



the Jane Goodall Institute

Monitoring and Forecasting Chimpanzee Habitat Health in Africa to Inform Conservation Actions, Strategies, and Measure Success

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*Nasa (to grasp or catch in Swahili)
female chimpanzee
from Kasekela community
in Gombe, Tanzania*

Source: National Geographic Society



Partners



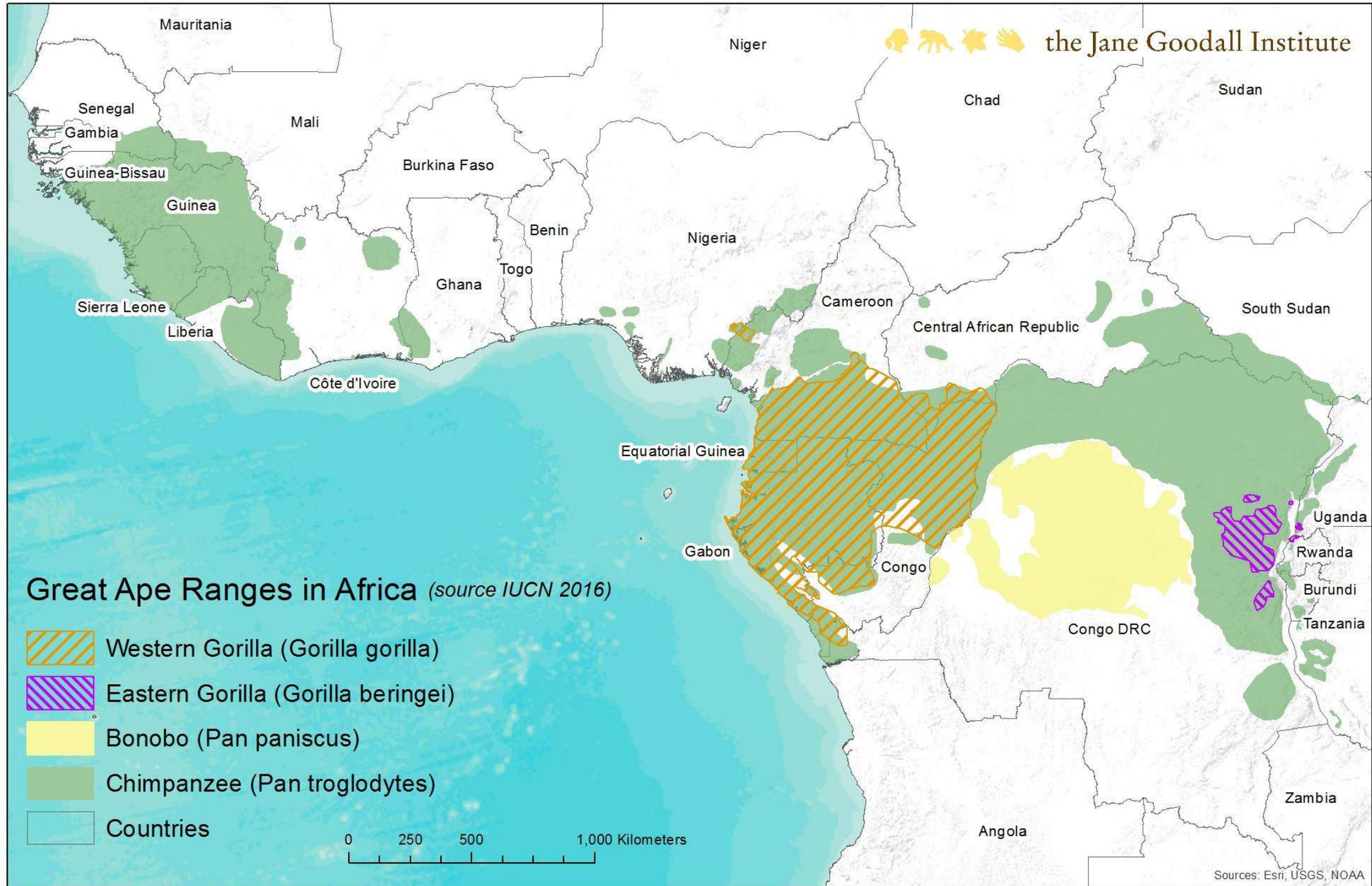
Local communities and Governments of
Tanzania, DRC, Uganda and Republic of Congo



Mission: to understand and protect chimpanzees, other apes and their habitats, and to work towards creating a critical mass of informed and compassionate citizens who will help to create a better world for people, other animals and our shared environment



the Jane Goodall Institute



Great Ape Ranges in Africa *(source IUCN 2016)*

Threats to Great Apes in Africa



Insecurity



Bushmeat hunting



Unregulated Mining



Low protection capacity

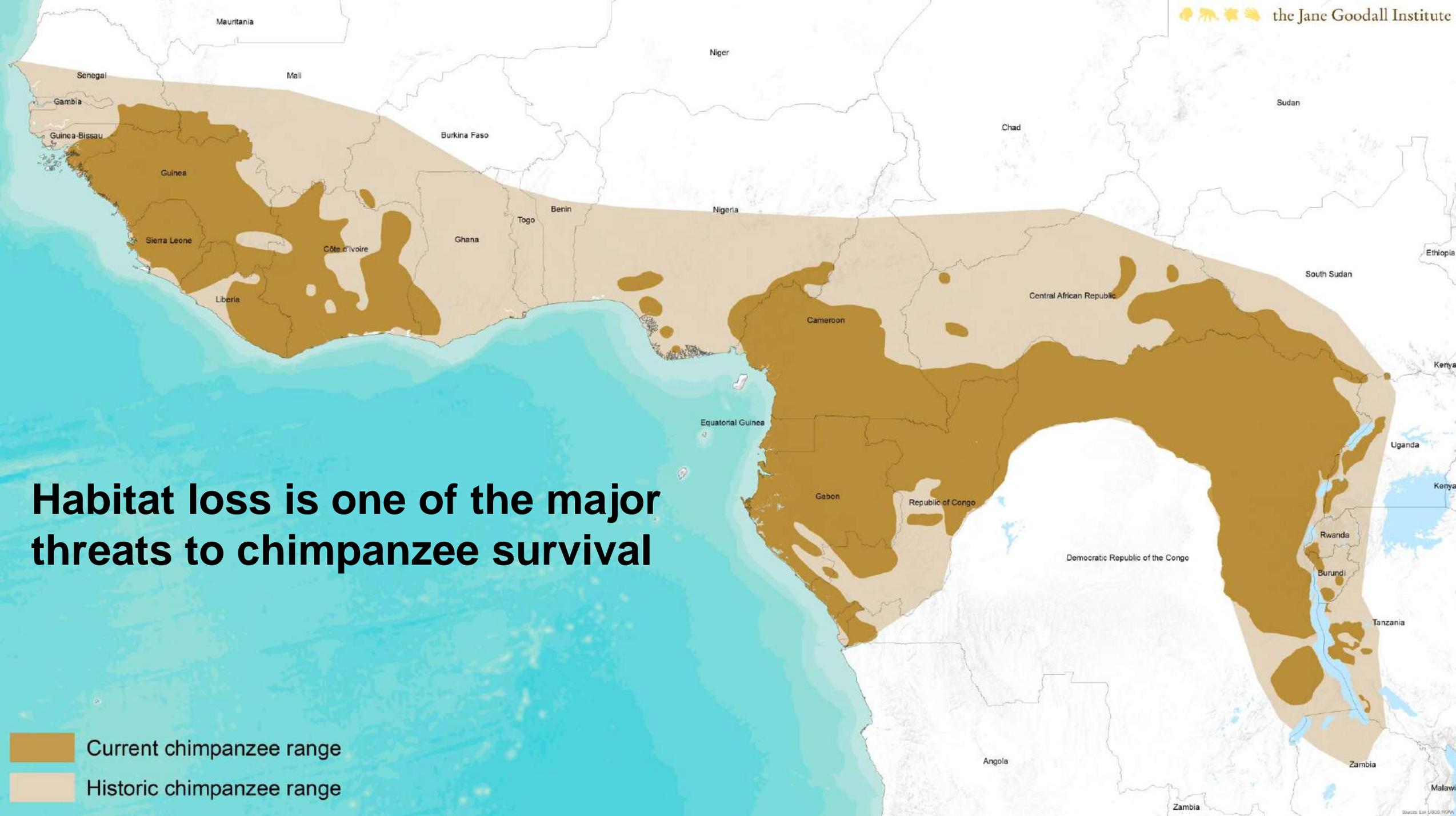


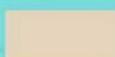
Habitat conversion to agriculture

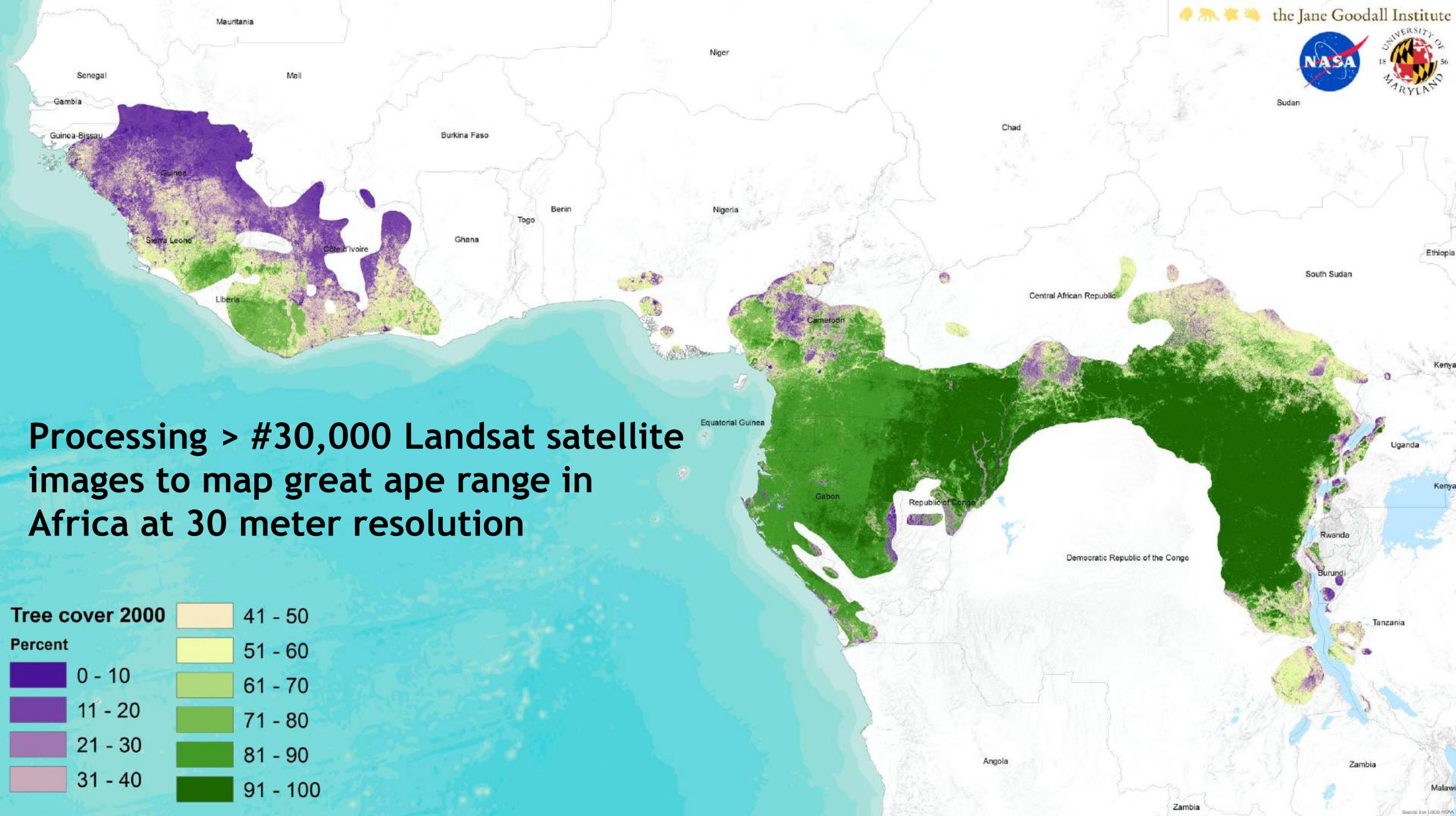


Logging

Habitat loss is one of the major threats to chimpanzee survival

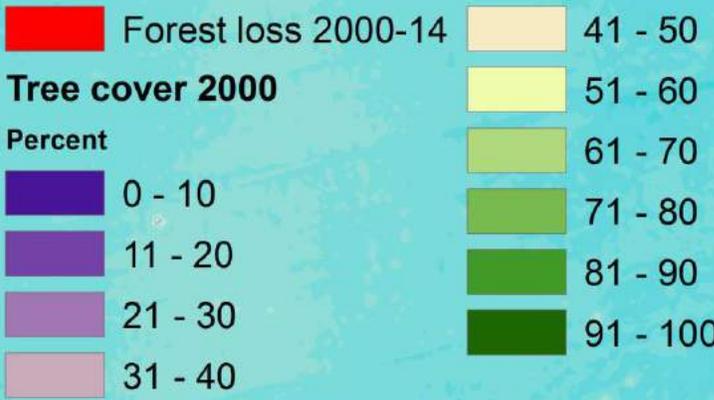
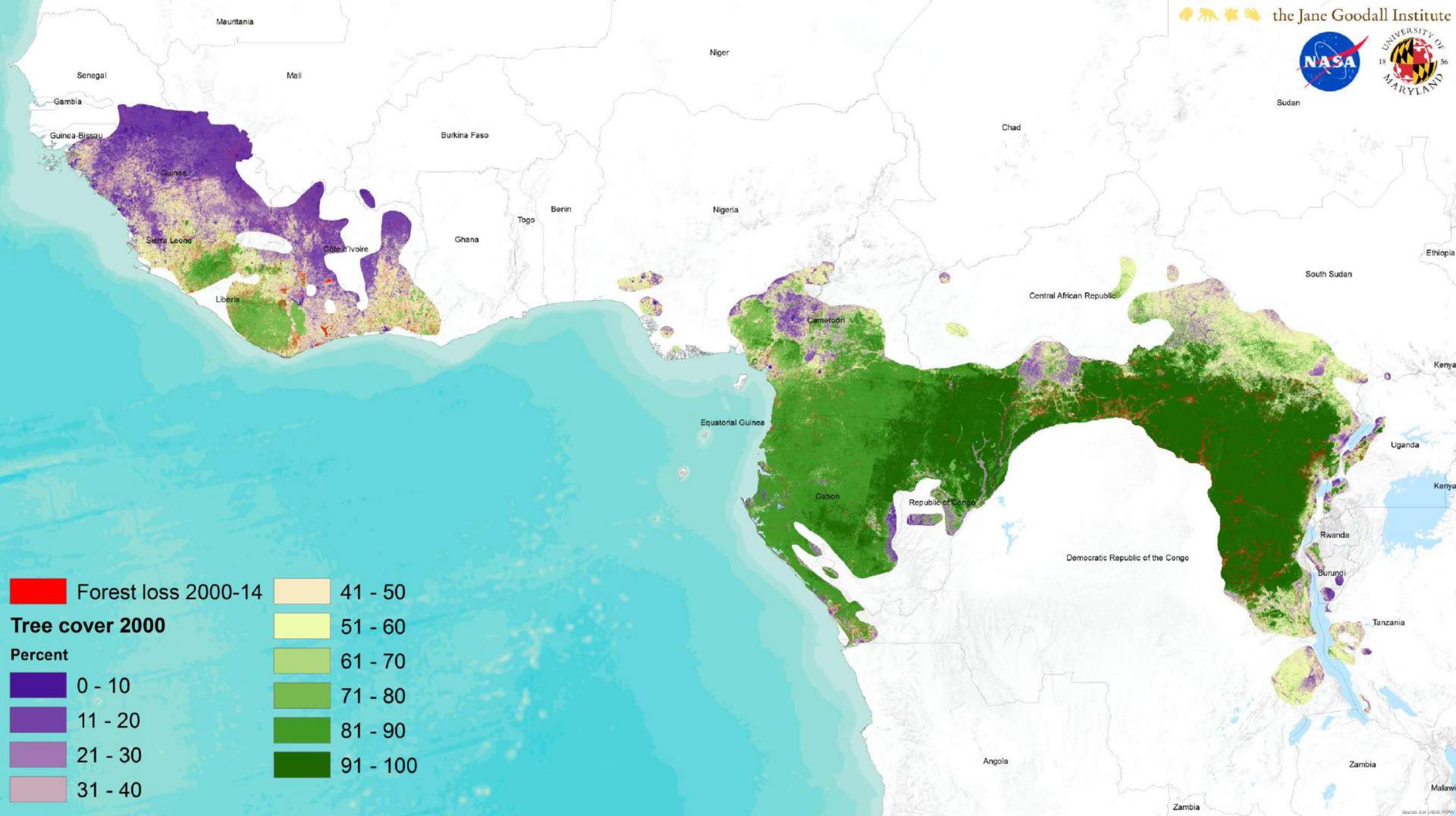


 Current chimpanzee range
 Historic chimpanzee range



Processing > #30,000 Landsat satellite images to map great ape range in Africa at 30 meter resolution

Tree cover 2000	
Percent	
0 - 10	41 - 50
11 - 20	51 - 60
21 - 30	61 - 70
31 - 40	71 - 80
	81 - 90
	91 - 100



Tree cover 2000
Percent

DSS Objective & Geographic Scope

- Develop a practical DSS to be used by the Jane Goodall Institute and partners to annually monitor and forecast chimpanzee habitat conditions to support decision-making from local to species range scales in Africa.
- DSS covers geographic ranges of all four sub-species of chimpanzees.
- Will enable systematic monitoring of habitat change over time.



