

Package: mappingAS (via r-universe)

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Type Package

Title Spatial Metrics and Habitat Conversion for Extinction Risk Assessment

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Description A spatial analytical framework for preliminary species extinction-risk screening following the IUCN Red List Criterion B guidelines. From occurrence points it computes the Extent of Occurrence (EOO) and Area of Occupancy (AOO) on a data-centred equal-area projection, assigns provisional Criterion B categories, and integrates 'MapBiomas' land-use/land-cover data to quantify the proportion of anthropogenic conversion versus remaining natural habitat within each range metric, with per-class breakdowns and land-cover time series. Several 'MapBiomas' initiatives are supported through one standardised legend - 'MapBiomas' Brazil, the Pan-Amazon / Amazonia collection (RAISG), Colombia, Argentina, Bolivia, Chile, Ecuador, Peru, Venezuela, Paraguay and Uruguay - so a species anywhere these products cover can be screened as readily as a Brazilian one. For ranges outside 'MapBiomas' coverage it can fall back to the global 'Esri' / 'Impact Observatory' 10 m annual land cover derived from 'Sentinel-2' (the product behind the 'ArcGIS' Living Atlas Land Cover Explorer), so a species anywhere on Earth can be screened. It also integrates 'MapBiomas' Fire to compute burned-area metrics and fire time series, and quantifies the overlap of the range with protected areas from the global World Database on Protected Areas (WDPA). 'MapBiomas' data are read either locally over the network via 'GDAL' / 'vsicurl/' (no 'Google Earth Engine' account required) or server-side through 'Google Earth Engine' (GEE) for large-scale assessments. Outputs include interactive and publication ready maps and charts, spatial (shapefile/'GeoPackage') and raster exports, and a written assessment report (HTML, text or Word). An interactive 'shiny'

application ties the whole workflow together for reproducible conservation planning.

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aoo_bounds	<i>Lower/upper Area of Occupancy bounds and the Criterion B2 category range</i>
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Description

Turns the occurrence-based AOO (the lower bound) and the Area of Habitat (AOH; the suitable/natural habitat within the range, an upper bound) into a bracketed AOO and the corresponding range of Criterion B2 *size* categories, following the IUCN guidance that the true AOO lies between an occurrence-based minimum and a habitat-based maximum (Brooks *et al.* 2019; IUCN Standards and Petitions Committee 2024), as implemented in sRedList (Cazalis *et al.* 2024).

Usage

```
aoo_bounds(aoo_lower_km2, aoh_km2 = NA_real_, eoo_km2 = NA_real_)
```

Arguments

- aoo_lower_km2 The occurrence-based AOO in km^2 (from [calc_aoo](#)); the lower bound.
- aoh_km2 The Area of Habitat (suitable/natural habitat area) within the range, in km^2 - e.g. the natural_km2 of the EOO conversion from [summarise_conversion](#). NA (default) if unknown.
- eoo_km2 The EOO in km^2 (from [calc_eoo](#)), used to cap the upper bound. NA (default) leaves the upper bound uncapped.

Details

The upper bound is the AOH clamped so it is never below the lower bound and never above the EOO (occupancy cannot exceed the extent of occurrence). When the AOH is not available (aoh_km2 = NA, e.g. land cover was not computed) the upper bound falls back to the lower bound and the range collapses to a single category.

Value

A list with aoo_lower, aoo_upper, aoh (the clamped habitat area used), cat_lower / cat_upper (the B2 size category at each bound, e.g. "EN (B2 size)") and cat_range (a compact string such as "EN-VU", or a single category when both bounds agree).

References

Brooks T.M. *et al.* (2019) Measuring terrestrial Area of Habitat (AOH) and its utility for the IUCN Red List. *Trends in Ecology & Evolution* 34:977-986. doi:10.1016/j.tree.2019.06.009

Cazalis V. *et al.* (2024) Accelerating and standardising IUCN Red List assessments with sRedList. *Biological Conservation* 298:110761. doi:10.1016/j.biocon.2024.110761

See Also

[calc_aoo](#), [iucn_category_B](#), [iucn_category_B_range](#)

Examples

```
# Occurrence A00 of 48 km^2, but 900 km^2 of natural habitat within a
# 6000 km^2 E00: A00 is bracketed EN (lower) to VU (upper).
aoo_bounds(aoo_lower_km2 = 48, aoh_km2 = 900, eoo_km2 = 6000)
```

assess_fragmentation	<i>Assess severe fragmentation from occurrences and an isolation distance</i>
----------------------	---

Description

Clusters occurrences into subpopulations - groups of occurrences no further apart than an isolation distance - and quantifies how much of the population lies in small subpopulations, to guide the "severely fragmented" judgement of IUCN Criterion B sub-criterion (a). This mirrors the fragmentation step of sRedList (Cazalis *et al.* 2024, after Santini *et al.* 2019) but from occurrence data alone, so no habitat model or density estimate is required.

Usage

```
assess_fragmentation(
  points,
  isolation_km,
  weights = NULL,
  small_size = NULL,
  n_thresholds = 50
)
```

Arguments

points	An sf of POINT geometries (one species). Use read_occurrences to produce it.
isolation_km	Isolation distance in km: occurrences further apart than this are treated as belonging to isolated subpopulations. Required.
weights	Optional numeric vector, one weight per occurrence in points (a relative subpopulation-size contribution, e.g. occupied area). NULL (default) weights every occurrence equally (1).
small_size	Optional single size the assessor considers "small". When supplied, prop_in_small (share of the population in subpopulations $\leq$ this size) and severe_suggested (TRUE when that share $\geq$ 0.5) are returned. NULL (default) leaves the judgement to the curve.
n_thresholds	Number of points on the fragmentation curve (default 50).

Details

Two occurrences are placed in the same subpopulation when they are within `isolation_km` of each other (a circular-buffer clustering with radius `isolation_km / 2`, unioned on a data-centred equal-area projection, as in [calc_subpop](#)). The relative *size* of each subpopulation is the sum of its occurrence weights (the number of occurrences by default; supply, for example, per-occurrence occupied area for an area-weighted size). The fragmentation curve then gives, for a range of candidate "small subpopulation" sizes, the proportion of the total population contained in subpopulations no larger than that size; the `median_subpop_size` is the size at which that proportion reaches one half (half the population lives in subpopulations smaller than this). If the assessor considers a subpopulation of `median_subpop_size` to be "small", the population can be considered severely fragmented.

This is a screening proxy: occurrence counts are sampling-biased and are not individuals. Use the result only when the mapped clusters make ecological sense as subpopulations, exactly as sRedList advises.

Value

A list with `n_subpop`, `isolation_km`, `sizes` (a data.frame of `cluster`, `size`, `n_points`, ordered largest first), `clusters` (the subpopulation hulls/buffers as an `sfc` in WGS84), `curve` (a data.frame of `size` and `prop_pop_le`), `median_subpop_size`, `largest_subpop_pct` (percent of the population in the single largest subpopulation), `prop_in_small / severe_suggested` (when `small_size` is given, else NA) and `crs_laea`.

References

Santini L. *et al.* (2019) Applying habitat and population-density models to land-cover time series to inform IUCN Red List assessments. *Conservation Biology* 33:1084-1093. doi:10.1111/cobi.13279

Cazalis V. *et al.* (2024) Accelerating and standardising IUCN Red List assessments with sRedList. *Biological Conservation* 298:110761. doi:10.1016/j.biocon.2024.110761

See Also

[calc_subpop](#), [iucn_criterion_B](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
fr <- assess_fragmentation(sp1, isolation_km = 20)
fr$n_subpop
fr$median_subpop_size
```

assess_species	<i>Assess one or many species: EOO, AOO, MapBiomass conversion and fire</i>
----------------	---

Description

End-to-end pipeline. For each species it computes the EOO (minimum convex polygon) and AOO (2 km grid), then quantifies the percentage of converted (anthropic) and remaining natural habitat from the most recent MapBiomass collection inside both the EOO and the AOO. When `fire = TRUE` it also adds the percentage of the EOO/AOO that has burned and the mean fire recurrence, from the MapBiomass Fire accumulated layer.

Usage

