- Close working relationships with governments already established through UNDP regional offices;
- Receptive to external support, politically important and provide a regional balance;
- Fast-growing forests for which the forest integrity metric is meaningful ecologically; Relatively large contiguous areas to facilitate meaningful connectivity analyses;
- Participation in UN REDD, New York Declaration on Forests, Norway priority countries (NICFI), BIOFIN, and/or UNDP's portfolio for 6th National Reporting.

## Pilot Countries

### South America

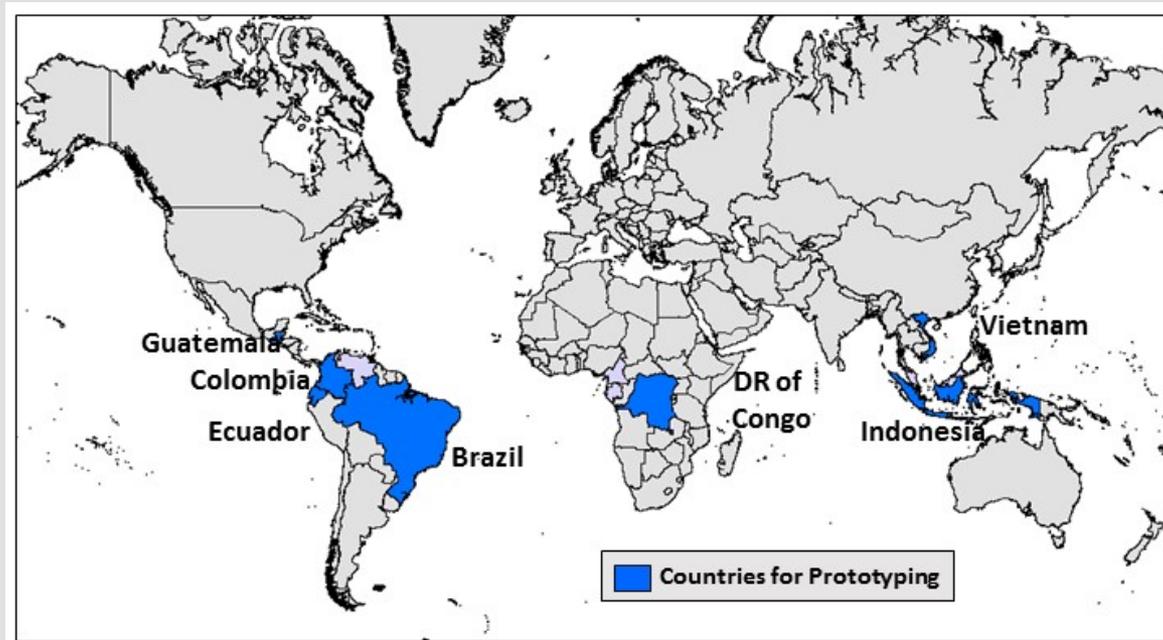
Colombia, Ecuador, Brazil, Guatemala

### Africa

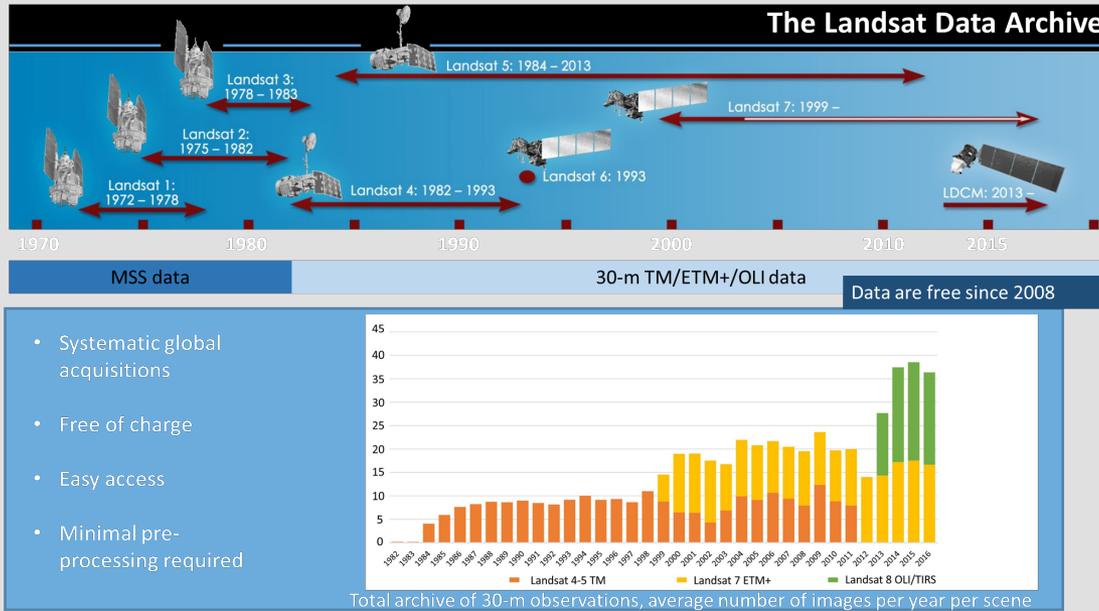
Democratic Republic of Congo

### Asia

Indonesia, Vietnam

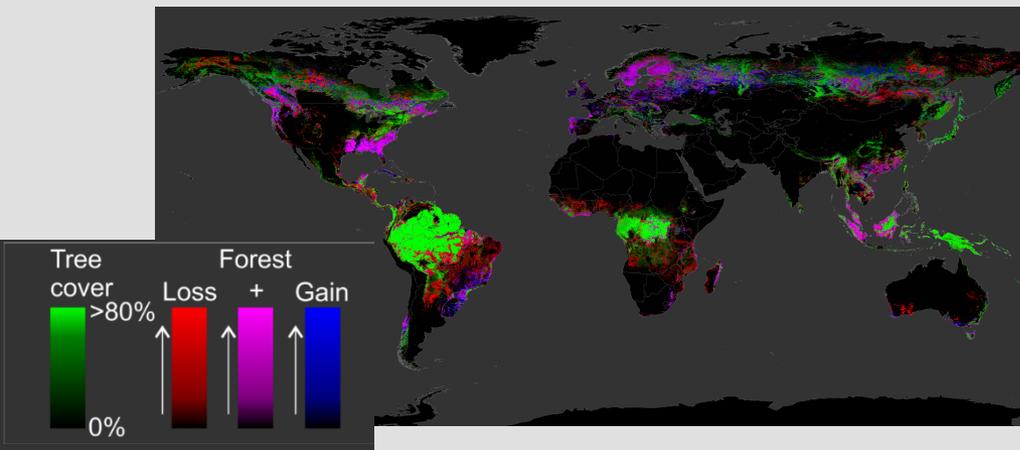


# Forest Condition

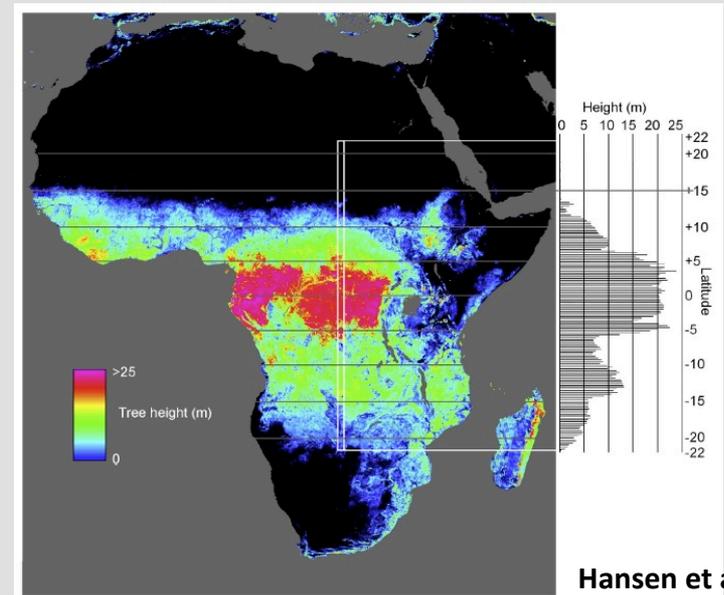


## Forest Height

### Canopy Cover and Time Since Disturbance

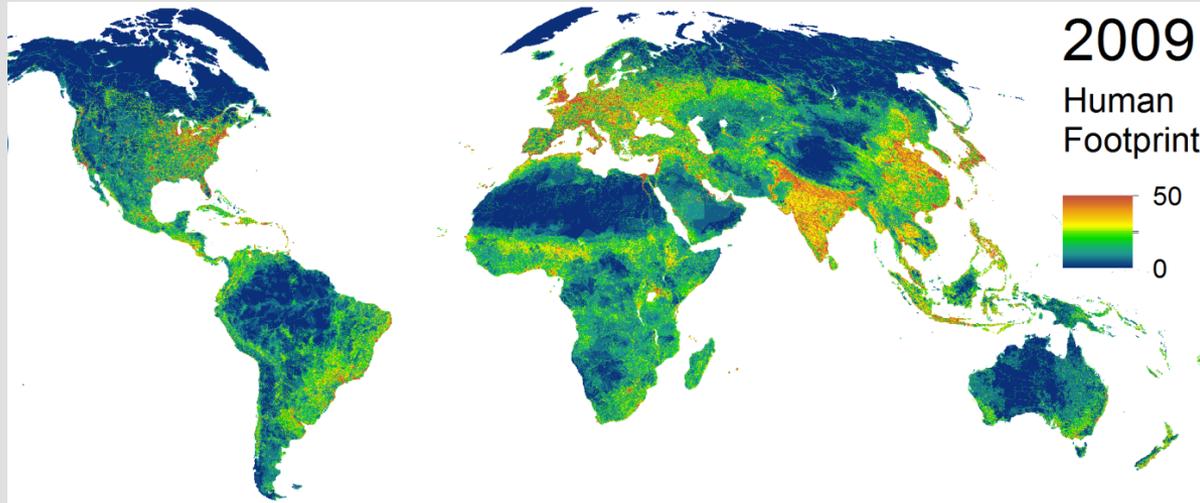


Hansen et al. 2013



Hansen et al. 2016

# Human Footprint



Venter et al. 2016

## Step 1 Acquire or develop data on individual human pressures

1993 pressure data

2009 pressure data

- Built environments
- Population density
- Electric infrastructure
- Crop lands
- Pasture lands
- Railways
- Major roadways
- Navigable waterways

- Built environments
- Population density
- Electric infrastructure
- Crop lands
- Pasture lands
- Railways
- Major roadways
- Navigable waterways