Article

Landsat ETM+ and SRTM Data Provide Near Real-Time Monitoring of Chimpanzee (*Pan troglodytes*) Habitats in Africa

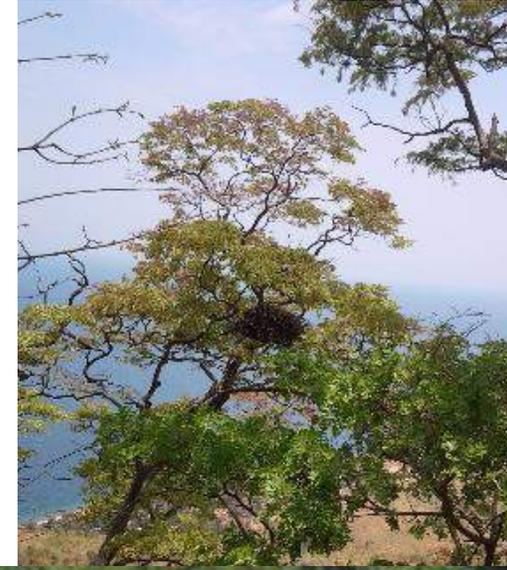
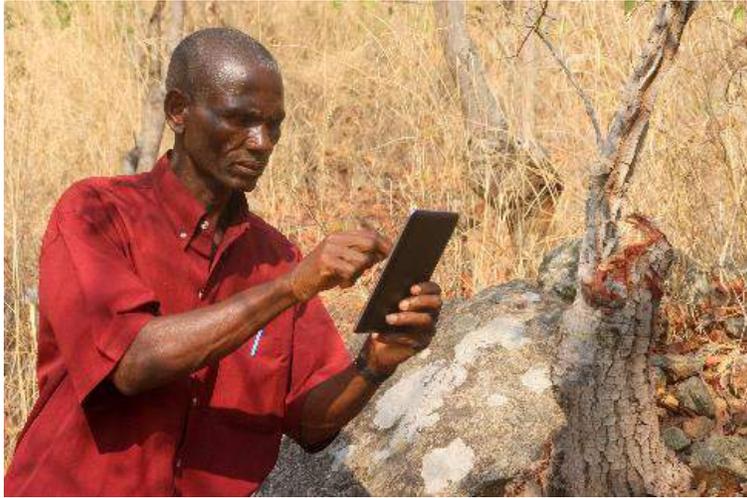
Samuel M. Jantz ^{1,*} , Lilian Pintea ² , Janet Nackoney ¹  and Matthew C. Hansen ¹  

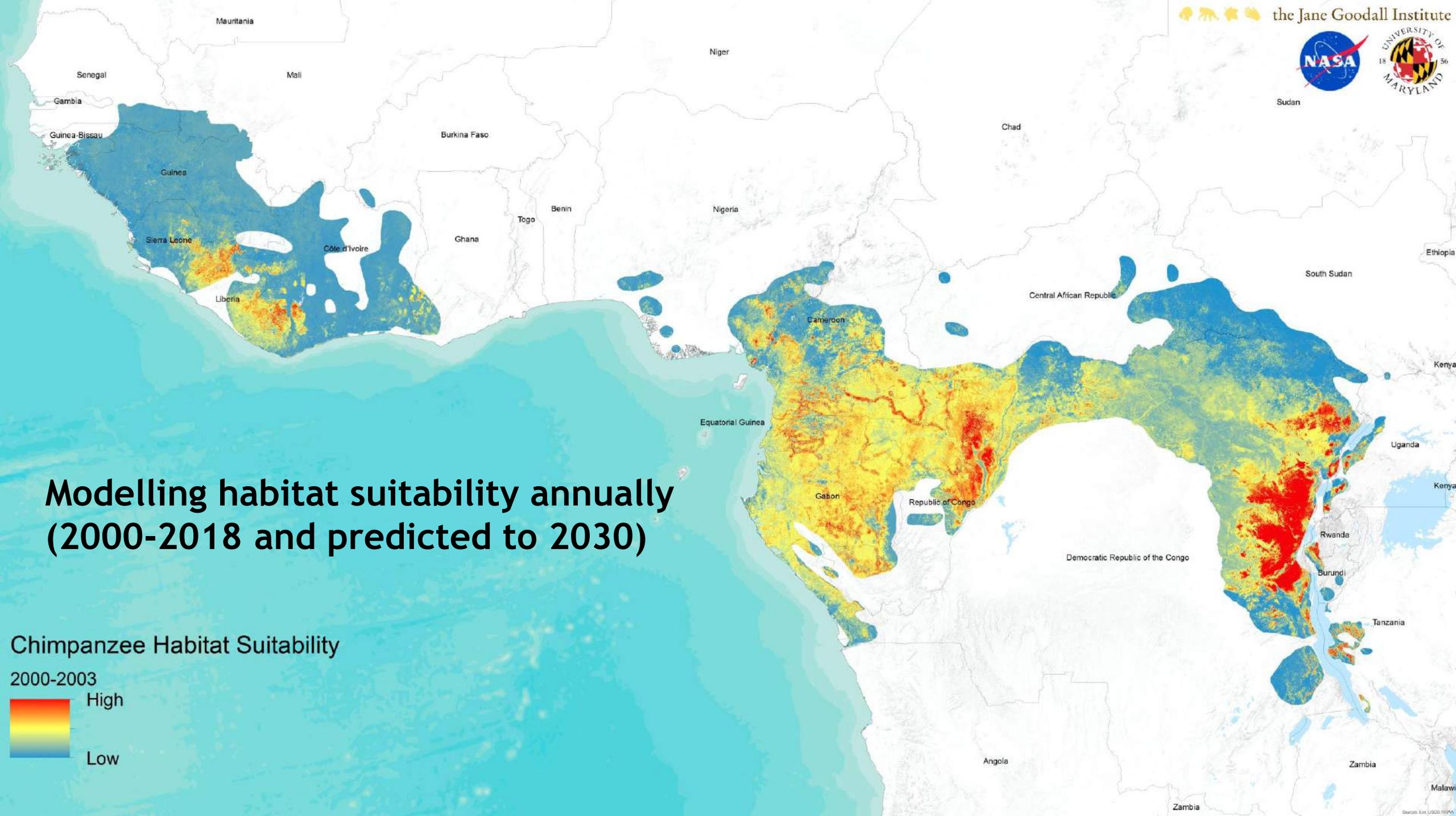
Table 1. List of predictor variables used as input to Random Forest regression models.

Variable	Units	Source	Abbreviation
Landsat ETM+ band 3 (0.63–0.69 μM)	% reflectance	Hansen <i>et al.</i> 2013 [28]	B3
Landsat ETM+ band 4 (0.77–0.90 μM)	% reflectance	Hansen <i>et al.</i> 2013 [28]	B4
Landsat ETM+ band 5 (1.55–1.75 μM)	% reflectance	Hansen <i>et al.</i> 2013 [28]	B5 *
Landsat ETM+ band 7 (2.09–2.35 μM)	% reflectance	Hansen <i>et al.</i> 2013 [28]	B7
Normalized difference band4/band3	Unitless	Hansen <i>et al.</i> 2013 [28]	NormB4/B3
Normalized difference band4/band5	Unitless	Hansen <i>et al.</i> 2013 [28]	NormB4/B5
Normalized difference band4/band7	Unitless	Hansen <i>et al.</i> 2013 [28]	NormB4/B7 *
band3/band5	Unitless	Hansen <i>et al.</i> 2013 [28]	B3/B5 *
band3/band7	Unitless	Hansen <i>et al.</i> 2013 [28]	B3/B7
band5/band7	Unitless	Hansen <i>et al.</i> 2013 [28]	B5/B7
Canopy cover	Percent	Hansen <i>et al.</i> 2013 [28]	CC *
Canopy height	M	Hansen <i>et al.</i> 2013 [28]	HT *
Distance to forest	M	Hansen <i>et al.</i> 2013 [28]	DF
Distance to forest loss	M	Hansen <i>et al.</i> 2013 [28]	DL
Forest loss in 1 km buffer	Proportion	Hansen <i>et al.</i> 2013 [28]	L1K
Forest loss in 25 km buffer	Proportion	Hansen <i>et al.</i> 2013 [28]	L25K *
Distance to forest edge	M	Hansen <i>et al.</i> 2013 [28]	DE *
Forest edge in 1 km buffer	Proportion	Hansen <i>et al.</i> 2013 [28]	E1K
Forest edge in 25 km buffer	Proportion	Hansen <i>et al.</i> 2013 [28]	E25K *
Distance to rivers	M	SWBD [35]	DR *
Distance to steep slopes	M	SRTM [35]	DS *
Elevation	M	SRTM [35]	EL *
Slope	Degrees	SRTM [35]	SLP *

* indicates variable was included in final model. See Section 2.4.1 for details on variable selection.

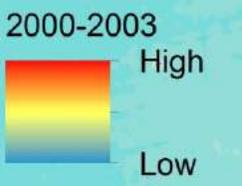
Crowdsourcing chimpanzee presence data from community monitoring, ranger patrols, researchers, Distance surveys, and UAVs)



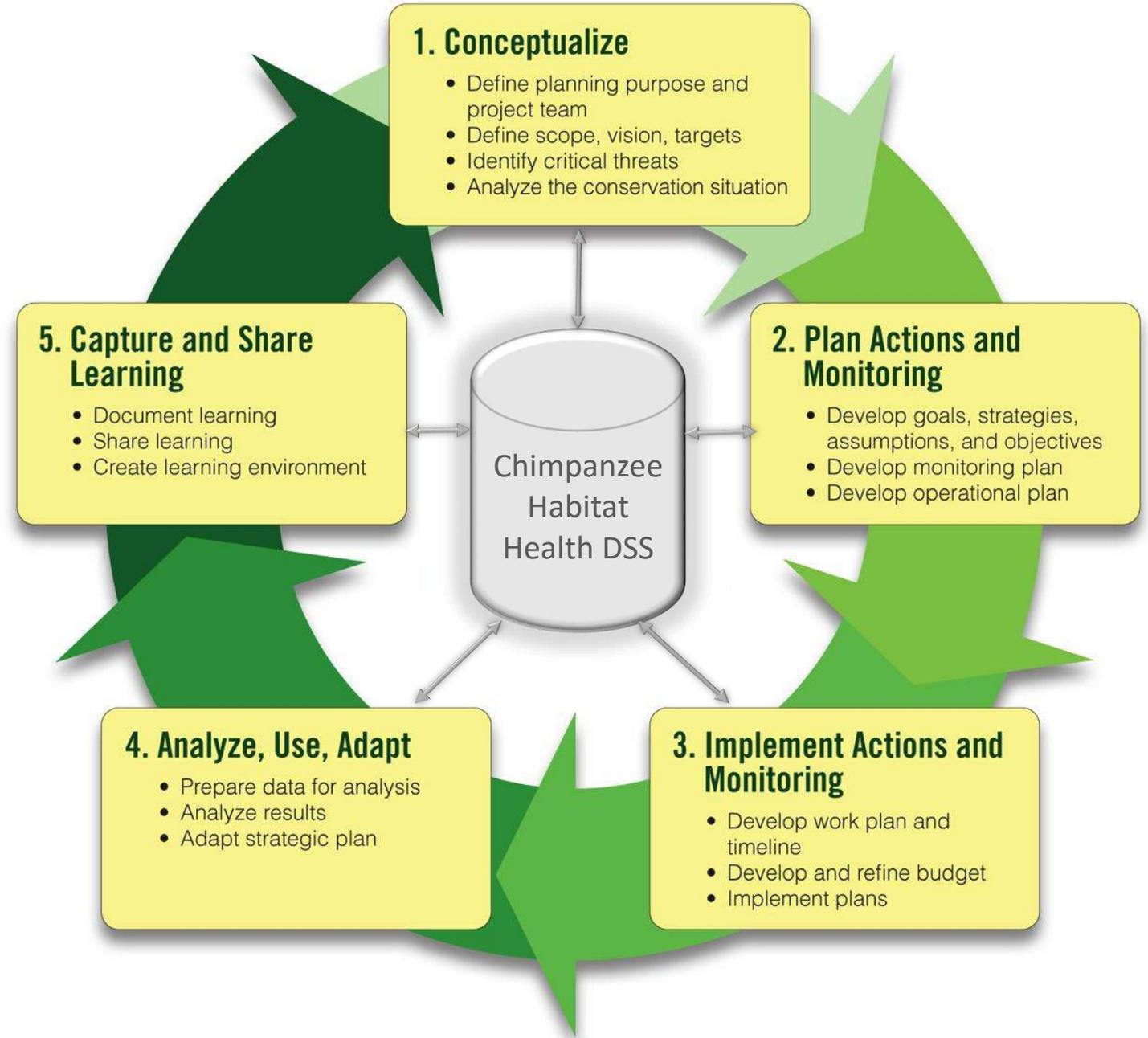


Modelling habitat suitability annually (2000-2018 and predicted to 2030)

Chimpanzee Habitat Suitability



Open Standards for the Practice of Biodiversity as a Management Framework

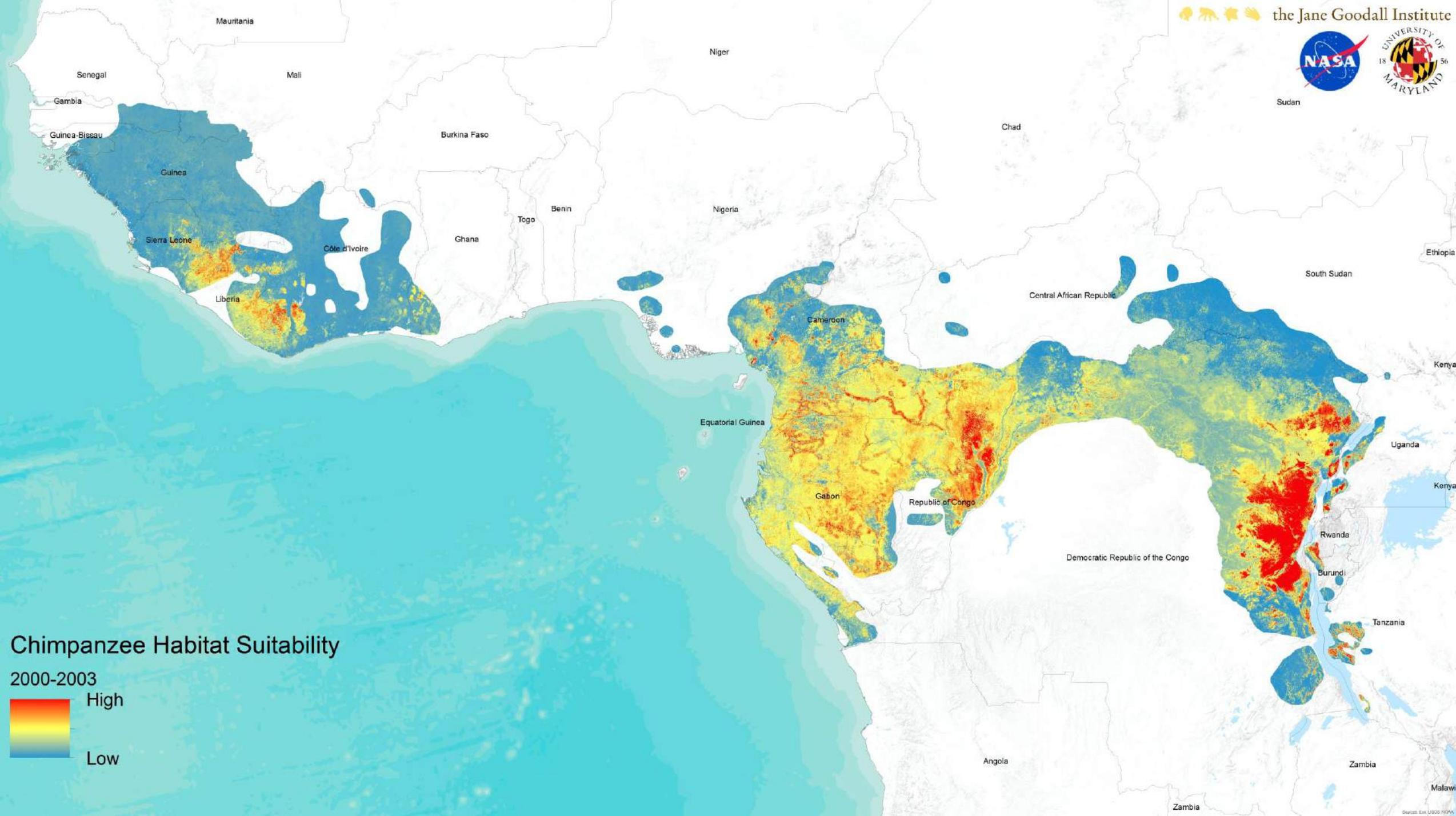


Chimpanzee Habitat Health Index using Open Standards

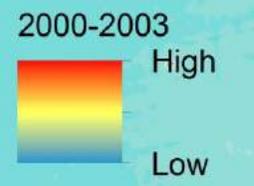
Open Standards Viability Analysis: Markings to Interpret Chimpanzee Health

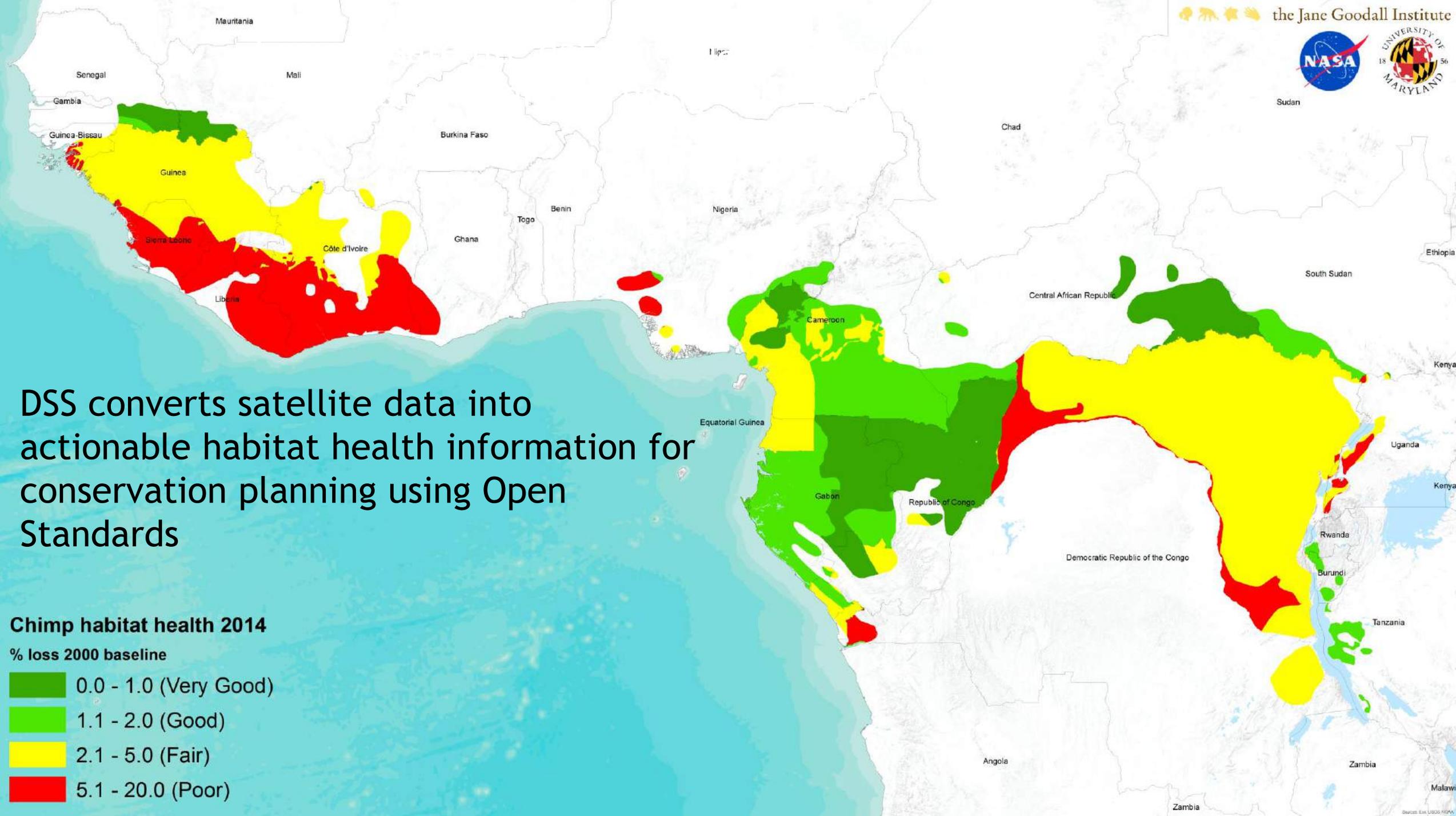
Poor: Restoration increasingly difficult; May result in extirpation	Fair: Outside acceptable range of variation; Requires intervention to get to good	Good: Within acceptable range of variation; Some intervention required to maintain	Very Good: Ecologically desirable status; Requires little intervention to maintain
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				Indicator Ratings			
Target	Category	KEA	Indicator	Poor	Fair	Good	Very Good
Chimpanzee Habitat in Zambezan Miombo Woodland	Size	Area with tree cover suitable for chimpanzees	% of 2000 baseline area loss	> 5 % loss	2.5 - 5.0 % loss	1 - 2.5% loss	< 1% loss
	Condition	Area with evergreen forests suitable for chimpanzees	% of 2000 baseline area loss	> 5% loss	2.5 – 5.0% loss	1 – 2.5% loss	< 1% loss
	Landscape context	Distance to humans	Avg pixel dist to human feature	< 2.5 km	2.5 – 5 km	5 – 10 km	> 10km



