Biodiversity Guidance for Road Corridor Investments: Mobilizing New Data from the Global Biodiversity Information Facility

Contents

Overview

The code in this replication package constructs the analysis file from the data sources on the World Bank Development Data Hub and local data using R. A main script run all of the code to generate the data for the figures 1-5 and tables 1-5 in the World Bank Policy Research Working Paper entitled, "Biodiversity Guidance for Road Corridor Investments: Mobilizing New Data from the Global Biodiversity Information Facility". The replicator should expect the code to run for about 10 hours.

Data Availability

Some data are not included in the reproducibility package, but all data are available and the code automates its download.

I certify that the author(s) of the manuscript have legitimate access to and permission to use the data used in this manuscript.

Data Sources

- Species Occurrence Regions: Dasgupta et al. 2024. Revisiting Global Biodiversity: A Spatial Analysis of Species Occurrence Data from the Global Biodiversity Information Facility.
https://datacatalog.worldbank.org/search/dataset/0066893/species_occurrence_regions using - GBIF.org (2025) GBIF Occurrence Download (Accessed from Google BigQuery on Jan 28, 2025)

- GBIF Species Information. World Bank Development Data Hub.
https://datacatalogfiles.worldbank.org/ddh-published/0066903/DR0095584/GBIF_Parallel_Data_GBIF_Species_Information.csv

- Global dataset of masked road corridors. World Bank Development Data Hub.
https://datacatalogfiles.worldbank.org/ddh-published/0066903/DR0095579/Global_Masked_Roads.tif

- Global key roads. World Bank Development Data Hub.
  https://datacatalogfiles.worldbank.org/ddh-
  published/0066903/DR0095583/Full_Global_Keyroads.rar

- Roads: Open Street Map (OSM). (Accessed from https://download.geofabrik.de/ on
  March 16, 2025.)

- World Bank Official Boundaries (2025). World Bank Development Data Hub.
  https://datacatalog.worldbank.org/search/dataset/0038272/World-Bank-Official-
  Boundaries

Instructions for Replicators

New users should follow these steps to run the package successfully: - Users must first have
access to all data files if they are not included in the reproducibility package. They should
go to the mentioned links, download the listed files, and place them in the local folder.

- `biod_roads_wp__main.R`

- Ensure all required software and dependencies are installed as listed in the
  Requirements section.

- Run the `biod_roads_wp__main.R` file.

List of Exhibits

Exhibit name	Output filename	Script	Note
Table 1	tbl01_Species_representation_by_group.csv	biod_roads_table01.R	Found in tables
Table 2	tbl02_Database_endemism_by_species_ .csv	biod_roads_table02.R	Found in tables
Table 3	tbl03_Database_by_species_group_ .csv	biod_roads_table03.R	Found in tables
Table 4	tbl04_Priority_status_groups.csv	biod_roads_table04.R	Found in tables
Table 5	tbl_05_total_road_category_in_corridor.csv	biod_roads_table05.R	Found in tables
Figure 1a	fig_1A_count_SOR_EndLg	fig_01_Peru.R	Found in figures
Figure	fig_1B_count_SOR_EndSm	fig_01_Peru.R	Found

Exhibit name	Output filename	Script	Note
1b			in figures
Figure 1d	fig_1C_count_SOR_NEndLg	fig_01_Peru.R	Found in figures
Figure 1c	fig_1D_count_SOR_NEndSm	fig_01_Peru.R	Found in figures
Figure 2a	fig02a_motorways_and_trunks*_NLD.png	fig_02a_road_map_nld.R	Found in figures
Figure 2b	fig02b_motorways_and_trunks*_DRC.png	fig_02b_road_map_drc.R	Found in figures
Figure 3	fig03_combined_vertical_titled.png	fig_03ab_road_map_drc.R	Found in figures
Figure 4a	fig_4A_roads_EndLg	fig_04_Philippines.R	Found in figures
Figure 4b	fig_4B_roads_EndSm	fig_04_Philippines.R	Found in figures
Figure 4c	fig_4C_roads_NEndLg	fig_04_Philippines.R	Found in figures
Figure 4d	fig_4D_roads_NEndSm	fig_04_Philippines.R	Found in figures
Figure 5a	fig_5A_roads_EndLg	fig_05_Africa.R	Found in figures
Figure 5b	fig_5B_roads_EndSm	fig_05_Africa.R	Found in figures
Figure 5c	fig_5C_roads_NEndLg	fig_05_Africa.R	Found in figures
Figure 5d	fig_5D_roads_NEndSm	fig_05_Africa.R	Found in

Exhibit name	Output filename	Script	Note
			figures

Requirements

Computational Requirements

Platform: x86_64-w64-mingw32/x64 (64-bit) Memory; 256GB

Software Requirements

Stata Version 18.