## Step 2 Assign relative pressure scores to individual pressures

1993 pressures

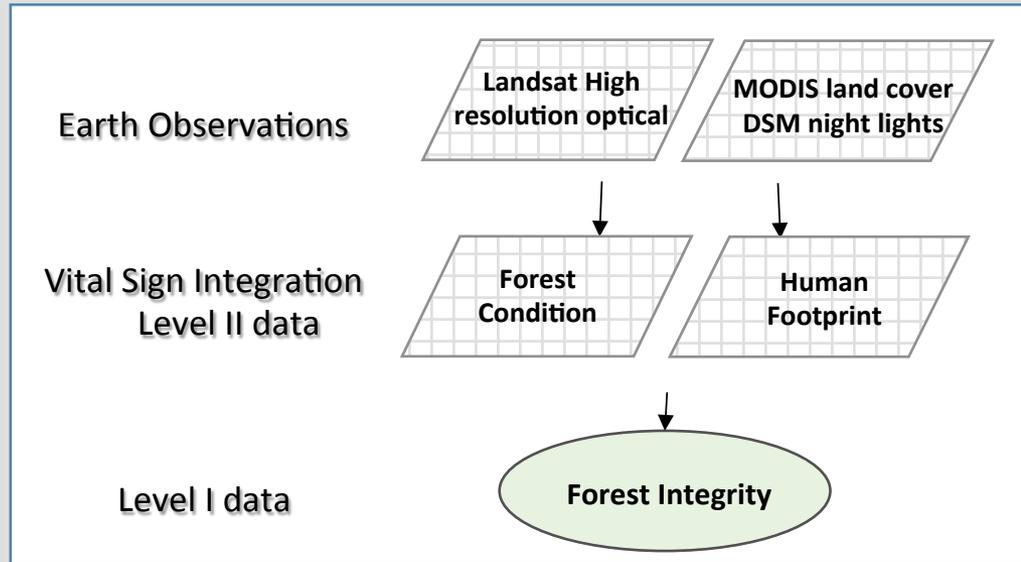
2009 pressures

## Step 3 Overlay individual pressures to create Human Footprint maps

1993 Human Footprint

2009 Human Footprint

# Forest Integrity



**Forest condition – structure, composition, function**

**Forest intactness – low human pressure**

**Hinterland forest – larger tracts of older forest free from human edge effects**

**Forest integrity – taller, older forests with high canopy cover and