Chimpanzee Habitat Suitability

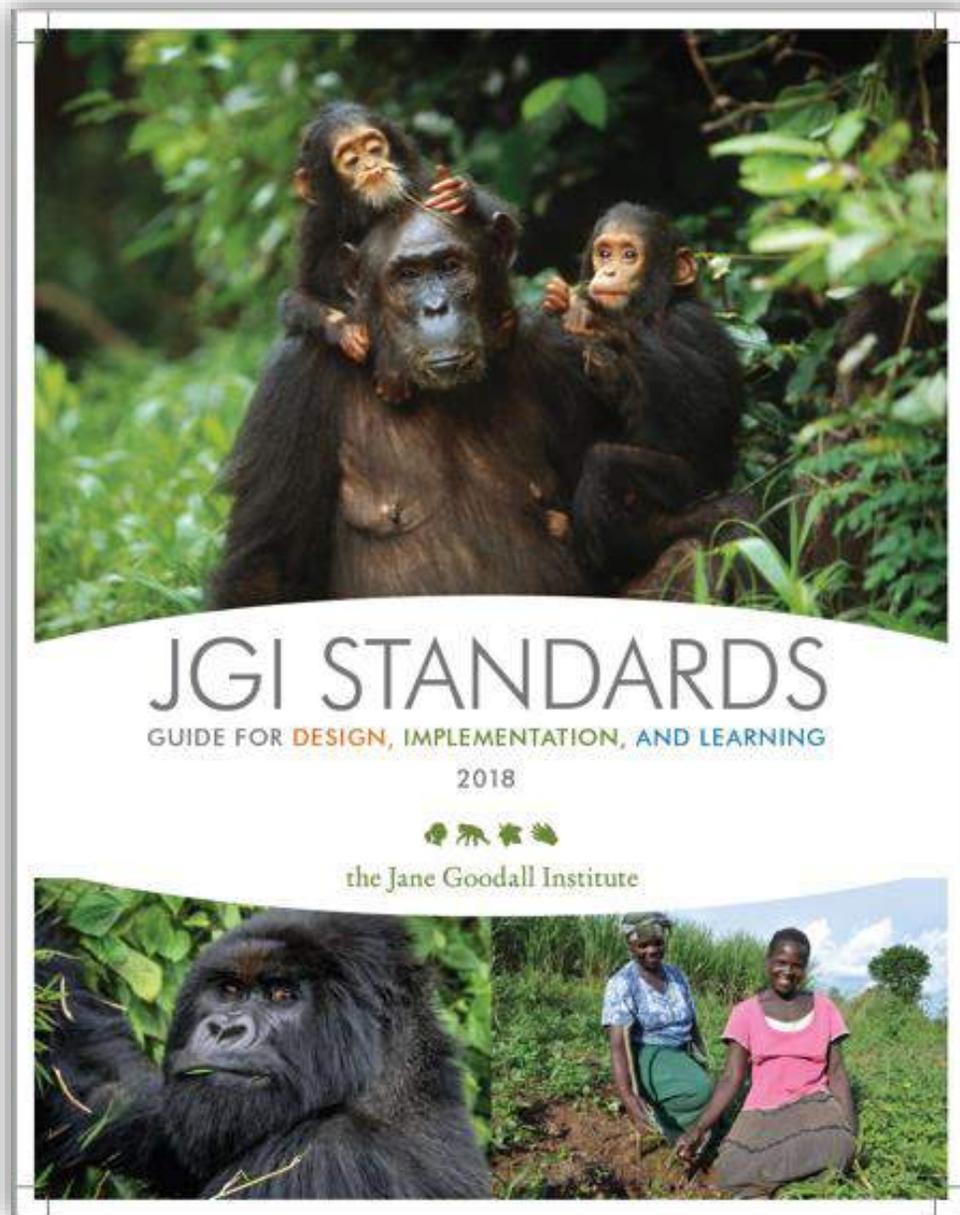




DSS converts satellite data into actionable habitat health information for conservation planning using Open Standards

Chimp habitat health 2014
% loss 2000 baseline

- 0.0 - 1.0 (Very Good)
- 1.1 - 2.0 (Good)
- 2.1 - 5.0 (Fair)
- 5.1 - 20.0 (Poor)



1

Step-By-Step adaptive management process clearly outlining connections between different Project phases and processes

2

Common Approach & Standard Terminology

3

Project Design, Implementation and Learning Modules tailored to JGI's specific needs & existing processes.

4

Set of Tools and Templates developed to support any Project from Design to Learning

5

Digital Tool Kit and Workbook designed to fit JGI's culture and practices





Our Africa Programs Ten-Year Strategy:

The Road Ahead



OUR VISION

Stable, viable, and diverse populations of chimpanzees live in peaceful coexistence with human population



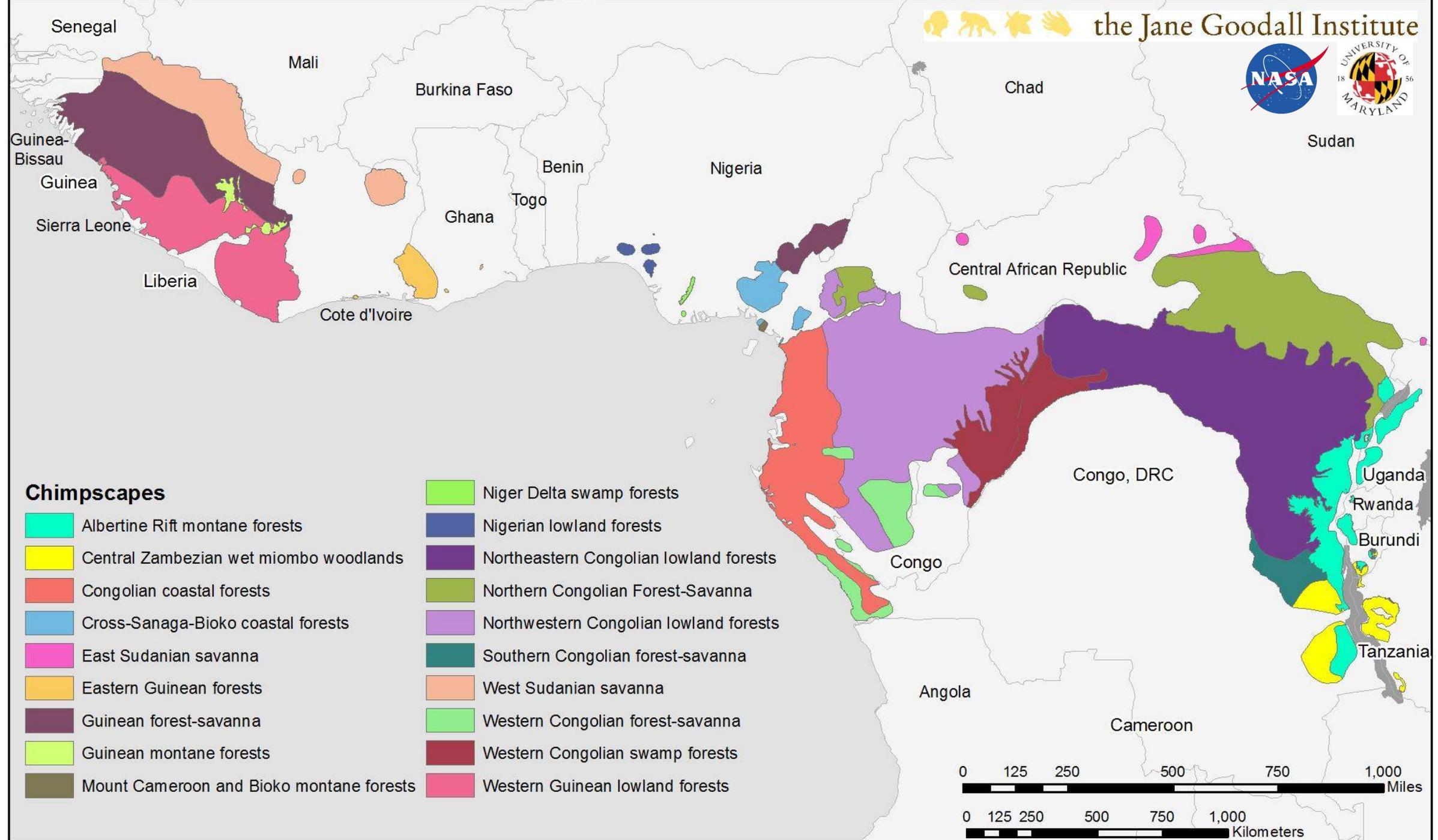
Our Africa Programs Ten-Year Strategy:

The Road Ahead



OUR GOAL

By 2044, ecological and cultural diversity of chimpanzees conserved in viable populations across the range

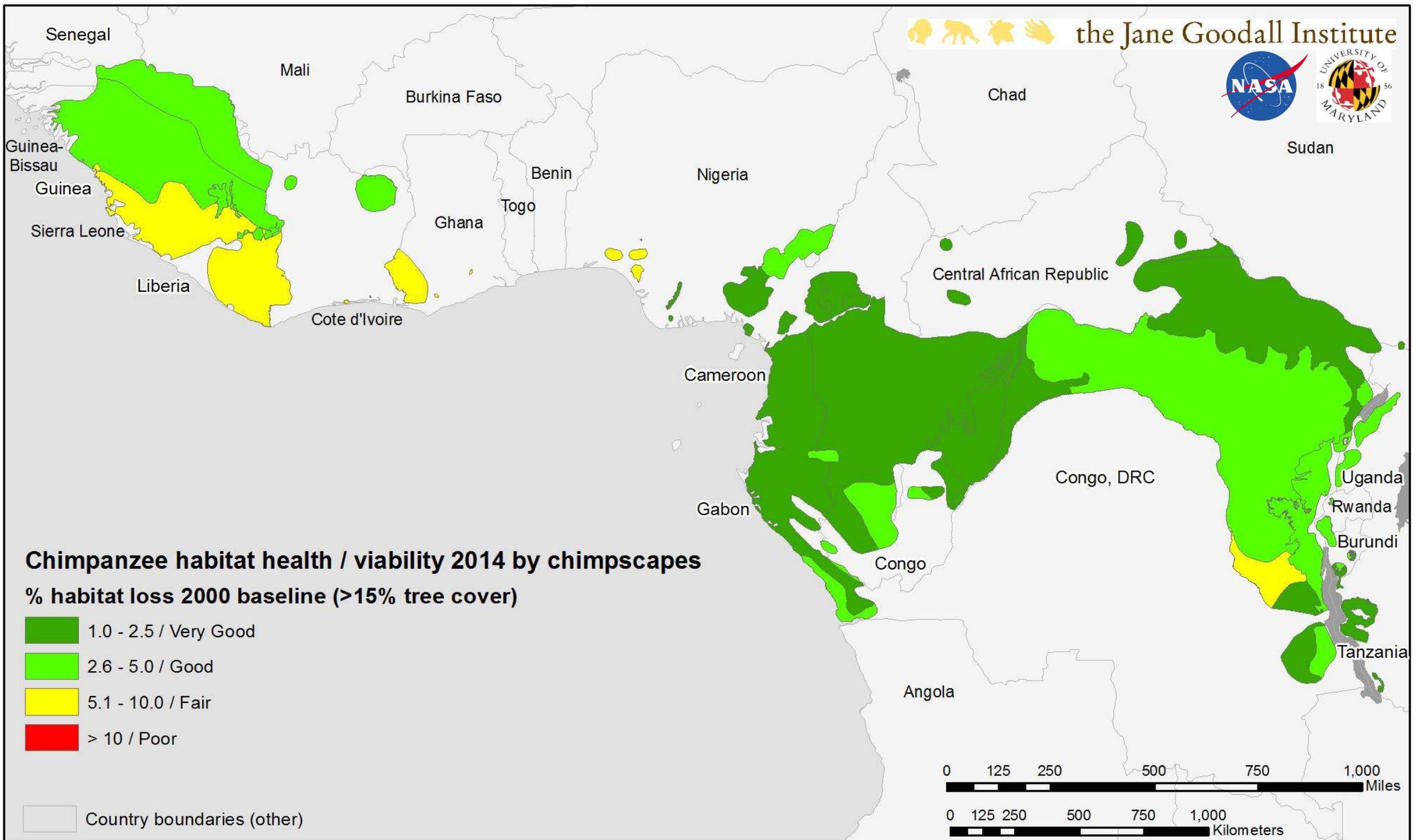


Chimpscapes

- Albertine Rift montane forests
- Central Zambesian wet miombo woodlands
- Congolian coastal forests
- Cross-Sanaga-Bioko coastal forests
- East Sudanian savanna
- Eastern Guinean forests
- Guinean forest-savanna
- Guinean montane forests
- Mount Cameroon and Bioko montane forests
- Niger Delta swamp forests
- Nigerian lowland forests
- Northeastern Congolian lowland forests
- Northern Congolian Forest-Savanna
- Northwestern Congolian lowland forests
- Southern Congolian forest-savanna
- West Sudanian savanna
- Western Congolian forest-savanna
- Western Congolian swamp forests
- Western Guinean lowland forests

0 125 250 500 750 1,000 Miles

0 125 250 500 750 1,000 Kilometers



Chimpanzee habitat health / viability 2014 by chimpscapes

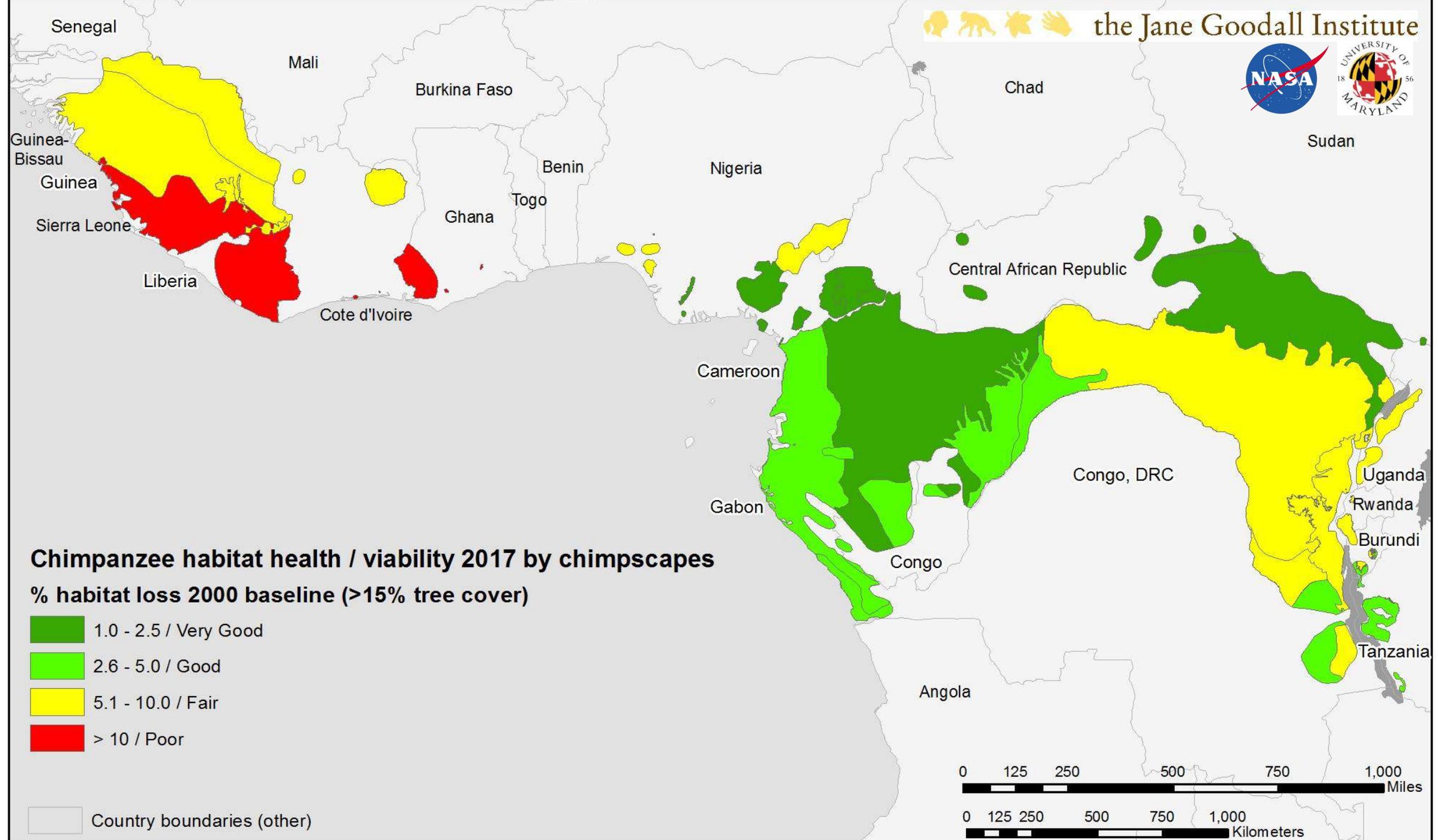
% habitat loss 2000 baseline (>15% tree cover)

- 1.0 - 2.5 / Very Good
- 2.6 - 5.0 / Good
- 5.1 - 10.0 / Fair
- > 10 / Poor

Country boundaries (other)

