

Biotic Drivers of Macrosystems Biodiversity

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Abstract

An interesting topic in ecology is how biodiversity is affected at different scales. Many models are successful in using abiotic factors such as climatic and geographical features, but biotic factors are usually excluded from these analyses. This research project focuses on two of the most important biotic aspects: human disturbances and species competition.

- To accurately map out human disturbances, computational tools like QGIS and R programming are used to construct hillshade maps from the Lidar images of NEON (National Ecological Observatory Network) sites, on which roads and man-made land features were manually recorded.
- Species competition usually happens between species occupying similar ecological niches, and this can be measured by overlaps between species trait distributions. An R package, *Ostats*, is developed to measure, graph and compare these overlaps in trait distributions across different communities.

Procedures

Land Use Maps

- The digital terrain model (DTM) images were downloaded from the NEON Lidar dataset.
- Images for each site were compiled to generate a hillshade map for the site.

```
# making a function to merge the tif files for each site
mergeLidar <- function(path) {
  site_path <- (paste("C:/Users/asus/Documents/Lidar/",path, sep = ""))
  rastlist <- list.files(site_path,
                        full.names = TRUE,
                        pattern = "DTM.tif")
  mosaic_rasters(gdalfile = rastlist, dst_dataset = paste(path, ".tif", sep=""), of = "GTiff")
}
```

- Road and river layers were imported from U.S. census data and the National Hydrography Dataset (NHD) to overlay known linear features on the hillshade images (Fig 1).
- New layers were created to add roads that are not included in the census data and other human land-use features (i.e., building foundations, agricultural features; Fig. 2).

Ostats Package

- R code and functions were adapted from the paper “Among-species overlap in rodent body size distributions predicts species richness along a temperature gradient” published in *Ecography* (Read et al. 2018).
- Documentation for individual functions was done using roxygen2 in R.
- Redundant functions were modified and merged; a new graphing function *Ostat_plot* was made collaboratively.
- A vignette was drafted to provide the user with a detailed guide to use the package (Fig. 3).

