Leveraging Climate and Governance Variability to Support Future Protected Area Risk Assessments

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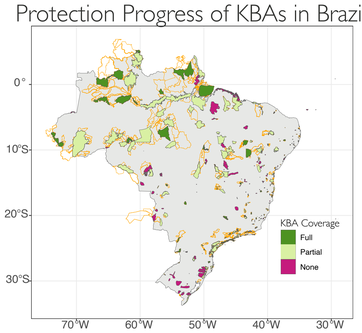
Introduction & Relevance

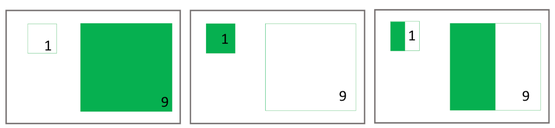
Identifying areas that are exceptionally rich in biodiversity, and likely to be exposed to changes driven by anthropogenic forcing is critical to the prioritization and development of future conservation measures. These Key Biodiversity Areas (KBAs) differ in species diversity and spatial distribution[1], and fall under a wide range of jurisdictions responsible for their preservation. Current drafts of the post 2020 global biodiversity framework[2] emphasize minimizing the impact of climate change on biodiversity, but there are few examples of integrating climate futures into decision frameworks. **To address this gap we propose a strategy that incorporates past progress, current protection status and future projections. We integrate governance data, remote sensing, and CMIP6 climate projections into the area-based KBA coverage calculations introduced in *Ly et al. 2023*[3]. Here, we use Brazil and CMIP6 SSP 3-7.0 as an example.**

Data & Methods

We identify calculate the coverage of Key Biodiversity Areas (KBAs) using the WCMC World Database on Protected Areas (PA). We employ an area-based method proposed in Ly et al. 2023 (in review).

Protection Progress of KBAs in Brazil





Site-based: 50%
Area-based: 90%

Site-based: 50%
Area-based: 10%

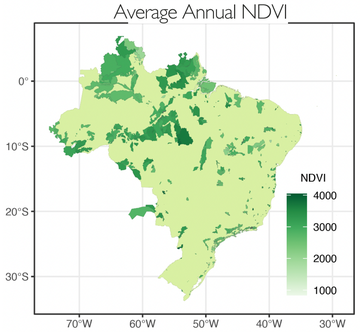
Site-based: 50%
Area-based: 50%

Site-Based: Average Coverage of KBAs. Currently used for SDG 15.4.1

Area-Based: Total Area of KBAs Covered. Proposed in Ly et al. using strategy promoted by the Convention on Biological Diversity

We extract the average of all grid cells within each KBA polygon to obtain (1) CMIP6 historic and future annual mean temperature and (2) historic average Normalized Difference Vegetation Index (NDVI). We use remotely sensed NDVI value as a proxy for estimating trends in habitat conservation.

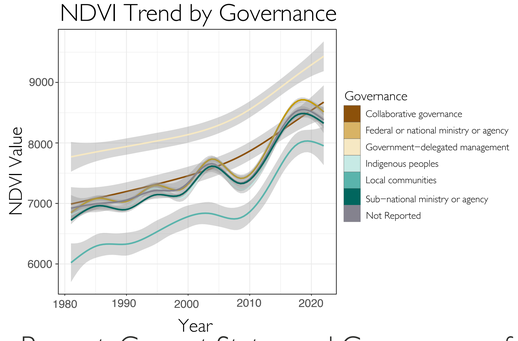
Average Annual NDVI



Results

Past: NDVI Trends

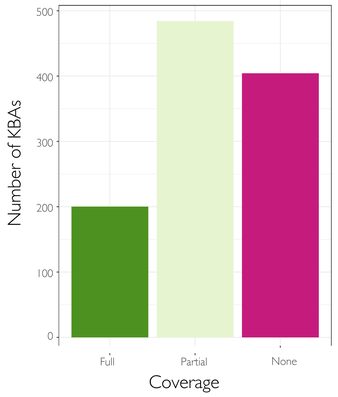
NDVI Trend by Governance



Utilizing remotely sensed NDVI, we can investigate vegetation trends in the region. Further stratification by governance type provides insight into progress and conservation successes by various actors.