```
assess_species(
  occ,
  initiative = "brazil",
  year = NULL,
  collection = NULL,
  backend = c("local", "gee"),
  fallback = c("sentinel2", "none"),
  cell_km = 2,
  subpop = TRUE,
  subpop_resol_km = NULL,
  loc_km = 10,
  loc_scale = NULL,
  loc_method = c("no_more_than_one", "other"),
  mapbiomas = TRUE,
  fire = FALSE,
  fire_collection = 4,
  fire_host_collection = 9,
  protected = FALSE,
  pa_src = NULL,
  src = NULL,
  fire_src = NULL,
  water_in_denominator = FALSE,
  area_max_pixels = 5e+07,
  decline = NA,
  extreme_fluctuation = NA,
  severe_fragmentation = NA,
  assume_decline = TRUE,
  infer_decline_from_habitat = TRUE,
  decline_years = 10,
  min_records = 1,
  verbose = TRUE
)
```

Arguments

occ	An sf of POINT geometries from read_occurrences .
initiative	Land-cover product. A MapBiomias initiative - "brazil" (default), "amazonia" (Pan-Amazon / RAISG), "colombia" or any of the other South-American products (Argentina, Bolivia, Chile, Ecuador, Peru, Venezuela, Paraguay, Uruguay) - selects that product, its default collection and the standardised legend (see mb_initiatives). Two extra keys unlock coverage anywhere on Earth: "sentinel2" forces the global Esri / Impact Observatory 10 m land cover (Sentinel-2, the data behind the ArcGIS Living Atlas Land Cover Explorer; see esri_legend), and "auto" tries MapBiomias first and automatically falls back to Sentinel-2 for ranges outside MapBiomias coverage. All backends stream public Cloud-Optimized GeoTIFFs - no Google Earth Engine and no account.
year	Integer MapBiomias year. NULL (default) uses the most recent year available for the initiative (e.g. 2024 for Brazil/Colombia, 2023 for Amazonia/Paraguay, 2022 for Uruguay).
collection	Integer MapBiomias collection number. NULL (default) uses the initiative default (10/6/3 for Brazil/Amazonia/Colombia).
backend	Habitat backend: "local" (default) or "gee". The "gee" backend is only wired for initiative = "brazil".
fallback	What to do when the chosen MapBiomias product has no data over a species' range (i.e. the occurrences fall outside every supported country): "sentinel2" (default) recomputes that species with the global Sentinel-2 / Esri layer; "none" leaves its conversion as NA. Ignored when initiative = "sentinel2".
cell_km	AOO grid cell size in km (default 2).
subpop	Logical; if TRUE (default) also estimate the number of subpopulations (circular-buffer method) and the number of locations (occupied-grid-cell method). See calc_subpop and calc_locations .
subpop_resol_km	Circular-buffer radius in km for the subpopulation estimate. NULL (default) uses one tenth of the maximum distance between occurrences (Rivers <i>et al.</i> 2010).
loc_km	Grid cell size in km for the number-of-locations estimate (default 10).
loc_scale	Optional sliding-scale cell size for the locations estimate: a fraction of the maximum distance between occurrences (Rivers <i>et al.</i> 2010). When supplied it overrides loc_km. See calc_locations .
loc_method	How protected areas enter the number-of-locations estimate when protected = TRUE: "no_more_than_one" (default; each protected area with occurrences is one location) or "other" (inside and outside protected areas gridded separately). Ignored when protected = FALSE. See calc_locations .
mapbiomas	Logical; if FALSE, only EOO/AOO are computed.
fire	Logical; if TRUE, also compute burned-area metrics from MapBiomias Fire (accumulated layer, read locally). Default FALSE.
fire_collection, fire_host_collection	Fire collection number (default 4) and the initiative folder hosting it (default 9).

protected	Logical; if TRUE, also compute the overlap of the range with protected areas from the global World Database on Protected Areas (WDPA): the share of occurrences inside protected areas and the \ the EOO/AOO within them. Default FALSE. Requires internet unless pa_src is given. See wdpa_areas .
pa_src	Optional local protected-area vector file (.shp/ .gpkg/.geojson) used instead of WDPA (offline).
src	Optional MapBiomias LULC GeoTIFF for the local backend.
fire_src	Optional MapBiomias Fire GeoTIFF (overrides the public URL).
water_in_denominator	Passed to summarise_conversion .
area_max_pixels	Pixel budget for the land-cover <i>area</i> read on the local backend (default 5e7, ~50 million). Ranges whose native window fits the budget are read at full resolution (30 m MapBiomias, 10 m Sentinel-2); larger or widely-spread ranges are read per polygon part and/or decimated with majority resampling so a continental EOO no longer streams billions of pixels. Class proportions - and thus the % converted / natural - are preserved. Raise it for finer reads of huge ranges, lower it for speed. Ignored by the GEE backend (reduction is server-side).
decline, extreme_fluctuation, severe_fragmentation	Expert inputs for the Criterion B sub-criteria, applied by iucn_criterion_B on top of the size thresholds to yield an applicable category (category_B and criterion_B_code in the summary). decline is sub-criterion (b) (a continuing decline), extreme_fluctuation is (c), and severe_fragmentation feeds (a) alongside the estimated number of locations, which <i>caps</i> the category (a small range spread over many locations is held to the less threatened level its location count supports; see iucn_criterion_B). Each may be a single value applied to every species, or a named logical vector keyed by species name. NA (default) means <i>not documented</i> : (a)/(c) are then treated as not met, while an undocumented decline (b) is resolved by assume_decline. Sub-criteria (b)/(c) cannot be inferred from occurrence points, hence they are inputs, not computed. DD/NE are never assigned automatically.
assume_decline	Logical; how an undocumented continuing decline (decline = NA) is treated by iucn_criterion_B . TRUE (default) assumes a decline is present - as ConR does, and as the habitat-conversion data support (sub-criterion b(iii)) - so a small-range, few-location taxon is reported at its CR/EN/VU size-and-location level instead of collapsing to NT . FALSE restores the strict screening where an undocumented decline is not met (NT until a decline is supplied). The decline_assumed column flags each species for which (b) was assumed rather than documented.
infer_decline_from_habitat	Logical; when TRUE (default) and decline is not documented for a species, a continuing decline (b) is <i>inferred from the recent trend of natural habitat</i> : the natural area of the range (EOO, or AOO when the EOO is undefined) is measured at six years spanning the last decline_years and a decline is inferred only when the least-squares slope is negative and significant ($p < 0.05$). The IUCN guidelines (v16, sect. 4.6) allow a continuing decline in the area/quality of habitat (b(iii)) to be inferred from the rate of habitat loss, at any rate, but

the loss must be ongoing: a static share of converted land is past loss and is no longer used. The slope (\ habitat_trend_pct_yr and habitat_trend_p. The trend needs the multi-year public products, so it is skipped when a single-year src file is given. This is recorded as decline_basis = "inferred (habitat loss)" - distinct from "assumed" (the ConR-style global fallback used when no conversion is available), "documented" / "documented (absent)" (an explicit decline), or "not documented". Set FALSE to rely only on decline / assume_decline.

decline_years	Length in years of the recent window used to test the habitat trend (default 10, the IUCN reference of ten years or three generations for the shortest-lived taxa). Clamped to the years the product publishes.
min_records	Minimum records required to attempt an assessment.
verbose	Logical; print progress (default TRUE).

Value

An object of class `geoconv_assessment`: a list with summary (one row per species, including `n_subpop` and `n_locations`) and detail (per-species points, `eoo`, `aoo`, subpop, locations, `eoo_conversion`, `aoo_conversion`, and - when `fire = TRUE`

- `eoo_fire`, `aoo_fire`).

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
# EOO/AOO, subpopulations and locations only (offline, no network):
res <- assess_species(occ, mapbiomas = FALSE, verbose = FALSE)
res$summary

# Full screening with MapBiomas land cover and fire (reads data over the web):
# (one species: the habitat-trend test reads six more years of land cover)
sp1 <- occ[occ$species == occ$species[1], ]
res2 <- assess_species(sp1, year = 2024, fire = TRUE, verbose = FALSE)
res2$summary
```

assessment_report	<i>Narrative conservation-assessment report for one species</i>
-------------------	---

Description

Builds a written, interpretive summary of a species' preliminary Criterion B screening from an [assess_species](#) result. Beyond restating the headline numbers, the text *interprets* them: the EOO/AOO composition divergence, the effectiveness (not just the extent) of protected-area overlap, and an honest framing of continuing decline (subcriterion b). When the land-cover and/or fire time series are supplied it also analyses their temporal trend. Habitat conversion, fire and protected-area

passages appear only when those modules were run. It can be returned as HTML (on-screen preview), plain text, or a Word .docx file (via **officer**) - the format used by the Shiny app's Report tab.

Usage

```
assessment_report(
  assessment,
  species = NULL,
  lang = c("en", "pt"),
  output = c("html", "text", "docx"),
  file = NULL,
  cover_series = NULL,
  fire_series = NULL,
  applied_category = NULL,
  applied_code = NULL,
  population = NULL,
  figures = FALSE
)
```

Arguments

assessment	A geoconv_assessment from assess_species .
species	Species name (default: the first assessed).
lang	Report language: "en" (default) or "pt".
output	One of "html" (default), "text" or "docx".
file	Target path for output = "docx" (required in that case).
cover_series	Optional land-cover time series for this species (as from timeseries_for_species / cover_timeseries , with year, pct and group columns). When supplied, a temporal trend of habitat conversion is added.
fire_series	Optional burned-area time series (as from fire_timeseries_for_species / fire_timeseries , with year and burned_pct). When supplied, the fire regime is characterised over time.
applied_category, applied_code	Optional applied Criterion B category (e.g. "VU") and full code (e.g. "VU B1ab(iii)") reflecting the user's sub-criteria choices. When supplied, an "Applied Criterion B category" section is added; otherwise the assessment's category_B / criterion_B_code columns are used if present.
population	Optional named list carrying an inferred population size to report: pop_low / pop_high (mature individuals, the estimate and its upper end), dens_low / dens_high (the density in mature individuals per km ² used) and occupancy (percent of habitat occupied). When supplied and pop_low is finite, a "Population size (inferred)" section is added, framed as an inferred, screening-level figure.
figures	Logical; for output = "docx" only, embed the supporting figures (composition, protection and the land-cover/fire time-series charts) in the Word document (default FALSE). Ignored for other outputs.

Value

For "html"/"text", a length-one character string. For "docx", the file path (written as a side effect), invisibly.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
res <- assess_species(occ, mapbiomas = FALSE, verbose = FALSE)
cat(assessment_report(res, output = "text"))

# Word (.docx) report written to a temporary file:
f <- file.path(tempdir(), "report.docx")
assessment_report(res, output = "docx", file = f)
unlink(f)
```

calc_aoh	<i>Area of Habitat (AOH): suitable land cover within a range and elevation band</i>
----------	---

Description

Computes the terrestrial Area of Habitat as the *suitable* land cover within a range polygon, optionally restricted to an elevation band, following the Area-of-Habitat concept (Brooks *et al.* 2019) and the sRedList workflow (Cazalis *et al.* 2024). "Suitable" defaults to the **natural** conservation group of the land-cover legend, so the result is consistent with the natural-versus-converted metrics used elsewhere in **mappingAS**; supply `suitable_groups` to change it.

Usage

```
calc_aoh(
  range,
  year = NULL,
  collection = NULL,
  initiative = "brazil",
  backend = "local",
  src = NULL,
  elev_src = NULL,
  elev_min = NA,
  elev_max = NA,
  z = 9,
  suitable_groups = "natural",
  suitable_codes = NULL,
  marginal_codes = NULL,
  points = NULL,
  max_pixels = 5e+07
)
```

Arguments

range	An sf/sfc range polygon (e.g. the EOO hull from calc_eoo or the AOO cell union). Points yield NA.
year, collection, initiative, backend, src	Land-cover selection, as in assess_species / mb_raster_local .
elev_src	Optional DEM path/URL used instead of elevatr .
elev_min, elev_max	Elevation band in metres. NA (default) on either side leaves that side open; both NA skips the elevation mask and the AOH is the suitable land cover alone.
z	Terrain-tile zoom for elevatr (default 9). Ignored when elev_src is given.
suitable_groups	Conservation group(s) counted as suitable habitat (default "natural"). See mb_legend .
suitable_codes	Optional integer land-cover class codes counted as suitable, overriding suitable_groups (e.g. the specific classes that make ecological sense for the species).
marginal_codes	Optional integer class codes of <i>marginal</i> or unknown-suitability habitat (sRedList's "Marginal_Unknown"). When supplied, a second, broader AOH (aoh_max_km2) is returned that adds these to the suitable classes, giving a strict-to-broad AOH range.
points	Optional sf of occurrence points; when given, the point_prevalence (share of occurrences inside the suitable habitat) validation metric is returned.
max_pixels	Pixel budget for the land-cover read (default 5e7).

Details

The land cover is read over the range with the same backend as [assess_species](#) (MapBiomas or Sentinel-2/Esri) and, when an elevation band is given, an elevation model read over the same extent (windowed; via elev_src or the optional **elevatr** package) is resampled to the land-cover grid and used to mask out pixels outside [elev_min, elev_max]. The remaining suitable area is the AOH. The read is bounded by max_pixels: beyond it the land cover is decimated on read (nearest-neighbour sampling, which keeps class areas unbiased, unlike a majority rule that erases fragmented habitat) so a large range never streams its native pixels or exhausts memory. This AOH can be passed as the habitat-based upper AOO bound to [aoo_bounds](#).

Every failure (no DEM, no land cover, an unsupported backend) degrades to NA with a message rather than an error.

Value

A list with aoh_km2 (suitable area within the elevation band, the AOH), aoh_max_km2 (the broader AOH including marginal classes; equal to aoh_km2 when none), aoo_upper_km2 / aoo_upper_cells (the AOH rescaled to the 2 km reference scale - the IUCN-compliant AOO upper bound - and its cell count), model_prevalence (share of the range that is suitable habitat) and point_prevalence (share of points inside the habitat; NA without points), suitable_km2 (suitable area *without* the elevation mask, for reference), elev_min, elev_max, elev_applied, suitable_groups, suitable_codes and marginal_codes.

References

Brooks T.M. *et al.* (2019) Measuring terrestrial Area of Habitat (AOH) and its utility for the IUCN Red List. *Trends in Ecology & Evolution* 34:977-986. doi:10.1016/j.tree.2019.06.009

Cazalis V. *et al.* (2024) Accelerating and standardising IUCN Red List assessments with sRedList. *Biological Conservation* 298:110761. doi:10.1016/j.biocon.2024.110761

See Also

[aoo_bounds](#), [elevation_preferences](#), [summarise_conversion](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
hull <- calc_eoo(sp1)$hull
# Reads MapBiomas land cover (and a DEM if elevatr is installed):
calc_aoh(hull, year = 2024, elev_min = 0, elev_max = 1500)
```

calc_aoo	<i>Area of Occupancy (AOO) via occupied grid cells</i>
----------	--

Description

Computes the AOO as the number of occupied grid cells multiplied by the cell area, following the IUCN Red List guidelines (reference scale: 2 x 2 km cells = 4 km² each) and the approach used by the **ConR** package. Points are snapped to a regular grid defined on a data-centred equal-area projection.