0 125 250 500 750 1,000 Miles

0 125 250 500 750 1,000 Kilometers

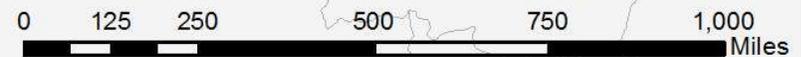


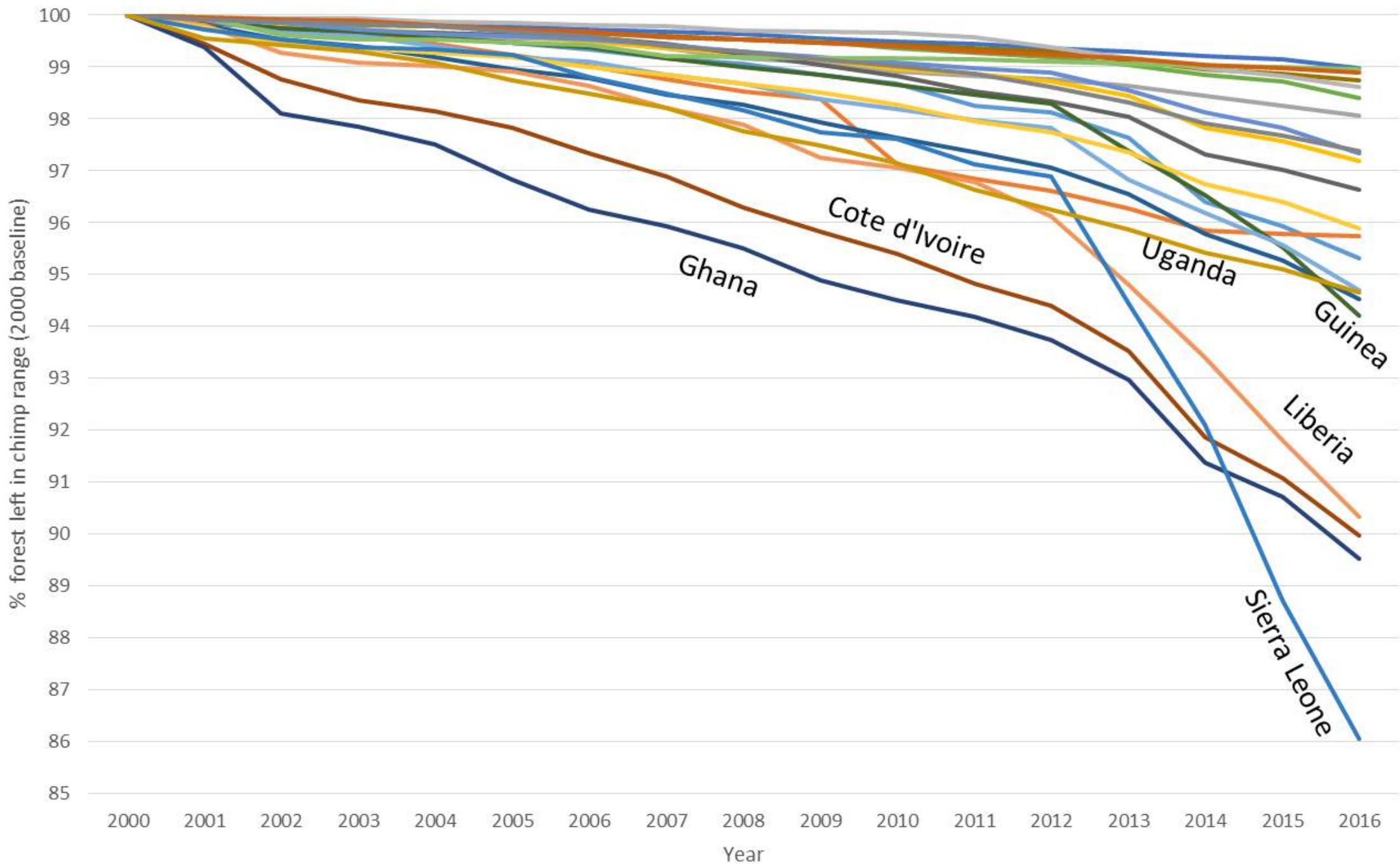
Chimpanzee habitat health / viability 2017 by chimpscapes

% habitat loss 2000 baseline (>15% tree cover)

- 1.0 - 2.5 / Very Good
- 2.6 - 5.0 / Good
- 5.1 - 10.0 / Fair
- > 10 / Poor

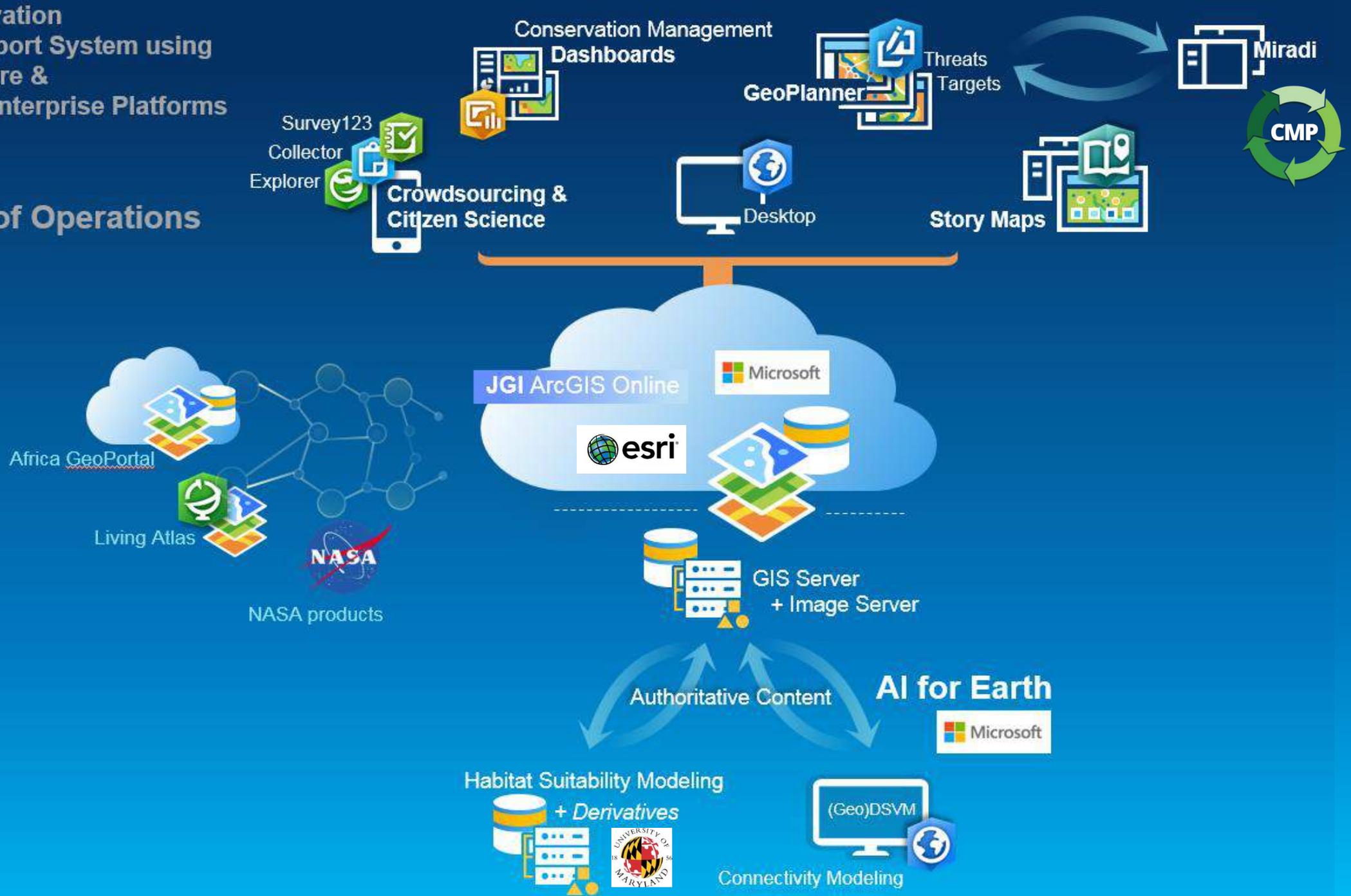
Country boundaries (other)





JGI's Conservation
Decision Support System using
Microsoft Azure &
Esri ArcGIS Enterprise Platforms

Concepts of Operations



USERS

USAID JGI COSTEC Health Gov. District NR officers Gov. Statistics / Permits

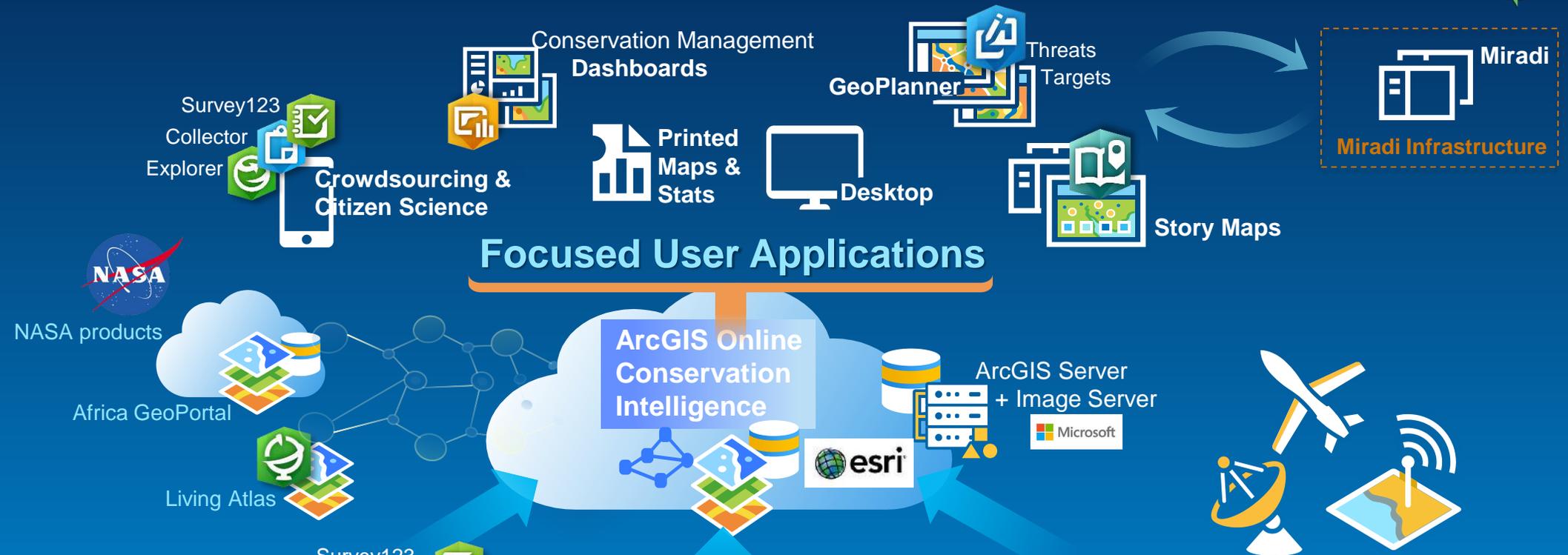
Pathfinder RTI NBS TAWIRI TANAPA Village Gov. NLUPC



VIZUALIZE
USE
SHARE
COMMUNICATE

INTEGRATE
STORE
CLEAN
MANAGE
ANALYZE

STANDARDISE
COLLECT



- ### Mobile Data
- **Village Forest Monitors**
 - Wildlife presence and threats
 - Community Health Workers app (Pathfinder)
 - TANAPA Ranger Patrol System
 - **Biodiversity / Chimpanzee surveys**
 - Ground livestock surveys
 - Disease surveys / monitoring
 - Baseline household surveys
 - Forest plots

- ### Sensor Data
- Weather station
 - Climate data
 - Camera traps
 - Acoustic sensors
 - Robotic insect traps
 - IoT (Internet of Things) * IR 3.4

- ### Satellite & Aerial Data
- DigitalGlobe imagery
 - Houses, habitat threats, ground-truthing
 - **DSS/Landsat imagery (JGI/UMD/NASA)**
 - Chimp habitat suitability, health and loss
 - Aerial livestock surveys (JGI/TAWIRI)
 - Livestock distribution, density, land use
 - UAVs * IR 3.4
 - Chimp nests, village land use change



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Migrating our village forest monitoring citizen science/crowdsourcing platform
From ODK & Google cloud → to Survey 123 and Esri's ArcGIS
New Partnership with Esri East Africa

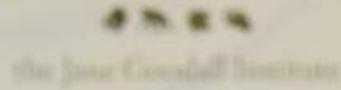


- Most of the world's biodiversity is under the care of indigenous people and local communities.
- An estimated 65% of the world's land is under indigenous or local community customary ownership and use (75 % in Tanzania and Uganda) (Rights and Resources Initiative, 2015).





USAID
FROM THE AMERICAN PEOPLE



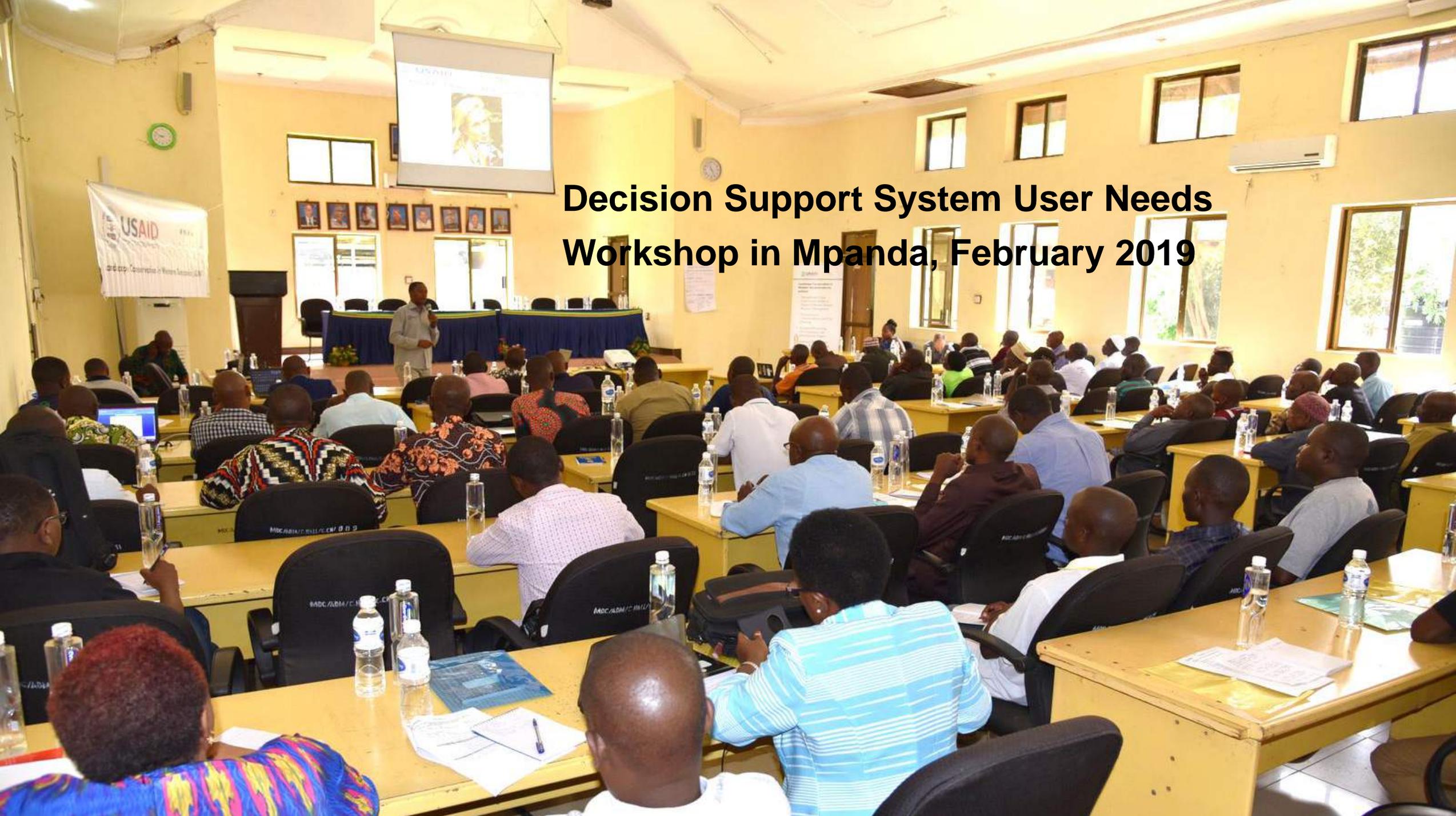
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Landscape Conservation in Western Tanzania (LCWT)

