Scenarios to Improve Ecological Service Delivery and Conservation Values in the Northern Nyasa Basin, Tanzania

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- **Challenge: In an area whose population is growing rapidly, where should we invest to help maintain ecosystem services and conserve biodiversity?**

- **What are the salient ecological or conservation features and major threats?**

Forests

- Montane Forests – center of endemism.
- Dense Miombo woodlands in Forest Reserves
- Source of food, medicine, and construction materials.
- montane, dense miombo, riparian woodland=21% of the basin.

Wetlands

- influx of people into the lake shore region in the mid-1970s contributed to conversion of wetlands to ag. Production, mostly rice.
- Impacts: reduced capacity to absorb sediment and nutrients exacerbating related water quality issues and degrading fish ecology, especially breeding zones (Nindi, 2007).

Bujingijila Wildlife Corridor

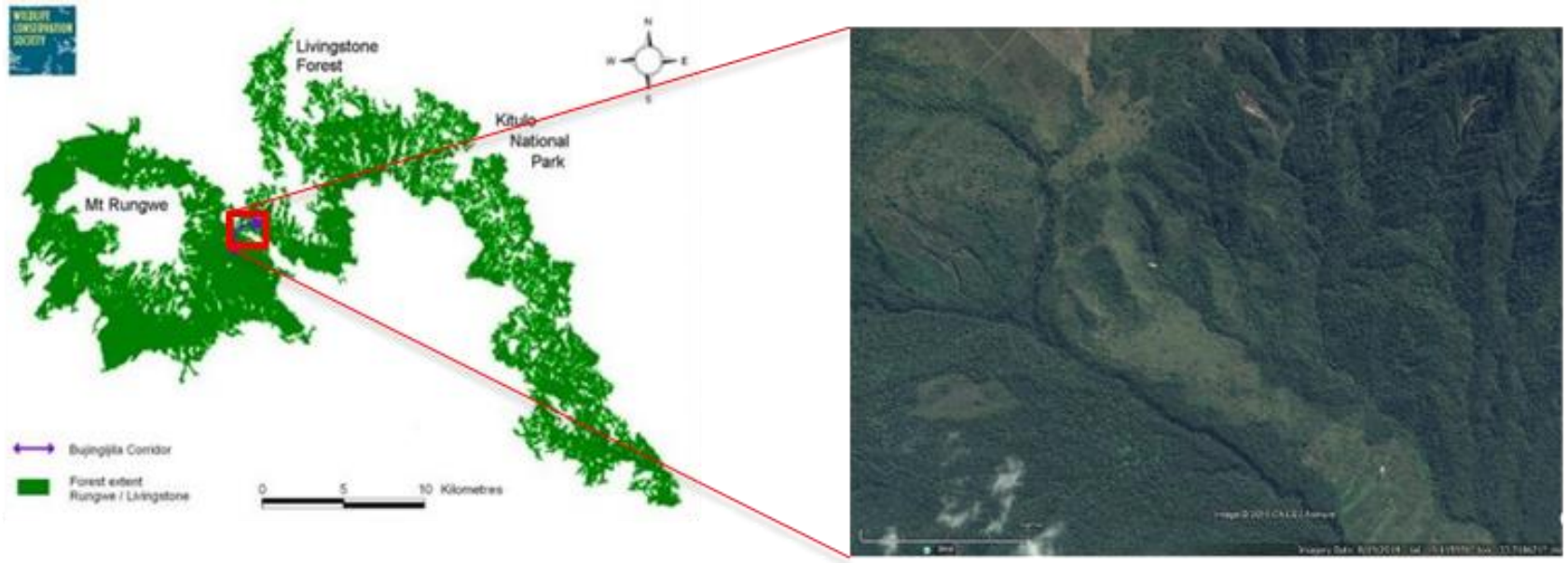
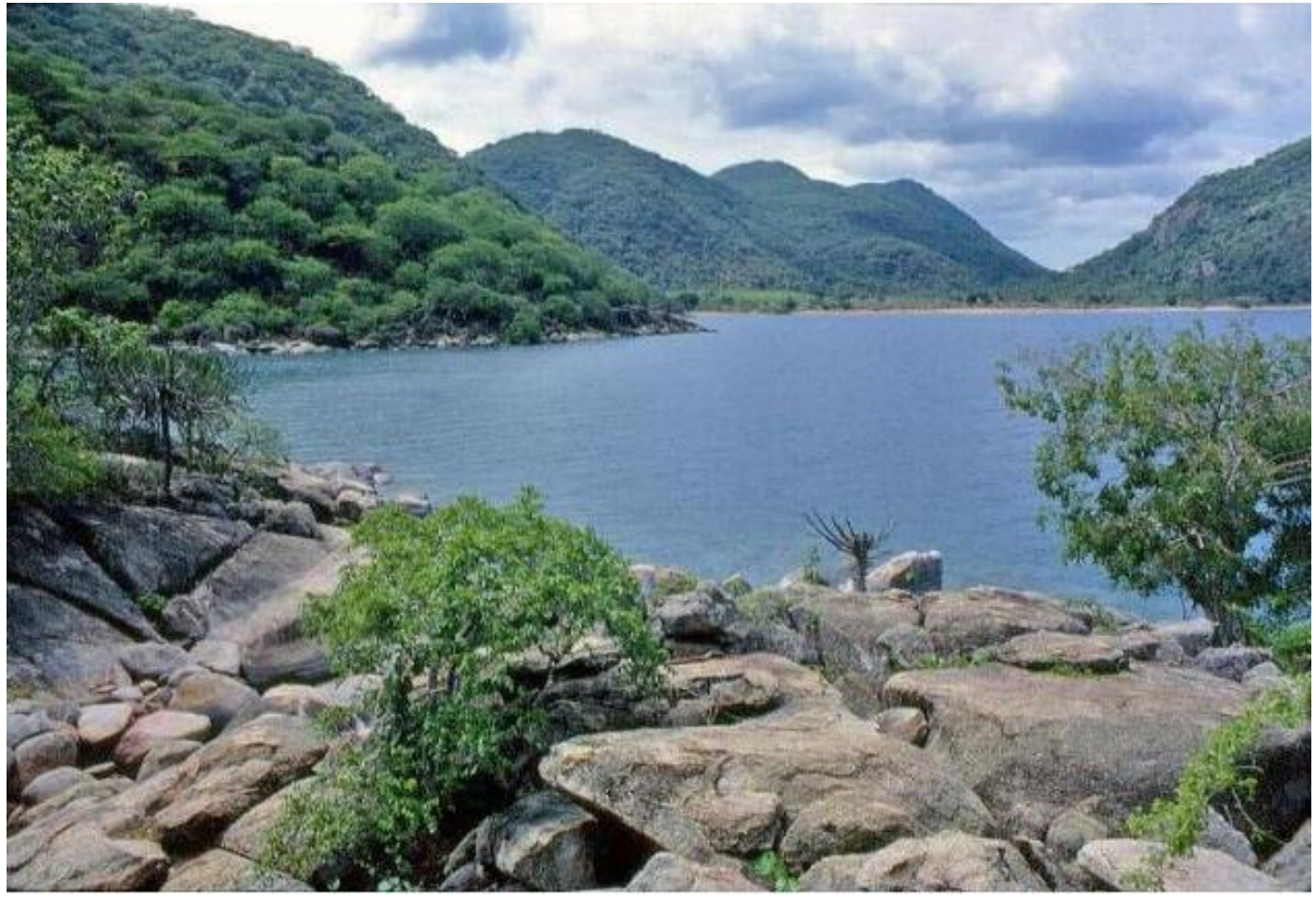


