Country-Level Pathways to 30x30 and Their Implications for Global Biodiversity Protection

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 11 figures and 13 tables in the World Bank Policy Research Working Paper entitled, “Country-Level Pathways to 30x30 and Their Implications for Global Biodiversity Protection” (No. X). The replicator should expect the code to run for about 10 minutes and require approximately 300MB of data

Data Availability

Data are included in the reproducibility package or the code automates its download.

Data Sources

- World Bank Official Boundaries. https://datacatalog.worldbank.org/search/dataset/0038272/World-Bank-Official-Boundaries
- World Bank Income Classification. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups
- World Bank Global Analysis of Protected Area Expansion and Species Coverage.

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

- Run the `global_pa_wp__main.R` file.

List of Exhibits

Exhibit name	Output filename	Script	Note
Table 1	Table_1.xlsx	Table_1.R	Found in Output_Tables
Table 2	Table_2.xlsx	Table_2.R	Found in Output_Tables
Table 3a	Table_3a.xlsx	Table_3a.R	Found in Output_Tables
Table 3b	Table_3b.xlsx	Table_3b.R	Found in Output_Tables
Table 4a	Table_4a.xlsx	Table_4a.R	Found in Output_Tables
Table 4b	Table_4b.xlsx	Table_4b.R	Found in Output_Tables
Table 5a	Table_5.xlsx	Table_5.R	Found in Output_Tables
Table 6	Tables_6_and_7.xlsx	Table_6_Table_7.R	Found in Output_Tables
Table 7	Tables_6_and_7.xlsx	Table_6_Table_7.R	Found in Output_Tables
Table 8	Tables_8_9_10.xlsx	Table_8_Table_9_Table_10.R	Found in Output_Tables
Table 9	Tables_8_9_10.xlsx	Table_8_Table_9_Table_10.R	Found in Output_Tables
Table 10	Tables_8_9_10.xlsx	Table_8_Table_9_Table_10.R	Found in Output_Tables
Table 11	Tables_8_9_10.xlsx	Table_11a_11b.R	Found in Output_Tables
Table 12	Tables_8_9_10.xlsx	Table_12.R	Found in Output_Tables
Table 13	Tables_8_9_10.xlsx	Table_13.R	Found in Output_Tables
Figure 1a	Figure_1a.png	Figure_1a.R	Found in Output_Figures
Figure 1b	Figure_1b.png	Figure_1b.R	Found in Output_Figures

Exhibit name	Output filename	Script	Note
Figure 2	Figure_2.png	Figure_2.R	Found in Output_Figures
Figure 3	Figure_3.png	Figure_3.R	Found in Output_Figures
Figure 4	Figure_4.png	Figure_4.R	Found in Output_Figures
Figure 5a	Figure_5a.png	Figure_5a.R	Found in Output_Figures
Figure 5b	Figure_5b.png	Figure_5b.R	Found in Output_Figures
Figure 6	Figure_6.png	Figure_6.R	Found in Output_Figures
Figure 7a	Figure_7a.png	Figure_7a.R	Found in Output_Figures
Figure 7b	Figure_7b.png	Figure_7b.R	Found in Output_Figures
Figure 8	Figure_8.png	Figure_8.R	Found in Output_Figures
Figure 9a	Figure_9a.png	Figure_9a.R	Found in Output_Figures
Figure 9b	Figure_9b.png	Figure_9b.R	Found in Output_Figures
Figure 10	Figure_10.png	Figure_10.R	Found in Output_Figures
Figure 11	Figure_11.png	Figure_11.R	Found in Output_Figures
Appendix 2	Africa_Terrestrial.png	Appendix_2.R	Found in Output_Figures
Appendix 2	Asia_Terrestrial.png	Appendix_2.R	Found in Output_Figures
Appendix 2	Europe_Terrestrial.png	Appendix_2.R	Found in Output_Figures
Appendix 2	Northern America_Terr .png	Appendix_2.R	Found in Output_Figures
Appendix 2	Oceania_Terrestrial.png	Appendix_2.R	Found in Output_Figures
Appendix 2	Southern America_Terr	Appendix_2.R	Found in

