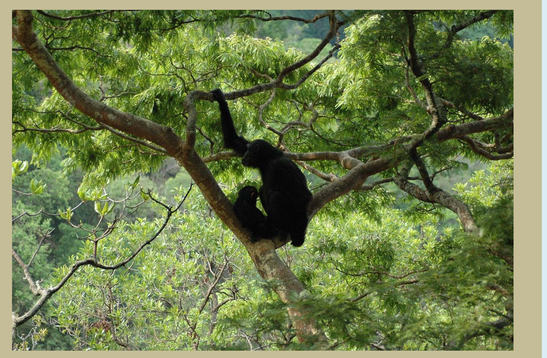
Monitoring and Forecasting Chimpanzee Habitat Health in Africa to Inform Conservation Actions, Strategies, and Measure Success

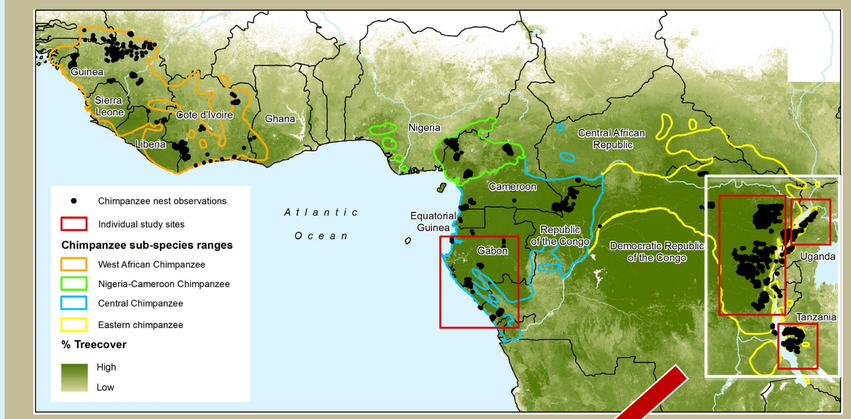
Samuel Jantz[1], Dr. Matthew Hansen[1], Dr. Janet Nackoney[1], Dr. Lilian Pintea[2], Dr. Peter Potapov[1]
[1] Department of Geographical Sciences, University of Maryland
[2] The Jane Goodall Institute

Mapping Chimpanzee Habitat Health

The chimpanzee (*Pan troglodytes),* listed as Endangered on the IUCN Red List since 1996, is threatened by habitat loss from resource extraction and land conversion, as well as hunting, disease and the illegal pet trade. It has been estimated that more than 70% of chimpanzee's tropical forest habitats in Africa are now threatened by infrastructure development and human-induced land use change. It has been estimated that their cumulative population has declined by more than 66 % over the past 40 years.

Understanding the relative condition, or "health," of chimpanzee habitat at high spatial resolution across the chimpanzee range will be key for planning effective conservation strategies for the species. This project focuses on the development of a decision support system (DSS) that uses a combination of modeling, data derived from remote sensing, and crowd-sourced field data to forecast and systematically monitor Eastern and Central chimpanzee habitat health.

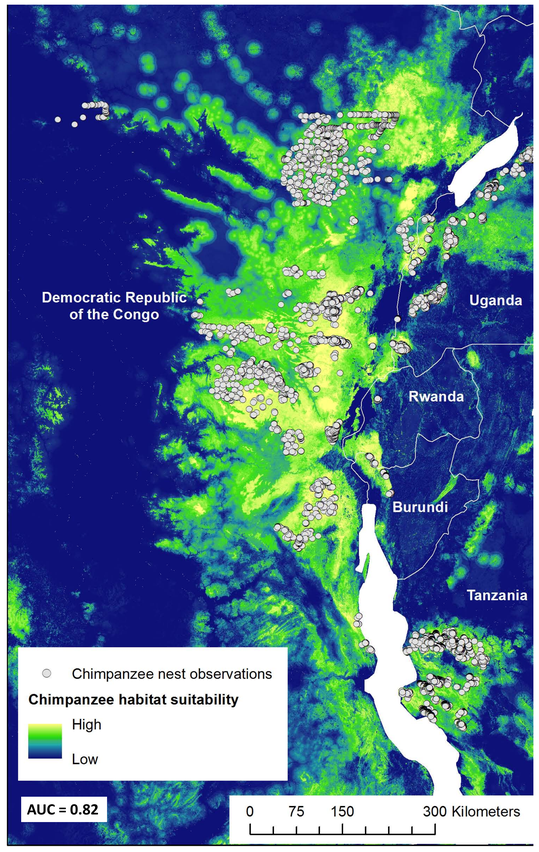




Study area

Chimpanzees live in a variety of vegetation types, from dry savanna woodlands and woodland-forest mosaics to humid-canopy rain forests. They feed mainly on ripe fruit, but also eat leaves, other plant parts, and insects, and hunt monkeys and other mammals. Because chimpanzees' diets require ripe fruit, their ranges include some proportion of evergreen or riverine forest, even in semiarid regions.