low human pressure**

# Forest Integrity

**Forest Condition Classes and (Weights)**

Time Since Disturbance (yrs)	Forest Height (m)		
	0-10	10-20	>20
<8	Short Stand initiation (1)	Mid-ht Stand initiation (4)	Tall Stand initiation (6)
8-17	Short Stem exclusion (4)	Mid-ht Stem exclusion (5)	Tall Stem exclusion (8)
>17	Short understory reinitiation (6)	Mid-ht understory reinitiation (8)	Tall understory reinitiation (10)

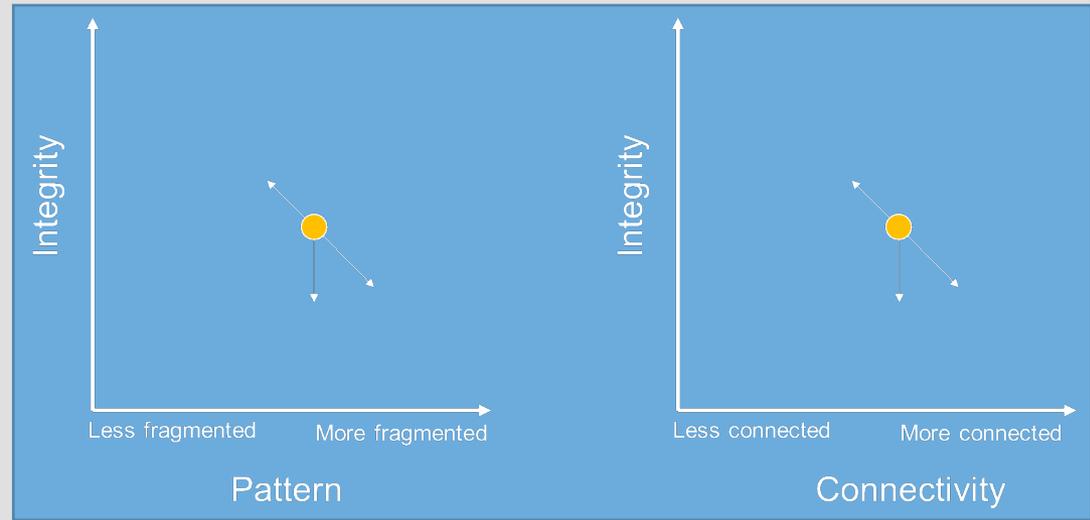
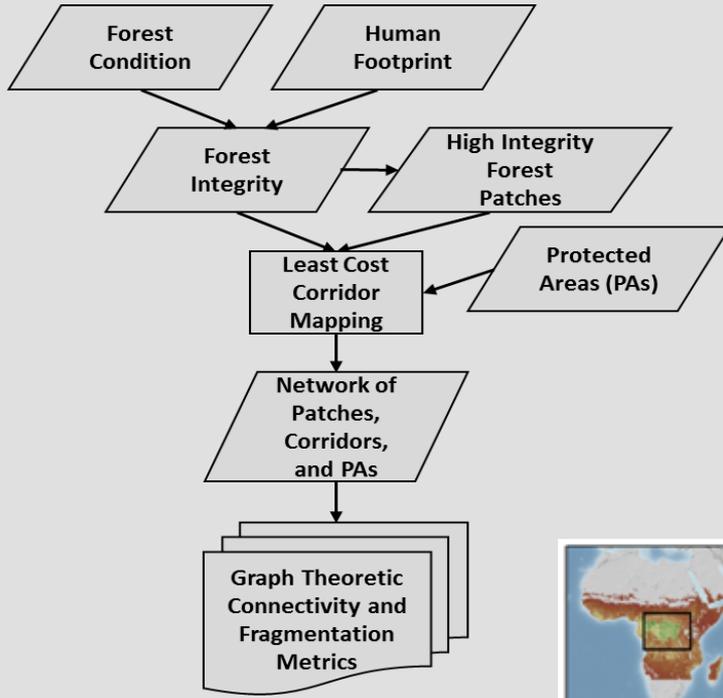
**HFP Classes and (Weights)**