Exhibit name	Output filename	Script	Note
	.png		Output_Figures
Appendix 3	Africa_Marine.png	Appendix_3.R	Found in Output_Figures
Appendix 3	Asia_Marine.png	Appendix_3.R	Found in Output_Figures
Appendix 3	Europe_Marine.png	Appendix_3.R	Found in Output_Figures
Appendix 3	Northern America_Marine.png	Appendix_3.R	Found in Output_Figures
Appendix 3	Oceania_Marine.png	Appendix_3.R	Found in Output_Figures
Appendix 3	Southern America_Marine.png	Appendix_3.R	Found in Output_Figures

Requirements

Computational Requirements

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

Software Requirements

R version 4.3.1 (2023-06-16 ucrt) Platform: x86_64-w64-mingw32/x64 (64-bit) Running under: Windows Server 2022 x64 (build 20348)

Matrix products: default

locale: [1] LC_COLLATE=English_United States.utf8 LC_CTYPE=English_United States.utf8
[3] LC_MONETARY=English_United States.utf8 LC_NUMERIC=C
[5] LC_TIME=English_United States.utf8

time zone: America/New_York tzcode source: internal

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

other attached packages: [1] ggtext_0.1.2 writexl_1.5.4 units_0.8-5 ggnewscale_0.4.10 tidyterra_0.4.0
[6] progressr_0.14.0 future.apply_1.11.1 future_1.33.0 raster_3.6-26 basemaps_0.0.8
[11] spatialEco_2.0-2 openxlsx_4.2.5.2 purrr_1.0.2 readxl_1.4.3 ggpattern_1.1.3
[16] exactextractr_0.10.0 readstata13_0.10.1 rgdal_1.6-7 sp_2.1-2 patchwork_1.2.0
[21] ggpubr_0.6.0 colourvalues_0.3.9 XML_3.99-0.14 dplyr_1.1.3 stars_0.6-4
[26] abind_1.4-5 gt_0.10.0 xfun_0.52 modelsummary_1.4.5 fasterize_1.0.5

[31] ordinal_2023.12-4 RColorBrewer_1.1-3 R.utils_2.12.2 R.oo_1.25.0 R.methodsS3_1.8.2
[36] ggplot2_3.5.1 renv_1.0.5 tidyr_1.3.0 terra_1.8-29 nngeo_0.4.7
[41] foreign_0.8-84 foreach_1.5.2 data.table_1.14.8 readr_2.1.4 Hmisc_5.1-2
[46] stringr_1.5.1 httr_1.4.7 sf_1.0-19

loaded via a namespace (and not attached): [1] rstudioapi_0.15.0 magrittr_2.0.3 magick_2.8.1 farver_2.1.1 rmarkdown_2.25
[6] ragg_1.2.5 vctrs_0.6.3 base64enc_0.1-3 rstatix_0.7.2 htmltools_0.5.6
[11] curl_5.0.2 broom_1.0.5 cellranger_1.1.0 Formula_1.2-5 parallelly_1.36.0
[16] slippymath_0.3.1 KernSmooth_2.23-21 htmlwidgets_1.6.2 commonmark_1.9.0 lifecycle_1.0.4
[21] iterators_1.0.14 pkgconfig_2.0.3 Matrix_1.6-1.1 R6_2.6.1 fastmap_1.1.1
[26] digest_0.6.33 numDeriv_2016.8-1.1 colorspace_2.1-0 textshaping_0.3.6 labeling_0.4.3
[31] compiler_4.3.1 proxy_0.4-27 withr_3.0.2 htmlTable_2.4.2 backports_1.4.1
[36] carData_3.0-5 DBI_1.2.3 ggsignif_0.6.4 MASS_7.3-60 ucminf_1.2.1
[41] classInt_0.4-11 zip_2.3.0 nnet_7.3-19 glue_1.6.2 nlme_3.1-162
[46] gridtext_0.1.5 grid_4.3.1 checkmate_2.3.1 cluster_2.1.4 generics_0.1.3
[51] gtable_0.3.4 tzdb_0.4.0 class_7.3-22 hms_1.1.3 xml2_1.3.5
[56] car_3.1-2 tables_0.9.17 markdown_1.10 pillar_1.11.1 lattice_0.22-5
[61] tidyselect_1.2.0 pbapply_1.7-2 knitr_1.44 gridExtra_2.3 stringi_1.7.12
[66] evaluate_0.21 codetools_0.2-19 tibble_3.2.1 cli_3.6.1 rpart_4.1.19
[71] systemfonts_1.0.4 munsell_0.5.0 Rcpp_1.0.11 globals_0.16.2 listenv_0.9.0
[76] scales_1.3.0 e1071_1.7-16 insight_0.19.10 crayon_1.5.2 rlang_1.1.5