**Focusing resources on capacity
Building needs to use DSS
Kigoma, March 2019**



Decision Support System User Needs Workshop in Mpanda, February 2019



Decision Support System User Needs Workshop in Kigoma, March 2019





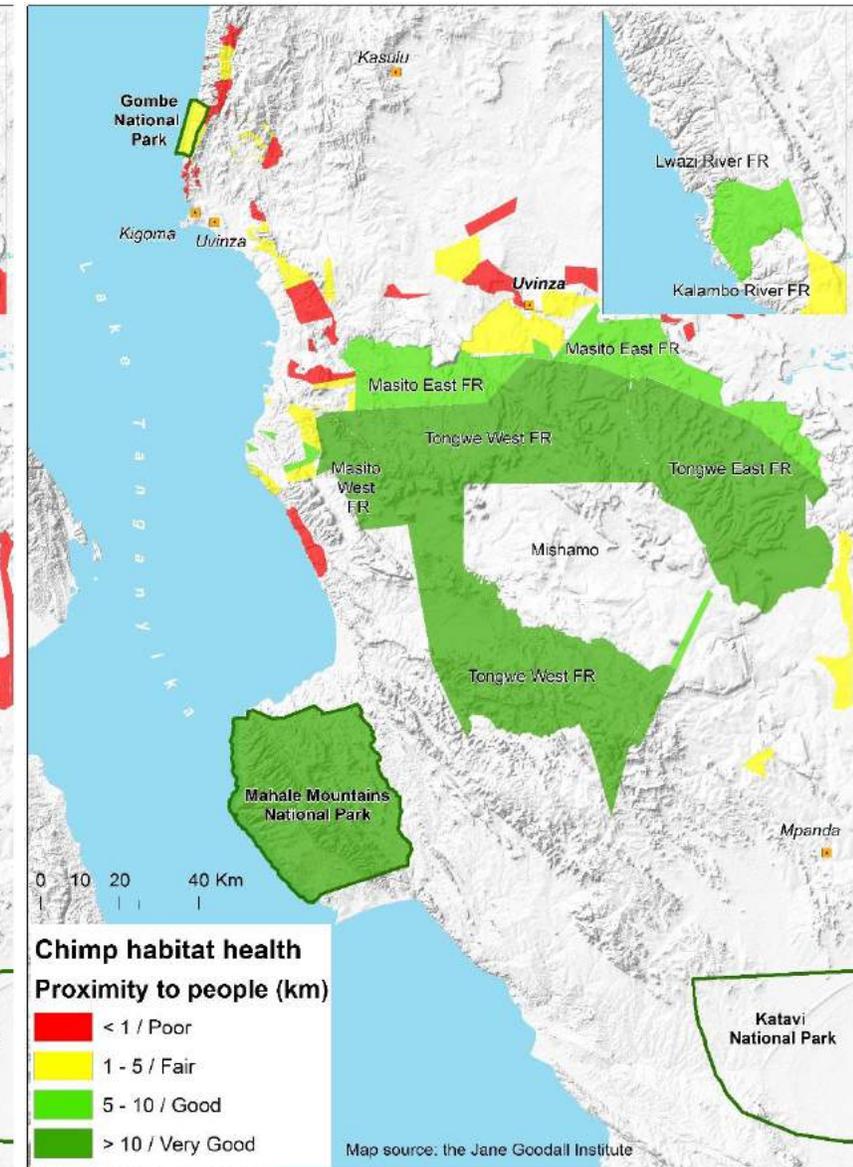
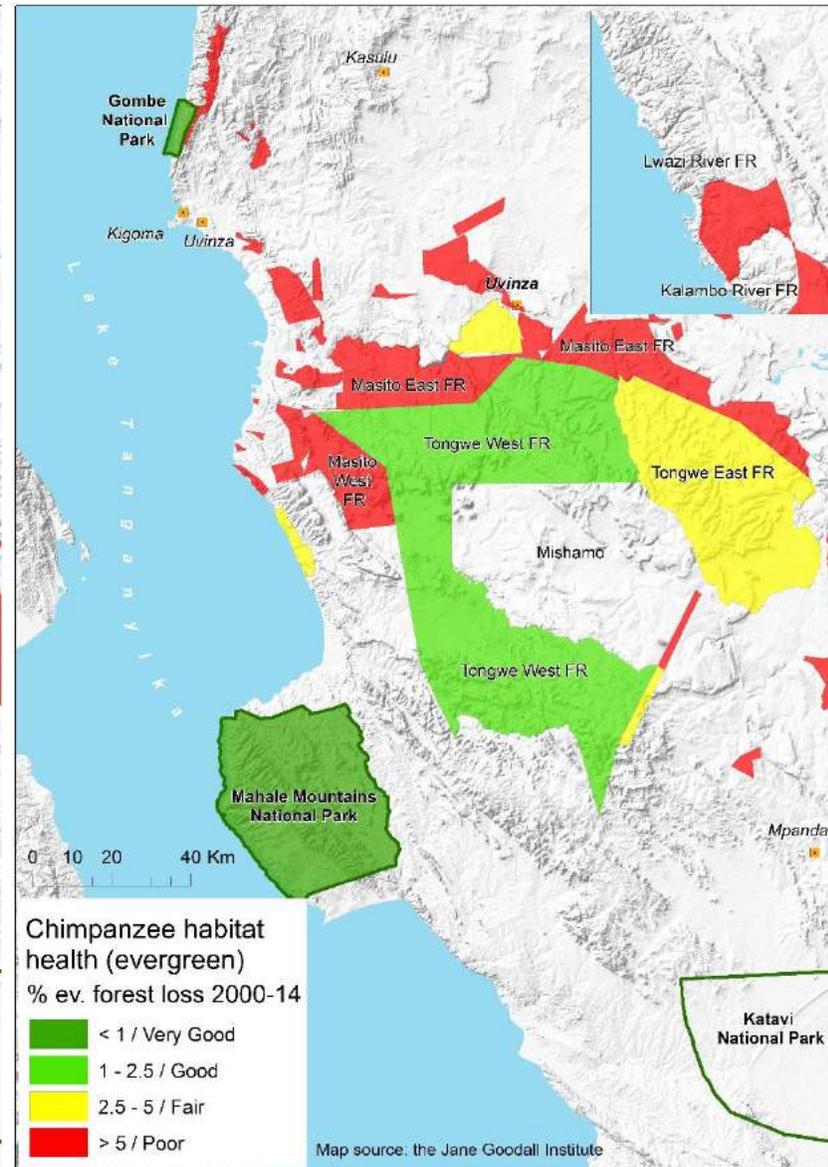
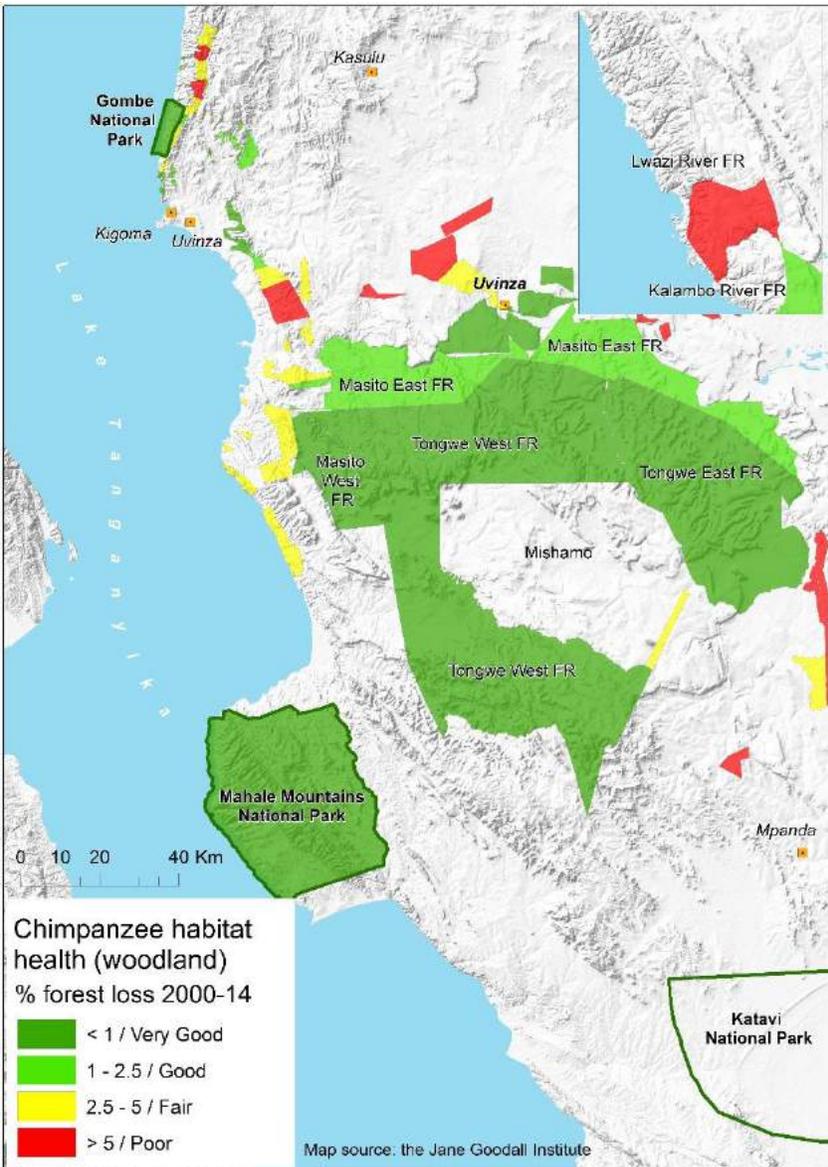
14

Chimpanzee Habitat Status: The plan assessed the status of chimpanzee habitat by assessing the viability of indicators for each of the key ecological attributes (Table 2.2).

Table 2.2. Key Attributes and Indicators for Chimpanzee Habitat

Item	Type	Poor	Fair	Good	Very Good
Habitat 1. Woodland cover	Size				
✓ Percent of forest loss (year 2000)		>5%	2-5-5%	1-2.5%	<1%
Habitat 2. Evergreen forest	Condition				
✓ Percent of forest loss (Year 2000)		>5%	2-5-5%	1-2.5%	<1%
Habitat 3. Distance to humans	Landscape				
✓ Average pixel (30m) distance to human feature		<250m	250-499m	500-1000m	>1000m

Chimpanzee habitat viability in protected areas management units (village & gov forest reserves and NP)



0 25 50 100 Meters



House data source: DigitalGlobe

Imagery: 2017-10-05
WorldView2 / DigitalGlobe

Map developed by:
Lilian Pintea,
the Jane Goodall Institute

JGI Office



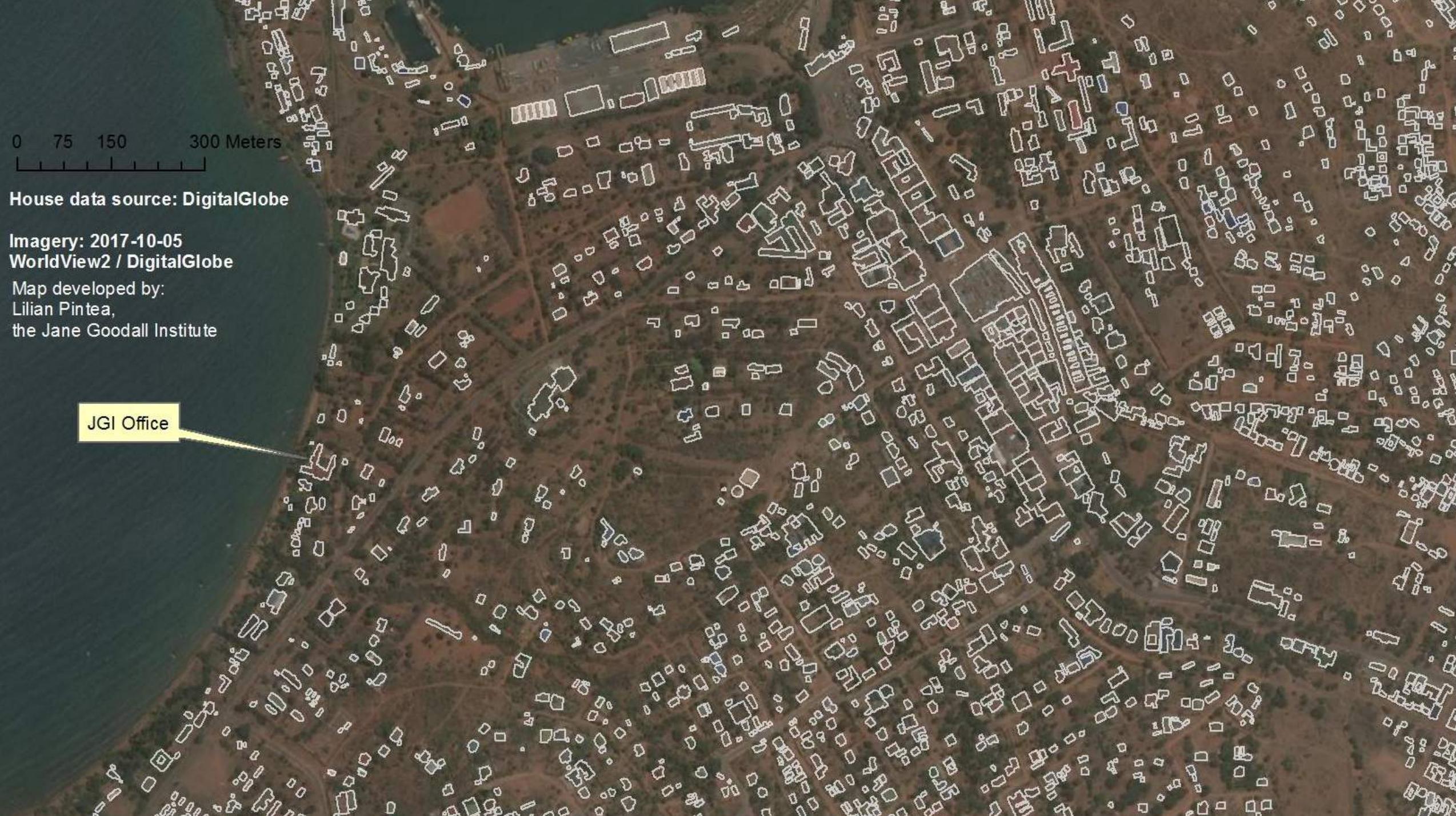
0 75 150 300 Meters

House data source: DigitalGlobe

Imagery: 2017-10-05
WorldView2 / DigitalGlobe

Map developed by:
Lilian Pintea,
the Jane Goodall Institute

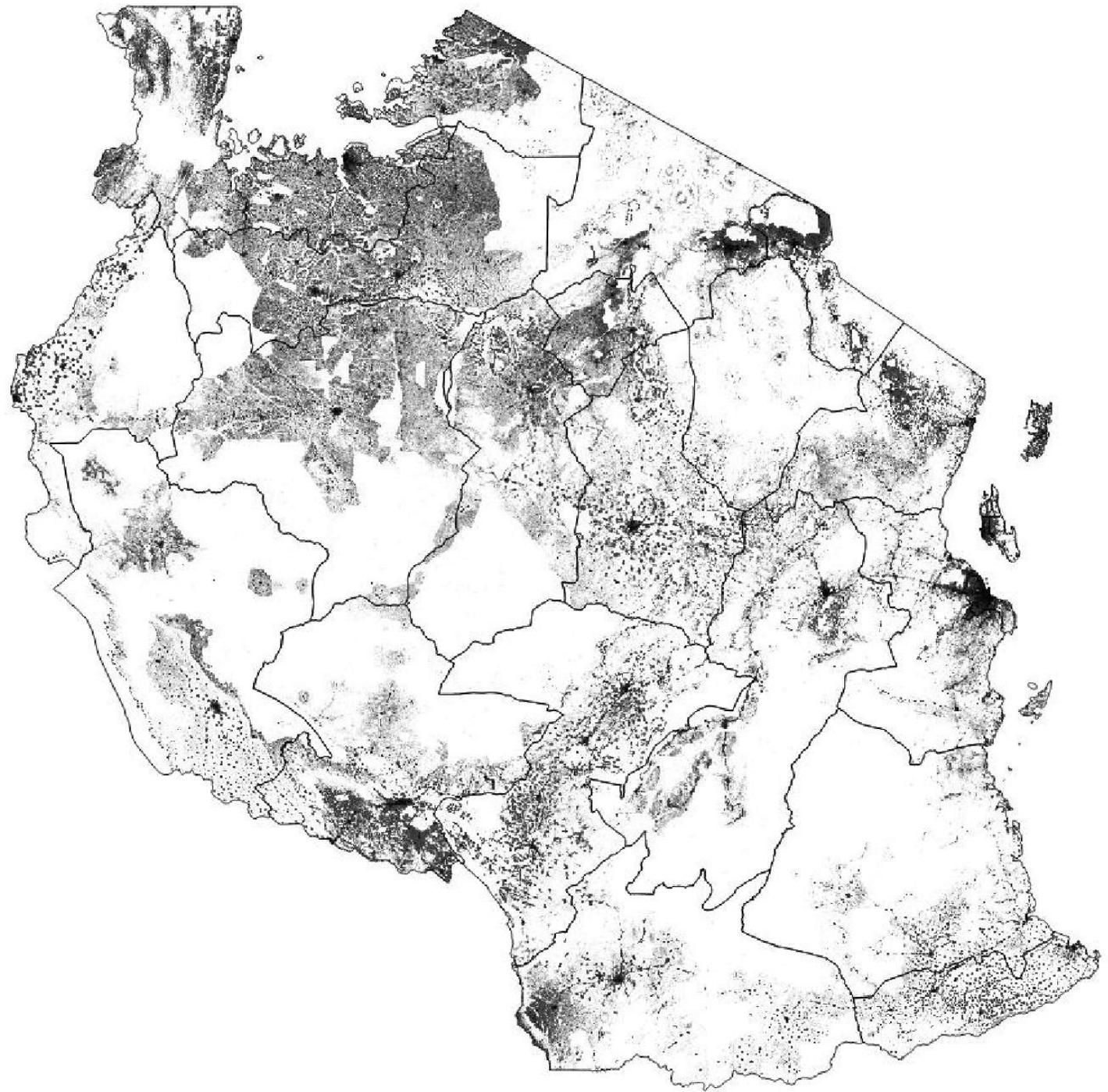
JGI Office



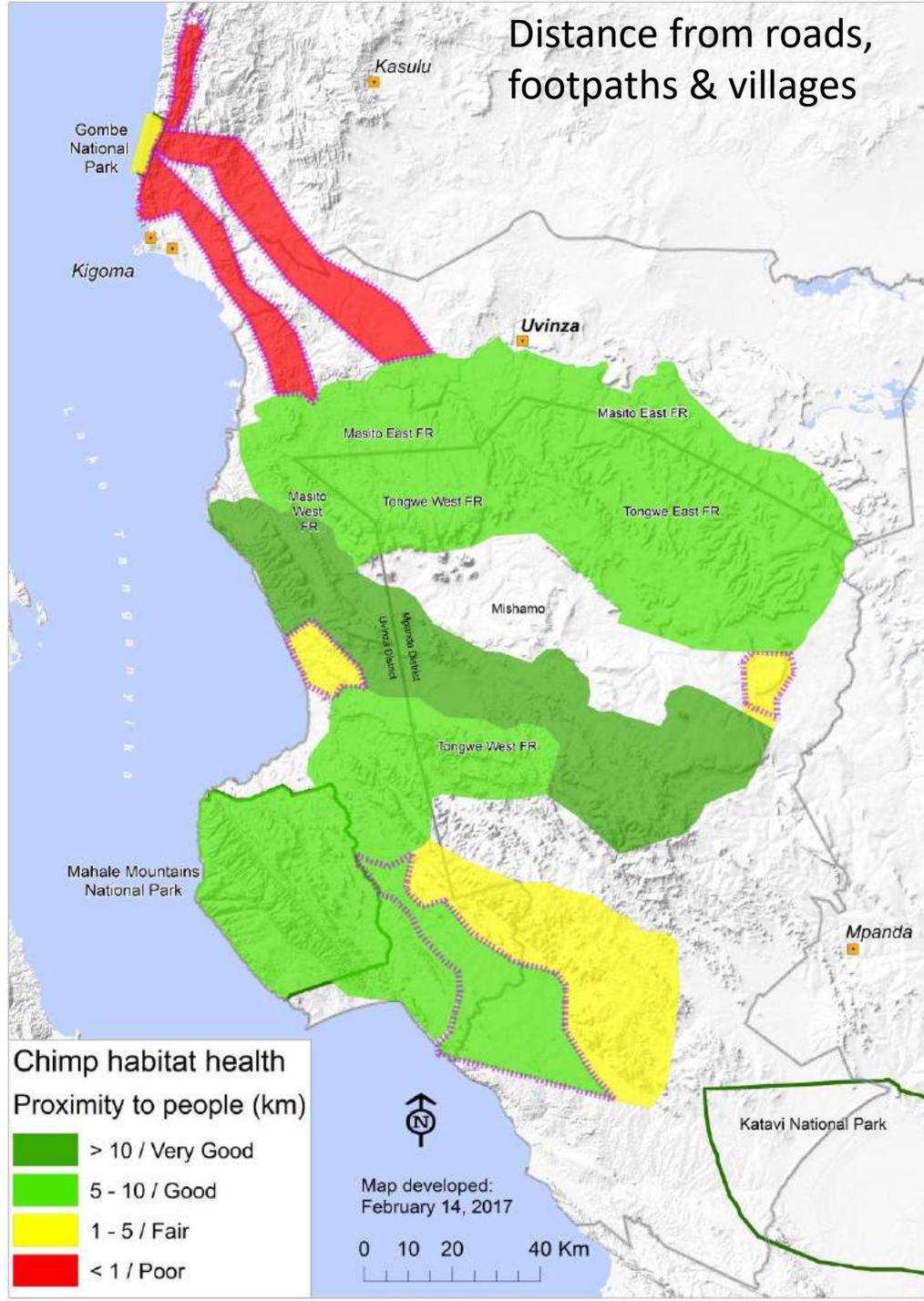
Map developed by:
Lilian Pintea,
the Jane Goodall Institute