HFP Value	Class
<4	Low (1)
5-15	Medium (5)
>15	High (10)

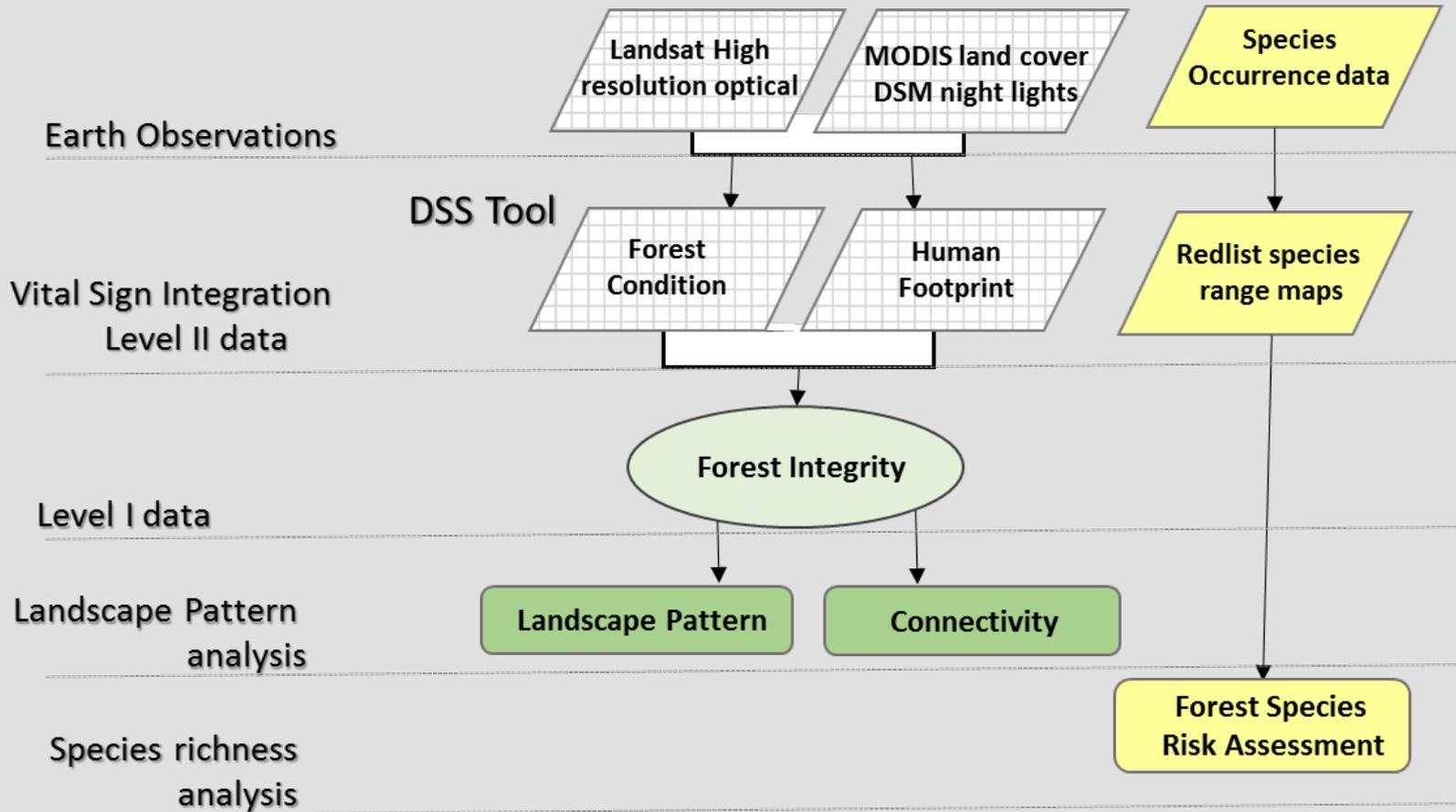
**Forest Integrity Index =  
FC weight x 1 / HFP weight**