Figure 1. Bujingijila wildlife corridor as mapped by WCS and a 2014 satellite image perspective (Astrium, 1.5m resolution) revealing significant agricultural encroachment.

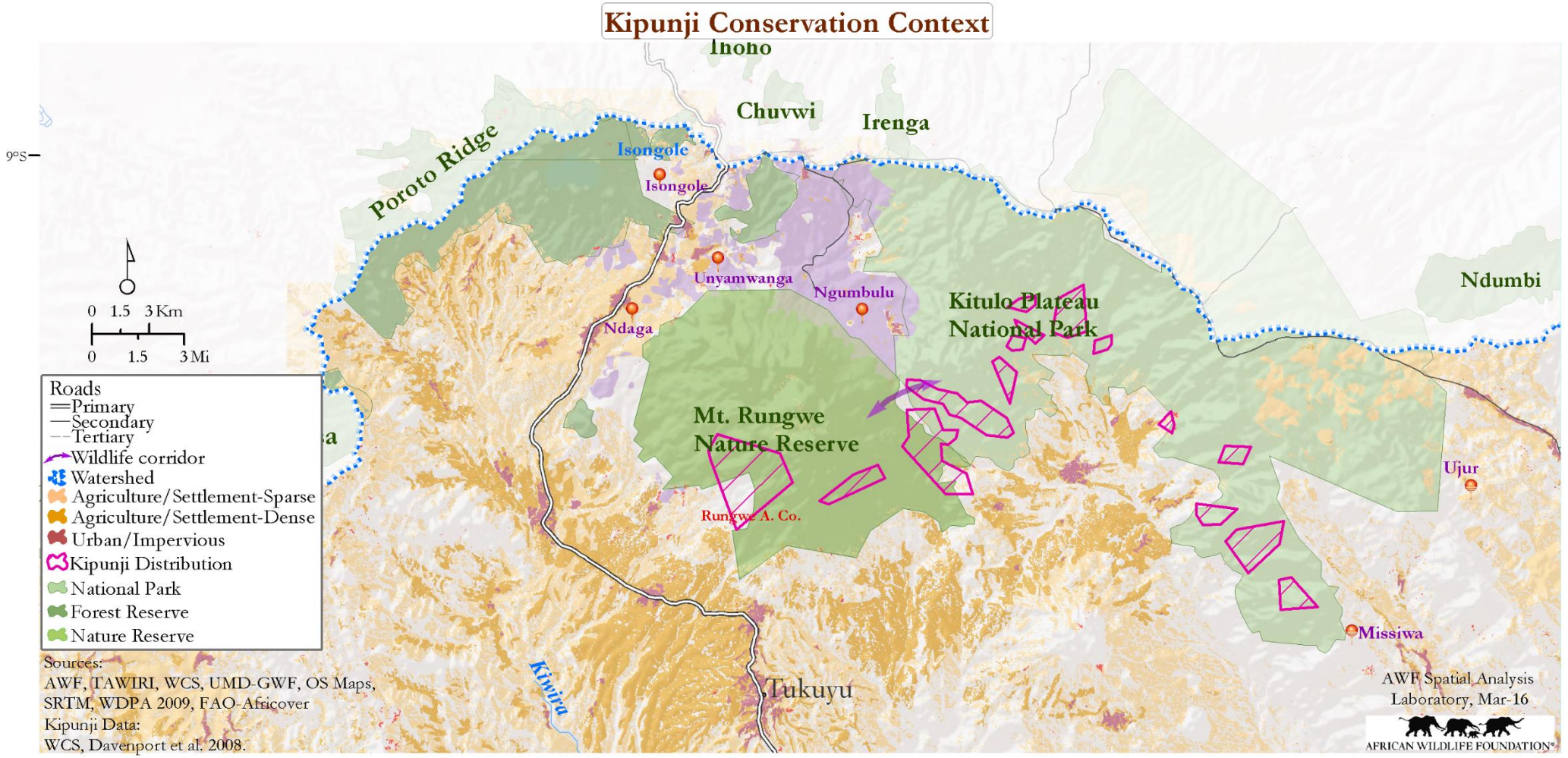
- Links Rungwe to Livingstone Forest. Degraded and encroached by farmers.
- Reforestation of this corridor would add additional habitat for an 8% Kipunji population and reconnect the Mt. Rungwe and Livingstone Kipunji subpopulations (Bracebridge et al., 2013).

Water Quality



- Agricultural expansion, deforestation, and poor agricultural management has increased catchment erosion and compromised water quality by increasing nutrient inputs and sedimentation.
- Sedimentation increases streams and shoreline water turbidity and degrades fisheries through the siltation of fish spawning grounds. Fisherfolk have seen large declines in catch (Nindi, 2007).