JGI Office

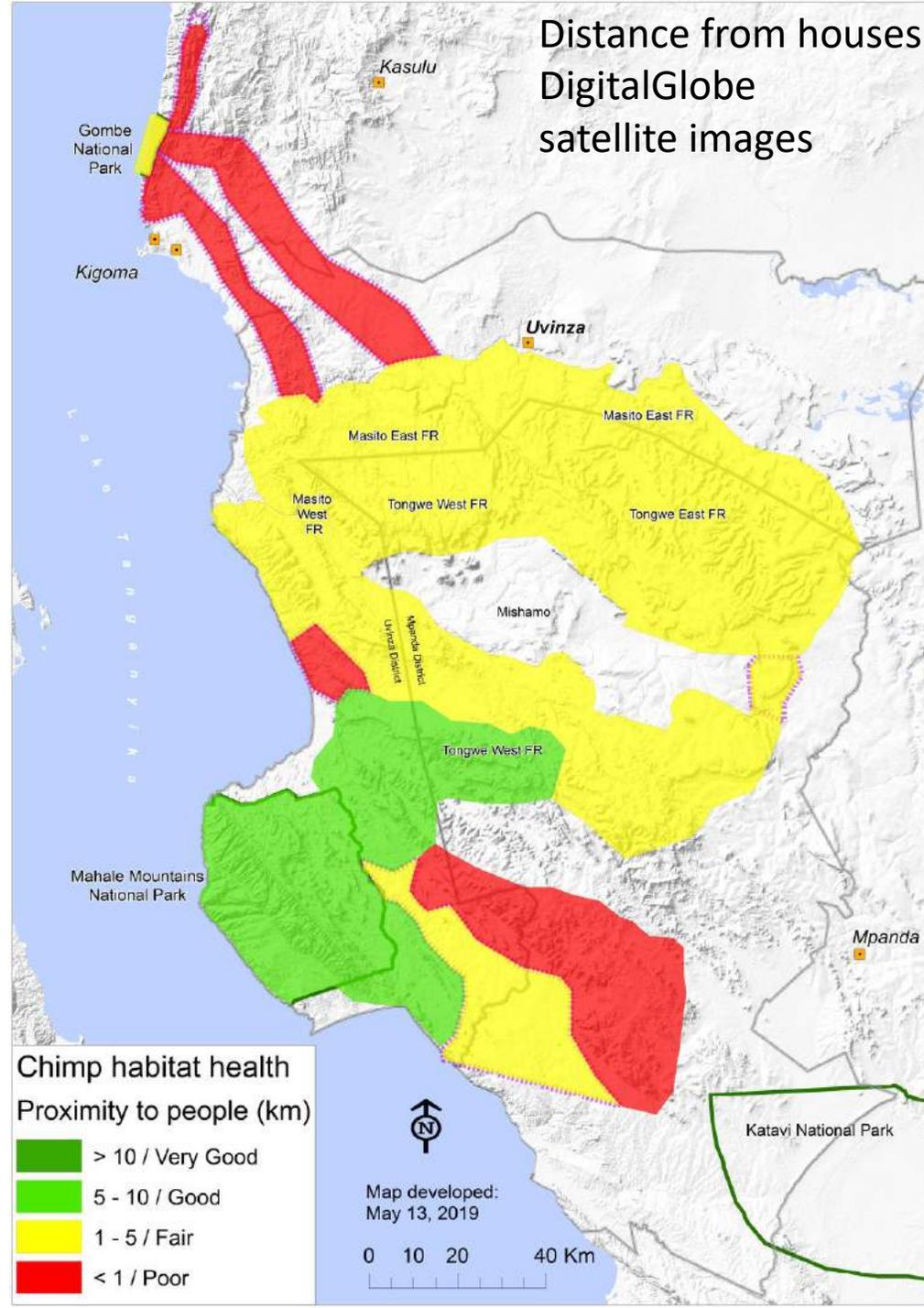




Distance from roads, footpaths & villages



Distance from houses DigitalGlobe satellite images



August 31, 2011
WorldView 2 Satellite



0 50 100 200 Meters

A horizontal scale bar with four segments, labeled 0, 50, 100, and 200 Meters.

August 30, 2018
WorldView 2 Satellite

Forest Loss (Hansen_GFC-2018)

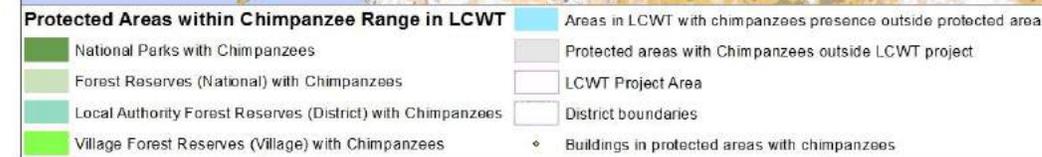
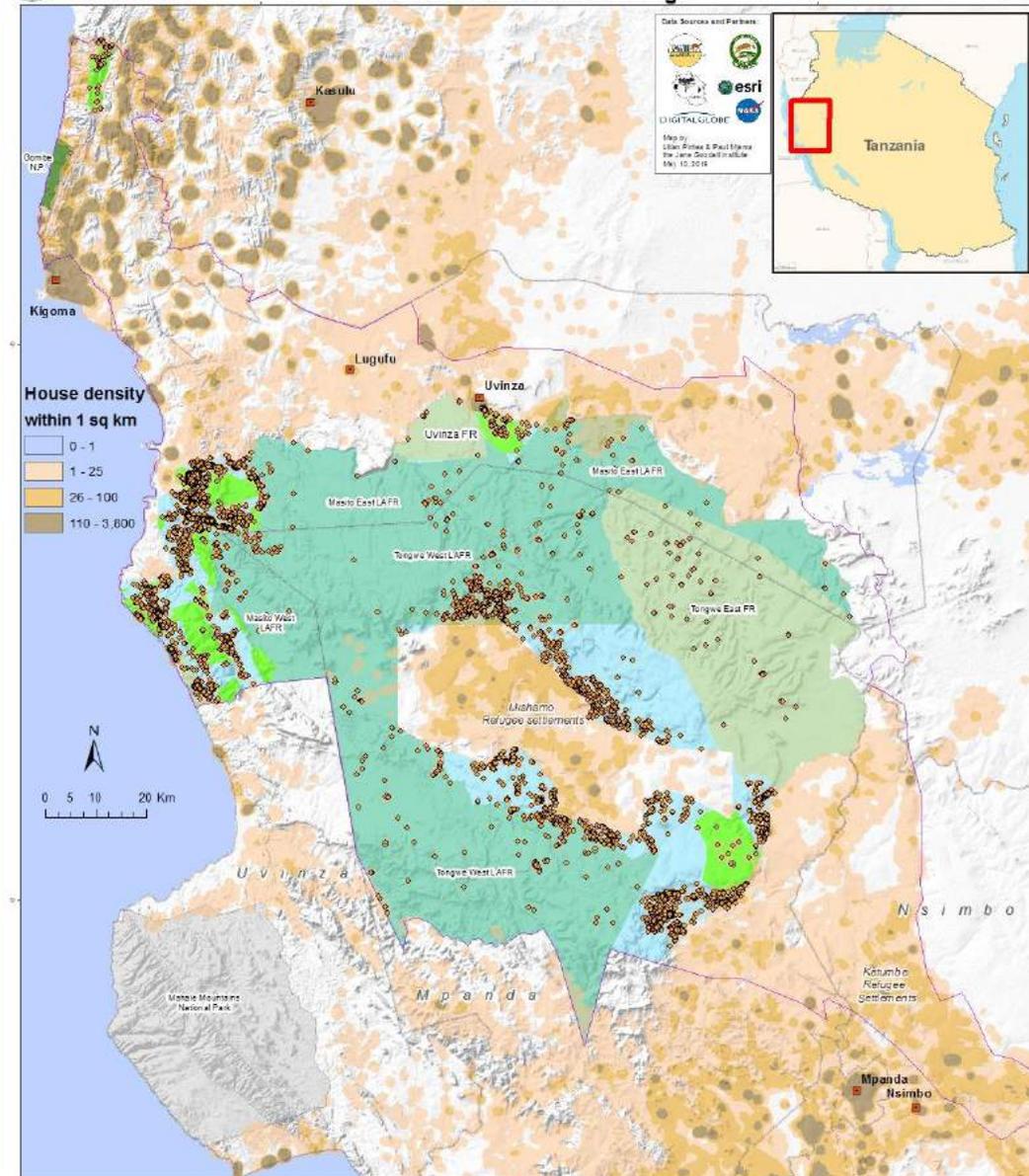
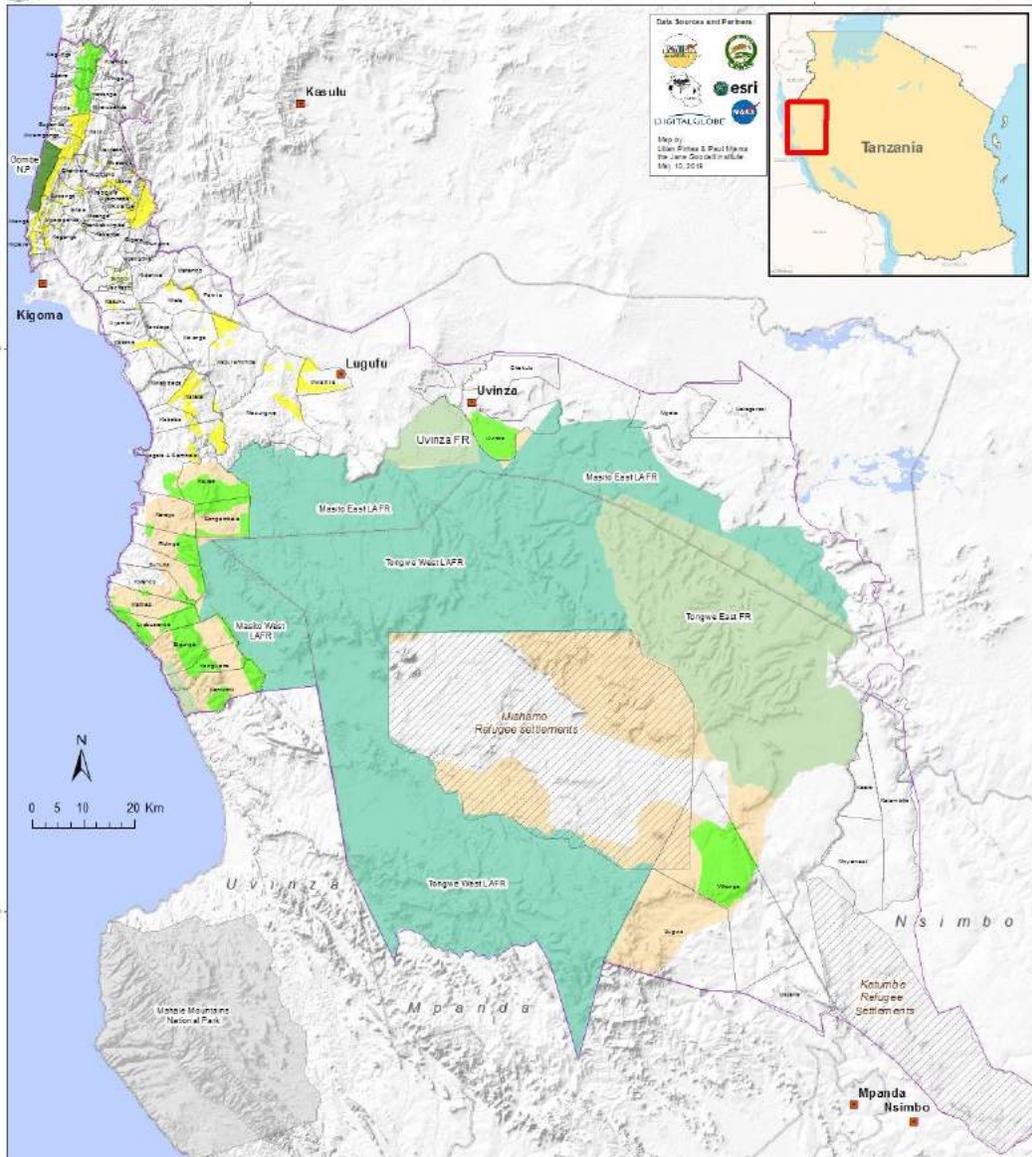
No loss reported

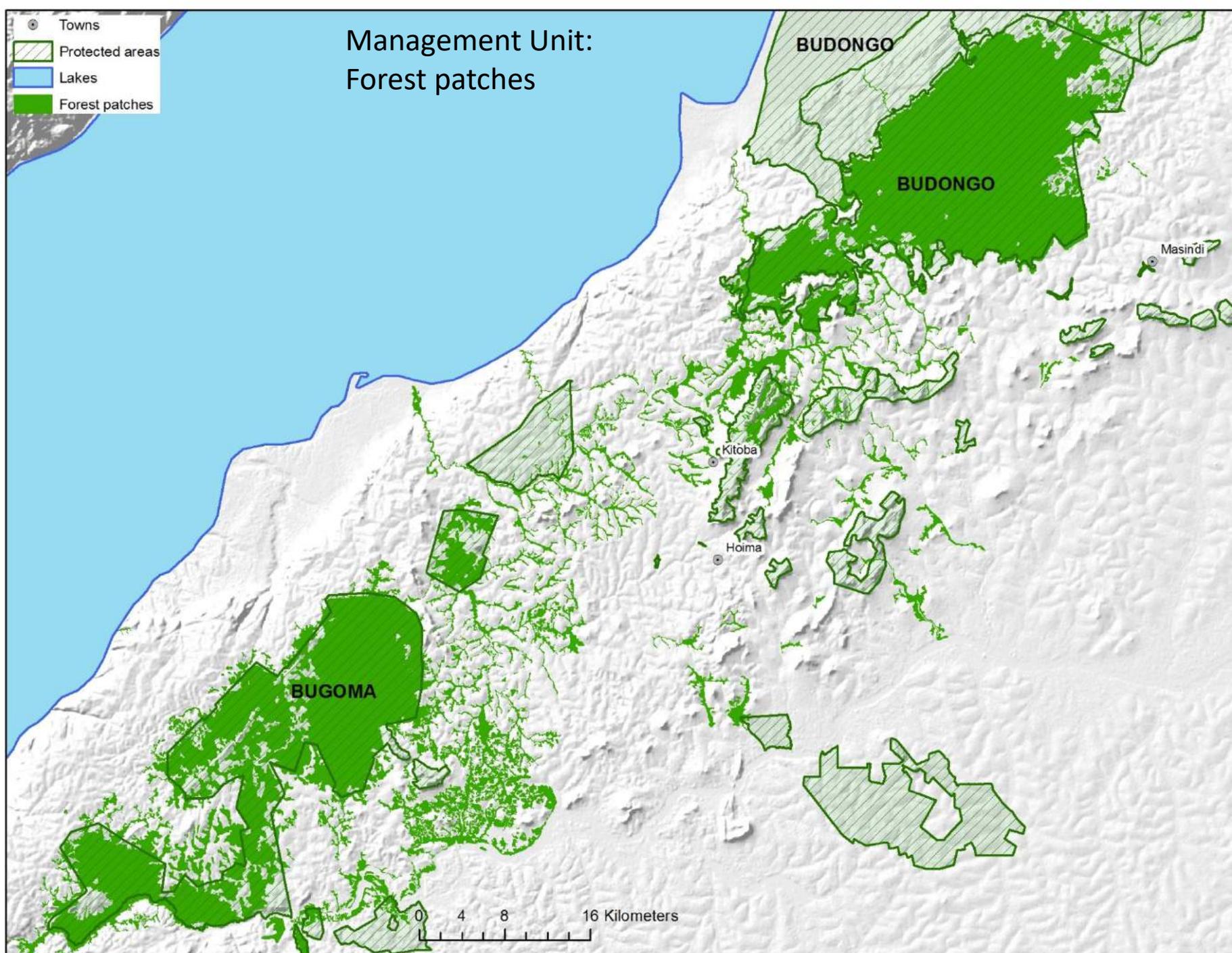
 Loss 2001-2010

 Loss 2011-2017

 Loss 2018







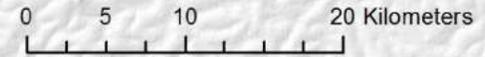
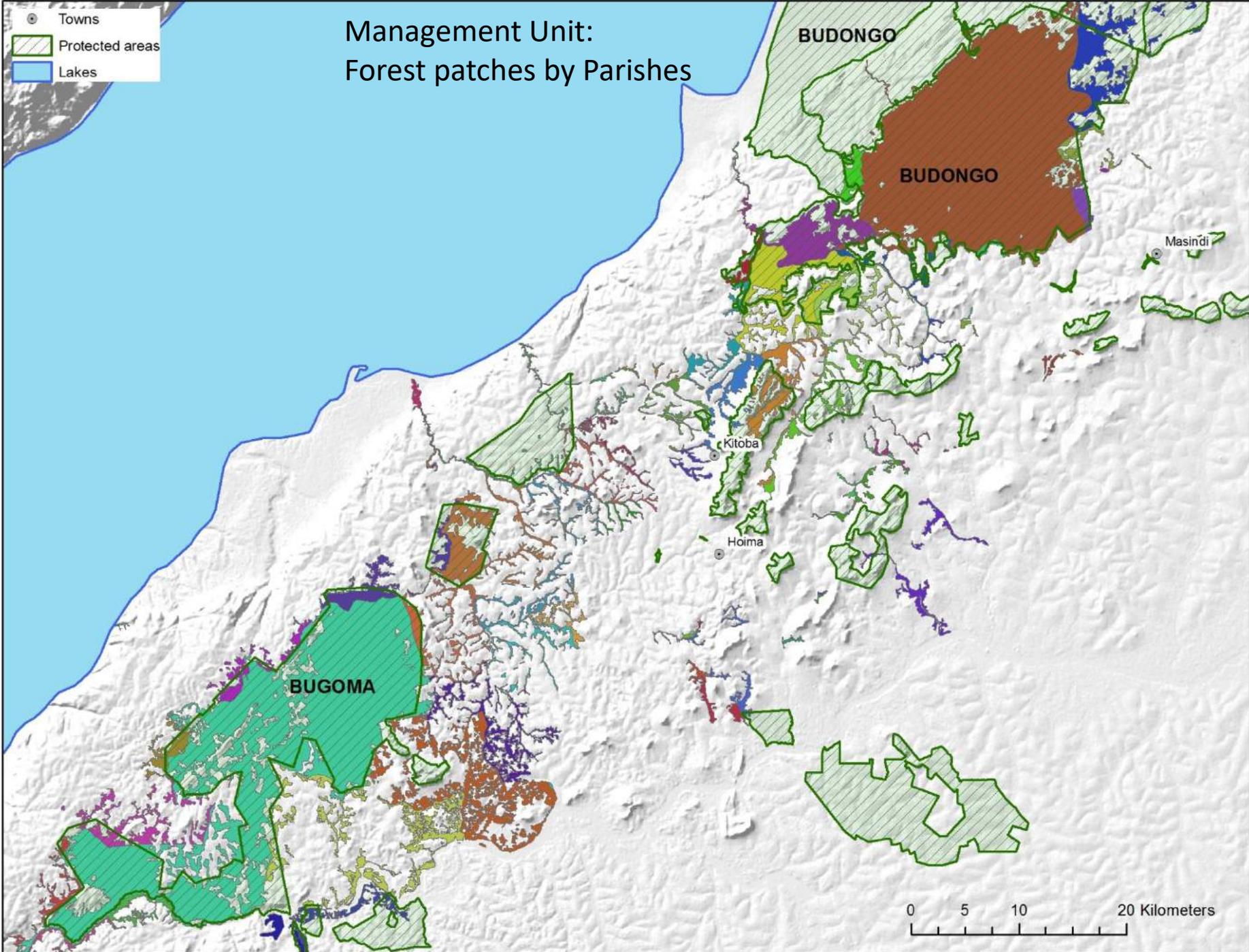
-  Towns
-  Protected areas
-  Lakes
-  Parishes

