Strengthening Natural Resource Management with New Protected Area Connectivity Tools

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(2) University of Oxford

(2) WILDCRU Wildlife Conservation Research Unit

(6) kaza Kavango Zambezi Trans Frontier Conservation Area — Angola, Botswana, Namibia, Zambia, Zimbabwe

(3) LP

(4) Forest Service US Department of Agriculture

(5) University of Montana

(7) Trans-Kalahari Predator Programme TKPP

Conservation Need

- The proliferation of infrastructure, agriculture, and other land uses has decreased movement potential for wildlife across much of the world
- Tools exist for assessing land use impacts, but they generally require technical expertise to run, may rely on proprietary software, and are not explicitly designed for scenario assessment
- The Wildlife Conservation Research Unit (WildCRU) and United States Forest Service expressed a need for an easy-to-use DSS that could automate assessment of conservation and development impacts on connectivity

Project Structure

Earth Observations

NASA

+

In-situ observations

UNIVERSITY OF OXFORD

WILDCRU
Wildlife Conservation Research Unit

+

Analysis, Modeling, and DSS Development

NAU

UNIVERSITY OF MONTANA

Scenario Development, Workshops, Training, Applications

kaza
Kavango Zambezi Trans Frontier Conservation Area
Angola Botswana Zimbabwe Zambia Namibia