Kipunji monkey

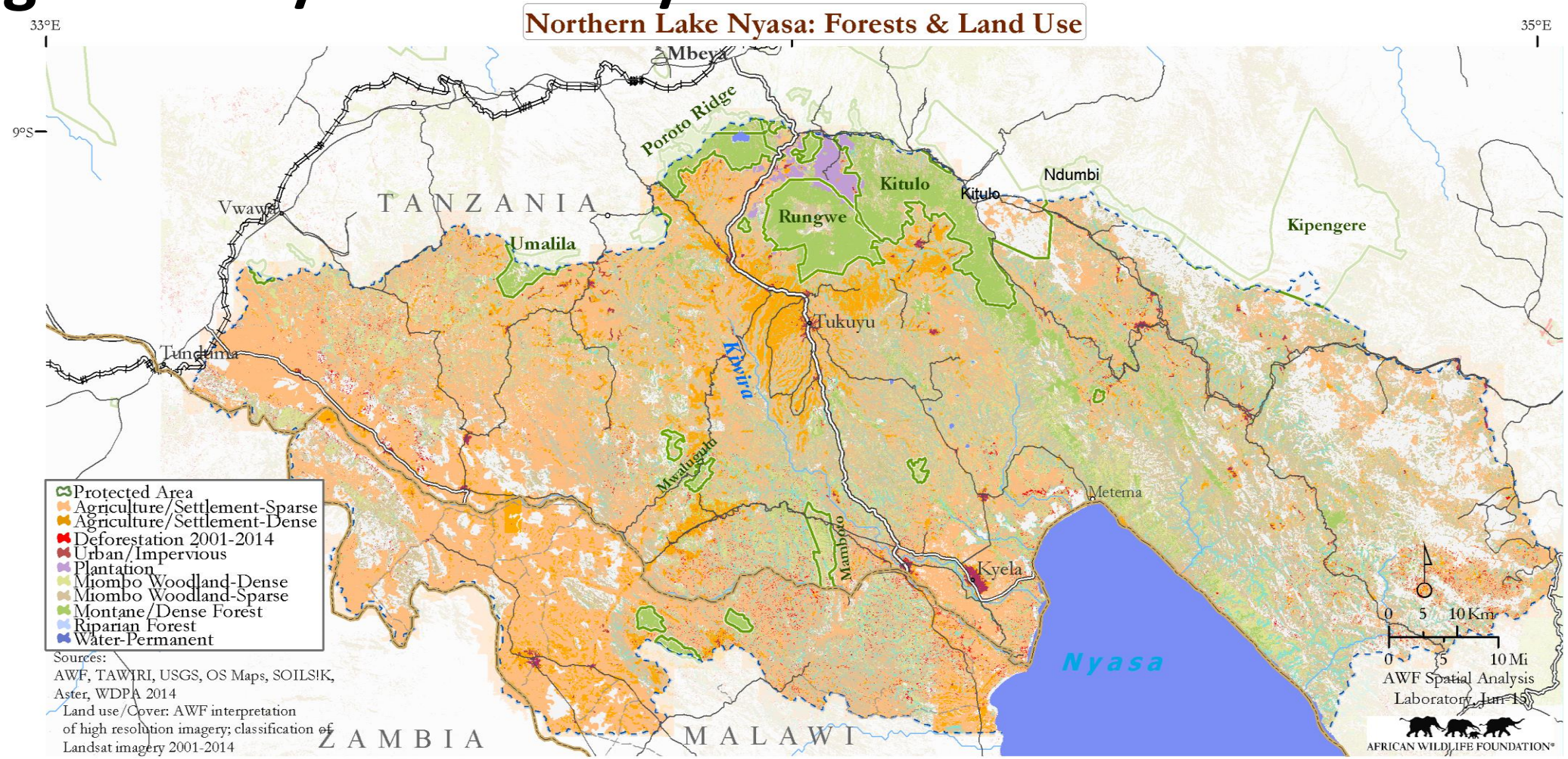


- Kipunji (Rungwecebus kipunji)- critically endangered Tanzanian endemic primate found in two populations separated by ca. 350 km of non-forested land.
- Top threats: habitat conversion/degradation due to logging, charcoal making, plantations, ag.
- Also suffer from illegal hunting and retaliatory killing.

Abbott’s duiker

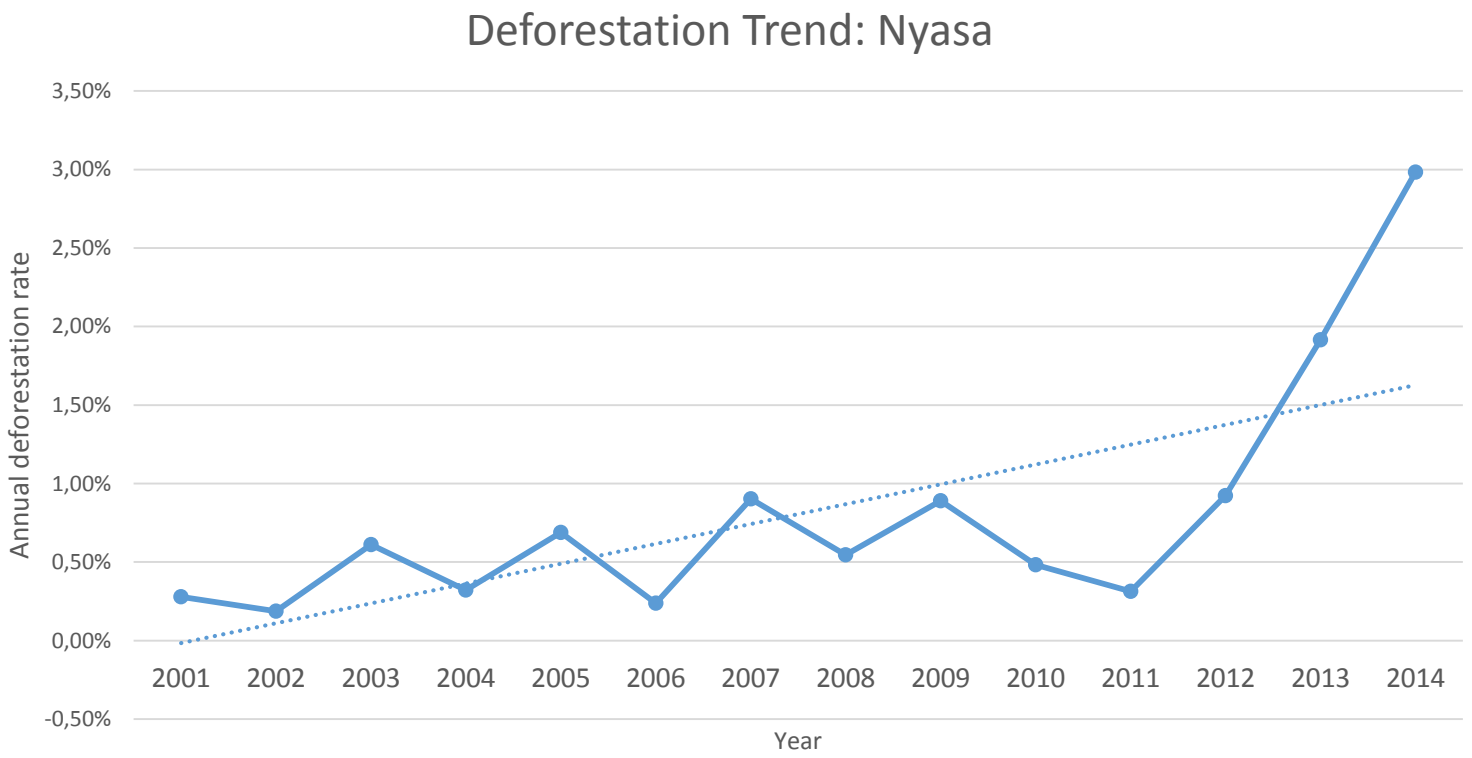
- Small Rungwe-Kitulo population is generally found in the mature montane and submontane forest but occasionally accesses Kitulo plateau and lower elevation montane grasslands (Bowkett et al., 2014).
- Seriously threatened: poaching (usually via snares), habitat loss, and habitat degradation (Moyer, 2003).