R version 4.3.1 (2023-06-16 ucrt) Running under: Windows Server 2022 x64

Cran libraries: attached base packages: [1] parallel tools stats graphics grDevices utils datasets methods base

other attached packages: [1] curl_5.0.2 mregions2_1.1.2 lubridate_1.9.3 tibble_3.2.1 tidyverse_2.0.0
[6] forcats_1.0.0 fasterize_1.0.5 basemaps_0.0.8 spatialEco_2.0-2 openxlsx_4.2.5.2
[11] purrr_1.0.2 readxl_1.4.3 ggpattern_1.1.3 exactextractr_0.10.0 readstata13_0.10.1
[16] rgdal_1.6-7 patchwork_1.2.0 ggpubr_0.6.0 colourvalues_0.3.9 XML_3.99-0.14
[21] dplyr_1.1.3 stars_0.6-4 abind_1.4-5 gt_0.10.0 xfun_0.52
[26] modelsummary_1.4.5 ordinal_2023.12-4 RColorBrewer_1.1-3 R.utils_2.12.2 R.oo_1.25.0
[31] R.methodsS3_1.8.2 ggplot2_3.5.1 renv_1.0.5 tidyr_1.3.0 terra_1.8-29
[36] nngeo_0.4.7 foreign_0.8-84 foreach_1.5.2 data.table_1.14.8 readr_2.1.4
[41] Hmisc_5.1-2 stringr_1.5.1 httr_1.4.7 sf_1.0-19 raster_3.6-26
[46] sp_2.1-2

loaded via a namespace (and not attached): [1] rstudioapi_0.15.0 wk_0.9.4 magrittr_2.0.3 magick_2.8.1 farver_2.1.1 rmarkdown_2.25
[7] ragg_1.2.5 vctrs_0.6.3 base64enc_0.1-3 rstatix_0.7.2 htmltools_0.5.6 broom_1.0.5
[13] cellranger_1.1.0 Formula_1.2-5 slippymath_0.3.1 KernSmooth_2.23-21 htmlwidgets_1.6.2 httr2_1.2.1
[19] lifecycle_1.0.4 iterators_1.0.14 pkgconfig_2.0.3 Matrix_1.6-1.1 R6_2.5.1 fastmap_1.1.1
[25] digest_0.6.33 numDeriv_2016.8-1.1 colorspace_2.1-0 ggnewscale_0.4.10 textshaping_0.3.6 labeling_0.4.3
[31] fansi_1.0.4 timechange_0.2.0 compiler_4.3.1 proxy_0.4-27 withr_3.0.0 htmlTable_2.4.2
[37] backports_1.4.1 carData_3.0-5 DBI_1.2.3 ggsignif_0.6.4 MASS_7.3-60 rappdirs_0.3.3
[43] ucminf_1.2.1 classInt_0.4-11 units_0.8-5 zip_2.3.0 nnet_7.3-19 glue_1.6.2
[49] nlme_3.1-162 grid_4.3.1 checkmate_2.3.1 cluster_2.1.4 generics_0.1.3 gtable_0.3.4
[55] tzdb_0.4.0 class_7.3-22 hms_1.1.3 xml2_1.3.5 car_3.1-2 utf8_1.2.3
[61] tables_0.9.17 pillar_1.9.0 lattice_0.22-5 tidyselect_1.2.0 pbapply_1.7-2 knitr_1.44
[67] gridExtra_2.3 stringi_1.7.12 evaluate_0.21 codetools_0.2-19 cli_3.6.1 rpart_4.1.19
[73] systemfonts_1.0.4 munsell_0.5.0 Rcpp_1.0.11 scales_1.3.0 e1071_1.7-16

insight_0.19.10
[79] rlang_1.1.5

Renv included in the reproducibility package

Memory and Runtime and Storage Requirements

The scripts are run on a computing environment with 256MB memory.

Code Description

The scripts are located in the WP directory for the main along with the figures and tables. The data directory has data. The figures_rp directory contains the figures. The gis directory has geospatial data. The Load data directory loads data. The tables_rp contains tables.

Folder Structure

```
wp
├── biod_roads_wp__main.R.R
├── biod_roads_wp_global_libraries.R
├── load
│   ├── biod_roads_load_biod_gbif_shps.R
│   ├── biod_roads_load_masked_road_corridors.R
│   ├── biod_roads_load_wb_gad_adm0.R
│   ├── biod_roads_load_wb_gad_adm0_lines.R
│   ├── biod_roads_load_wb_gad_adm1.R
│   └── biod_roads_load_wb_gad_adm2.R
├── R Programs
│   ├── 1 Generate World Bank Disputed Countries File from July  2025
Revision.R
│   ├── 2 Generate World Bank ADM Files From July 2025 Revision.R
│   ├── 3 Generate WBADM0 with IDs and 5KM Raster.R
│   ├── 4 Generate WBADM0 1KM IDs Raster.R
│   ├── 5 Generate Species Country Matches.R
│   ├── 6 Generate Species Country Counts.R
│   ├── 7 Generate Species Database with Area and Country Count.R
│   ├── 8 Extract Full Country Species Rasters.R
│   ├── 9 Generate Global Roads GBIF.R
│   └── 10 Generate Country Roads GBIF and Color-Coded.R
├── R Applications
│   ├── fig_01_Peru.R
│   ├── fig_02a_road_map_nld.R
│   ├── fig_02b_road_map_drc.R
│   ├── fig_03ab_road_map_afg.R
│   ├── fig_04_Philippines.R
│   └── fig_05_Africa.R
├── R Tables
│   ├── biod_roads_table01.R
│   ├── biod_roads_table02.R
│   ├── biod_roads_table03.R
│   ├── biod_roads_table04.R
```

```
        ├── biod_roads_table05.R
├── Stata Program
        └── Generate Computation Stata File.do
```