The map to the left shows the geographic ranges of the four sub-species of chimpanzees that encompass the study area. In addition, the project will also focus on four sub-regions (shown in red) that capture the entire gradient of the chimpanzees' habitat types, ranging from the humid tropical forests of Eastern DRC to the dry savanna woodlands of western Tanzania.



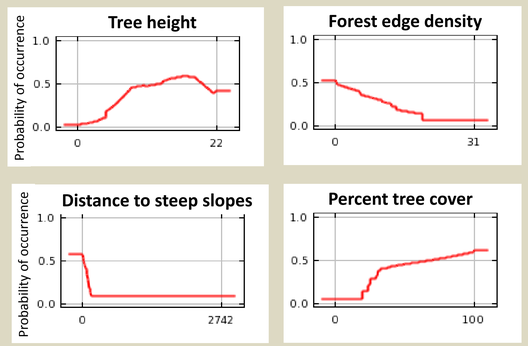
Habitat suitability modeling: past (2005-2013) and future (2014-2030)

Species distribution models use associations between species' occurrences and associated environmental conditions, such as resource, biotic and climatic factors, in order to estimate conditions that are suitable for population viability.

Here, we employed a maximum-entropy modeling approach using MaxEnt software to test a suite of basic biotic factors derived from Earth observations data, including the tree canopy cover and height metrics, that promote chimpanzee nesting habitat throughout their range. The table below lists some of the variables tested, in order of model importance. In addition, selected response curves are shown.

Input species data consisted of locations of chimpanzee sleeping nests, sourced from the Jane Goodall Institute and a variety of other data providers through the Max Plank Institute A.P.E.S. data portal.

Future projections of land use and land cover change constrained to the chimpanzee range and informed by the MaxEnt suitability model will then be generated to predict future scenarios of chimpanzee habitat health for 2014, 2020 and 2030. The projections will be generated via a cellular automata model within the freely available DINAMICA EGO platform.



The above plots show the response curves of selected variables generated by MaxEnt. They the show that chimpanzee nesting occurrence probability responds (clockwise from upper left): positively to increased tree height, negatively to increased forest edge density, positively to increased tree cover, and negatively to increased distance from steep slopes.

Environmental variables tested
Preliminary; listed in order of model importance
AUC = 0.82

- Distance to steep slopes
- Percent tree cover
- Distance to water
- Proportion of forest loss
- Forest edge density
- Tree height

Other variables were tested, but exhibited some multicollinearity:

- Elevation
- NSDI (normalized difference structural index)
- NDVI (normalized difference vegetation index)

Developing a Decision Support System (DSS)

In 2012, the Jane Goodall Institute adopted a new 30-year over-arching objective to protect 85% of chimpanzees and their habitats in Africa. However, currently the organization lacks the necessary spatial information to make decisions about how to target and prioritize required conservation actions and measure their success. Chimpanzee habitat suitability data are currently limited with respect to spatially-explicit data on biological variables that are consistent range-wide; furthermore, no system has been developed to monitor these factors geographically and systematically over time.

The project's decision support system (DSS) consists of a habitat health index and monitoring system that will assess annual changes to chimpanzee habitat health. From the DSS, JGI will be able to have near real-time access to data describing current threats and status of chimpanzee populations throughout their range and be able to develop and implement conservation strategies to protect remaining chimpanzee habitat and ensure the species' long-term survival.

Crowd-sourced information

Community-based crowd-sourced field data will be collected to provide input and validation data for all of the models. Specifically, mobile mapping applications, such as Open Data Kit (ODK) and Android smartphones and tablets, as well as Google cloud-based technologies will be utilized by local communities to monitor wildlife presence as well as human activity impacting chimpanzee presence.

The data will be used to complement the efforts outlined above and substantially increase the amount of data available for the development and validation of species distribution, land cover change and habitat health models.

The Jane Goodall Institute's (JGI) crowd-sourcing platform currently focuses on specific projects in Tanzania, Uganda, eastern Democratic Republic of the Congo (DRC) and in the western Republic of Congo. Throughout the project, this platform will be expanded in all four countries in order to cover more areas and collect additional validation data.

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UNIVERSITY OF MARYLAND 1856

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