Agriculture/Settlement/Deforestation



- 28% of forest is protected.
- Agriculture and settlement areas occupy 29% of the basin & drive deforestation.
- Commercial and village plantations in highlands.

Agriculture/Settlement/Deforestation



Source: Hansen, Univ. of Maryland

- Before 2011, deforestation rates fell below the average annual deforestation rate for Tanzania of 1.1% (Blomley, T. and Iddi, S. 2009) and have increased markedly since.

Conceptual model of Nyasa Conservation/Ecological Features and Threats

Nyasa Basin	Conservation Targets					
Direct Threats	**Forest**	**Water quality**	**Wetlands**	**Abbot's Duiker**	**Kipunji**	**Wildlife Corridors**
Deforestation	↑	↑	→	↑	↑	↑
Unplanned Agriculture	↑	↑	↑	↑	↑	↑
Illegal hunting				↗	↗	
Retaliatory Killing					↗	

Threat taxonomy:

Habitat loss, degradation and fragmentation

Direct target species decline

Threat's impact on biodiversity over last 30 years:

Low

Moderate

High

Very high

Current threat trend:

Decreasing impact

Continuing impact

Increasing impact

Rapidly increasing impact

Evaluation considered the severity, scope and reversibility of the threats

- Agriculture is a major land use change driver leading to habitat conversion/deforestation.
- Deforestation is also driven by logging, charcoal production, plantation expansion.

Where are opportunities to protect or improve ecosystem services delivery through intervention activities?

Methodology

- Natural Capital Project aims to integrate the value nature provides to society into decision making.

- Resource Investment Optimization System (RIOS) combines biophysical, social, and economic data to identify the locations for protection and restoration activities that maximize the ecological return on investment.

natural capital PROJECT

RIOS

University of Minnesota

The Nature Conservancy
Protecting nature. Preserving life.™

WWF

Methodology

RIOS activities to improve delivery of ecosystem services:

Conservation Agriculture: improve agricultural practices and increase output through: a) crop planting practices, b) agroforestry practices, c) ditching or terracing to control erosion, and d) fertilizer management.

Protection: protection of forests and wetlands.

Restoration-Assisted: revitalization of vegetation on agricultural land through active interventions (tree planting, education, or improved management).

Restoration-Unassisted: as above but using natural regrowth.

Methodology

Relative cost per unit area of Nyasa activities.

Restoration-Assisted	Restoration-Unassisted	Conservation Ag.	Protection
3	2.5	4	4

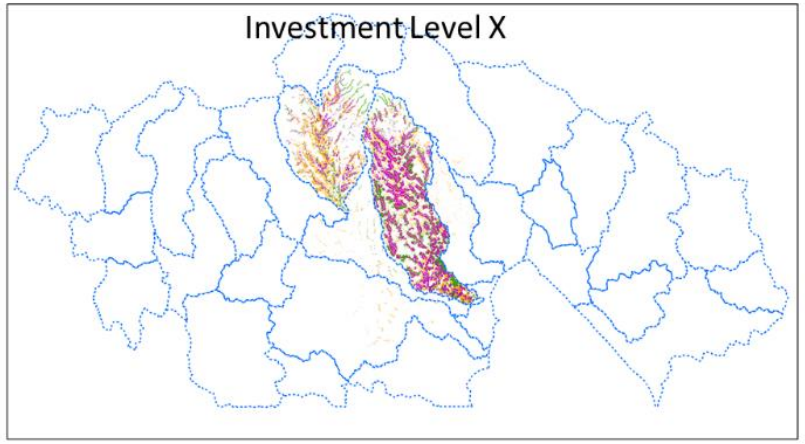
Relative budget allocation for intervention activities used across the three scenario investment levels (1X to 3X) where 2 is simply twice the allocation of 1.

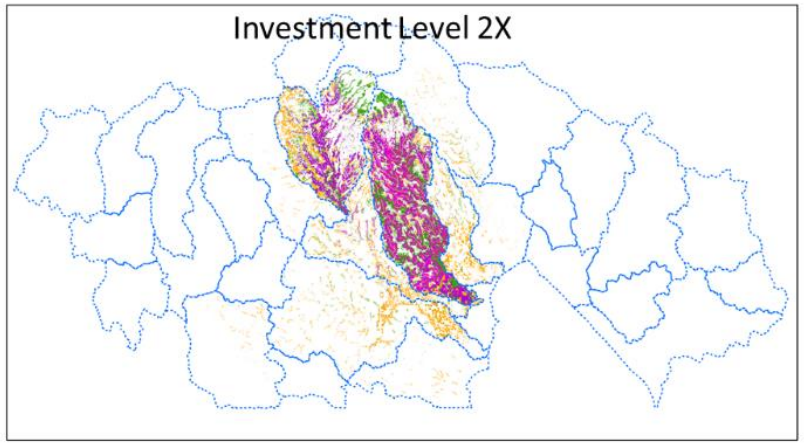
Restoration-Assisted	Restoration-Unassisted	Conservation Ag.	Protection
1	1	2	2

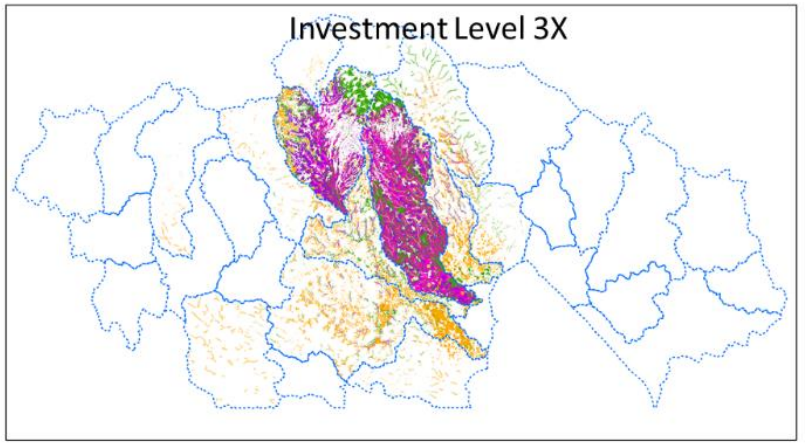
- Assigned relative cost per unit area to each activity.
- Pre-allocated funding among activities to ensure that each activity is represented.