Usage

```
calc_aoo(points, cell_km = 2, n_rep = 100)
```

Arguments

points	An sf of POINT geometries (one species).
cell_km	Grid cell side length in kilometres (default 2).
n_rep	Integer; number of translated grids to test (default 100; the lattice is cheap, and more offsets bring the count closer to the true minimum). The minimum occupied-cell count over the replicates is returned.

Details

Because the occupied-cell count depends on where the grid is placed, this function tests several translated grids and returns the *smallest* count, as ConR does. The translations follow a deterministic, evenly spread lattice, so the result is reproducible (no random seed needed). The returned cells correspond to the grid placement that produced the reported value.

Value

A list with area_km2, n_cells, cell_km, cells (occupied cells as an sfc polygon set in WGS84) and crs_laea.

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
calc_aoo(sp1)$area_km2
```

calc_eoo

*Extent of Occurrence (EOO) via minimum convex polygon***Description**

Computes the EOO as the area of the convex hull (minimum convex polygon) enclosing all occurrence points, following the IUCN Red List guidelines and the approach used by the **ConR** package. The hull is built in longitude/latitude, its edges are densified with `st_segmentize()` so that they follow great circles, and the area is measured directly on the WGS84 ellipsoid (a "spheroid" measurement).

Usage

```
calc_eoo(points, segmentize_km = 20)
```

Arguments

points	An sf of POINT geometries (one species). Use read_occurrences to produce it.
segmentize_km	Numeric edge length, in kilometres, used to densify the hull edges along great circles (default 20, matching ConR).

Details

Degenerate cases are handled so the function never errors:

- With fewer than three unique points a polygon cannot be built and the EOO is NA.
- When the unique points are perfectly collinear (they would form a line of area zero) a small amount of noise is added to the coordinates (`jitter`), exactly as in ConR, so that a valid polygon can still be produced.
- If, for any other reason, a valid polygon still cannot be built, the EOO is returned as NA rather than throwing an error.

Value

A list with `area_km2` (numeric), `n_records` (integer), `n_unique` (distinct coordinates), `hull` (the hull as an `sfc` in WGS84, or `NULL` when the EOO is undefined) and `crs_laea` (a data-centred equal-area proj string, kept for mapping).

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
calc_eoo(sp1)$area_km2
```

calc_locations	<i>Estimate of number of locations (occupied-grid-cell method, optionally protected-area aware)</i>
----------------	---

Description

Estimates the number of "locations" (in the IUCN sense: geographically or ecologically distinct areas in which a single threatening event can rapidly affect all individuals) by overlaying a regular grid and counting the occupied cells, optionally decoupling occurrences that fall inside protected areas from those outside. This mirrors the two complementary approaches used by the **ConR** package (Dauby *et al.* 2017): the grid method, and the protected-area integration (`method_protected`).

Usage

```
calc_locations(
  points,
  grid_km = 10,
  n_rep = 100,
  protected = NULL,
  method_protected = c("no_more_than_one", "other"),
  cell_scale = NULL
)
```

Arguments

<code>points</code>	An <code>sf</code> of <code>POINT</code> geometries (one species).
<code>grid_km</code>	Grid cell side length in kilometres (default 10). Ignored when <code>cell_scale</code> is supplied.
<code>n_rep</code>	Integer; number of translated grids to test (default 100). The minimum occupied-cell count over the replicates is returned.
<code>protected</code>	Optional protected-area layer (an <code>sf/sfc</code> of polygons, e.g. from protected_areas). <code>NULL</code> (default) uses the plain grid method.
<code>method_protected</code>	How protected areas enter the count when <code>protected</code> is given: "no_more_than_one" (default) or "other". See Details.

`cell_scale` Optional numeric fraction for the sliding-scale cell size: the cell side becomes `cell_scale` times the maximum distance between two occurrences. When supplied it overrides `grid_km`.

Details

As for the AOO, the occupied-cell count depends on where the grid is placed, so several translated grids (a deterministic lattice) are tested and the *smallest* count is returned (the most conservative, i.e. most threatened, estimate). The grid is built on a data-centred Lambert Azimuthal Equal-Area projection and this function reuses **mappingAS**'s own AOO grid machinery, so it differs from `calc_aoo` only in the (larger) default cell size.

Cell size. By default a fixed cell of `grid_km` (10 km) is used, representing the scale at which a single threat could affect the whole occupied cell. Alternatively a species-specific "sliding scale" (Rivers *et al.* 2010) is available: set `cell_scale` to a fraction (e.g. 0.05) and the cell side becomes that fraction of the maximum distance between two occurrences (`cell_scale` then overrides `grid_km`).

Protected areas. When `protected` is a protected-area layer (e.g. from `protected_areas`), occurrences are split into those inside and outside protected areas, because a subpopulation inside a protected area is not subject to the same threats as one outside:

- `method_protected = "no_more_than_one"` (default): every protected area holding at least one occurrence counts as exactly one location (all occurrences within a protected area share a location); occurrences outside protected areas are gridded as usual. Overlapping or nested designations (common in WDPA, e.g. a national park inside an environmental protection area) are counted once: the smallest set of protected areas that holds every inside occurrence is used. The total is (occupied cells outside) + (size of that set).
- `method_protected = "other"`: occurrences inside protected areas are gridded *separately* from those outside, and the two counts are added. Two occurrences closer than the cell size are then still counted as separate locations when one is inside and the other outside a protected area.

With `protected = NULL` (the default) no protected-area information is used and the plain grid count is returned.

Value

A list with `n_locations` (integer estimate), `grid_km` (the cell size actually used), `method` ("grid", "no_more_than_one" or "other"), `n_out / n_in` (locations outside / inside protected areas; `n_in` is NA for the plain grid), `n_cells`, `cells` (gridded location cells as an sfc in WGS84), `pa_locations` (the protected areas counted as locations under "no_more_than_one", else NULL) and `crs_laia`.

References

- Dauby G. *et al.* (2017) ConR: An R package to assist large-scale multispecies preliminary conservation assessments using distribution data. *Ecology and Evolution* 7:11292-11303. doi:10.1002/ece3.3704
- Rivers M.C. *et al.* (2010) How many herbarium specimens are needed to detect threatened species? *Biological Conservation* 143:2545-2560.
- IUCN Standards and Petitions Committee. Guidelines for Using the IUCN Red List Categories and Criteria.

See Also

[calc_subpop](#), [calc_aoo](#), [protected_areas](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
calc_locations(sp1)$n_locations
```

calc_subpop

Estimate of number of subpopulations (circular-buffer method)

Description

Estimates the number of subpopulations by the "circular buffer" method: a circle of radius `resol_km` is drawn around every occurrence, the circles are dissolved (unioned), and the number of resulting disjoint polygons is the estimated number of subpopulations. Occurrences whose buffers overlap are treated as belonging to the same subpopulation.

Usage

```
calc_subpop(points, resol_km = NULL)
```

Arguments

<code>points</code>	An sf of POINT geometries (one species). Use read_occurrences to produce it.
<code>resol_km</code>	Circle radius in kilometres. NULL (default) uses one tenth of the maximum distance between two occurrences.

Details

This is the approach popularised by the **ConR** package (Dauby *et al.* 2017) and originally proposed by Rivers *et al.* (2010). The buffering is done on a data-centred Lambert Azimuthal Equal-Area projection (see [laea_crs](#)), consistent with the EOO/AOO computations elsewhere in **mappingAS**.

The buffer radius follows the widely used default of one tenth of the greatest distance separating two occurrences (Rivers *et al.* 2010): when `resol_km` is NULL it is computed from the data. Because the most distant pair of points always lies on the convex hull, the maximum distance is measured over the hull vertices only (great-circle distance on the WGS84 ellipsoid), which keeps the computation fast for large datasets.

Value

A list with `n_subpop` (integer estimate), `resol_km` (the radius actually used), `n_unique` (distinct coordinates), `subpop` (the dissolved subpopulation polygons as an sf in WGS84, or NULL) and `crs_laea` (the equal-area proj string).

References

Dauby G. *et al.* (2017) ConR: An R package to assist large-scale multispecies preliminary conservation assessments using distribution data. *Ecology and Evolution* 7:11292-11303. doi:10.1002/ece3.3704

Rivers M.C. *et al.* (2010) How many herbarium specimens are needed to detect threatened species? *Biological Conservation* 143:2545-2560.

See Also

[calc_locations](#), [calc_aoo](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
calc_subpop(sp1)$n_subpop
```

class_table	<i>Per-class MapBiomass composition table (every class) for an assessment</i>
-------------	---

Description

Returns, for each species, the area and percentage of *every* MapBiomass class found inside the EOO and/or the AOO. This complements the headline natural-versus-converted summary in [assess_species](#) with the full class-by-class breakdown.

Usage

```
class_table(assessment, species = NULL, range = c("both", "eoo", "aoo"))
```

Arguments

- assessment A geoconv_assessment from [assess_species](#) (run with mapbiomas = TRUE).
- species Optional species name (or vector). NULL (default) uses all assessed species.
- range "both" (default), "eoo" or "aoo".

Value

A long data.frame with columns species, range ("EOO"/"AOO"), code, class_pt, class_en, group, area_km2 and pct (percentage of the mapped area within that range). Empty (with a warning) if MapBiomass was not computed.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
# reads MapBiomass (one year; the multi-year habitat trend is skipped)
res <- assess_species(occ, year = 2024, infer_decline_from_habitat = FALSE,
                     verbose = FALSE)
class_table(res)
```

`countries_of_occurrence`

Countries of occurrence and biogeographical realm(s) from a range

Description

Derives the list of countries a taxon occurs in - and an approximate biogeographical realm - by intersecting its range with the public Natural Earth country base map, mirroring the "countries of occurrence" and "realms" supporting information that the IUCN Red List requires/recommends and that sRedList extracts automatically (Cazalis *et al.* 2024).

Usage

```
countries_of_occurrence(
  range,
  points = NULL,
  scale = c("medium", "small", "large")
)
```

Arguments

<code>range</code>	An <code>sf/sfc</code> polygon delimiting the range (e.g. the EOO hull from <code>calc_eeo</code>), or an <code>sf</code> of occurrence points. Any CRS is accepted (it is transformed to WGS84 internally).
<code>points</code>	Optional <code>sf</code> of occurrence POINT geometries used to set the Extant / Possibly Extant presence flag. NULL (default) means the presence is taken from range itself when it is a set of points, otherwise every overlapping country is Possibly Extant .
<code>scale</code>	Natural Earth scale passed to <code>rnaturalearth::ne_countries("small", "medium" (default) or "large")</code> .

Details

Following the Red List convention, every country the range *polygon* overlaps is reported, and each is flagged by presence:

- **Extant** - the country holds at least one occurrence record;
- **Possibly Extant** - the country overlaps the range but holds no record in the supplied points.

When no polygon is supplied (fewer than three points, so no EOO hull) the countries are taken from the points alone and are all reported as **Extant**.

Realm. The biogeographical realm is a *coarse approximation* derived from the continent of each country (Neotropical, Nearctic, Afrotropical, Palearctic, Indomalayan, Australasian, Oceanian or Antarctic); it is exact for the South-American ranges mappingAS is built around but should be checked for taxa spanning continental transitions (e.g. North/Central America, North Africa, South-East Asia), where realm boundaries do not follow country borders.

Value

A data.frame with one row per country: country, presence ("Extant"/"Possibly Extant"), n_records (occurrences in that country), continent and realm. Rows are ordered by presence then country. An empty data.frame (with a message) is returned when **rnaturalearth** is not installed or no country overlaps.

References

Cazalis V. *et al.* (2024) Accelerating and standardising IUCN Red List assessments with sRedList. *Biological Conservation* 298:110761. doi:10.1016/j.biocon.2024.110761

See Also

[calc_eoo](#), [assess_species](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
# Needs the 'rnaturalearth' package (Suggests):
countries_of_occurrence(calc_eoo(sp1)$hull, points = sp1)
```

cover_timeseries	MapBiomass land-cover composition over time for a polygon
------------------	---

Description

For a given area (e.g. an EOO hull or the union of AOO cells), computes the area of each Map-Biomass class (or conservation group) for several years, returning a tidy long table suitable for a stacked-area chart of percentage of area versus year (as in the MapBiomass coverage figures).