WILDCRU
Wildlife Conservation Research Unit

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

TRANS-KALAHARI PREDATOR PROGRAMME TKPP

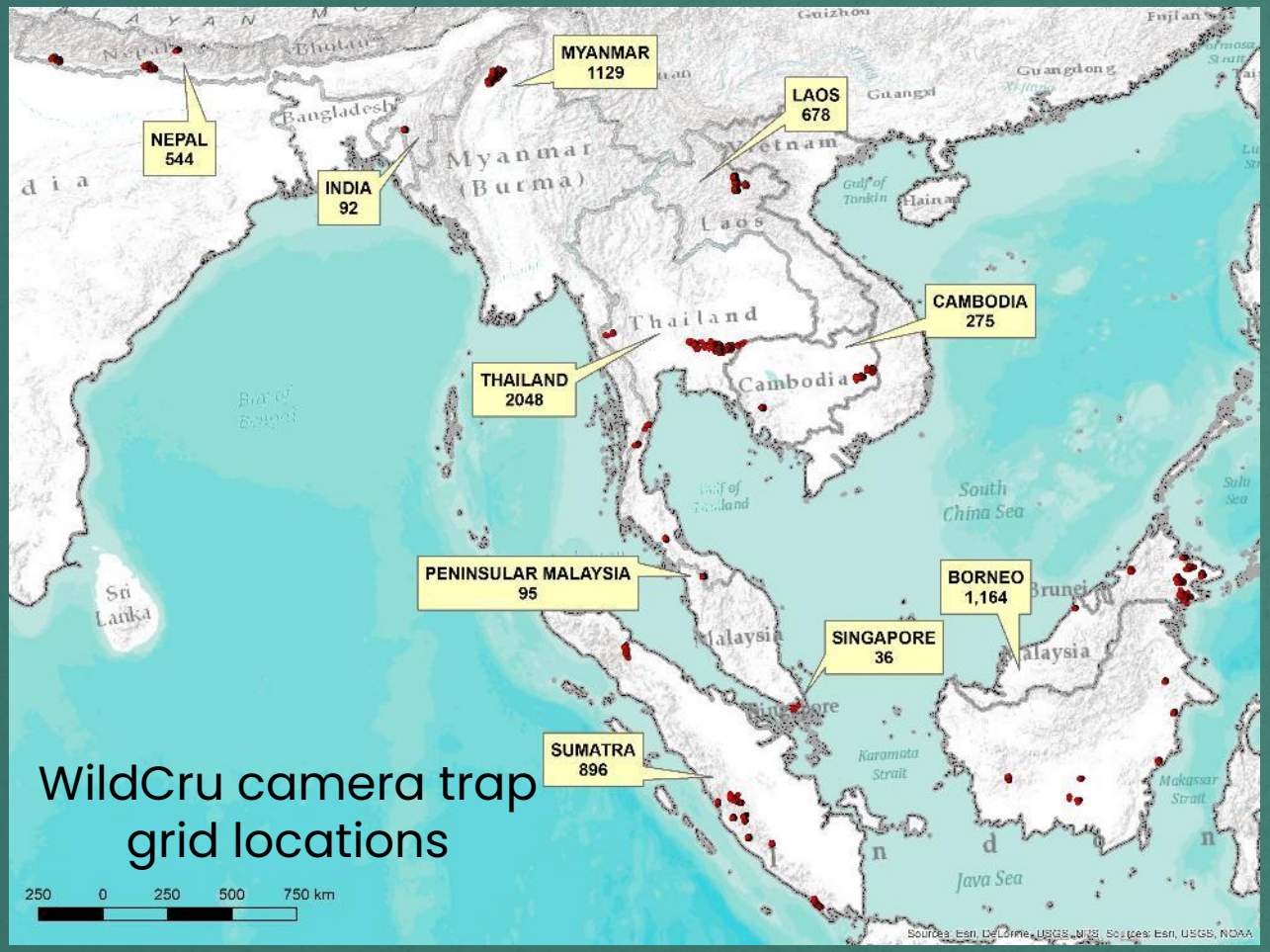
lp

Participatory watershed management planning exercise led by USFS, Mount Elgon, Kenya.

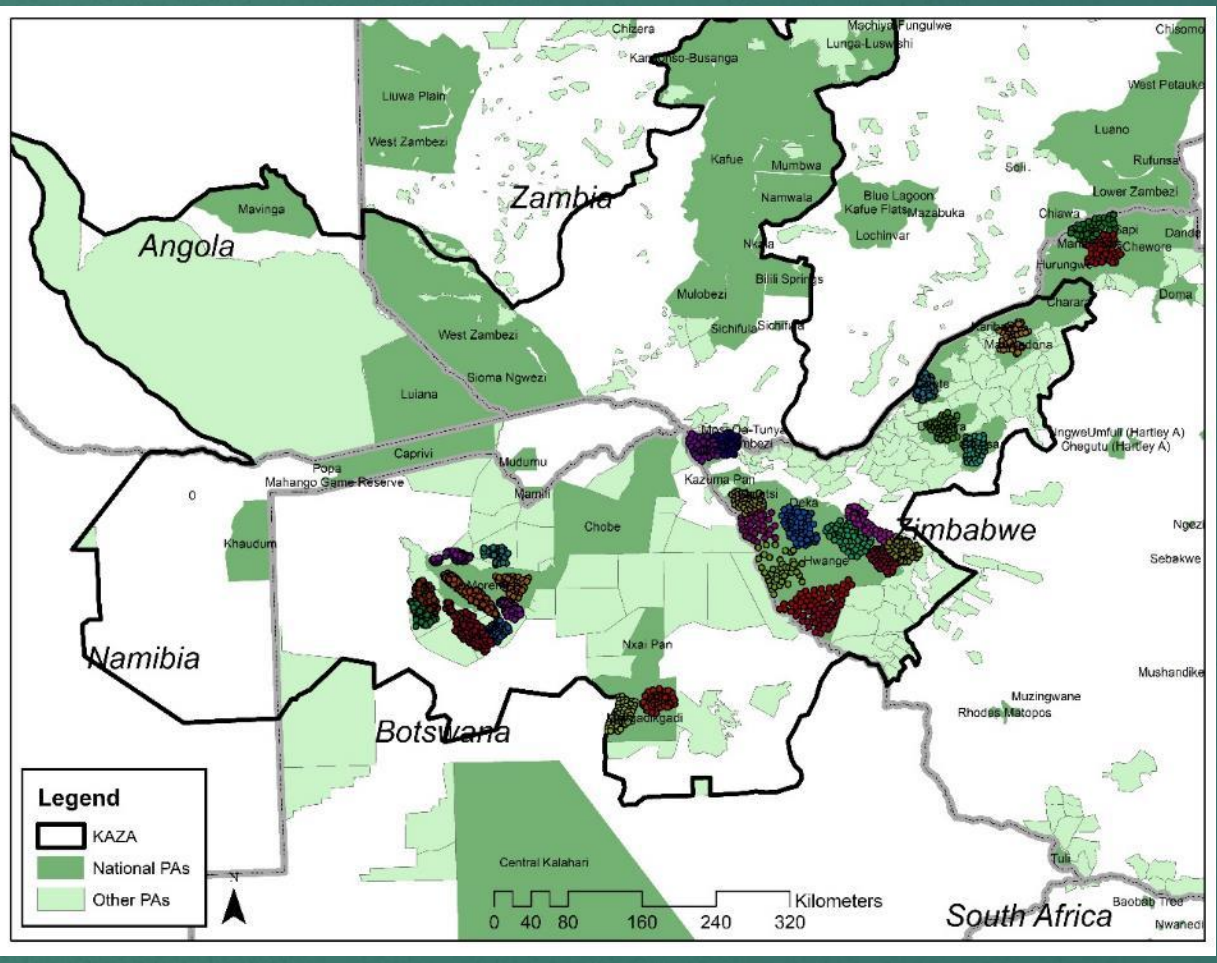
Participatory land use planning facilitated by WCS and USFS, Tanintharyi Region, Myanmar.