Results

- RIOS analysis generated activity portfolios producing 3 scenarios that expanded activity areas in sub-watersheds with increasing investment. Level 1X to 3x activity portfolios ranged from 3 to 6% of basin area across 33 sub-basins.



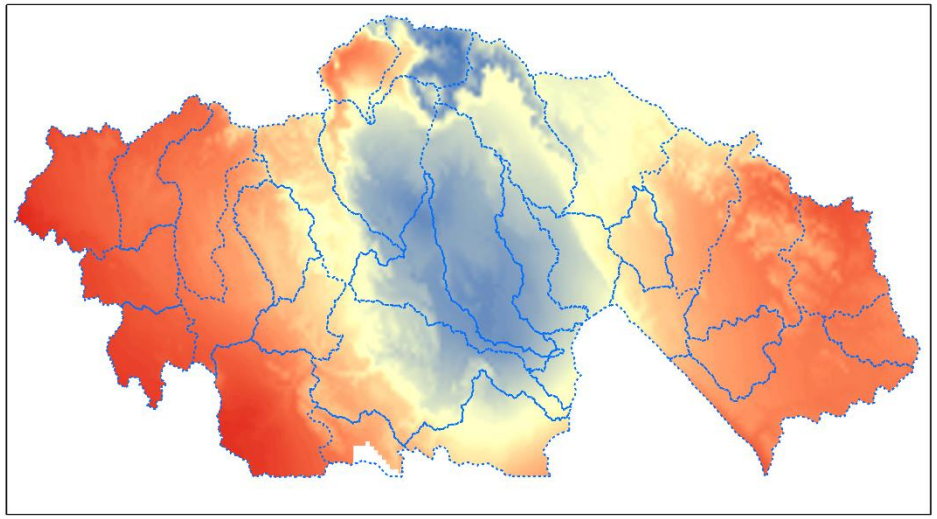




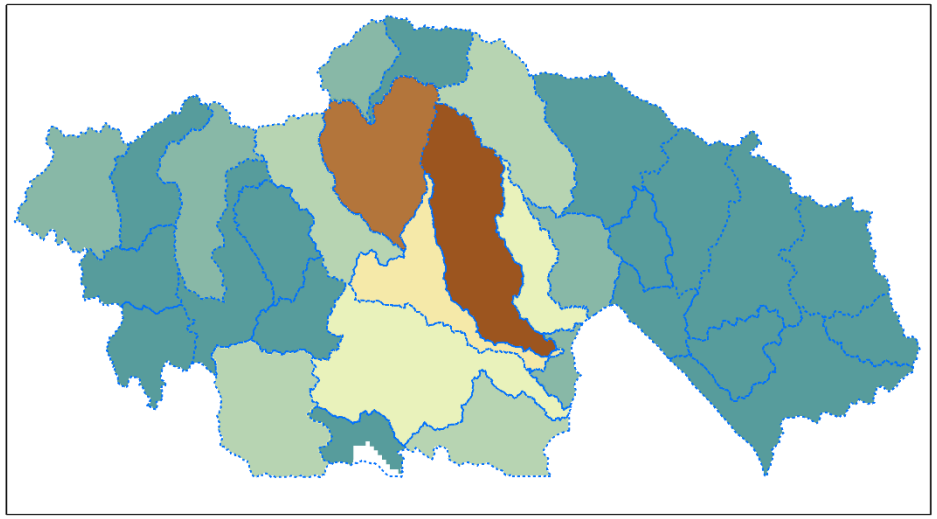
RIOS

Drivers

- The RIOS model aims to select activity areas for max. impact as defined by delivering ES to the most people therefore rainfall and population (beneficiaries) are key drivers.