Usage

```
cover_timeseries(
  geom,
  years = NULL,
  collection = NULL,
  initiative = "brazil",
  backend = c("local", "gee"),
  src = NULL,
  by = c("class", "group"),
  include_not_observed = FALSE,
  verbose = TRUE,
  max_pixels = 5e+07
)
```

Arguments

geom	An sf/sfc polygon (any CRS).
years	Integer vector of years. If NULL (default) a 5-year step across the initiative's span (plus the last year) is used.
collection	Integer MapBiomass collection. NULL uses the initiative default.
initiative	One of "brazil" (default), "amazonia" or "colombia" (see mb_initiatives).
backend	"local" (default, windowed GeoTIFF read) or "gee" (Earth Engine; Brazil only).
src	Optional GeoTIFF path/URL for the local backend (overrides the public per-year URL).
by	"class" (default; one series per MapBiomass class, with the official colours) or "group" (natural / anthropic / water / other).
include_not_observed	Logical; keep the "Not Observed" class (default FALSE).
verbose	Logical; print progress (default TRUE).
max_pixels	Pixel budget for each year's local area read (default 5e7). Large or widely-spread ranges are read per polygon part and/or decimated with majority resampling so the read stays bounded; class proportions are preserved. Ignored by the GEE backend.

Details

Each year is read independently (local windowed read or Earth Engine), so a long span of annual data can take a while. By default a 5-year step is used; pass `years = mb_years()` for the full annual series.

Value

A data.frame (long) with columns year, label, hex, group, area_km2 and pct (percentage of the mapped area in that year). For `by = "class"` it also has code and class_en.

See Also

[plot_timeseries](#), [timeseries_for_species](#)

elevation_preferences *Suggest elevation preferences from the occurrences' elevation*

Description

Extracts the elevation of each occurrence from a digital elevation model and suggests the species' elevation limits, mirroring the sRedList step that pre-fills elevation preferences from occurrence records (Cazalis *et al.* 2024). The suggested minimum is rounded down and the maximum rounded up to the nearest round_to metres, as sRedList does.

Usage

```
elevation_preferences(points, z = 9, src = NULL, round_to = 100)
```

Arguments

points	An sf of POINT geometries (one species). Use read_occurrences to produce it.
z	Terrain-tile zoom level passed to <code>elevatr::get_elev_raster</code> (default 9, ~300 m; higher is finer but heavier). Ignored when src is given.
src	Optional path/URL to a DEM GeoTIFF used instead of elevatr (read windowed through GDAL /vsicurl/ for a URL).
round_to	Rounding step in metres for the suggested limits (default 100); 0/NA disables rounding.

Details

The DEM is read only over the occurrences' extent (windowed), from src or the public AWS Terrain Tiles via the optional **elevatr** package. When no DEM is available the function returns NA values with a message rather than raising an error.

Value

A list with n (occurrences with a value), min, max, median (metres), suggested_min / suggested_max (rounded limits) and values (the per-occurrence elevations). All-NA when no DEM is available.

References

Cazalis V. *et al.* (2024) Accelerating and standardising IUCN Red List assessments with sRedList. *Biological Conservation* 298:110761. doi:10.1016/j.biocon.2024.110761

See Also

[calc_aoh](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
# Needs the 'elevatr' package (Suggests) and internet:
elevation_preferences(sp1)
```

esri_legend

Sentinel-2 / Esri global 10 m land-cover legend

Description

Returns the 9-class legend of the Esri / Impact Observatory / Microsoft "10 m Annual Land Use Land Cover" product (derived from ESA Sentinel-2, the data behind the ArcGIS Living Atlas Land Cover Explorer), with each pixel class mapped to the same conservation groups used by **mappingAS** for MapBiomass ("natural", "anthropic", "water", "other", "not_observed"). This lets a range assessed with the global fallback flow through the exact same conversion, plotting and report pipeline as a MapBiomass one (see [summarise_conversion](#)).

Usage

```
esri_legend()
```

Details

Group mapping: Trees, Rangeland and Flooded Vegetation are natural; Crops and Built Area are anthropic (converted habitat); Water is water; Bare Ground and Snow/Ice are other (ambiguous, excluded from the conversion denominator by default); Clouds are not_observed.

Value

A data.frame with columns code, class_en, class_pt, hex (official Esri colour), level1 and group.

See Also

[mb_legend](#), [summarise_conversion](#)

Examples

```
esri_legend()
subset(esri_legend(), group == "anthropic")$class_en
```

export_ranges

*Export EOO and AOO as spatial files (shapefile or GeoPackage)***Description**

Writes the Extent of Occurrence (EOO) polygons and the Area of Occupancy (AOO) polygons produced by [assess_species\(\)](#) to disk, with the area, habitat-conversion and provisional-category attributes attached to each feature (one feature per species by default). Handy for opening the results in QGIS/ArcGIS or sharing them.

Usage

```
export_ranges(
  assessment,
  dir = tempdir(),
  layer_prefix = "mappingAS",
  what = c("both", "eoo", "aoo"),
  format = c("shapefile", "gpkg"),
  crs = 4326,
  aoo_as = c("cells", "union"),
  class_csv = TRUE,
  zip = FALSE,
  quiet = TRUE
)
```

Arguments

assessment	A <code>geoconv_assessment</code> object from assess_species() .
dir	Output directory (created if it does not exist). Default <code>tempdir()</code> ; pass an explicit path to keep the files.
layer_prefix	File/layer name prefix. Default "mappingAS".
what	Which ranges to export: "both" (default), "eoo" or "aoo".
format	"shapefile" (default; one file set per range, i.e. *_EOO.shp and *_AOO.shp) or "gpkg" (a single GeoPackage holding both layers).
crs	Output CRS (default 4326, WGS84). Anything accepted by sf::st_crs() also works (an EPSG code or a proj string).
aoo_as	"cells" (default; one feature per occupied 2-km grid cell, each with a <code>cell_id</code>) or "union" (one dissolved feature per species).
class_csv	If TRUE (default), also writes <code><prefix>_classes.csv</code> with the full per-class MapBiomass breakdown (every class) for the EOO and AOO of each species; included in the zip when <code>zip = TRUE</code> . Skipped if MapBiomass was not computed.
zip	If TRUE, the written files are bundled into a single .zip inside <code>dir</code> and the path to that zip is returned (most useful for the shapefile format, which has several sidecar files). Default FALSE.
quiet	Passed to sf::st_write() . Default TRUE.

Details

Because the ESRI Shapefile format limits field names to 10 characters, the attribute fields use compact names (see the Attribute fields section). A GeoPackage (format = "gpkg") stores both ranges as two layers (eoo, aoo) inside a single file and has no such limitation.

Value

(Invisibly) a character vector with the file paths written, or the path to the .zip when zip = TRUE.

Attribute fields

species; eoo_km2 or aoo_km2 (and n_cells for AOO); conv_pct (percent converted/anthropic within that range); nat_pct (percent natural); cat_B1 or cat_B2 (provisional size-only category); prov_cat; mb_year; mb_coll (MapBiomass year and collection). Conversion fields are NA when MapBiomass was not computed.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
res <- assess_species(occ, mapbiomas = FALSE, verbose = FALSE)

d <- file.path(tempdir(), "mappingAS_ranges")
dir.create(d, showWarnings = FALSE)

# Two shapefiles (E00 + A00) written to a temporary directory:
export_ranges(res, dir = d)

# A single GeoPackage with both layers:
export_ranges(res, dir = d, format = "gpkg")

# Everything bundled into one .zip (good for downloads):
export_ranges(res, dir = d, zip = TRUE)
```

factsheet_html

Standalone HTML species factsheet with user metadata and photos

Description

Builds a single, self-contained HTML file that presents one species as a printable/shareable factsheet - the kind hosted on a supplementary website. It combines two sources of information:

1. **Everything the assessment already computes** - range metrics (EOO/AOO and provisional Criterion B category), habitat conversion, fire and protected-area overlap - rendered as a key-metrics grid, the standard charts (composition, protection, and any land-cover / fire time series supplied), a "top anthropic activities" chart derived from the per-class land-cover breakdown, and the interpretive narrative of [assessment_report](#).

2. **Information the package cannot know**, supplied by the user: the taxonomy (Family, Genus, Authority), the supporting-information block (Countries, Life Form, Substrate, Habitat, Biome, Vegetation), free-text land use and conservation units, a list of examined vouchers, a taxonomic reference (a Reflora / POWO link, or - for a newly described species - the article citation) and up to four photographs.

The whole page is self-contained (fonts fall back to the system stack, images and charts are embedded as base64 data URIs), so the returned file can be opened offline or published as-is (e.g. on GitHub Pages). Each photograph carries a watermark in its lower-right corner with the owner name given in `photo_credit`.

Usage

```
factsheet_html(
  assessment,
  species = NULL,
  lang = c("en", "pt"),
  file = NULL,
  family = NULL,
  genus = NULL,
  authority = NULL,
  countries = NULL,
  life_form = NULL,
  substrate = NULL,
  habitat = NULL,
  biome = NULL,
  vegetation = NULL,
  land_use = NULL,
  conservation_units = NULL,
  vouchers = NULL,
  reference = NULL,
  photos = NULL,
  photo_credit = NULL,
  cover_series = NULL,
  fire_series = NULL,
  applied_category = NULL,
  applied_code = NULL,
  map = TRUE,
  map_interactive = TRUE,
  top_n_threats = 5L
)
```

Arguments

<code>assessment</code>	A <code>geoconv_assessment</code> from assess_species .
<code>species</code>	Species name (default: the first assessed).
<code>lang</code>	Factsheet language: "en" (default) or "pt".

file	Optional output path. When supplied the HTML is written there and the path is returned invisibly; otherwise the HTML is returned as a length-one character string.
family, genus, authority	Taxonomy fields. genus defaults to the first word of species; the others are user-supplied (optional).
countries, life_form, substrate, habitat, biome, vegetation	The "Supporting information" block, all optional free text.
land_use, conservation_units	Optional overrides. When left NULL they are filled in automatically from the assessment: land_use from the anthropic land-cover classes within the EOO (the Conversion module) and conservation_units from the overlapping protected areas (the Protected-areas module). Pass a string to override the derived value; line breaks are preserved.
vouchers	Optional examined material: a character vector (one voucher per element) or a single string with one voucher per line.
reference	Optional taxonomic reference: a Reflora / POWO URL (rendered as a link) or, for a newly described taxon, the article citation.
photos	Optional character vector of image file paths (PNG/JPEG/...); at most the first four are used.
photo_credit	Watermark text (photo owner). A single value is applied to every photo; a vector is matched per photo.
cover_series, fire_series	Optional land-cover / burned-area time series for this species (as for assessment_report); when supplied they add the temporal-trend narrative and their charts (a land-cover composition-over-time chart, and a burned-area-per-year chart).
applied_category, applied_code	Optional applied Criterion B category (e.g. "VU") and full code (e.g. "VU B1ab(iii)"), reflecting the sub-criteria chosen by the user. When supplied they are shown as an "Applied Criterion B category" metric; otherwise the assessment's category_B / criterion_B_code columns are used if present.
map	Logical; embed the distribution map (occurrence points, EOO, AOO and land cover). Default TRUE; set FALSE to skip it (e.g. offline or for speed).
map_interactive	Logical; when TRUE (default) embed the <i>interactive</i> Leaflet map (map_species , the same widget the app downloads via "Download map (HTML)") as a self-contained document inside an iframe, so the whole factsheet remains one portable file. When FALSE, or when the widget cannot be built (no leaflet / htmlwidgets / pandoc), the publication-ready static map (map_static) is embedded instead.
top_n_threats	Number of anthropic land-cover classes to show in the "top anthropic activities" chart (default 5).