Focal Areas

Southeast Asia



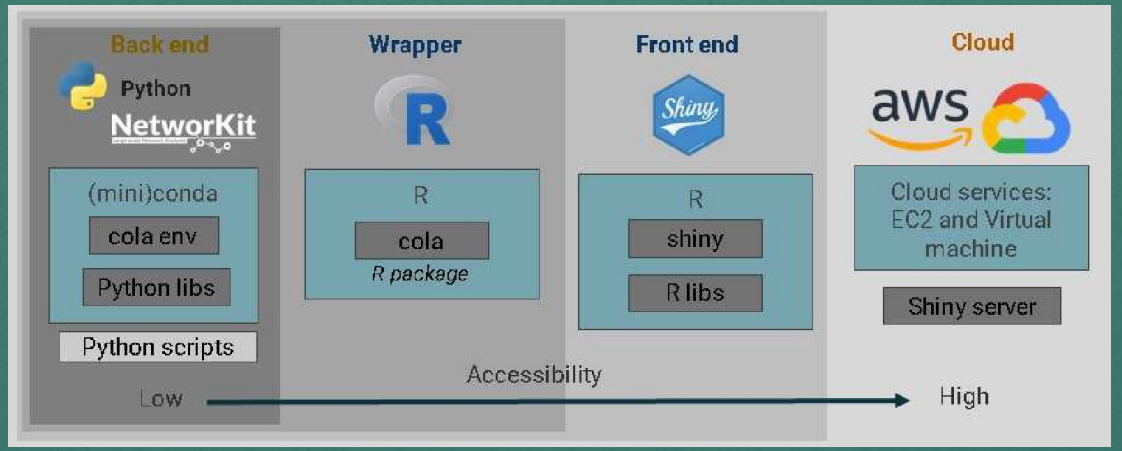
Kavango-Zambezi Transfrontier Conservation Area