Land Use Maps

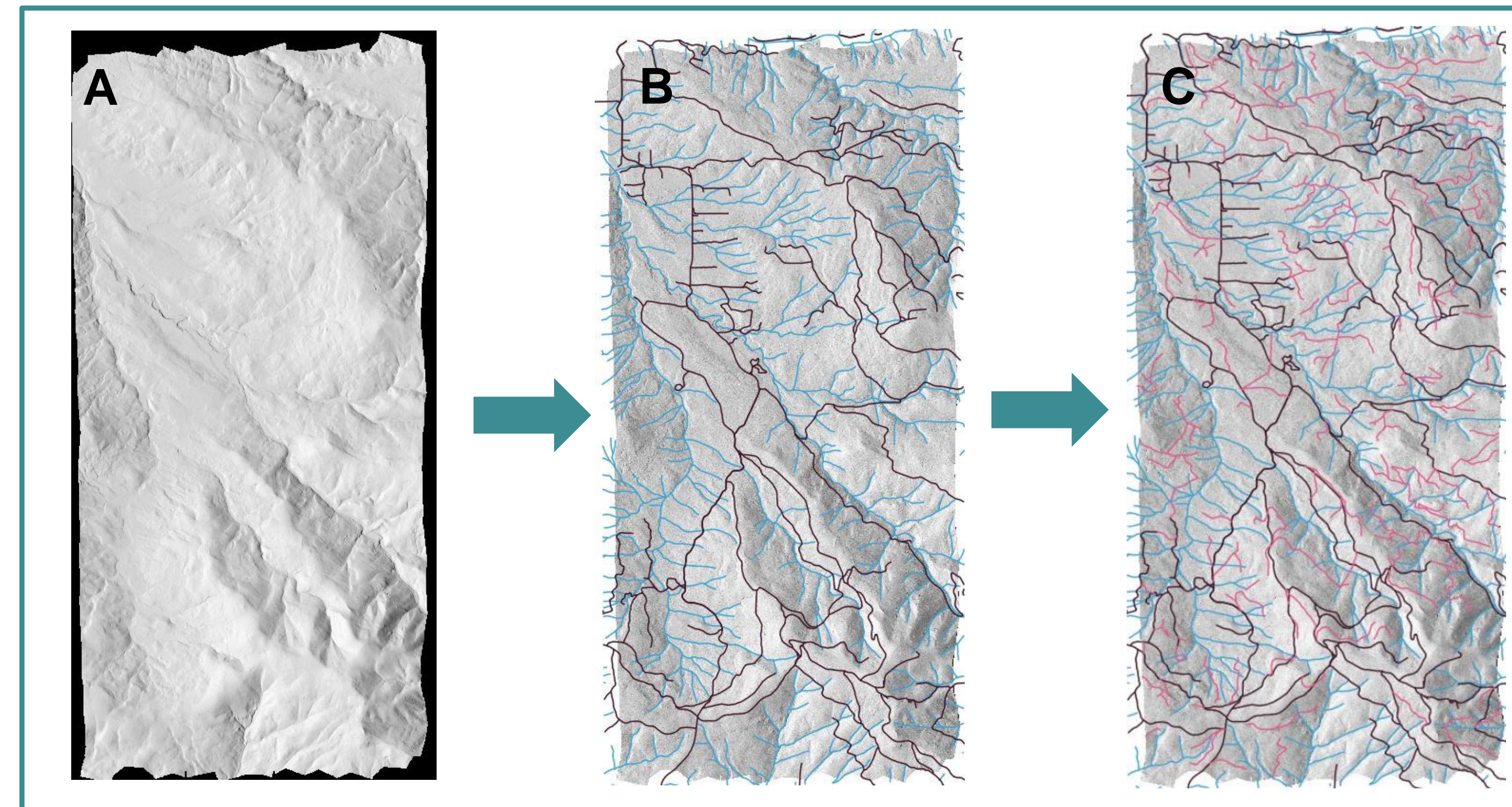


Fig. 1(A-C). Land Use Maps for the NEON site “Abby Road”: hillshade map, hillshade map with imported river and roads layers, and hillshade map with imported layers and added roads layer. Hillshade map generation was completed in R Studio while roads and river layers were added using QGIS.