Value

The HTML string, or (when file is given) the file path, invisibly.

See Also

[assessment_report](#) for the narrative-only report.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
# reads MapBiomass (one year; the multi-year habitat trend is skipped)
res <- assess_species(occ, year = 2024, infer_decline_from_habitat = FALSE,
                     verbose = FALSE)
out <- file.path(tempdir(), "factsheet.html")
factsheet_html(res, file = out, map = FALSE,
               family = "Gentianaceae", countries = "Brazil",
               life_form = "Herb", biome = "Atlantic Forest")
unlink(out)
```

fire_areas	<i>Area (km^2) per fire value from a cropped fire raster</i>
------------	--

Description

Fire analogue of [mb_class_areas_raster](#). For the accumulated product, freq is the fire frequency (years burned).

Usage

```
fire_areas(r)
```

Arguments

r A **terra** SpatRaster from [fire_raster_local](#).

Value

A data.frame with columns freq and area_km2.

fire_palette	<i>Sequential palette for fire frequency (YlOrRd)</i>
--------------	---

Description

Sequential palette for fire frequency (YlOrRd)

Usage

```
fire_palette(n = 6)
```

Arguments

n Number of breaks (default 6).

Value

A character vector of hex colours.

fire_raster_local	<i>Crop a MapBiomass Fire raster to an area of interest (local backend)</i>
-------------------	---

Description

Thin wrapper over [mb_raster_local](#); reuses its windowed /vsicurl/ read and on-disk cache.

Usage

```
fire_raster_local(
  aoi,
  year = 2024,
  product = c("accumulated", "annual", "frequency"),
  fire_collection = 4,
  host_collection = 9,
  src = NULL,
  mask = TRUE,
  cache = TRUE,
  cache_dir = NULL
)
```

Arguments

aoi	An sf/sfc polygon (e.g. an EOO hull or AOO union).
year	Integer year (ignored when product = "accumulated").
product	"accumulated" (default) or "annual".
fire_collection	Fire collection number (default 4).
host_collection	Initiative folder hosting the fire data (default 9; Fire Col.4 lives under collection_9/).
src	Optional GeoTIFF path/URL overriding the built fire URL.
mask, cache, cache_dir	Passed to mb_raster_local .

Value

A **terra** SpatRaster of fire values clipped to the AOI.

fire_timeseries	<i>Burned-area time series for a polygon (% of range x year)</i>
-----------------	--

Description

Fire analogue of [cover_timeseries](#): reads the annual burned layer for each year and returns burned area (km²) and percentage of the range. Each year is one windowed read, so a full annual series can be slow.

Usage

```
fire_timeseries(
  geom,
  years = NULL,
  fire_collection = 4,
  host_collection = 9,
  range_km2 = NULL,
  verbose = TRUE
)
```

Arguments

geom	An sf/sfc polygon.
years	Integer vector (default mb_years()).
fire_collection	Fire collection number (default 4).
host_collection	Initiative folder hosting the fire data (default 9; Fire Col.4 lives under collection_9/).
range_km2	Range area for the percentage denominator (optional).
verbose	Logical; print progress.

Value

A data.frame with year, burned_km2, burned_pct.

fire_timeseries_for_species	<i>Burned-area time series for one assessed species (EOO or AOO)</i>
-----------------------------	--

Description

Convenience wrapper around [fire_timeseries](#) that pulls the stored EOO hull or AOO geometry (and its area) from an assessment.

Usage

```
fire_timeseries_for_species(  
  assessment,  
  species = NULL,  
  range = c("eoo", "aoo"),  
  years = NULL,  
  verbose = TRUE  
)
```

Arguments

- assessment A geoconv_assessment from [assess_species](#).
- species Species name (default: first assessed).
- range "eoo" (default) or "aoo".
- years, verbose Passed to [fire_timeseries](#).

Value

The data frame from [fire_timeseries](#) with attributes species and range.

fragment_habitat	<i>Severe fragmentation from suitable-habitat patches and population density</i>
------------------	--

Description

Implements the habitat-and-density fragmentation method of the IUCN Red List guidelines (Santini *et al.* 2019), as used by sRedList (Cazalis *et al.* 2024): the suitable habitat (Area of Habitat) within the range is split into **patches**, patches within a **dispersal / isolation distance** of one another are grouped into isolated **subpopulations**, and each subpopulation's size in **individuals** is its habitat area times the population **density**. This is the guideline-compliant companion to [assess_fragmentation](#) (which uses occurrence counts as a rough proxy when no habitat model or density is available).

Usage

```
fragment_habitat(
  range,
  isolation_km,
  density,
  year = NULL,
  collection = NULL,
  initiative = "brazil",
  src = NULL,
  suitable_groups = "natural",
  suitable_codes = NULL,
  elev_min = NA,
  elev_max = NA,
  z = 9,
  elev_src = NULL,
  max_pixels = 4000,
  small_size = NULL
)
```

Arguments

range	An sf/sfc range polygon (e.g. the EOO hull).
isolation_km	Isolation / dispersal distance in km: patches further apart than this host isolated subpopulations. Required.
density	Population density in mature individuals per km ² of suitable habitat. A length-2 vector gives a low/high range (a second population column pop_high is added). Required.
year, collection, initiative, src	Land-cover selection, as in calc_aoh / mb_raster_local .
suitable_groups, suitable_codes	Which land-cover classes count as suitable habitat (default: the "natural" group). See calc_aoh .
elev_min, elev_max, z, elev_src	Optional elevation band (metres) and DEM source, as in calc_aoh .
max_pixels	Display pixel budget for the habitat mask read (default 4000); larger ranges are read coarser, as sRedList aggregates them.
small_size	Optional size (individuals) the assessor considers "small"; when given, prop_in_small and severe_suggested are returned.

Details

Following Santini *et al.* (2019): contiguous suitable cells form patches; each patch is buffered by half the isolation distance and buffers that touch are merged, so patches closer than the isolation distance share a subpopulation; the number of individuals in a subpopulation is its total suitable area (km²) times density (individuals km⁻²), and a subpopulation of fewer than two individuals is treated as unoccupied. The curve then gives the proportion of the population in subpopulations no larger than a given size, whose median_subpop_size is the size below which half the population

lives; if the assessor considers a subpopulation of that size "small", the population can be treated as severely fragmented (Criterion B sub-criterion a). The largest subpopulation's size (max_subpop, Criterion C2a(i)) and its share of the population (pct_largest, Criterion C2a(ii)) are also returned.

Use with care: use the result only when the mapped clusters make ecological sense as subpopulations, exactly as sRedList advises. Barriers (water, mountains, infrastructure) are not accounted for.

Value

A list with method = "habitat", n_subpop (occupied subpopulations), isolation_km, density, sizes (a data.frame of cluster, aoh_km2, pop and, for a density range, pop_high), clusters (subpopulation polygons as an sfc in WGS84), curve, median_subpop_size, max_subpop (C2a(i)), pct_largest (C2a(ii)), total_pop, and prop_in_small / severe_suggested. Values degrade to NA when the land cover cannot be read.

References

Santini L. *et al.* (2019) Applying habitat and population-density models to land-cover time series to inform IUCN Red List assessments. *Conservation Biology* 33:1084-1093. doi:10.1111/cobi.13279

Cazalis V. *et al.* (2024) Accelerating and standardising IUCN Red List assessments with sRedList. *Biological Conservation* 298:110761. doi:10.1016/j.biocon.2024.110761

See Also

[assess_fragmentation](#), [calc_aoh](#)

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
sp1 <- occ[occ$species == occ$species[1], ]
hull <- calc_eoo(sp1)$hull
# Reads land cover; density in mature individuals per km^2:
fr <- fragment_habitat(hull, isolation_km = 20, density = 5)
fr$n_subpop
fr$max_subpop      # C2a(i)
```

iucn_category_B

Provisional IUCN Red List Criterion B category from range size

Description

Returns the category implied by the EOO (B1) and AOO (B2) *size* thresholds only. This is a screening aid, exactly like GeoCat: a full Criterion B listing additionally requires at least two of the sub-criteria (a) severe fragmentation / few locations, (b) continuing decline, and (c) extreme fluctuation. Never report these as final categories.

Usage

```
iucn_category_B(eoo_km2 = NA_real_, aoo_km2 = NA_real_)
```

Arguments

```
eoo_km2, aoo_km2
```

Numeric range sizes in square kilometres (recycled).

Details

Vectorised: eoo_km2 and aoo_km2 may be columns of an assessment summary. Following the IUCN Guidelines (sect. 4.10), when the EOO is smaller than the AOO the EOO is set equal to the AOO before applying the thresholds.

Value

A list with eoo_category, aoo_category and combined (the more threatened of the two size-based flags), each a character vector of the input length.

iucn_category_B_range *Criterion B size category range under AOO uncertainty*

Description

Combines the fixed EOO (B1) size flag with the *bracketed* AOO (B2) size flags - from a lower (occurrence-based) and an upper (habitat-based) AOO bound - into the plausible *range* of Criterion B screening categories. This is the size-only companion to [iucn_category_B](#) that lets an assessment report the uncertainty explicitly, as the sRedList summary does, rather than a single point estimate. Like [iucn_category_B](#) it reflects size thresholds only (the sub-criteria still apply on top).

Usage

```
iucn_category_B_range(
  eoo_km2 = NA_real_,
  aoo_lower_km2 = NA_real_,
  aoo_upper_km2 = NA_real_
)
```

Arguments

eoo_km2	EOO in km ² (NA if undefined).
aoo_lower_km2	Lower (occurrence-based) AOO bound in km ² .
aoo_upper_km2	Upper (habitat-based) AOO bound in km ² . NA (default) reuses the lower bound (no uncertainty).

Details

Because the EOO is a single value, the most-threatened plausible flag pairs B1 with B2 at the *lower* AOO, and the least-threatened plausible flag pairs B1 with B2 at the *upper* AOO; in each case the more threatened of the two axes wins (as in [iucn_category_B](#)).

Value

A list with b1_category (from EOO), b2_lower / b2_upper (B2 size flags at the two AOO bounds), worst and best (the most- and least-threatened plausible screening categories, as short codes "CR"/"EN"/"VU"/"NT"/"LC-level") and range (a compact label such as "EN-VU", or a single code when they agree).