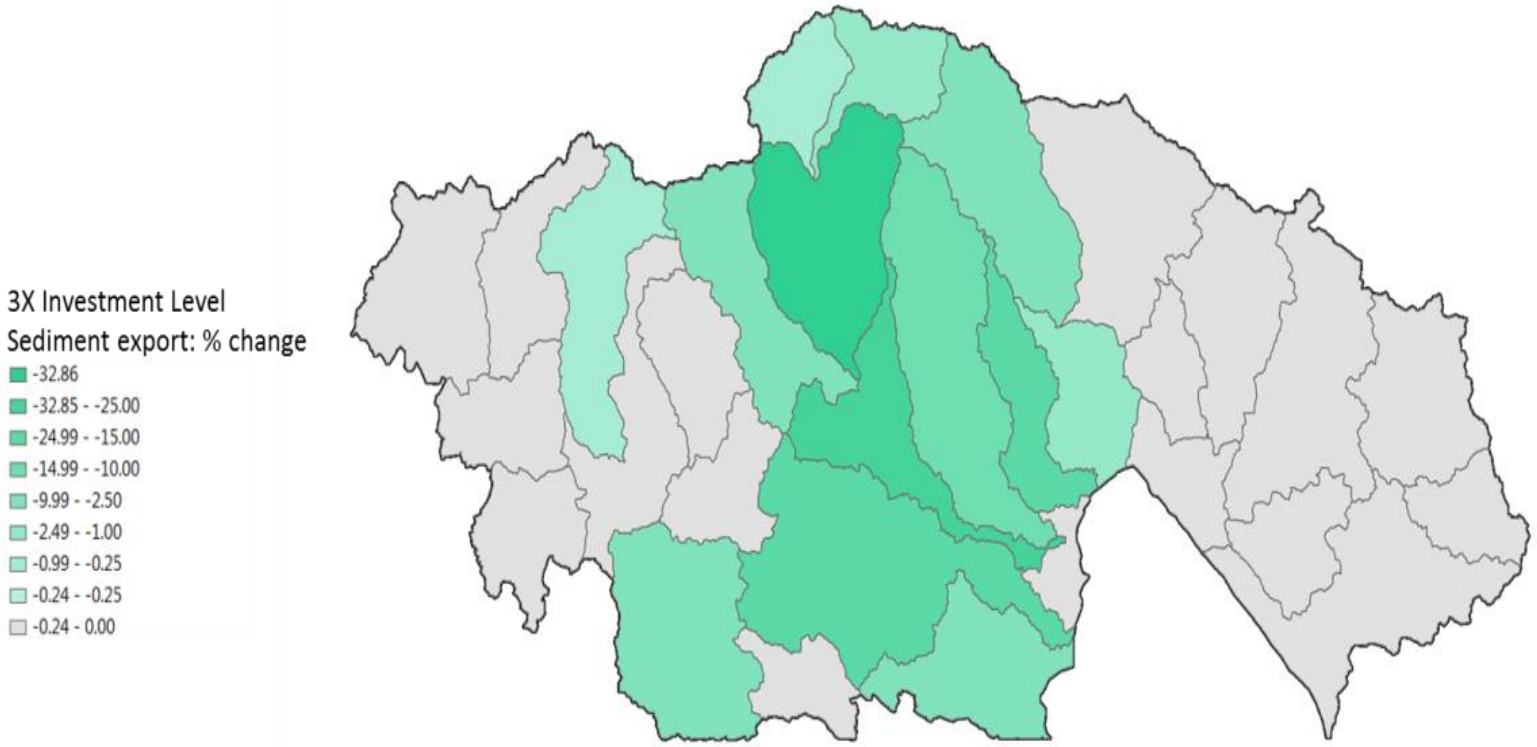
Annual rainfall



Human population by sub-basin

RIOS

Expected Impact: Sedimentation



- The RIOS models can be used to estimate impact on ecosystem services. For example if Level 3x RIOS activities were implemented, we estimate that sedimentation would be reduced 8.6% across the basin and up to 33% in sub-basins.

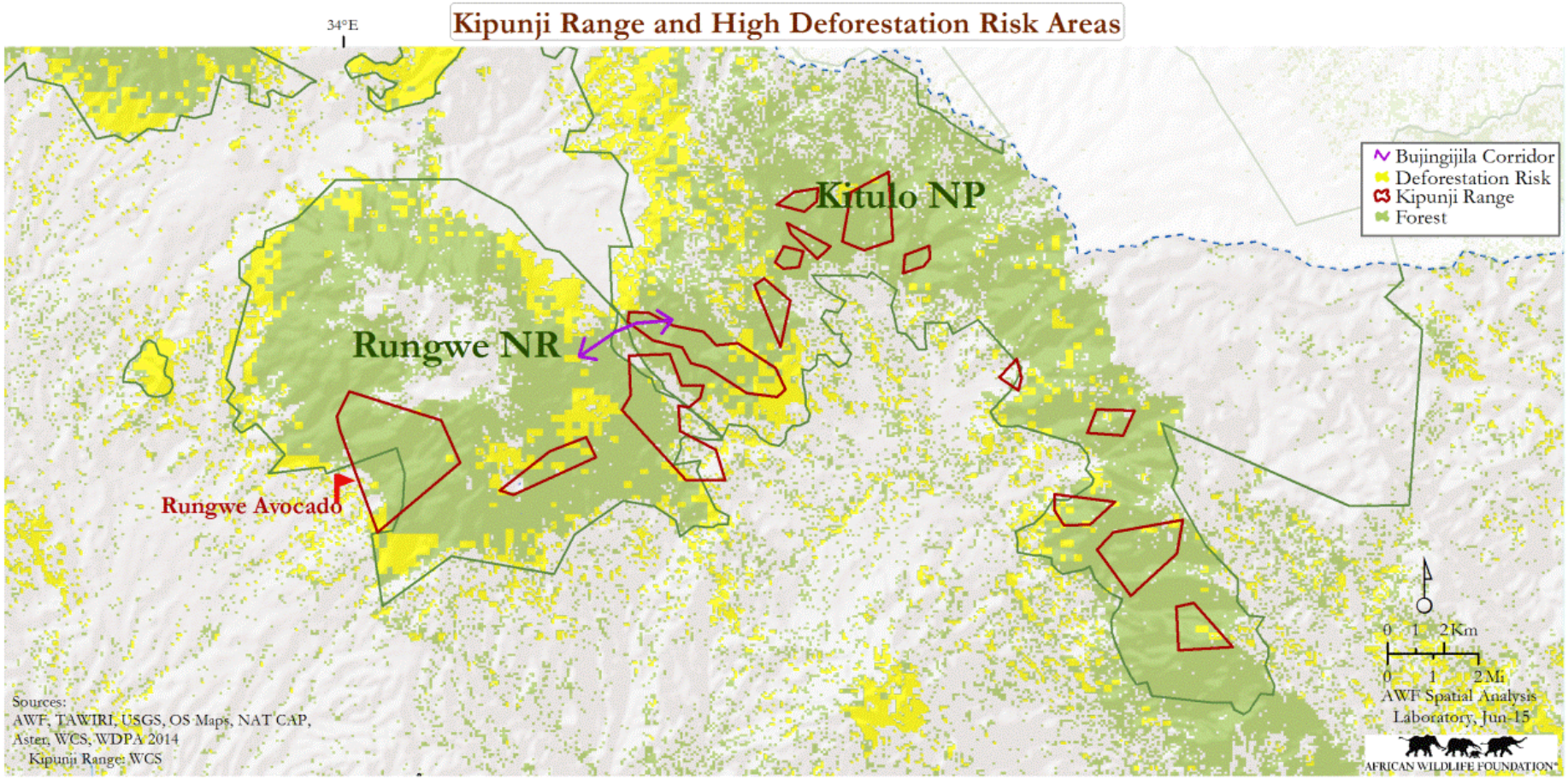
What areas are at most risk for deforestation?

Deforestation Risk

- Driven primarily by prior percent forest cover, land use influence, elevation, and distance from road.
- Attributed moderate to high deforestation risk to 32% (759 Km^2) of forest in basin.
- 15% of at risk forest is under conservation status &almost 10% was identified for protection activity by RIOS analysis.
- Driven primarily by prior fire density, land use influence, and elevation.
- AUC scores of 0.747
- Natural fire cycle in Miombo but vast majority set by humans.

- deforestation model attributed moderate to high deforestation risk to 32% (759 Km^2) of forest in the basin with most in the moderate category.
- 15% of at risk forest is under conservation status and almost 10% was identified for protection activity by NatCap RIOS analysis.
- RIOS 3x Level protection activity forests that that are at higher risk for deforestation.
- Most of 6,642 Ha of forest fall in and along the southern flank of the Rungwe-Kitulo highlands.