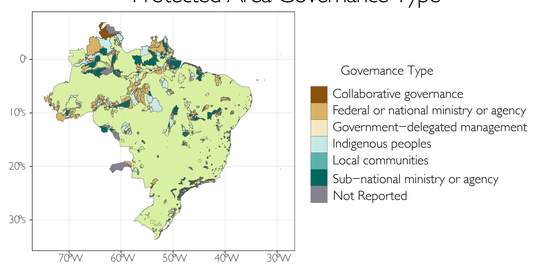
Present: Current Status and Governance of Current Protected KBAs

2022 KBA Coverage Status



Our data allows for a detailed look into the current status of KBA protections, including summaries of current protection progress, and governance.

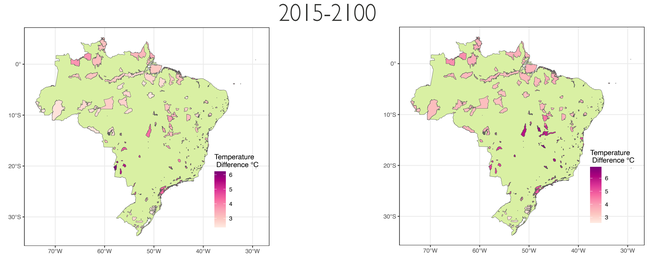
Protected Area Governance Type



Future: Integration of Climate Models

We use KBA delinetations to extract annual mean temperature from CMIP6 SSP370 models from 2015-2100,

Modeled change in annual mean temperature 2015-2100



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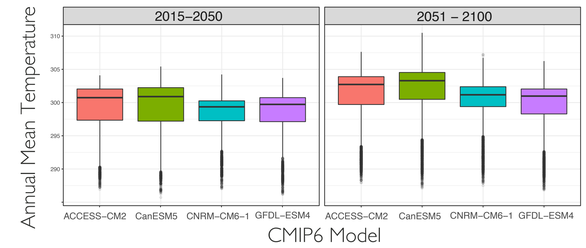
Results

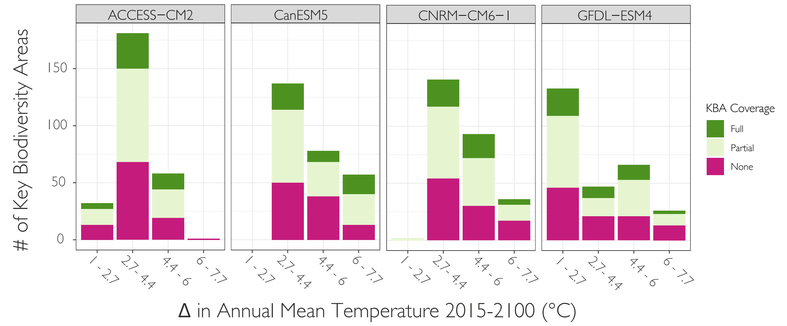
Future: Integration of Climate Models

Understanding future climate risks can be a valuable tool for conservation prioritzation of KBAs. Here we show a subset of CMIP6 model estimates of annual mean temperature in the first and second half of the century. Model agreement declines towards later years.



Furtherwe can stratify data by the magnitude of expected changes, and combine it wih information on current progress towards protecting these areas. This offers further insight into potential exposure, and current state of protections.

Expected Δ Annual Mean Temperature by Model



Next Steps

While we present an overview of data, there are a number of steps we must take in order to accurately assess the current status and future risks associated with these KBAs. (1) A spatial analysis of goverance types, NDVI, and KBAs that considers the distribution of varying environment and climate types (e.g. rainforest vs. coastal). (2) CMIP6 Models each have their own biases. In order to improve temperature trends estimates, we will select models shown to perform well over this region. (3) Investigate changes in NDVI (our proxy for effective habitat conservation) before and after protections were put in place.

References

[1] Kullberg, P., Di Minin, E., & Moilanen, A. (2019). Using key biodiversity areas to guide effective expansion of the global protected area network. Global Ecology and Conservation, 20, e00768. https://doi.org/10.1016/j.gecco.2019.e00768 [2] First draft of the post-2020 global biodiversity framework. (2021). [3] Ly et al. Assessing the protection of Key Biodiversity Areas in mountains at conservation-relevant scales. (2022, December 6). https://doi.org/10.21203/rs.3.rs-2328550/v1, preprint, in review.

Acknowledgements

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