Connecting Landscapes DSS

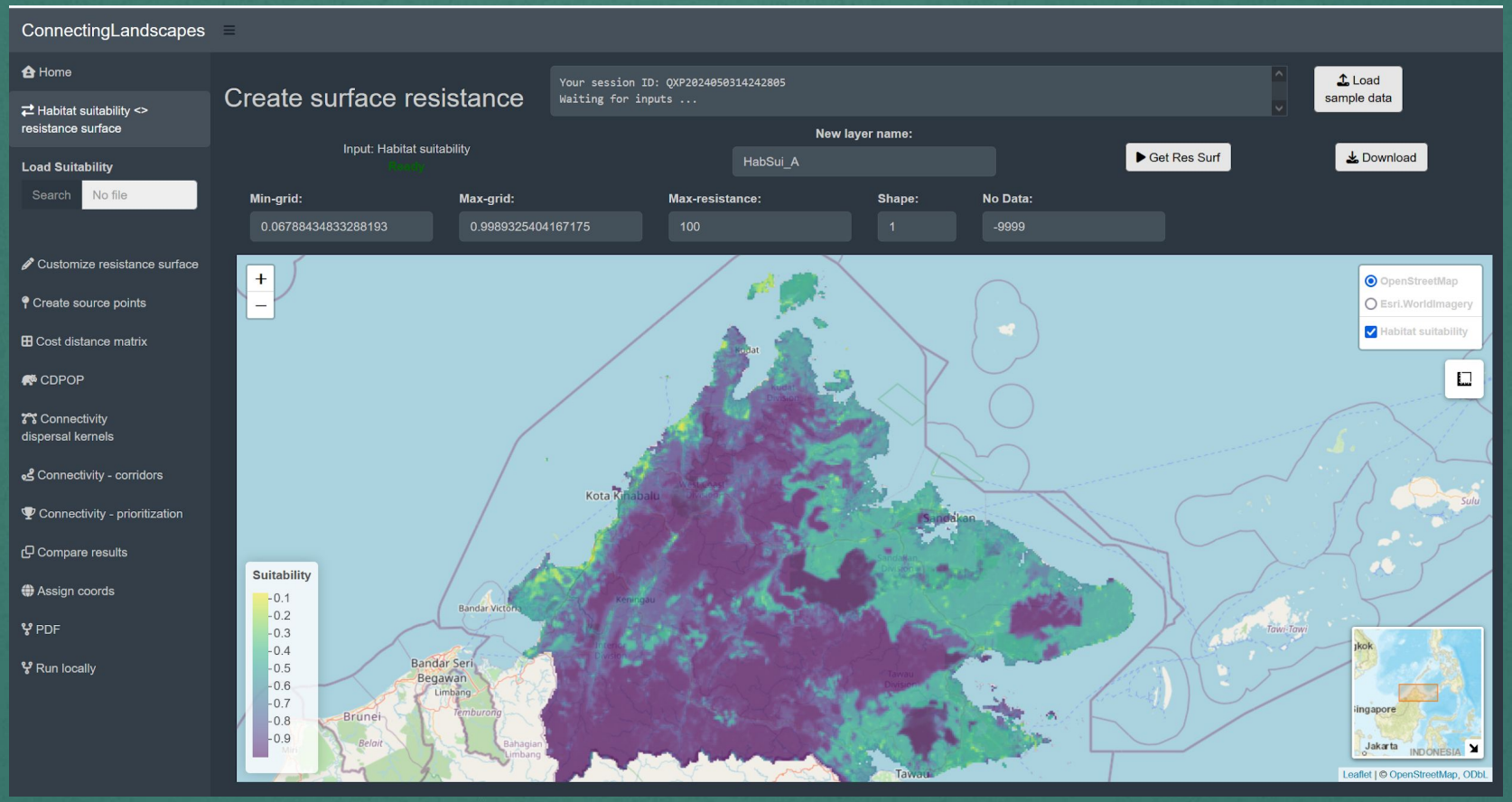
- Predecessor tools (UNICOR and CDPOP, Landguth et al. 2010, 2012) used by WildCRU and USFS for connectivity modeling via command line in Python (e.g. Kaszta, Ż., Cushman, S.A., Hearn, A., Sloan, S., Laurance, W.F., Haidir, I.A. and Macdonald, D.W., 2024. Projected development in Borneo and Sumatra will greatly reduce connectivity for an apex carnivore. Science of The Total Environment, 918, p.170256.)

- We updated and integrated these tools using high performance graph libraries running in Python, accessed via a Shiny front-end



Project Status

- DSS delivered to end-users and is in use – ARL 8
- The DSS runs on an AWS server and is available for download and installation locally in R via Github https://github.com/connectingLandscapes/cola/tree/main