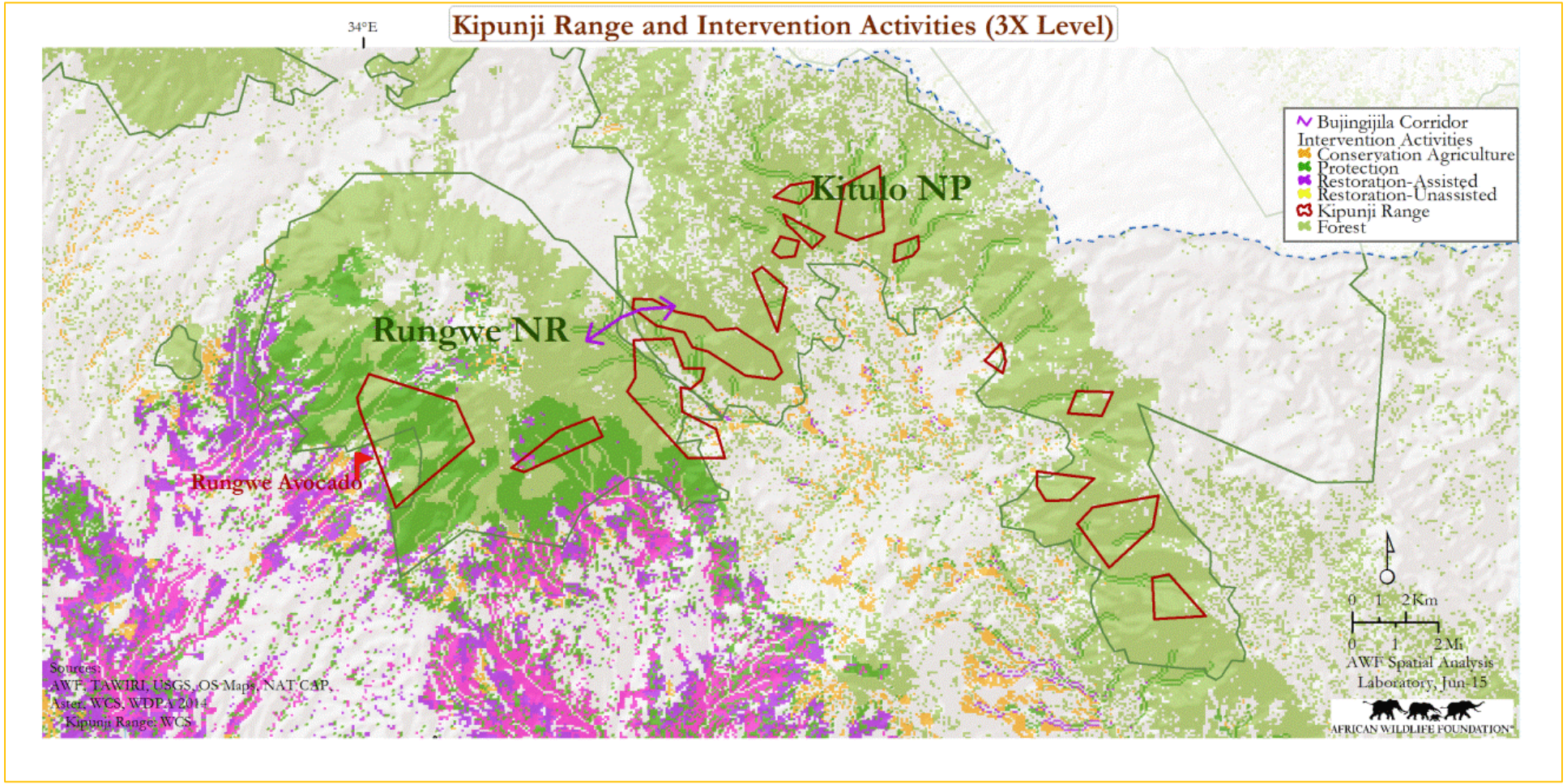
Deforestation Risk



- 8% of the forests within the Kipunji sites are at high deforestation risk
- Within the immediate 1Km and 2Km peripheral zones, 15 and 19% of the Kipunji forests respectively are at risk.
- Bujingijila Corridor also appears to be at risk.

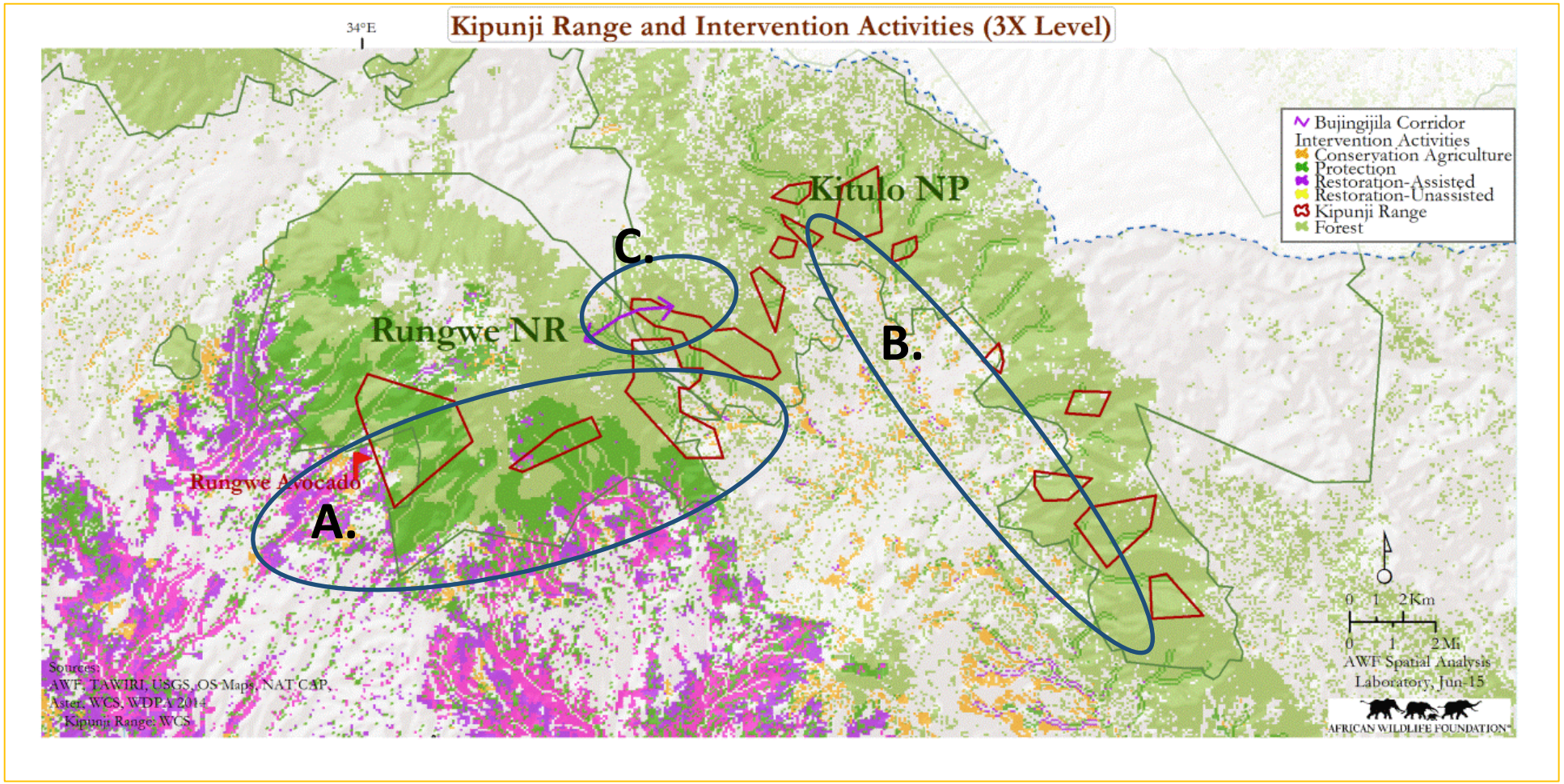
What recommendations can we make based on the analyses?