Management Unit: Parishes





Management Unit: Forest patches by Parishes



Management Unit: Forest patches by Parishes

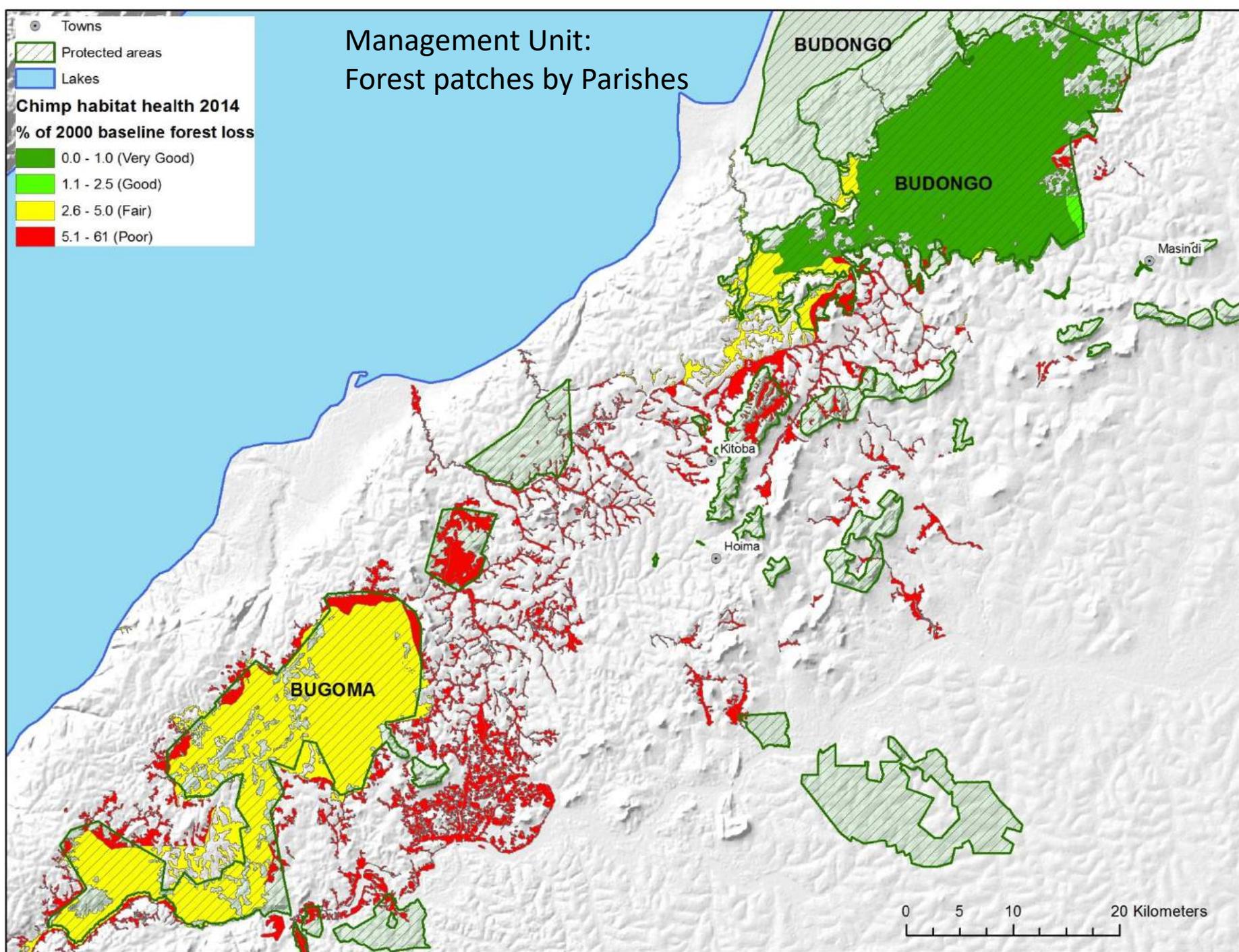
● Towns

▨ Protected areas

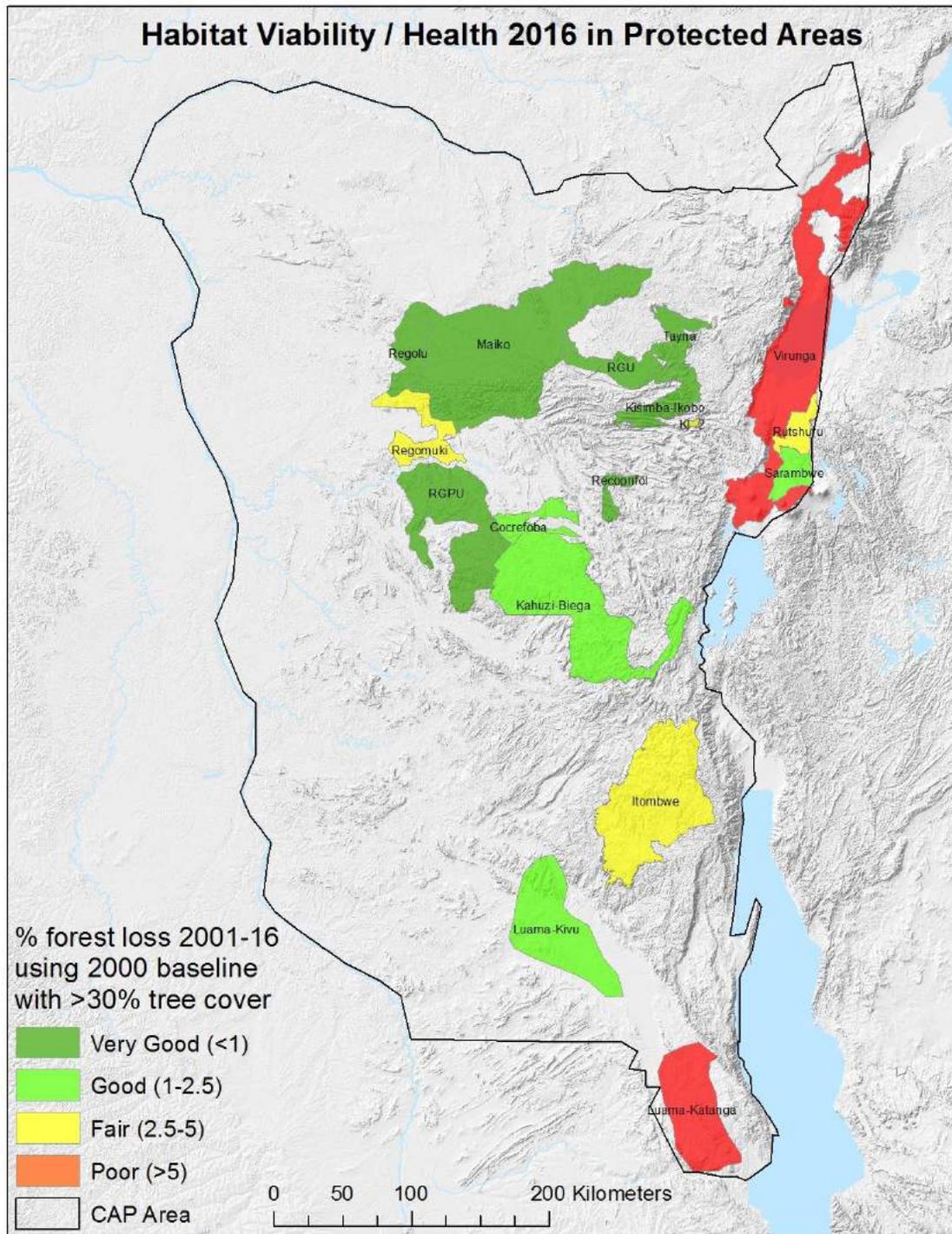
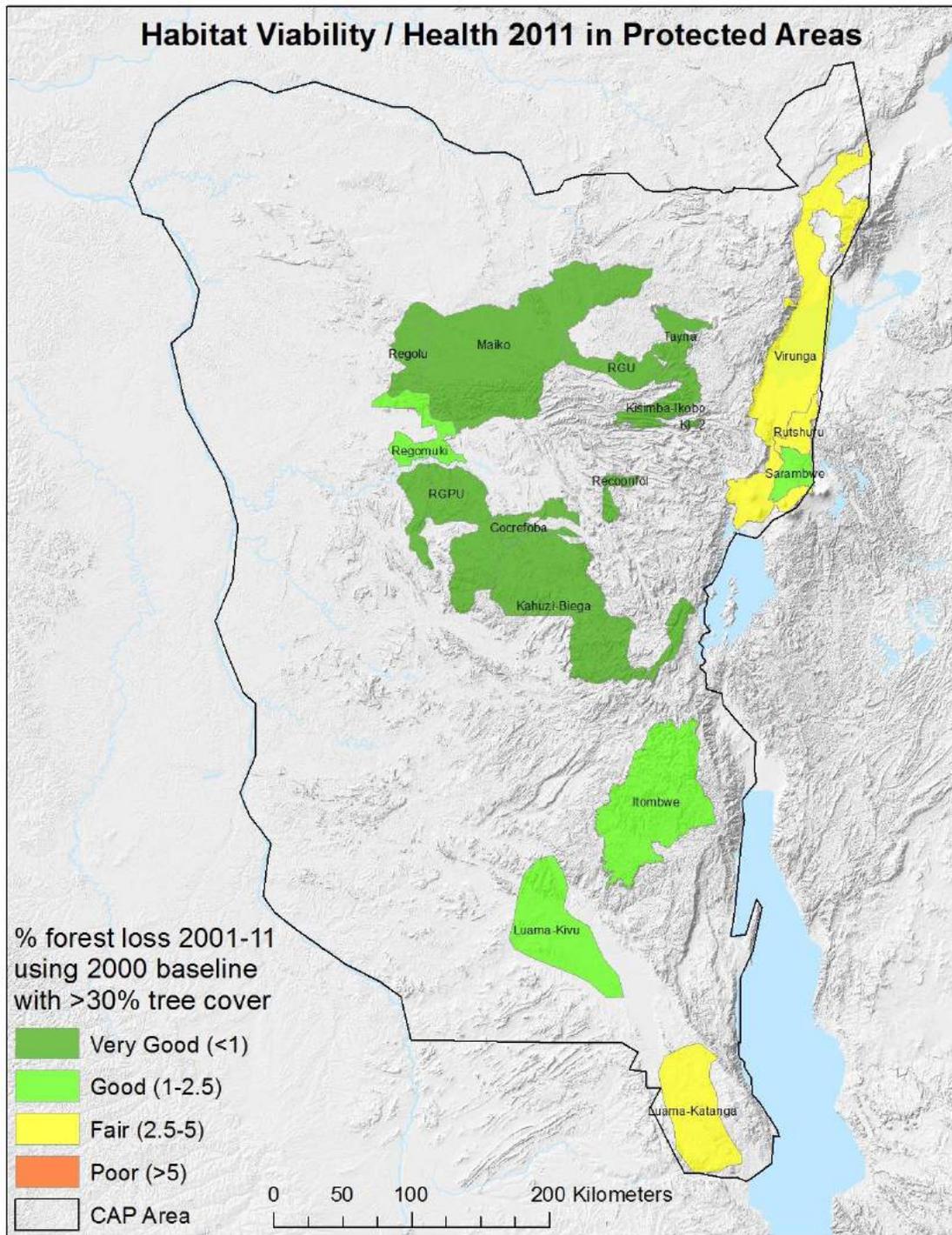
■ Lakes

Chimp habitat health 2014
% of 2000 baseline forest loss

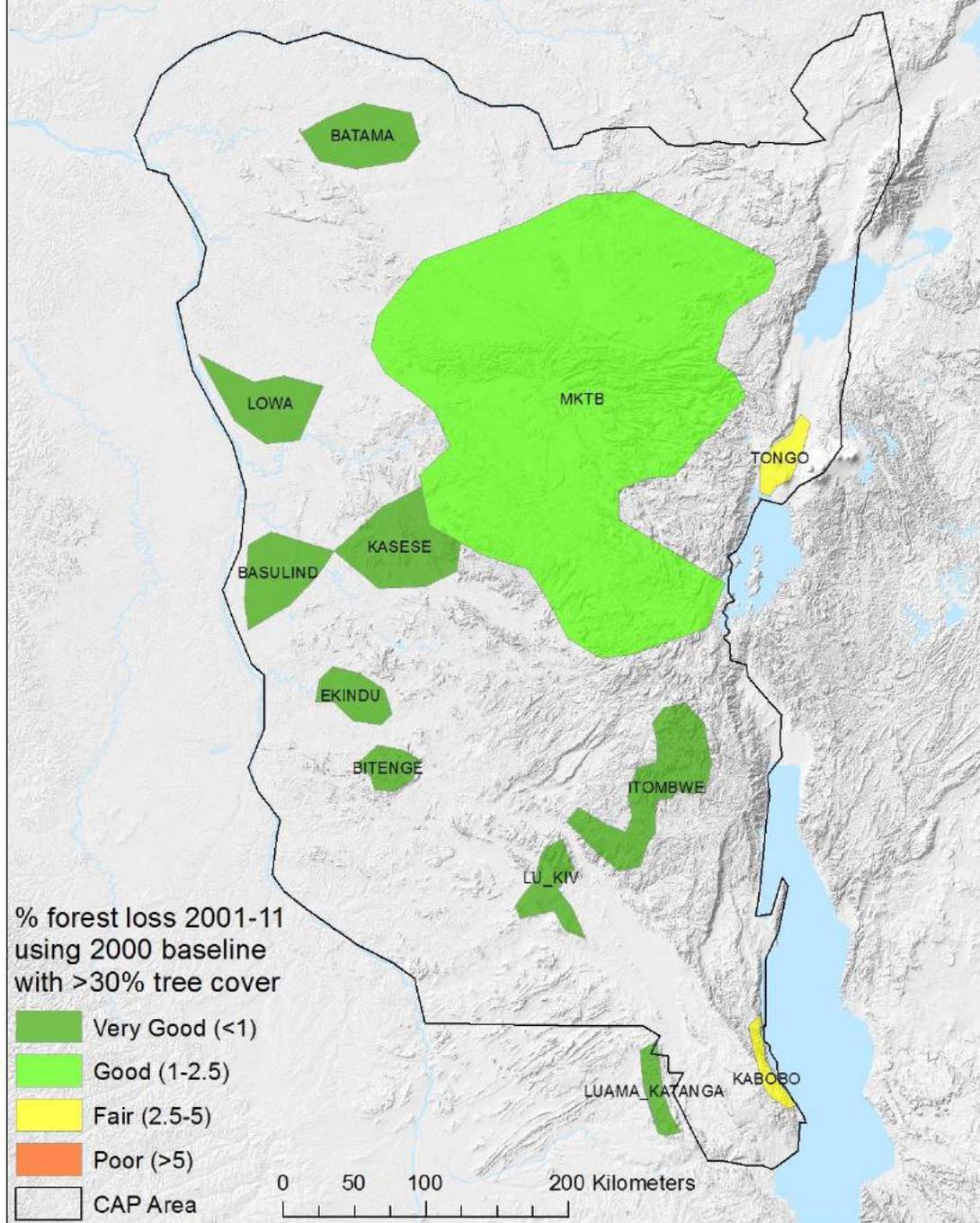
■	0.0 - 1.0 (Very Good)
■	1.1 - 2.5 (Good)
■	2.6 - 5.0 (Fair)
■	5.1 - 61 (Poor)



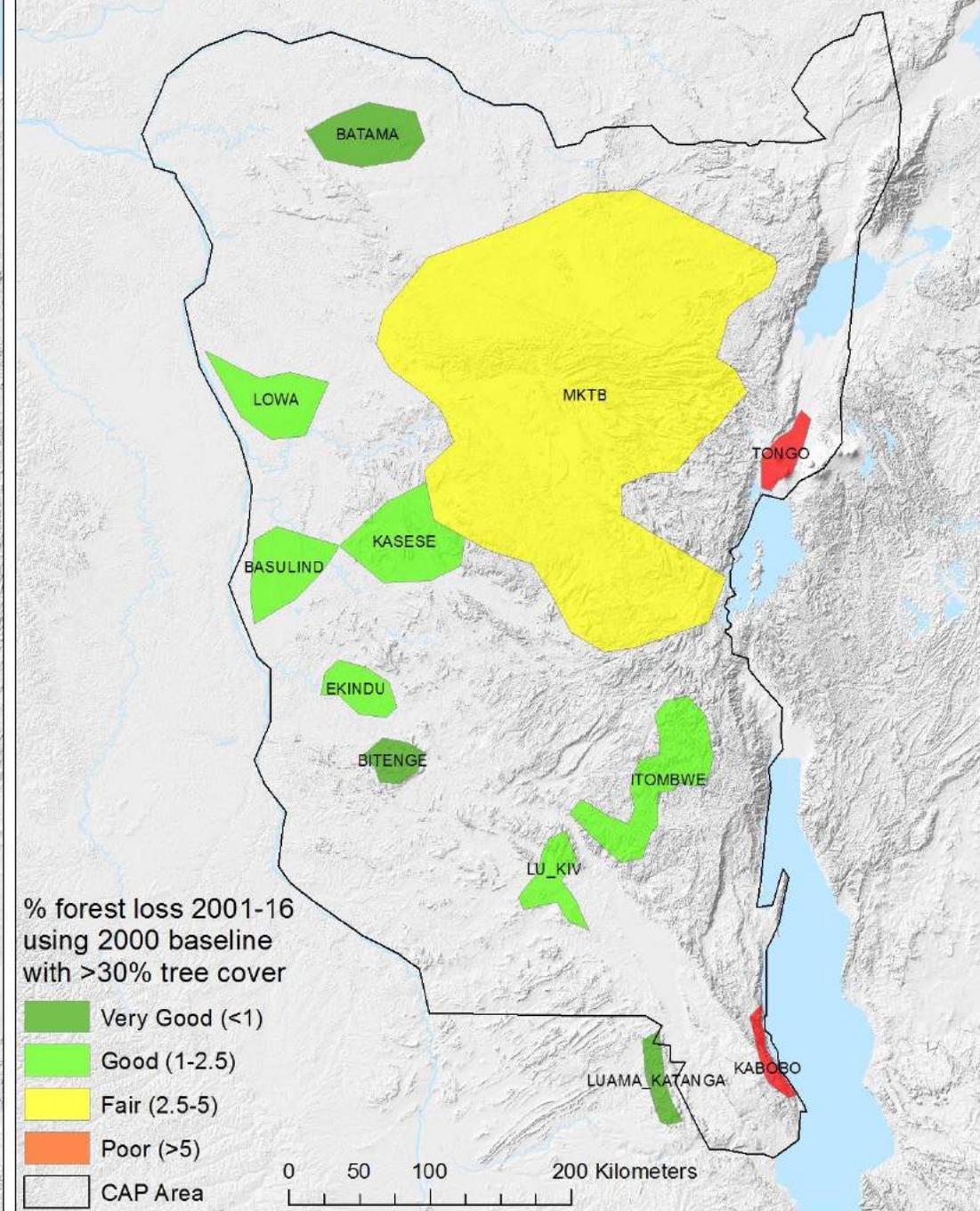
Focusing on the right data summarized by relevant management units