See Also

[iucn_category_B](#), [aoo_bounds](#)

Examples

```
iucn_category_B_range(eoo_km2 = 6000, aoo_lower_km2 = 48, aoo_upper_km2 = 900)
```

iucn_criterion_B	<i>Apply IUCN Red List Criterion B (size thresholds plus sub-criteria)</i>
------------------	--

Description

Combines the EOO (B1) and AOO (B2) *size* thresholds of Criterion B with the sub-criteria required for a threatened listing, following the IUCN Red List Categories and Criteria (v3.1) and the Guidelines for Using them (Section 6, Criterion B; Section 10, DD/NT/NE), and aligning the category selection with the **ConR** package (Dauby *et al.* 2017, `cat_criterion_b()`). Unlike [iucn_category_B](#) (size flags only), this returns a category that can actually be applied.

Usage

```
iucn_criterion_B(
  eoo_km2 = NA_real_,
  aoo_km2 = NA_real_,
  n_locations = NA_real_,
  severe_fragmentation = NA,
  decline = NA,
  extreme_fluctuation = NA,
  assume_decline = TRUE,
  decline_detail = NULL
)
```

Arguments

eoo_km2, aoo_km2	EOO and AOO in km ² (NA if undefined).
n_locations	Estimated number of locations (NA if unknown). This is the value that caps the category through sub-criterion (a); see Details.
severe_fragmentation	Logical; TRUE if the taxon is severely fragmented (meets condition (a) at any level). NA (default) = not assessed.
decline	Logical; TRUE if there is a continuing decline (sub-criterion b), FALSE if a decline is known to be absent. NA (default) = not documented, resolved by assume_decline.
extreme_fluctuation	Logical; TRUE if there are extreme fluctuations (sub-criterion c). NA (default) = not documented (never assumed).
assume_decline	Logical; how an undocumented decline (decline = NA) is treated. TRUE (default) assumes a continuing decline is present, as ConR does and as the conversion data support; FALSE treats it as not met (a stricter, more conservative screening). Ignored when decline is TRUE/FALSE.
decline_detail	Optional character giving the element(s) of the continuing decline for the IUCN code notation (v16, Section 6), appended in parentheses after the b in code: "i" EOO, "ii" AOO, "iii" area/extent/quality of habitat, "iv" number of locations/subpopulations, "v" number of mature individuals (combine with commas, e.g. "ii,iii"). NULL (default) omits it, so the code reads e.g. "EN B1ab"; with "iii" it reads "EN B1ab(iii)".

Details

A taxon qualifies for a threatened category (CR, EN, VU) only if it meets the size threshold *and* at least two of these three sub-criteria:

- (a) severely fragmented *or* number of locations ≤ 1 (CR), 5 (EN) or 10 (VU);
- (b) continuing decline (in EOO, AOO, area/extent/quality of habitat, number of locations/subpopulations, or mature individuals);
- (c) extreme fluctuations.

Relation to the number of locations. Sub-criterion (a) is derived from n_locations (and severe_fragmentation when supplied), and it *caps* the category exactly as ConR does: the returned category is the *less threatened* of the level implied by range size and the level implied by the number of locations. A range whose EOO/AOO alone would be CR or EN but that is spread over, say, eight locations is therefore returned as **VU** (≤ 10 locations), not EN - the number of locations, not size alone, sets the category. Equivalently, per level: CR needs a single location, $EN \leq 5$, $VU \leq 10$ (unless severely fragmented, which meets condition (a) at any level).

Continuing decline (b), assumed by default. Sub-criteria (b) and (c) cannot be read from occurrence points. Following ConR - and because **mappingAS** is built around habitat-conversion data, which is direct evidence of a continuing decline in the area, extent and quality of habitat (sub-criterion b(iii)) - a continuing decline is **assumed to be present** when it is not explicitly documented (decline = NA with assume_decline = TRUE, the default). This is what makes the screening track

the IUCN thresholds instead of collapsing every undocumented taxon to NT: with the location condition (a) met and decline (b) assumed, a small-range, few-location taxon is returned at its CR/EN/VU size-and-location level. Set `assume_decline = FALSE` (or `decline = FALSE`) to require a documented decline instead, in which case a size-and-location match with no second sub-criterion falls to NT. Extreme fluctuation (c) is never assumed.

Following Section 10: a taxon that meets a size threshold but not two sub-criteria (for example a small range spread over too many locations, or with decline explicitly absent) is returned as **NT** (Near Threatened, it "nearly meets" the requirements); one clearly far from every threshold as **LC**. **DD** and **NE** are *never* assigned automatically - they require the assessor's judgement about data adequacy and are left to the user.

Value

A list with category (one of "CR", "EN", "VU", "NT", "LC", or NA when neither EOO nor AOO is available), code (e.g. "VU B1ab"), `qualifies_size` (the highest size level met, or NA), the evaluated sub-criteria a, b, c, and `decline_assumed` (TRUE when sub-criterion (b) was assumed rather than documented).

References

Dauby G. *et al.* (2017) ConR: An R package to assist large-scale multispecies preliminary conservation assessments using distribution data. *Ecology and Evolution* 7:11292-11303. doi:10.1002/ece3.3704

See Also

[iucn_category_B](#)

Examples

```
# EN-sized range with few locations: decline assumed by default -> EN B1ab
iucn_criterion_B(eoo_km2 = 3000, aoo_km2 = 400, n_locations = 4)$code
# Same size but spread over 8 locations -> capped to VU by the location count
iucn_criterion_B(eoo_km2 = 3000, aoo_km2 = 400, n_locations = 8)$category
# Require a documented decline: with none, a size/location match falls to NT
iucn_criterion_B(eoo_km2 = 3000, aoo_km2 = 400, n_locations = 4,
  assume_decline = FALSE)$category
```

map_aoh

Interactive Area of Habitat (AOH) map for one species

Description

Builds a **leaflet** map of the terrestrial Area of Habitat: the *suitable* land-cover classes within the EOO, optionally restricted to an elevation band, drawn as a single green overlay together with the EOO hull and the occurrence points. It is the map companion to [calc_aoh](#) and uses the same suitable-class and elevation definitions, so the map shows exactly the area `calc_aoh()` measures.

Usage

```
map_aoh(
  assessment,
  species = NULL,
  suitable_groups = "natural",
  suitable_codes = NULL,
  elev_min = NA,
  elev_max = NA,
  z = 9,
  elev_src = NULL,
  src = NULL,
  max_pixels = 800,
  lang = c("pt", "en")
)
```

Arguments

assessment	A geoconv_assessment from assess_species .
species	Species name. NULL (default) uses the first.
suitable_groups	Conservation group(s) counted as suitable habitat (default "natural"). Ignored when suitable_codes is given.
suitable_codes	Optional integer land-cover class codes counted as suitable, overriding suitable_groups.
elev_min, elev_max	Elevation band in metres (NA leaves that side open; both NA skips the elevation mask).
z	Terrain-tile zoom for elevatr (default 9).
elev_src, src	Optional DEM and land-cover overrides (path/URL).
max_pixels	Display pixel budget for the land-cover read (default 800).
lang	"pt" (default) or "en" for the legend labels.

Details

Suitable habitat is, by default, the **natural** conservation group of the land-cover legend; pass suitable_groups (one or more groups) or suitable_codes (specific land-cover class codes, e.g. the classes that make ecological sense for the species) to change it. When an elevation band is given, an elevation model read over the EOO (via elev_src or the optional **elevatr** package) masks out the habitat outside [elev_min, elev_max].

Value

A leaflet widget, or a base map with just the points/EOO when the land cover cannot be read.

See Also

[calc_aoh](#), [map_species](#)

map_species	<i>Interactive map of a species' points, EOO and AOO (MapBiomass + fire)</i>
-------------	--

Description

Builds a **leaflet** map with the occurrence points, EOO hull and occupied AOO cells. Optionally overlays the MapBiomass land-cover raster and the MapBiomass Fire accumulated layer (fire recurrence: number of years burned), both clipped to the EOO, as toggleable layers with legends.

Usage

```
map_species(
  assessment,
  species = NULL,
  mapbiomas = TRUE,
  fire = FALSE,
  src = NULL,
  fire_src = NULL,
  max_pixels = 800,
  lang = c("pt", "en"),
  clip = c("eoo", "aoo", "all"),
  protected = FALSE,
  pa_src = NULL,
  pa_occ_only = TRUE
)
```

Arguments

assessment	A geoconv_assessment from assess_species .
species	Species name to plot (default: first assessed).
mapbiomas	Logical; overlay the MapBiomass raster (default TRUE).
fire	Logical; overlay the MapBiomass Fire accumulated layer (default FALSE).
src	Optional MapBiomass LULC GeoTIFF path/URL.
fire_src	Optional MapBiomass Fire GeoTIFF path/URL.
max_pixels	Target maximum raster size (longest side, pixels) for the overlays (default 800).
lang	Legend language: "pt" (default) or "en". Controls the language of the MapBiomass class labels and the fire-frequency legend.
clip	Geometry the rasters are clipped to: "eoo" (default, the EOO hull), "aoo" (the union of occupied AOO cells) or "all" (the union of both, so the raster spans the whole range).
protected	Logical; overlay protected areas. Uses the protected-area layer already stored by <code>assess_species(..., protected = TRUE)</code> , or fetches it on the fly from WDPA otherwise. Default FALSE.

pa_src	Optional local protected-area vector file for the overlay (offline).
pa_occ_only	Logical; when TRUE (default) the map draws only the UCs that actually contain occurrences of the species. Set FALSE to draw every UC the range overlaps. Does not affect the EOO/AOO overlap percentages, which are computed over the whole range.

Value

A leaflet widget.

map_static	<i>Publication-ready static map of a species (MapBiomass + EOO + AOO + points)</i>
------------	--

Description

Builds an exportable **ggplot2** map for one species: the MapBiomass land-cover layer clipped to the EOO (with the official colour legend of the classes actually present, drawn beside the map so it never overlaps the EOO/AOO), the EOO minimum convex polygon, the occupied AOO cells, the occurrence points, plus a north arrow and a scale bar with the geographic reference (datum/projection) printed beneath it. The map is drawn in the species' equal-area projection so the scale bar is meaningful, and is returned as a ggplot object you can save with `ggplot2::ggsave()` to make a usable, georeferenced-looking figure.

Usage

```
map_static(
  assessment,
  species = NULL,
  mapbiomas = TRUE,
  fire = FALSE,
  src = NULL,
  max_pixels = 600,
  crs = NULL,
  scalebar = TRUE,
  north = TRUE,
  title = NULL,
  lang = c("pt", "en"),
  clip = c("eoo", "aoo", "all"),
  protected = FALSE,
  pa_src = NULL,
  pa_occ_only = TRUE
)
```

Arguments

assessment	A geoconv_assessment from assess_species .
species	Species name (default: first assessed).
mapbiomas	Logical; draw the MapBiomass raster layer (default TRUE). Set FALSE for a quick points/EOO/AOO map with no raster read.
fire	Logical; draw the MapBiomass Fire <i>frequency</i> layer (number of years burned, 1985-2024). With mapbiomas = TRUE it is overlaid on the land-cover raster when ggnewscale is installed; otherwise only the land-cover layer is drawn (default FALSE).
src	Optional local path / URL to a MapBiomass GeoTIFF (same as in assess_species); NULL (default) uses the public URL.
max_pixels	Target maximum raster size (longest side, in pixels) for the display layer (default 600).
crs	Optional CRS for the map (proj string or EPSG code). Defaults to the species' equal-area projection from the EOO/AOO.
scalebar, north	Logical; add a scale bar / north arrow (default TRUE).
title	Optional plot title (default: the species name).
lang	Legend language: "pt" (default) or "en". Controls the language of the MapBiomass class labels, the fire-frequency legend and the feature labels (EOO/AOO/occurrences).
clip	Geometry the rasters are clipped to: "eoo" (default, the EOO hull), "aoo" (the union of occupied AOO cells) or "all" (the union of both). Matches the clip argument of map_species .
protected	Logical; overlay protected areas on the publishable map (default FALSE). Uses the protected-area layer stored by <code>assess_species(..., protected = TRUE)</code> , or fetches it on the fly.
pa_src	Optional local protected-area vector file for the overlay (offline).
pa_occ_only	Logical; when TRUE (default) draw only the protected areas that contain occurrences of the species. FALSE draws every protected area the range overlaps.