Recommendations



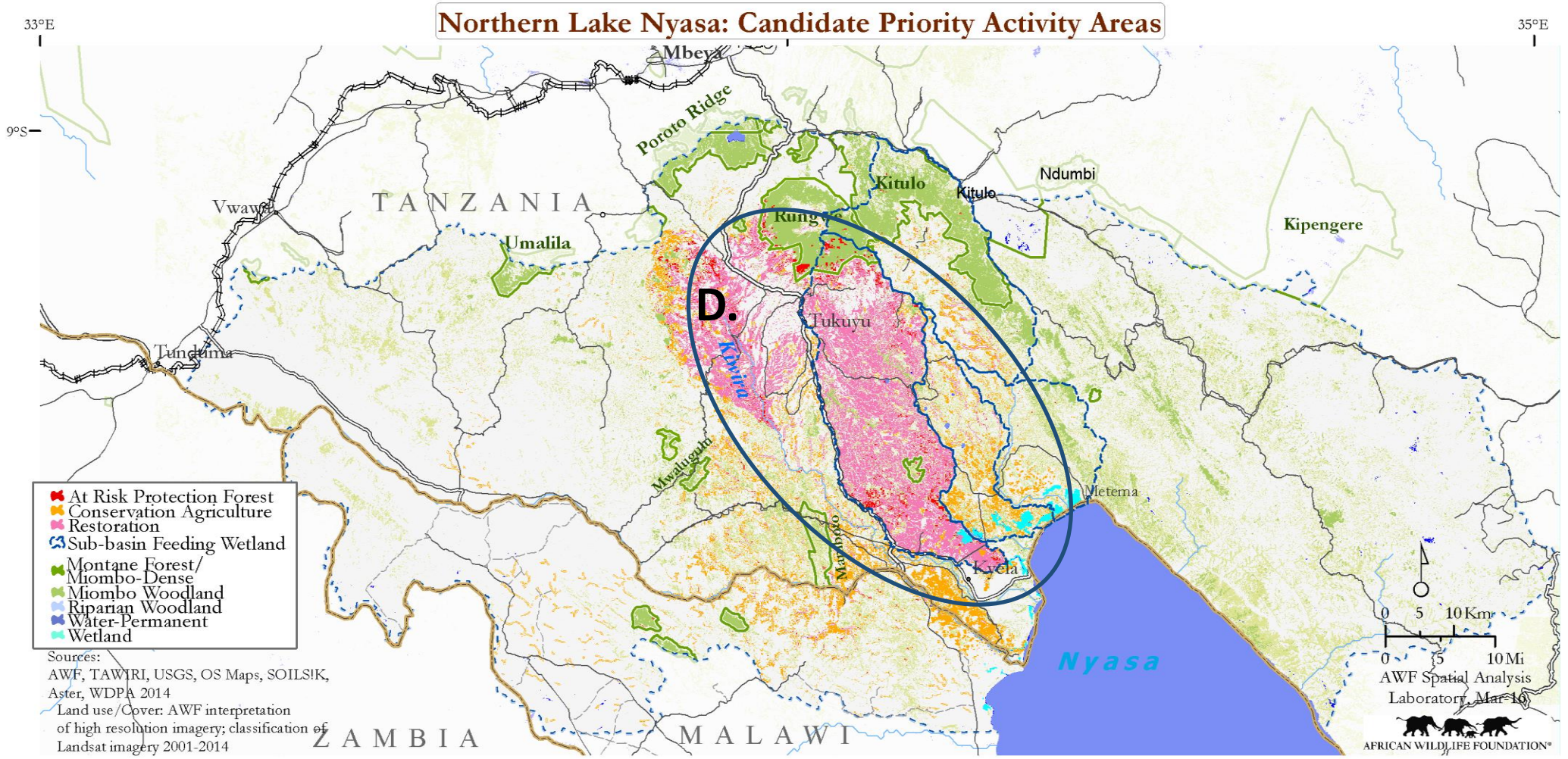
- Kipunji range overlaid with Rungwe-Kitulo forests and RIOS-derived intervention activities at the 3X investment level
- RIOS forest protection areas occupied 27% of Kipunji population distribution.

Recommendations



A. Win-win areas for ecosystem services delivery and Kipunji/Abbot's Duiker protection/buffering. Reinforces call for reforestation of likely former Kipunji monkey (*Rungwecebus kipunji*) habitat immediately to south of current range (Bracebridge and Davenport, 2011).
B. Conservation ag. areas that could help buffer Kipunji/Abbot's Duiker habitat.
C. Corridor restoration and management.

Recommendations



D. Below Rungwe/Kitulo, larger patches of forest identified for protection activities that also are at high deforestation risk warrant priority consideration. Conservation ag and restoration activity areas within the central watersheds would also benefit downstream wetlands vis a vis site-level management plans.

Recommendations: Tools and Approaches to Improve Monitoring and Evaluation

- Application of SMART & CyberTracker (What can it do for you?)
- Where are the threats coming from?
- What are the trends?
- Monitoring efforts and coverage
- Evaluate Metrics of success
- Improve adaptive management
- Assist in Strategic Planning

Conclusions

- How can we make use of these outputs?
- InVEST and Rios are tools that are best used to generate spatially-explicit scenarios that inform a stakeholder-driven discussion. Could we create more relevant scenarios?
- Stakeholder engagement can help vet model input data and assumptions, calibrate parameters, and ground truth outputs.
- Next steps: RIOS model refinement with more emphasis on potential impacts/benefits. Integration with other data/findings

Thank You

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