**Range: 0-10**

# Forest Fragmentation and Connectivity

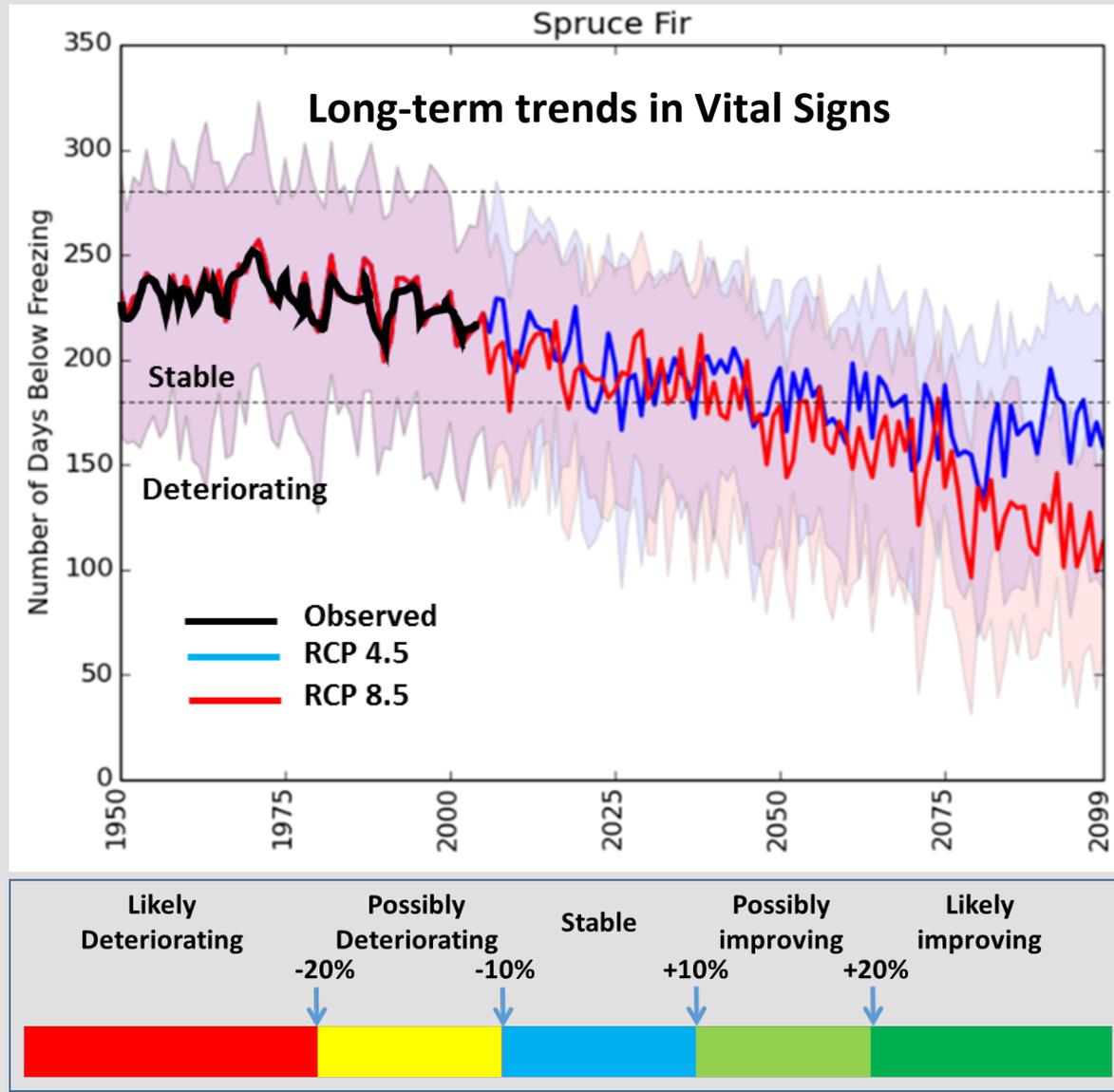


# Consequences for Mammal Species



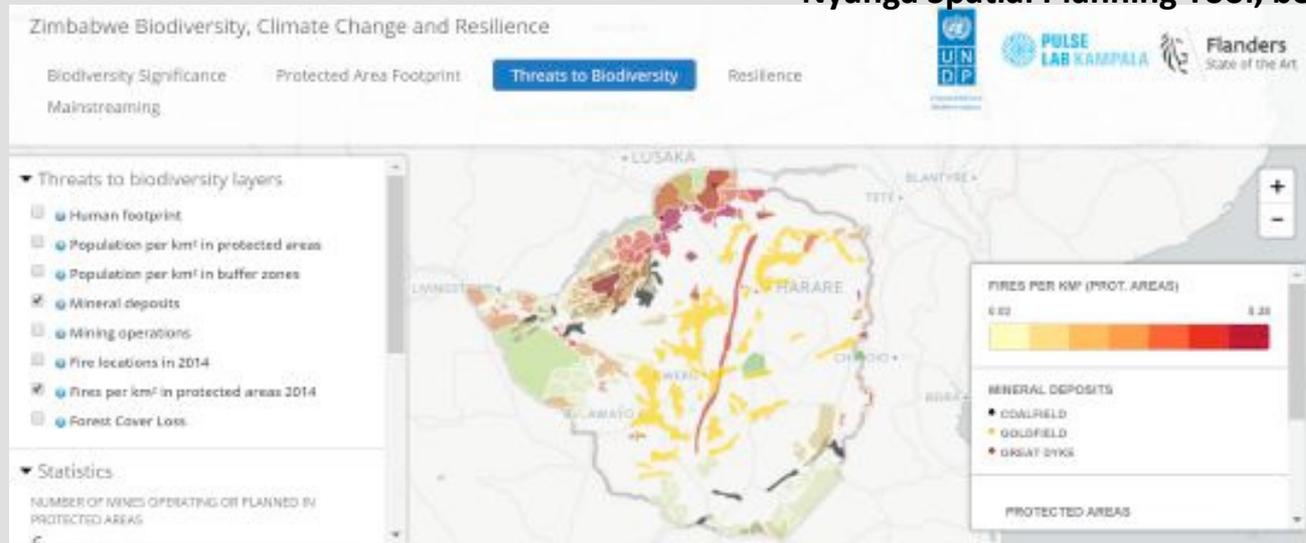
# Evaluation of Ecological Condition and Decision Support