Habitat Viability / Health 2011 in Known Chimpanzee Areas

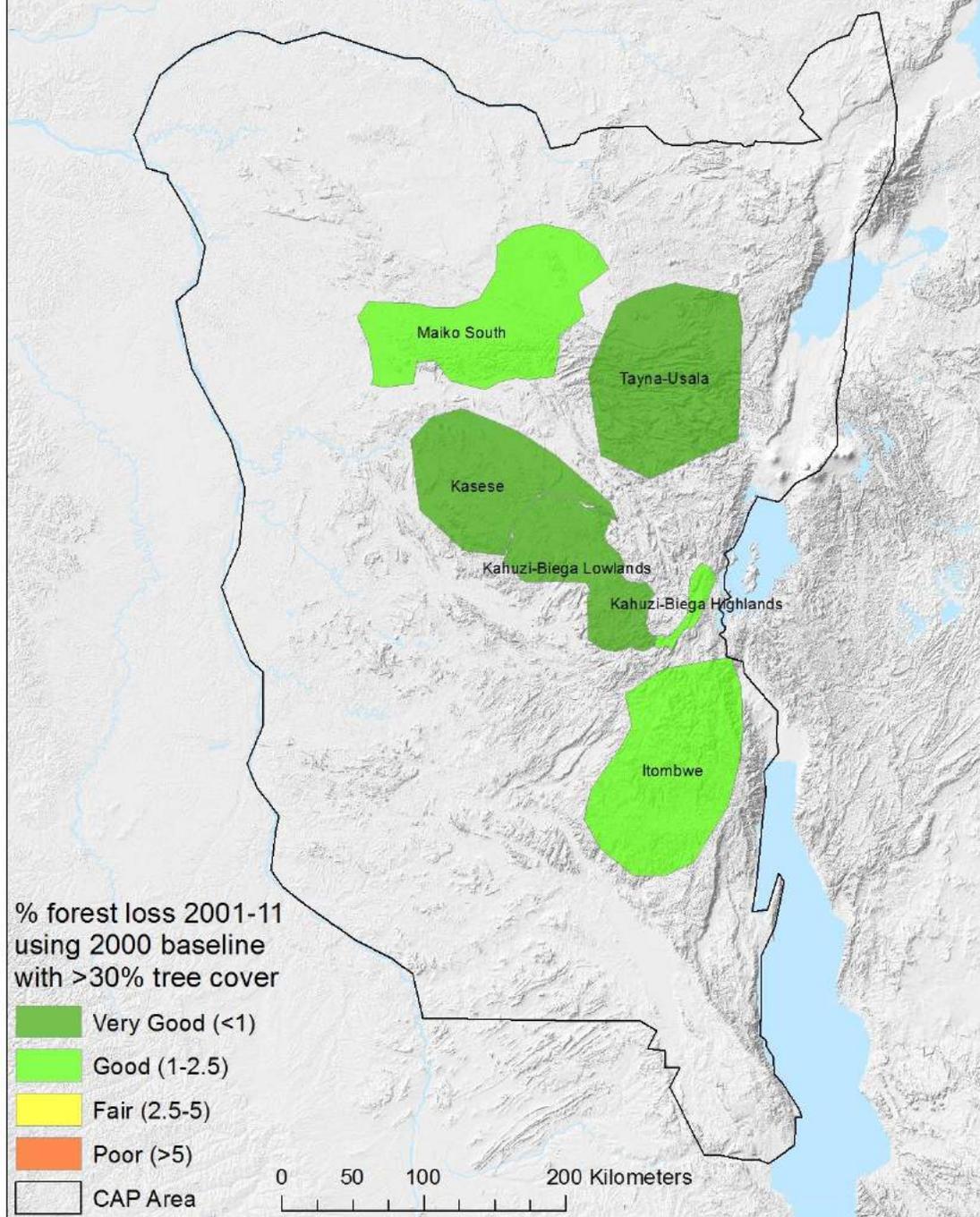


Habitat Viability / Health 2016 in Known Chimpanzee Areas

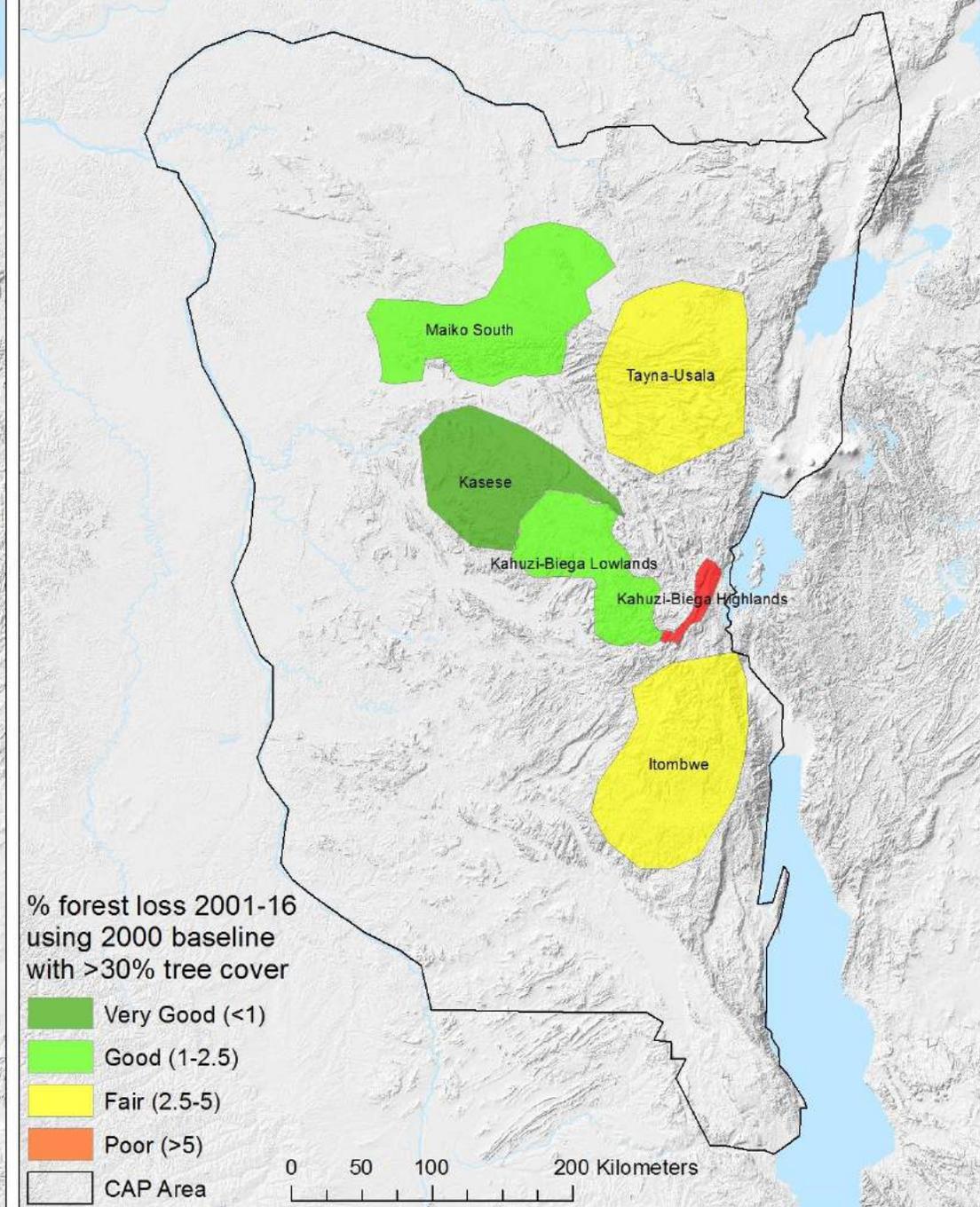


Focusing on the right data summarized by relevant management units

Habitat Viability / Health 2011 in Known Gorilla Areas



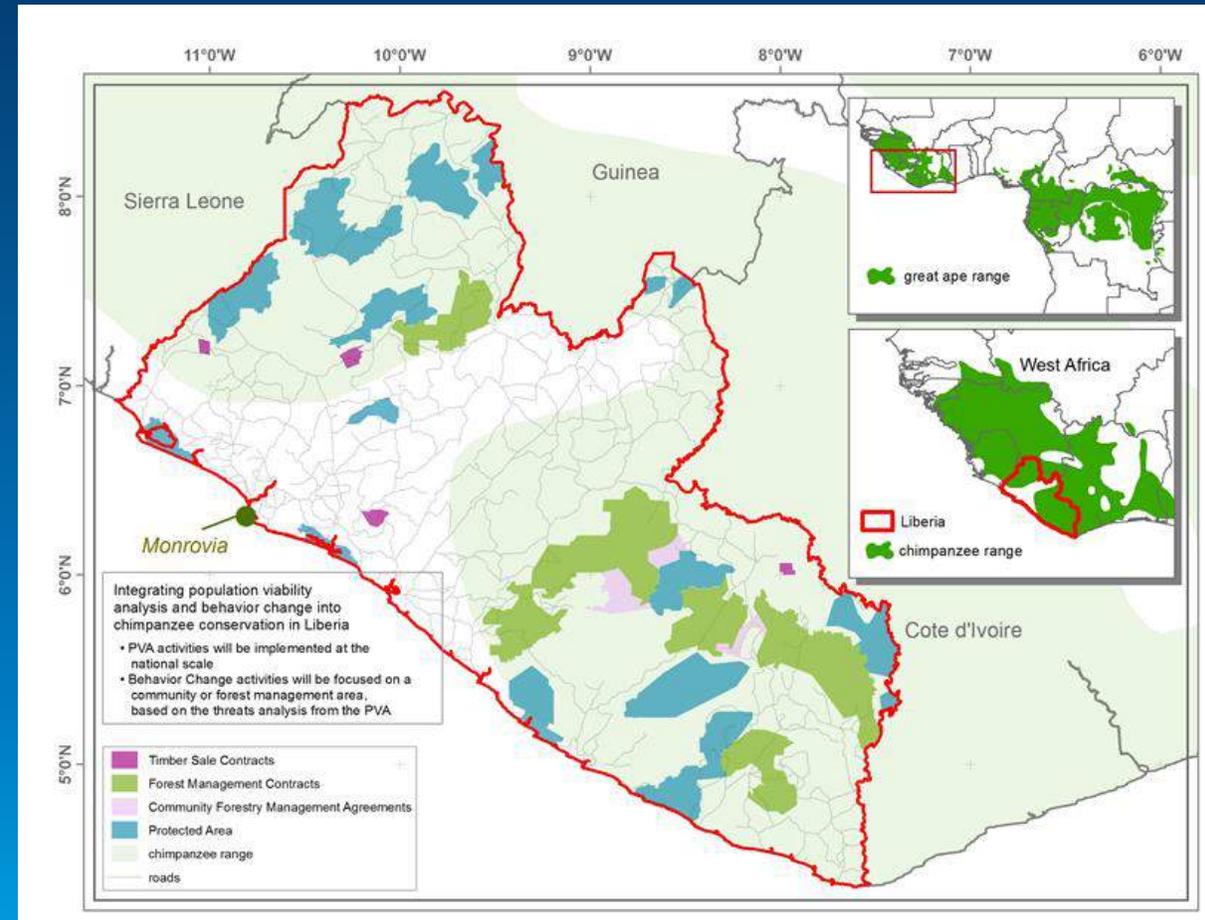
Habitat Viability / Health 2016 in Known Gorilla Areas



Focusing on the right data summarized by relevant management units

Next Steps

- Expand suitability models to cover all great apes in Africa
- Finalize the GeoPlanner tool
- Use the DSS to support more conservation action plans and great ape conservation efforts (Liberia, Angola, Burundi etc)
- Integrating Population Habitat Viability Analysis into the OS process in order to correlate a threat reduction to a measured response in the chimpanzee habitat health index
- Explore other digital sensors to monitor chimpanzee habitat health



JGI & Microsoft's Gombe Project Premonition

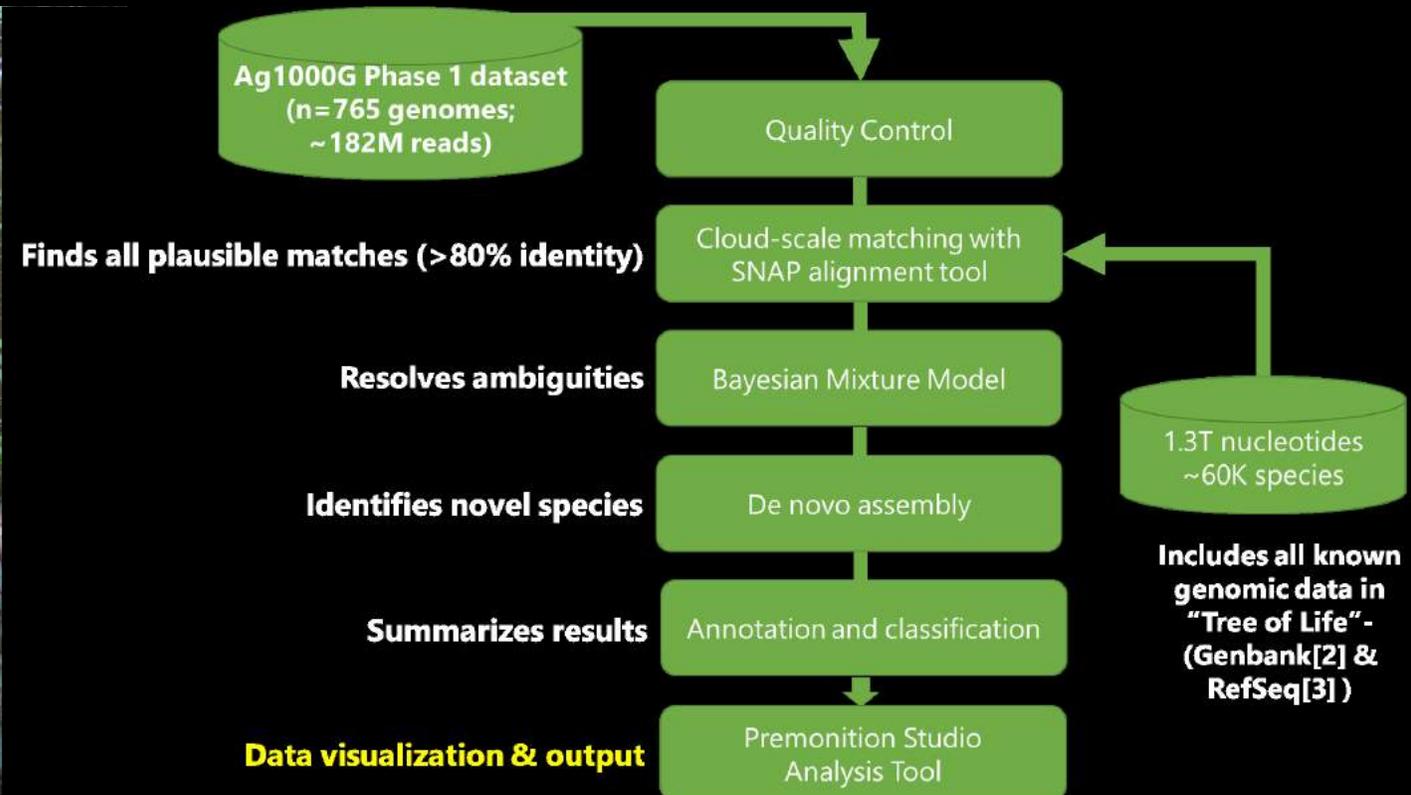
Using mosquitoes as surveying tools:

Developing a novel, scalable, entomological monitoring platform that harnesses advances in arthropod collection and next generation "deep" sequencing (NGS) methods to convert biologic samples into big digital genomic data.

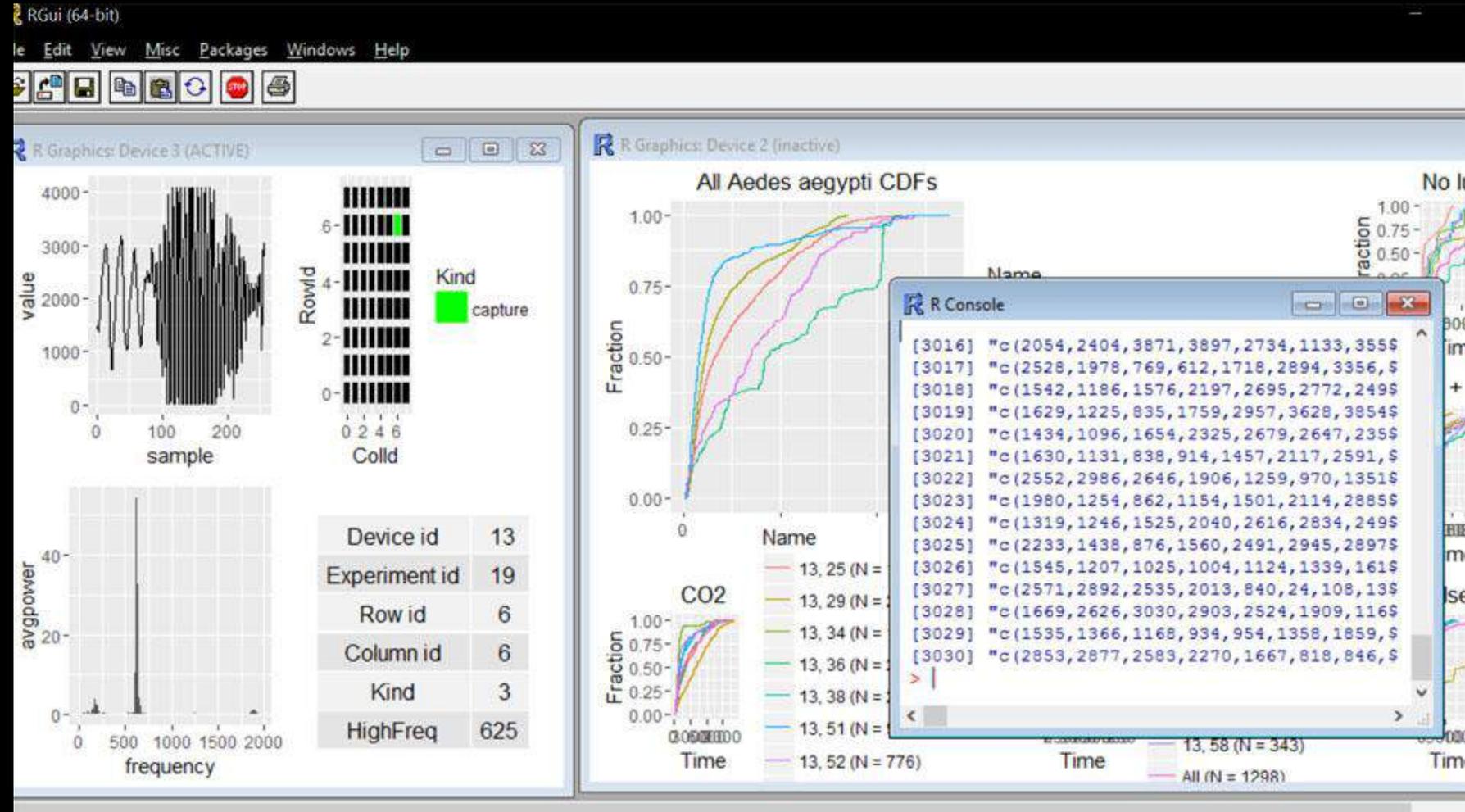
Robotic trap in Gombe



Metagenomic pipeline



Robotic mosquito traps that identify and capture interesting mosquitoes in milliseconds





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arcus
FOUNDATION



Local communities and
Governments of Tanzania, DRC,
Uganda and Republic of Congo

THANK YOU!



esri



Microsoft

DIGITALGLOBE

Google



SSC
Species Survival Commission



**WORLD
RESOURCES
INSTITUTE**



the Jane Goodall Institute