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 Build_Databases directory includes scripts to build the databases. 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 Output_Data directory contains output data. The Output_GIS directory contains output geospatial data. The tables_rp contains tables. The UDF directory has user defined functions.

Folder Structure

```
wp
  ├── global_pa_wp__main.R
  ├── global_pa_wp_global_libraries.R
  ├── Joint_PA
      ├── Output_Figures
          ├──  Figure_4
               ├──  Peru_PER.shp
```

```
            ├──  Peru_PER_ADM1.shp
            ├──  Peru_PER_ADM2.shp
            └──  SPA_Peru_PER.shp
        ├──  Figure_5
            ├──  Marine GIS
                ├──  Mexico_MEX_PctGroup_90_100.tif
                └──  SPA_Mexico_MEX.shp
            └──  Terrestrial GIS
                ├──  Mexico_MEX_PctGroup_90_100.tif
                └──  SPA_Mexico_MEX.shp
        ├──  Figure_7
            ├──  Marine GIS
                ├──  Mozambique_MOZ_PctGroup_90_100.tif
                └──  SPA_Mozambique_MOZ.shp
            └──  Terrestrial GIS
                ├──  Mozambique_MOZ_PctGroup_90_100.tif
                └──  SPA_Mozambique_MOZ.shp
        └──  Figure_9
            ├──  Marine GIS
                ├──  Papua_New_Guinea_PNG_PctGroup_90_100.tif
                └──  SPA_Papua New Guinea_PNG.shp
            └──  Terrestrial GIS
                ├──  Papua_New_Guinea_PNG_PctGroup_90_100.tif
                └──  SPA_Papua New Guinea_PNG.shp
    └── Output_Programs
        ├──  Appendix_2.R
        ├──  Appendix_3.R
        ├──  Figure_1a.R
        ├──  Figure_1b.R
        ├──  Figure_2.R
        ├──  Figure_3.R
        ├──  Figure_4.R
        ├──  Figure_5a.R
        ├──  Figure_5b.R
        ├──  Figure_6.R
        ├──  Figure_7a.R
        ├──  Figure_7b.R
        ├──  Figure_8.R
        ├──  Figure_9a.R
        ├──  Figure_9b.R
        ├──  Figure_10.R
        ├──  Figure_11.R
        ├──  load_wb_gad_adm0.R
        ├──  load_wb_gad_adm0_lines.R
        ├──  Table_1.R
        ├──  Table_2.R
        ├──  Table_3a.R
        ├──  Table_3b.R
        ├──  Table_4a.R
        ├──  Table_4b.R
```

```
        ├── Table_5.R
        ├── Table_6_Table_7.R
        ├── Table_8_Table_9_Table_10.R
        ├── Table_11a_11b.R
        ├── Table_12.R
        └── Table_13.R
├── Marine_New_PA
    └── Data
        ├── All_Countries_Species_Protection.csv
        ├── Country_Totals_Area_Parkarea.csv
        ├── Global_5KM_Countries.csv
        ├── Marine_Country_Total_Protection_Status.csv
        └── WBADM0_CHN_USA_UNRegions_Matched.csv
└── New_PA
    └── Data
        ├── All_Countries_Species_Protection.csv
        ├── Country_Totals_Area_Parkarea.csv
        ├── Global_5KM_Countries.csv
        ├── Terrestrial_Country_Total_Protection_Status.csv
        ├── WBADM0_CHN_USA_UNRegions_Matched.csv
        └── Working_GBIF_Species_Information.csv
```