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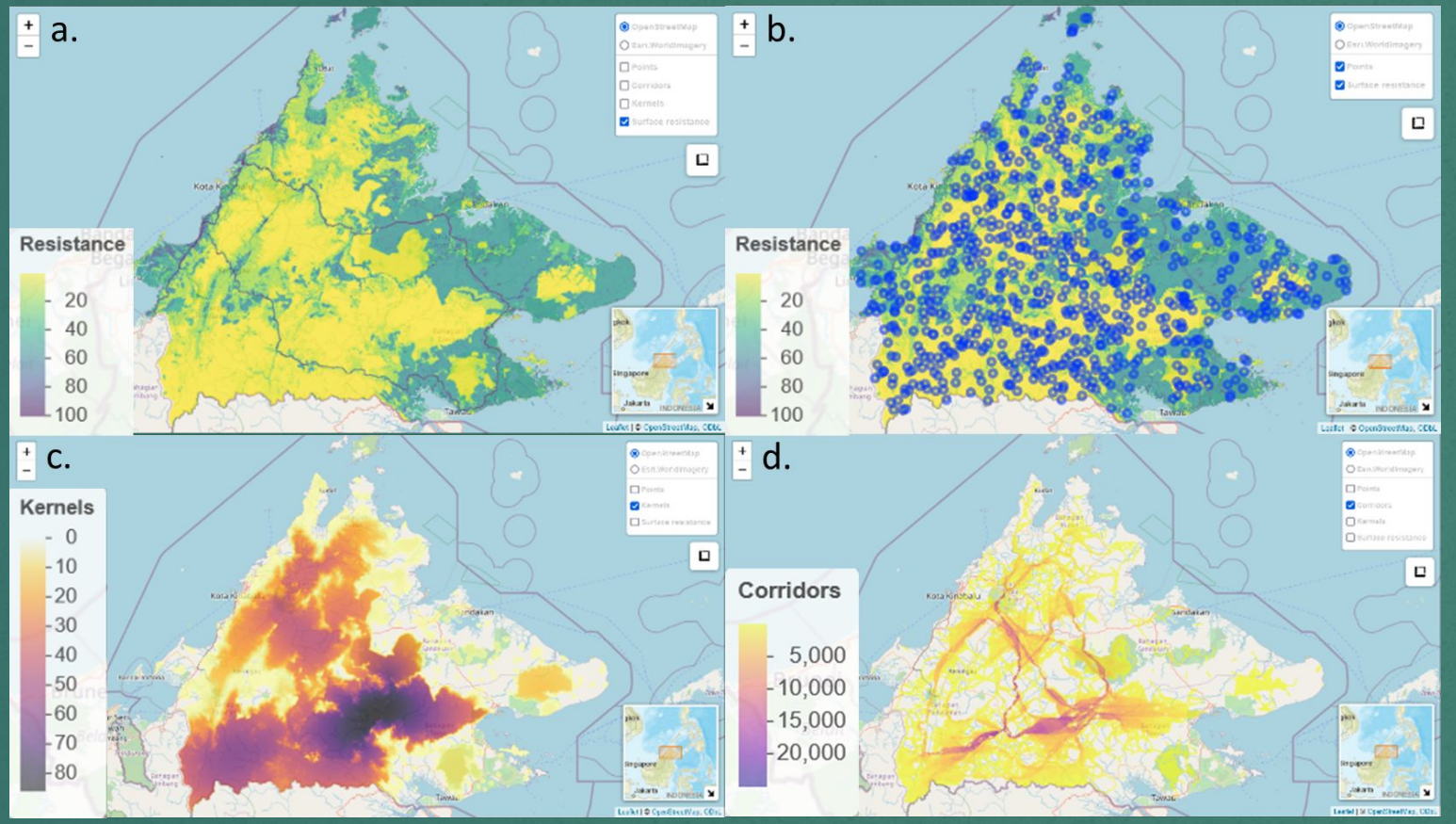