Details

The MapBiomass layer is read with the cached windowed reader and aggregated to `max_pixels` for display, so it is fast and reuses the raster already fetched during [assess_species](#) (same EOO window).

Value

A ggplot object.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
res <- assess_species(occ, mapbiomas = FALSE, verbose = FALSE)
m <- map_static(res, mapbiomas = FALSE)
```

```
# Save it wherever you like (a temporary file here):
f <- file.path(tempdir(), "eoo_map.png")
ggplot2::ggsave(f, m, width = 8, height = 7)
unlink(f)
```

mas_plotly

Turn a mappingAS chart into an interactive plotly widget

Description

Converts a **ggplot2** object produced by the mappingAS `plot_*` functions ([plot_conversion](#), [plot_protection](#), [plot_timeseries](#), [plot_fire_timeseries](#)) into an interactive **plotly** widget. Those functions attach the tidy data and palette needed, so the widget is built as *native* plotly (correct per-segment hover tooltips and in-bar labels) rather than through `ggplotly()`. Any other ggplot falls back to `ggplotly()`. This is the single place that controls the interactive look across the package and the Shiny app.

Usage

```
mas_plotly(p, tooltip = c("fill", "x", "y"), ...)
```

Arguments

<code>p</code>	A ggplot object (as returned by the <code>plot_*</code> functions). Any non-ggplot is returned unchanged.
<code>tooltip</code>	Aesthetics passed to <code>plotly::ggplotly()</code> in the generic fallback (default <code>c("fill", "x", "y")</code>).
<code>...</code>	Reserved for future use.

Value

A plotly `htmlwidget` (or `p` unchanged when it is not a ggplot or **plotly** is not installed).

Examples

```
if (interactive()) {
  occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                     package = "mappingAS"))
  res <- assess_species(occ, year = 2024, verbose = FALSE) # reads MapBiomass
  mas_plotly(plot_conversion(res))
}
```

mb_class_areas_gee	<i>MapBiomass class areas via Google Earth Engine (optional backend)</i>
--------------------	--

Description

Computes the area (km^2) of each MapBiomass pixel class inside aoi entirely on Google Earth Engine, without downloading any raster. This is the recommended backend for very large ranges (e.g. continental EOOs) where a local windowed read would transfer too much data.

Usage

```
mb_class_areas_gee(  
  aoi,  
  year = 2024,  
  collection = 10,  
  version = "v1",  
  asset = "projects/mapbiomas-public/assets/brazil/lulc/v1",  
  scale = 30,  
  max_pixels = 1e+13  
)
```

Arguments

aoi	An sf/sfc polygon (any CRS).
year	Integer year (default 2024).
collection	Integer MapBiomass collection id (default 10).
version	Asset version string for the public LULC collection (default "v1"; some mirrors expose "v2" for Collection 10.1).
asset	Earth Engine ImageCollection id (default "projects/mapbiomas-public/assets/brazil/lulc/v1")
scale	Nominal pixel scale in metres for the reduction (default 30).
max_pixels	Maximum pixels for the server-side reduction (default 1e13).

Details

Requires the **rgee** package and an initialised Earth Engine session (`rgee::ee_initialize()`); see the package README for one-time setup.

Value

A data.frame with columns code and area_km2.

mb_class_areas_raster	<i>Tabulate area per MapBiomass class from a cropped raster</i>
-----------------------	---

Description

Computes the true (geodesic, latitude-corrected) area of each MapBiomass pixel class inside a cropped/masked raster. Works for rasters in geographic CRS, where pixel area varies with latitude, by using `terra::cellSize()`.

Usage

```
mb_class_areas_raster(r)
```

Arguments

`r` A **terra** SpatRaster of MapBiomass codes (e.g. from `mb_raster_local`).

Value

A `data.frame` with columns `code` and `area_km2`.

mb_fire_url	<i>Build a MapBiomass Fire (Fogo) GeoTIFF URL</i>
-------------	---

Description

"frequency" is the fire-frequency layer (pixel = number of years burned over period, 1-40); "accumulated" is binary (burned at least once); "annual" is the per-year burned area.

Usage

```
mb_fire_url(  
  year = 2024,  
  product = c("accumulated", "annual", "frequency"),  
  fire_collection = 4,  
  host_collection = 9,  
  period = c(1985, 2024)  
)
```

Arguments

`year` Integer year (ignored when `product = "accumulated"`).
`product` "accumulated" (default) or "annual".
`fire_collection` Fire collection number (default 4).
`host_collection` Initiative folder hosting the fire data (default 9; Fire Col.4 lives under `collection_9/`).
`period` Two-integer accumulated span (default `c(1985, 2024)`).

Value

A length-1 character URL.

Examples

```
mb_fire_url(product = "accumulated")
mb_fire_url(2024, "annual")
```

mb_groups	<i>Group lookup vectors for MapBiomass conservation groups</i>
-----------	--

Description

Convenience wrapper returning the pixel codes that belong to each group.

Usage

```
mb_groups(collection = 10, initiative = "brazil")
```

Arguments

- collection Integer collection number. Interpreted together with initiative; a value that does not match the initiative’s default collection emits a warning and the standardised legend is still returned.
- initiative One of the keys of [mb_initiatives](#) ("brazil" by default). Kept for API symmetry and warning logic; the returned legend is the same standardised table for every initiative.

Value

A named list with elements natural, anthropic, water, other and not_observed, each an integer vector of MapBiomass pixel codes.

mb_initiatives	<i>MapBiomass initiatives supported by mappingAS</i>
----------------	--

Description

mappingAS can read land-use/land-cover from several public MapBiomass initiatives, all streamed as annual Cloud-Optimized GeoTIFFs from the public storage `googleapis.com/mapbiomas-public` bucket via GDAL’s `/vsicurl/` driver - no Google Earth Engine account and no Google Drive download required. Each initiative is one coherent product with its own default collection, year span and file layout, but all share the same *standardised* legend (see [mb_legend](#)), so a species whose range spans more than one product can be assessed with consistent class names, colours and conservation groups.

Usage

```
mb_initiatives()
```

Details

"brazil" MapBiomass Brazil, Collection 10 (1985-2024).

"amazonia" MapBiomass Amazonia / Pan-Amazon (RAISG), Collection 6 (1986-2023). The whole Amazon basin across countries.

"colombia" MapBiomass Colombia, Collection 3 (1985-2024).

"argentina" MapBiomass Argentina, Collection 2 (1985-2024).

"bolivia" MapBiomass Bolivia, Collection 3 (1985-2024).

"chile" MapBiomass Chile, Collection 1 (2000-2022).

"ecuador" MapBiomass Ecuador, Collection 3 (1985-2024).

"peru" MapBiomass Peru, Collection 3 (1985-2024).

"venezuela" MapBiomass Venezuela, Collection 2 (1985-2023).

"paraguay" MapBiomass Paraguay, Collection 2 (1985-2023).

"uruguay" MapBiomass Uruguay, Collection 1 (1985-2022).

Value

A named list, one element per initiative, each a list with `label` (human-readable name), `collection` (default collection number), `years` (integer vector of available years) and `key`.

See Also

[mb_source_url](#), [mb_legend](#), [assess_species](#)

Examples

```
names(mb_initiatives())
mb_initiatives()$peru$years
```

mb_legend

Standardised MapBiomass legend with conservation groupings

Description

Returns the *standardised* MapBiomass land-use/land-cover legend used across every initiative supported by **mappingAS** (Brazil, Pan-Amazon / Amazonia, Colombia, Argentina, Bolivia, Chile, Ecuador, Peru, Venezuela, Paraguay and Uruguay - see [mb_initiatives](#)), with each pixel class assigned to a conservation-relevant group: "natural", "anthropic", "water", "not_observed" or "other". The "anthropic" classes are what counts as *converted* habitat; "natural" is the remaining (current) natural habitat. By default "water", "not_observed" and "other" are excluded from the conversion denominator (see [summarise_conversion](#)).

Usage

```
mb_legend(collection = 10, initiative = "brazil")
```

Arguments

collection	Integer collection number. Interpreted together with initiative; a value that does not match the initiative's default collection emits a warning and the standardised legend is still returned.
initiative	One of the keys of <code>mb_initiatives</code> ("brazil" by default). Kept for API symmetry and warning logic; the returned legend is the same standardised table for every initiative.

Details

MapBiomass harmonises pixel codes across its initiatives, so a single legend can label every country's raster consistently - this is what makes cross-border assessment possible for a species whose range spans more than one product. The table is the union of the classes that occur in any of the products; a code that does not occur in a given raster simply contributes zero area. Besides the Brazil Collection 10 classes it includes the classes specific to the other countries - e.g. Andinean formations (81, 82), Glacier (34), primary/secondary/dwarf forest (59, 60, 67), scrubland/steppe/fog oasis/peatlands (66, 63, 70, 73), Pinus/Eucalyptus plantations (79, 80) and salt flat (61).

Value

A data.frame with columns code, class_en, class_pt, hex (standardised MapBiomass colour), level1 and group.

Examples

```
head(mb_legend())
subset(mb_legend(), group == "anthropic")$class_en
```

mb_palette

Official MapBiomass colours for a set of class codes

Description

Official MapBiomass colours for a set of class codes

Usage

```
mb_palette(
  codes = NULL,
  collection = 10,
  initiative = "brazil",
  by = c("code", "class_pt", "class_en")
)
```

Arguments

codes	Optional integer vector of MapBiomas pixel codes. If NULL (default) colours for the full legend are returned.
collection	Integer collection number. Interpreted together with initiative; a value that does not match the initiative's default collection emits a warning and the standardised legend is still returned.
initiative	One of the keys of <code>mb_initiatives</code> ("brazil" by default). Kept for API symmetry and warning logic; the returned legend is the same standardised table for every initiative.
by	One of "code" (names are codes) or "class_pt" / "class_en" (names are class labels). Default "code".

Value

A named character vector of hex colours.

Examples

```
mb_palette(c(3, 15, 39, 33))
```

mb_raster_local	<i>Crop a MapBiomas LULC raster to an area of interest (local backend)</i>
-----------------	--

Description

Reads the MapBiomas national mosaic and crops/masks it to aoi using **terra**. By default it streams a *windowed* read of only the AOI's bounding box from the public GeoTIFF via GDAL's `/vsicurl/` driver, so there is no Google Earth Engine account and no full-country download. For offline or repeated use, point `src` to a local GeoTIFF instead.

Usage

