Modeling Biodiversity in Response to Climate Change and Habitat Fragmentation

Method: Using Occupancy models – analyze historic and opportunistic records

- Big picture: Identifying causes of changes in distributions (drivers of biodiversity) and project into the future what factors might affect future occupancy patterns and which species are most vulnerable to future changes.
    - Specific questions to address:
        - How are species distribution affected by climate change?
        - Impacts of logging on species occupancy and habitat use and/or long-term recovery after logging. Also look at clear-cut vs selective logging.
        - Biodiversity loss and roads (forecasting changes in species occupancy with road expansion)
- Preliminary focus will tentatively be Brazil, where we will hopefully have sufficient data from the Amazon to acquire enough consistent datasets and develop a modeling approach. If that is successful, we can broaden our scope and look at other geographic regions or broader global data.

Data:

- Bird species data:
    - https://www.gbif.org/dataset/4fa7b334-ce0d-4e88-aaae-2e0c138d049e (eBird via GBIF)
    - https://www.gbif.org/dataset/50c9509d-22c7-4a22-a47d-8c48425ef4a7#description (iNaturalist via GBIF)

- Climate data:
    - https://www.worldclim.org/data/monthlywth.html

- Road development data:
    - Geofabrik, openstreetmap

- Logging/deforestation data
    - GlobalForestWatch

Stakeholders: Ecologists, conservation groups, government environmental agencies, logging operations, land developers

KPIs: Area under the curve, f score, Akaike's information criterion, Bayesian information criterion, MSE (?), time series (rolling) validation, generalization of model to a different geographic region, comparison with existing predictions

- Article - 'Model Selection in Occupancy Models: Inference vs. Prediction' - could be useful for evaluating different KPIs and error metrics https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1002/ecy.3942

Next Tasks:

- Find and extract similar data (noting time period/geographic region) from the different data sources. First focus on Brazil and the Amazon, then other regions/global data later.
    - Global Forest Watch - Yusup
    - Road development - Sriram
    - Climate data - Dawit
    - Bird data - Jeremy
- Learn about species distribution modeling/occupancy modeling. See if any nice packages exist in Python. Here are a couple I have found, but there might be more out there. **In addition we may also be able to directly implement some of the packages that exist in R with a little bit of python-translation (look into this).**
    - https://occuspytial.readthedocs.io/en/latest/index.html
    - https://github.com/martiningram/occu_py
- Jeremy - make a github repo and also put in my notes on occupancy modeling
- Next meeting date - **Friday Oct 11** at 6 Eastern, 5 Central, 4 Mountain, 3 Pacific