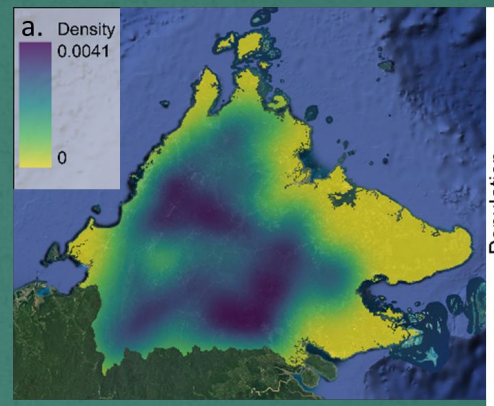

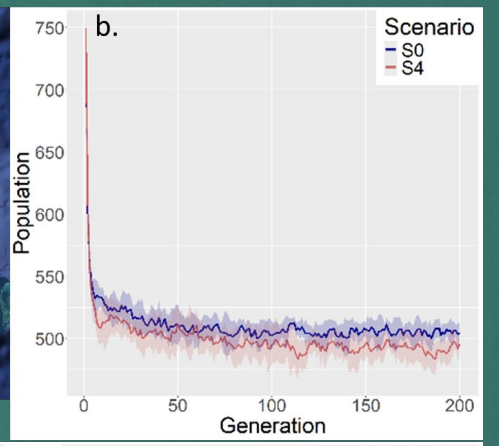

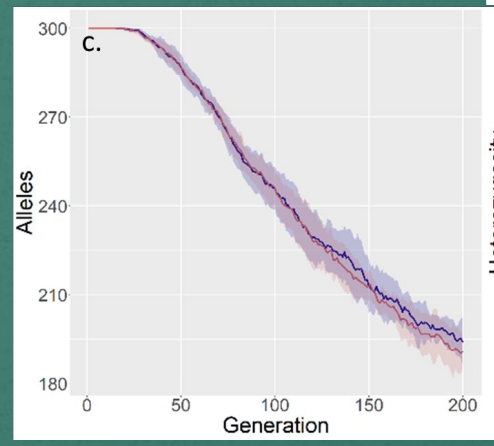

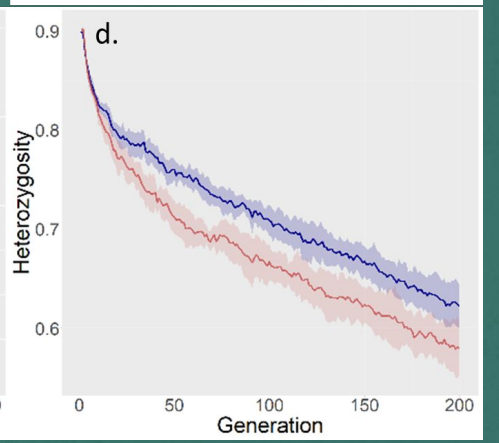

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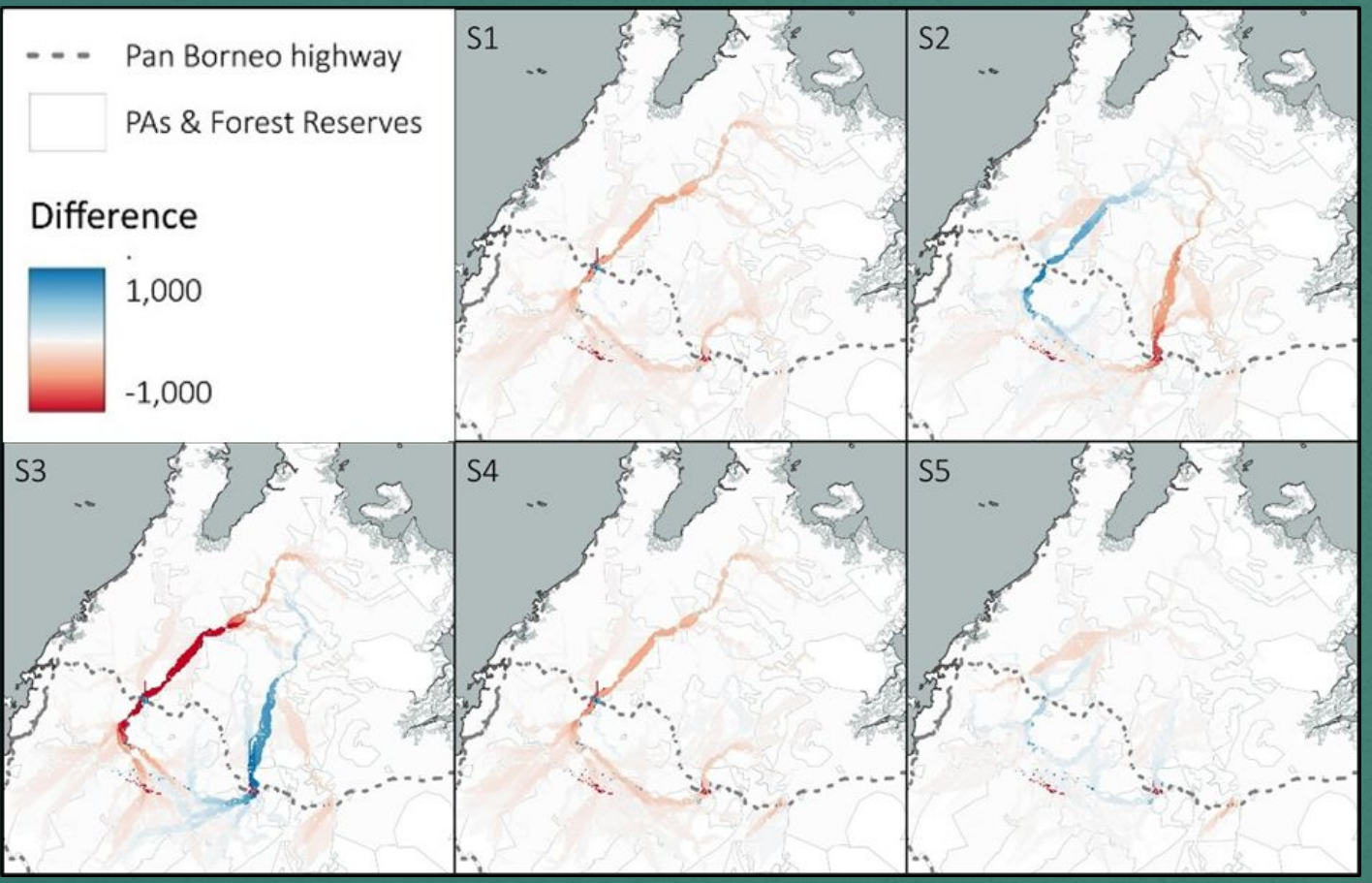
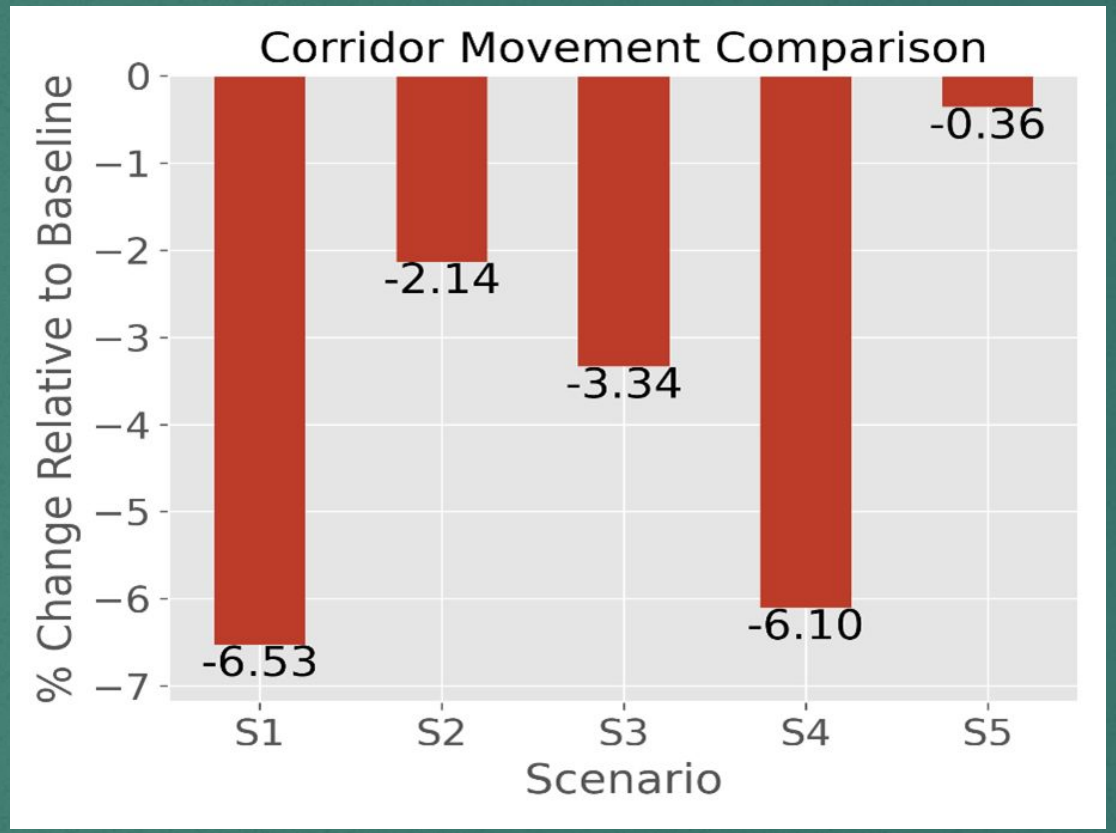