## Evaluation of Trends



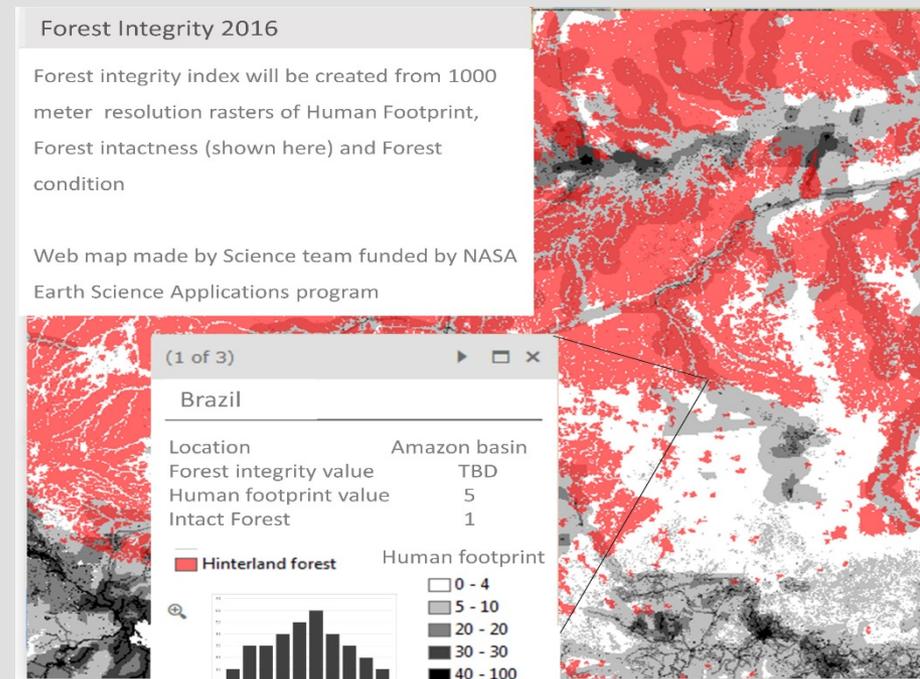
# Decision Support

Nyanga Spatial Planning Tool, beta version



**Spatial analysis tools will be integrated into the DSS to enable users to download spatial data or calculate summary statistics output from our remote sensing, forest integrity, and other products.**

- **A cloud system will provide easy data access and storage**
  - **ArcGIS Online 'in the Cloud' system or**
  - **Amazon**
- **An on-line server will provide data viewing and download**
  - **Leaflet/CartoDB or**
  - **ArcGIS Server**
- **Spatial analysis tools will enable calculations of spatial metrics and statistics**
  - **ESRI Developer network or**
  - **Other Open source processing such as GDAL**



# Synergies

- Inform National Biodiversity Strategic Action Plans in >34 countries
- Inform Essential Biodiversity Variables with a Land health index
- Link with GEO Bon

## GEO BON Essential Biodiversity Variables

EBV Class	Candidate RS-EBV	Aichi Targets
Species populations	Species distribution*	4,5,7,9,10,11,12,14,15
Species populations	Species abundance*	5,7,9,12,14,15
Species traits	Phenology (e.g., leaf-on and -off dates; peak)	5,9,11,12,14,15
Species traits	Plant traits (e.g., specific leaf area, leaf N)	7,9,12,14
Community comp.	Taxonomic diversity	8, 10, 12, 14
Community comp.	Functional diversity	5,7,10,12,14,15
Ecosystem function	Productivity (e.g., NPP, LAI, FAPAR)	5,7,10,12,14,15
Ecosystem function	Disturbance regime (e.g., fire, inundation)	7,9,10,12,14,15
Ecosystem structure	Habitat structure (e.g., height, cover, density)	5,7,9,14,15
Ecosystem structure	Ecosystem extent and fragmentation	5,11,12,14,15
Ecosystem structure	Ecosystem composition by functional type	5,7,10,12,14,15

## Land Health Index

Level 1 Vital Sign	Level 2 Vital Sign	Level 3 Vital Signs
Stressors / Threats	Urbanization Intensive land use	Land cover change Distance to roads & other infrastructure Integrated human footprint Night lights
Water	Water quantity Flow regime	Snow cover and extent Frozen - non-frozen season timing & duration Stream / river hydrology Soil moisture
Weather and Climate	Seasonality Climate	Climate & meteorology Climate change velocity and novel climates Land surface temperature
Habitat	Ecosystem extent Intactness / pattern Stream intactness Community naturalness	Habitat integrity / intactness Habitat fragmentation & connectivity Canopy structure, height, biomass Stream / river fragmentation
Species	Trophic structure Threatened species	Completeness of animal communities IUCN red-listed species
Ecosystem Processes	Disturbance Plant growth (productivity) Forest structure	Fire & deforestation extent and frequency Annual plant growth rate Start, peak & end of growing season

## Join GEO BON in building BON in a Box

Your toolbox for successful biodiversity monitoring.