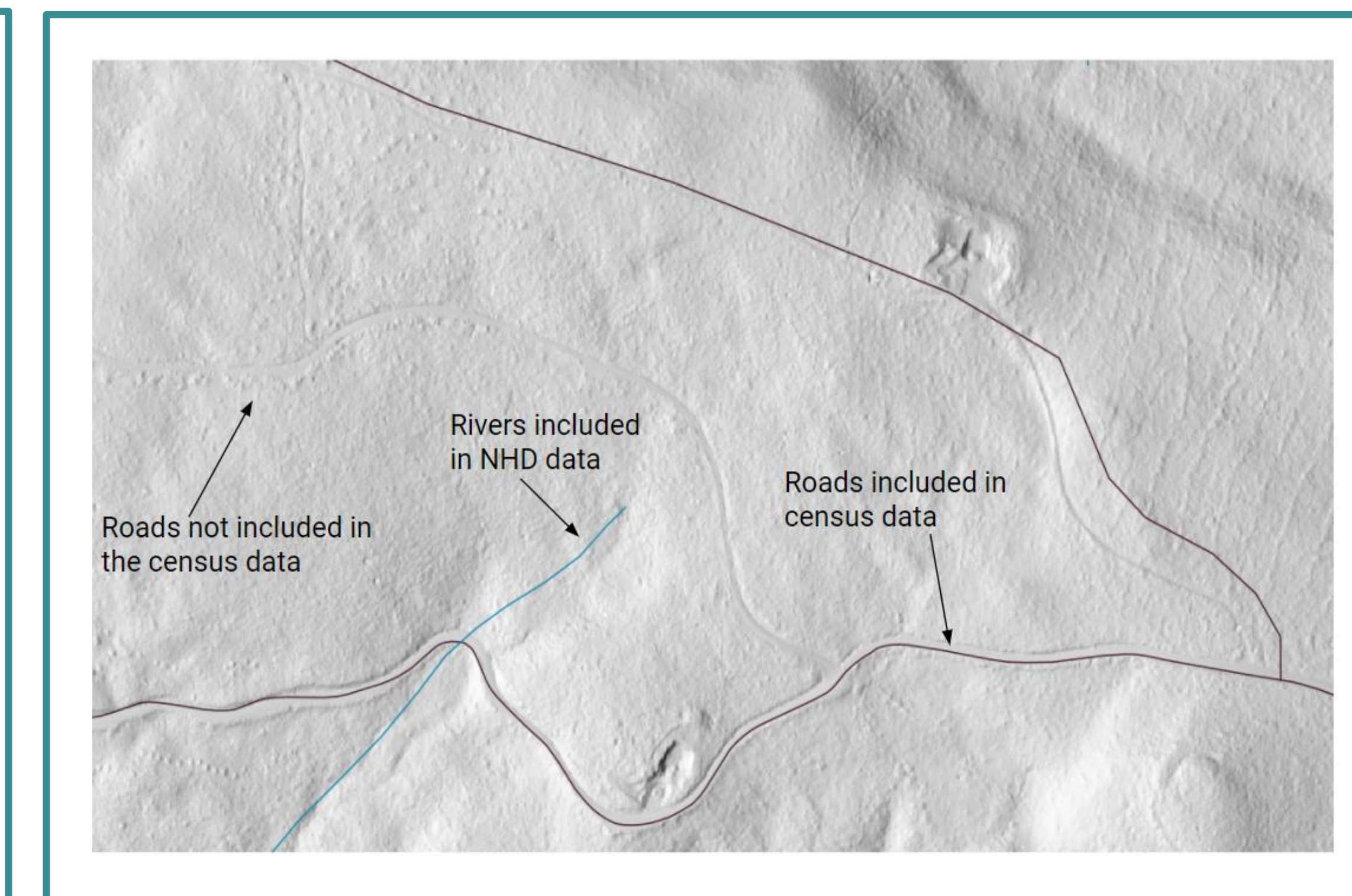


Fig. 2. Image showing roads included in census data, rivers included in NHD data, and roads that are not recorded for the NEON site “Abby Road”. New roads were traced and saved separately in a new shapefile in QGIS. The whole site was inspected for unrecorded roads and anthropogenic land-use features. New road layers will be verified with Google Earth imagery and when needed correspondence with landowners.

Ostats Package Development

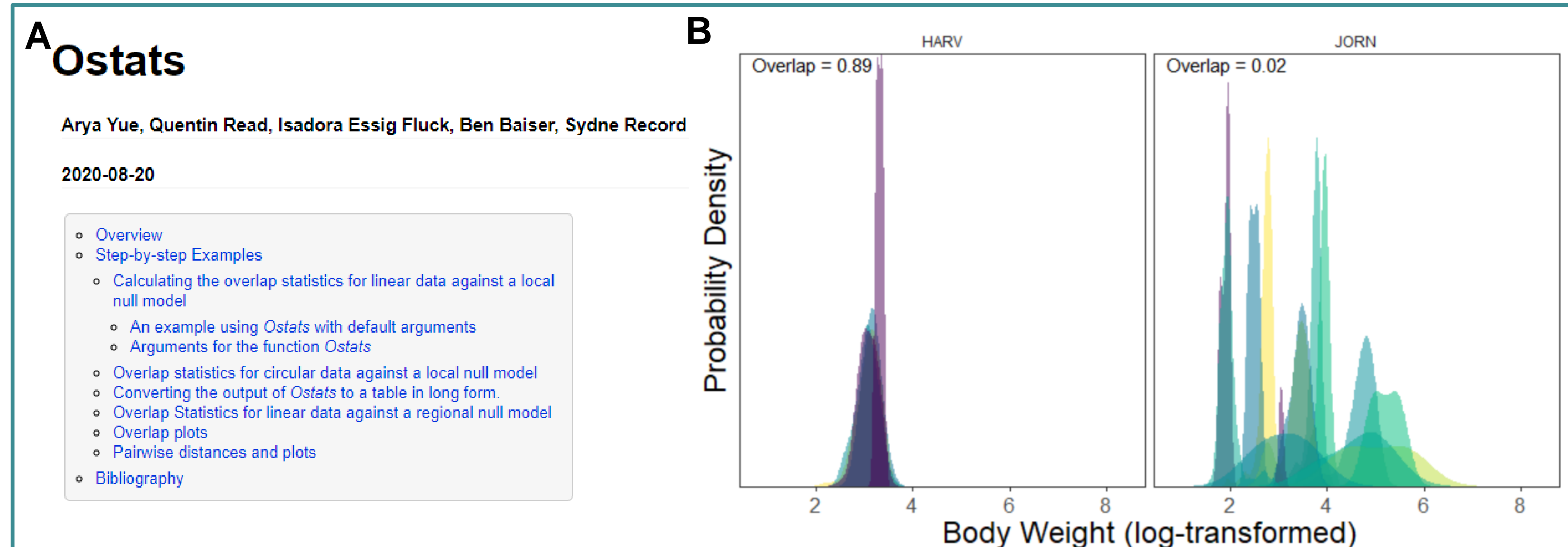


Fig. 3 (A-B). A displays the table of contents of the vignette for *Ostats*; B shows an example graph of community overlap for the NEON sites “Harvard Forest” and “Jornada Experimental Range”, plotted by the function *Ostats_plot* within the package, developed by Quentin Read, Isadora Fluck and Arya Yue.

Future Directions

Land Use Maps: Overlay the shapefile layer on satellite images to confirm the presence of roads and other man-made structures; quantify the level of disturbance at sample points to access its impact on biodiversity.

Ostats: Develop a teaching manual and get the package ready for publication on R's CRAN server and in a peer-reviewed journal.

References

- Read, Q. D. et al. Among-species overlap in rodent body size distributions predicts species richness along a temperature gradient. *Ecography* 41, 1718-1727 (2018).

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