Activities

Workshops

~12 Workshops Throughout the World in the Past Two Years

- Bhutan, Brunei, Laos, Malaysia (2x), Taiwan, Thailand
- Botswana, South Africa
- Oxford, UK – WildCRU and Panthers
- Flagstaff, AZ – USFS Landscape Ecology Course (2x)
- 100's of participants

Activities

Papers and Case Studies

Potential for Clouded Leopard (*Neofelis nebulosa*) Reintroduction to Taiwan – **YiFeng Leo Wang**

Mapping Indochinese Leopard Connectivity Priorities in Southeast Asia - **Luciano Atzeni**

Potential Impacts of a Planned Megacity in Southern Bhutan on Elephant, Dhole, and Tiger Connectivity – **Signye Wangmo**

Connectivity and Population Assessment of Dhole Throughout Southeast Asia – **Caroline Sartor**

Connectivity Assessment for Recovery and Rewilding of Milu (Père David's deer) in China – **Yuanyuan Zhang**

Connecting Landscapes: A decision support system to facilitate conservation led development – **Jantz et al. in review at Environmental Modeling & Software**

Impacts

- 100's of participants with a wide array of backgrounds introduced to the DSS
  - NGOs, Universities, Government Agencies
  - Numerous installations at each workshop

- Several case studies initiated

- New connectivity priorities identified for several species – dhole, elephant, tiger, milu, Indochinese leopard, clouded leopard. More planned.

- Government interest in Bhutan to use the DSS as a spatial planning tool in parks and forest units nationwide

  "This workshop- a collaborative effort between the DoFPS, Royal Government of Bhutan, Oxford University, NASA, and Northern Arizona University -stands as a testament to the transformative power of partnerships in advancing conservation science. Coming together as a team to enhance Bhutan's capacity in conservation technology and planning, while advancing the broader field of conservation science, was an incredibly rewarding experience." **Signye Wangmo, Principal Forestry Officer, Department of Forests and Park Services, WildCRU Ph.D. Student**

Gelephu Mindfulness City Case Study

N

WILDCRU
Wildlife Conservation Research Unit

0 15 30 60 Kilometers

Legend
Existing roads
PA-BC boundary
Elevation
High
Low

Credit: S. Wangmo

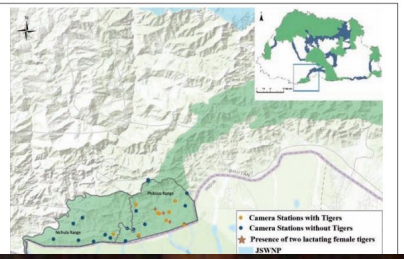

WILDCRU
Wildlife Conservation Research Unit
Credit: S. Wangmo

NIDUP[2], TSHERING WANGDI[1], TENZIN CHOIJEY[1], DORJI DUBA[1] KENCHO RIGZIN[1] AND SAPNA SUNAR[1]

Phibsoo Wildlife Sanctuary records signs of breeding tigers for the first time

We report the presence of breeding tigers for the first time in Phibsoo Wildlife Sanctuary PWS, as evidenced by the photographic records of two lactating females following a photographic capture-recapture survey. Given the inviolate space to secure breeding populations and its strategic location in maintaining landscape-wide connectivity, PWS is a small yet, potential stronghold for tigers. Conservation investments must prioritize critical tiger habitats like PWS for sustained protection in securing breeding populations backed by a robust scientific monitoring approach.

Wild tigers are among the most threatened large carnivores globally (Walston et al. 2010; Karanth et al. 2011, Harihar et al. 2017, Goodrich et al. 2022). They have experienced significant population decline in the last two centuries due to synergistic impacts of habitat fragmentation, prey depletion and direct hunting (Karanth et al. 2004, Ripple et al. 2014, Wolf & Ripple 2017). In an attempt to reverse the decline of the global tiger population which stands at a dismal ~ 3140 (Goodrich et al. 2022), conservationists have identified a suite of Tiger Conservation Landscapes and Source Sites across the remaining potential habitat of ~978,293 km^2 in Asia (Walston et al. 2010;Goodrich et al.



genetic viability (Watson et al. 2010, Wikramanayake et al. 2011).

While these priority landscapes are indubitably simultaneous imperatives for the global tiger recovery - a clear, well-reasoned conservation vision, a systematic assessment of the current status of the species, and a proper directed process for a site-based conservation priority are critical for the long-term persistence of tigers in the wild. Furthermore, when the goal is to recover populations, identifying the ecological conditions that facilitate recovery and using long-term and site-specific monitoring to measure demographic metrics is crucial to measure the success of tiger conservation efforts (Harihar et al. 2020).

Credit: S. Wangmo

WILDCRU
Wildlife Conservation Research Unit

Credit: S. Wangmo

Challenges

- Partner persistence related to U.S. government shake-up
- Underbudgeted time and $ for outreach
  - Workshops
  - Documentation translation
- Underestimated time needed for software debugging, installation debugging, and enhancements for scaling

Upcoming Activities

- ConnectingLandscapes: A Decision Support System for modelling population connectivity and the effect of conservation and development scenarios - Pre-Congress Workshop on the CoLa DSS at **ICCB 2025**, June 14th https://www.xcdsystem.com/iccb/program/5UZ6ezJ/index.cfm

- Organized by Caroline Sartor (WildCRU) with help from Ivan Gonzalez (NAU)

- Global release event in Oxford, UK, September 2025
  - Details TBD but planned online and in-person options

Thank You!!

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