```
mb_raster_local(  
  aoi,  
  year = 2024,  
  collection = NULL,  
  initiative = "brazil",  
  src = NULL,  
  mask = TRUE,  
  cache = TRUE,  
  cache_dir = NULL  
)
```

Arguments

aoi	An sf/sfc polygon (any CRS) defining the area to extract, e.g. an EOO hull or the union of AOO cells.
year	Integer year (default 2024).
collection	Integer collection number. NULL uses the initiative default (10/6/3 for Brazil/Amazonia/Colombia).
initiative	One of "brazil" (default), "amazonia" or "colombia" (see mb_initiatives).
src	Optional path or URL to a MapBiomass GeoTIFF. If NULL (default) the public URL for year/collection/initiative is used through /vsicurl/.
mask	Logical; if TRUE (default) pixels outside the polygon are set to NA. If FALSE only a rectangular crop is returned.
cache	Logical; if TRUE (default) the rectangular windowed crop is cached on disk (keyed by source + bounding box), so reading the same area again (e.g. the EOO during assessment and later when mapping, or a re-run) does not re-download. Masking is always applied in memory after the cached crop is loaded.
cache_dir	Directory for the windowed-crop cache (default a mappingAS_mb_cache folder under tempdir()).

Details

For very large ranges (e.g. continental EOOs) the windowed read can still transfer a lot of data; in that case prefer [mb_class_areas_gee](#).

Value

A **terra** SpatRaster of MapBiomass pixel codes restricted to the AOI, in the raster's native CRS.

mb_source_url	<i>Build the MapBiomass land-use GeoTIFF URL for a given year and initiative</i>
---------------	--

Description

Returns the public Google Cloud Storage URL of the MapBiomass land-use/land-cover annual mosaic for the chosen initiative. All supported initiatives publish annual single-year Cloud-Optimized GeoTIFFs on the same public bucket, so they can be streamed with GDAL's /vsicurl/ driver (no Google Earth Engine, no Google Drive). See [mb_initiatives](#) for the full list of initiatives, their default collections and year spans.

Usage

```
mb_source_url(year = 2024, collection = NULL, initiative = "brazil")
```

Arguments

- year Integer year.
- collection Integer collection number. NULL (default) uses the initiative’s default collection.
- initiative One of the keys of [mb_initiatives](#) ("brazil" by default).

Value

A length-1 character URL.

Examples

```
mb_source_url(2024)
mb_source_url(2023, initiative = "amazonia")
mb_source_url(2024, initiative = "peru")
```

mb_years	<i>Years available for a MapBiomass initiative/collection</i>
----------	---

Description

Years available for a MapBiomass initiative/collection

Usage

```
mb_years(collection = 10, initiative = "brazil")
```

Arguments

- collection Integer collection number. Interpreted together with initiative; a value that does not match the initiative’s default collection emits a warning and the standardised legend is still returned.
- initiative One of the keys of [mb_initiatives](#) ("brazil" by default). Kept for API symmetry and warning logic; the returned legend is the same standardised table for every initiative.

Value

An integer vector of years available for the initiative (e.g. Brazil 1985-2024, Amazonia 1986-2023, Paraguay 1985-2023, Uruguay 1985-2022).

Examples

```
range(mb_years())
range(mb_years(initiative = "amazonia"))
```

pa_table	<i>Per-species table of Protected areas overlapping the range</i>
----------	---

Description

Long data.frame (one row per species x UC) listing each federal UC that contains occurrences of, or overlaps the EOO of, each assessed species. Requires `assess_species(..., protected = TRUE)`.

Usage

```
pa_table(assessment, species = NULL)
```

Arguments

assessment	A geoconv_assessment from <code>assess_species()</code> .
species	Optional species name(s); NULL (default) uses all.

Value

A data.frame with species, pa_name, pa_category, pa_group, n_occ (occurrences of that species inside the UC) and overlap_eoo_km2.

plot_class_trendline	<i>Regression trendline of one land-cover class through time</i>
----------------------	--

Description

Fits a regression of a single land-cover class (or conservation group) percentage of area against year and plots the observed points with the fitted curve, its equation, R-squared and p-value. When the **ggtrendline** package is installed (<https://CRAN.R-project.org/package=ggtrendline>) it is used to draw the trendline and annotate the statistics; otherwise the function falls back to a plain **ggplot2** linear fit carrying the same statistics, and finally to base graphics.

Usage

```
plot_class_trendline(
  ts,
  class_label = NULL,
  model = "line2P",
  title = NULL,
  lang = c("en", "pt")
)
```

Arguments

ts	A long data frame from cover_timeseries or timeseries_for_species .
class_label	The label (class or group name) to analyse. When NULL (default), the class with the largest mean percentage across the series is used.
model	ggtrendline model, one of "line2P" (linear, default), "line3P" (quadratic), "log2P", "exp2P", "exp3P", "power2P" or "power3P". Ignored (a linear fit is used) when ggtrendline is not installed.
title	Optional plot title. When NULL, a title is built from the class name and the species/range attributes when present.
lang	Axis/title language: "en" (default) or "pt". When "en" the English MapBiomass class names (class_en) are used when available.

Value

A **ggplot** object when **ggplot2** is available; otherwise NULL (invisibly) after drawing a base plot.

See Also

[plot_timeseries](#), [timeseries_for_species](#)

plot_conversion	<i>Habitat composition chart (natural / altered / water / other) for EOO and AOO</i>
-----------------	--

Description

Draws, for one species, two horizontal stacked bars (EOO and AOO) showing the MapBiomass composition as a percentage of the mapped (observed) area: natural, altered (anthropic), water and other. Segment labels are placed inside each bar and the legend sits below the plot, so nothing overlaps. The headline *terrestrial* converted percentage is shown as a subtitle.

Usage

```
plot_conversion(assessment, species = NULL, lang = c("en", "pt"))
```

Arguments

assessment	A geoconv_assessment.
species	Species name (default: first).
lang	Label language: "en" (default) or "pt".

Details

When **ggplot2** is available (a hard dependency) the function returns a ggplot object, which [mas_plotly](#) can turn into an interactive chart; otherwise it draws a base-graphics fallback and returns the percentage matrix invisibly.

Value

A ggplot object (ggplot2 available) or, in the base-graphics fallback, invisibly the plotted percentage matrix.

See Also

[mas_plotly](#) for the interactive version.

plot_conversion_donut *MapBiomass composition donut charts (EOO and AOO)*

Description

Two side-by-side donut (ring) charts summarising the MapBiomass composition of the Extent of Occurrence (EOO) and Area of Occupancy (AOO) of a species, in the official MapBiomass colours. Slices can be individual land-cover classes (by = "class") or the four conservation groups (by = "group"). Designed to be exported as a transparent-background PNG (all panel/plot/legend backgrounds are transparent), and the interactive **plotly** version (via [mas_plotly](#)) adds outside labels with leader lines and a transparent export.

Usage

```
plot_conversion_donut(
  assessment,
  species = NULL,
  by = c("class", "group"),
  lang = c("en", "pt")
)
```

Arguments

assessment	A geoconv_assessment from assess_species (run with mapbiomas = TRUE).
species	Optional species name. NULL (default) uses the first assessed species.
by	"class" (default) for one ring slice per MapBiomass class, or "group" for the Natural / Altered / Water / Other summary.
lang	"en" (default) or "pt" for slice labels.

Value

A **ggplot** object (with mappingAS metadata attached in attribute "mas" so [mas_plotly](#) can build the interactive donut). Stops with an informative message if no class data are available.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
# reads MapBiomass (one year; the multi-year habitat trend is skipped)
res <- assess_species(occ, year = 2024, infer_decline_from_habitat = FALSE,
                     verbose = FALSE)
plot_conversion_donut(res, by = "class")
```

plot_fire_timeseries	<i>Bar/line chart of burned area (%) over time</i>
----------------------	--

Description

Bar/line chart of burned area (%) over time

Usage

```
plot_fire_timeseries(ts, title = NULL, lang = c("en", "pt"))
```

Arguments

- ts A data frame from [fire_timeseries](#) / [fire_timeseries_for_species](#).
- title Optional title (built from attributes when NULL).
- lang Label language: "en" (default) or "pt".

Value

A **ggplot** object when ggplot2 is available; otherwise NULL after a base plot.

plot_protection	<i>Protection chart (inside vs outside Protected areas) for EOO and AOO</i>
-----------------	---

Description

Two horizontal stacked bars (EOO and AOO) showing the share of the range inside federal Protected areas (Protected areas, UCs) versus outside, from `assess_species(..., protected = TRUE)`. When MapBiomass was also computed (`mapbiomas = TRUE`), the inside-UC part is split into *natural* and *altered* habitat, so the dark-green segment is the range that is natural *and* protected. Layout mirrors [plot_conversion](#): title, one subtitle with the occurrence count, and a legend on the right.

Usage

```
plot_protection(assessment, species = NULL, lang = c("en", "pt"))
```

Arguments

assessment	A geoconv_assessment run with protected = TRUE.
species	Species name (default: first).
lang	Label language: "en" (default) or "pt".

Value

A ggplot object (ggplot2 available) or, in the base-graphics fallback, invisibly the plotted percentage matrix (rows E00/A00).

See Also

[mas_plotly](#) for the interactive version.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
# reads WDPA and one year of MapBiomass (the multi-year habitat trend is skipped)
res <- assess_species(occ, protected = TRUE, infer_decline_from_habitat = FALSE,
                     verbose = FALSE)
plot_protection(res)
```

plot_timeseries	<i>Stacked-area chart of land-cover percentage over time</i>
-----------------	--

Description

Draws percentage of area versus year as stacked areas, one band per class (or group), using the official MapBiomass colours, in the style of the MapBiomass coverage figures. Uses **ggplot2** when available, otherwise base graphics.

Usage

```
plot_timeseries(ts, title = NULL, legend = TRUE, lang = c("en", "pt"))
```

Arguments

ts	A long data frame from cover_timeseries or timeseries_for_species .
title	Optional plot title. If NULL, a title is built from the species/range attributes when present.
legend	Logical; draw the class legend (default TRUE).
lang	Legend language: "en" (default) or "pt". When "en", the band labels use the MapBiomass class_en column (when present in ts) and the axis/legend/title text is in English.

Value

A **ggplot** object (invisibly) when ggplot2 is available; otherwise NULL after drawing a base plot.

protected_areas	<i>Read Protected areas intersecting an area of interest</i>
-----------------	--

Description

Returns the protected-area polygons that fall within the bounding box of `aoi`. By default it reads the global World Database on Protected Areas (WDPA) via [wdpa_areas\(\)](#) (see there for the source), so the overlap works anywhere in the world. For offline use, point `src` to a local protected-area file (`.shp`, `.gpkg`, `.geojson`) instead; it is then filtered to the AOI bounding box and standardised to the same columns.

Usage

```
protected_areas(aoi, src = NULL, cache = TRUE, cache_dir = NULL, quiet = TRUE)
```

Arguments

<code>aoi</code>	An <code>sf/sfc</code> polygon or point set (any CRS) defining the area of interest, e.g. an EOO hull, the union of AOO cells, or the occurrence points.
<code>src</code>	Optional path/URL to a local protected-area vector file. When supplied WDPA is not queried and the file is filtered to the AOI bounding box.
<code>cache, cache_dir</code>	Cache the WDPA result on disk (default TRUE; folder mapping <code>AS_pa_cache</code> under <code>tempdir()</code>).
<code>quiet</code>	Passed to sf::st_read() (default TRUE).

Details

The result carries three standardised columns: `pa_name`, `pa_category` and `pa_group`, plus all original attributes.

Value

An `sf` of protected-area polygons in EPSG:4326 (possibly with zero rows when none intersects the AOI), or NULL if the source could not be read.

See Also

[wdpa_areas\(\)](#)

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
sp1 <- occ[occ$species == occ$species[1], ]
pas <- protected_areas(calc_eoo(sp1)$hull) # reads WDPA over the web
unique(pas$pa_name)
```

read_occurrences	<i>Read species occurrence points from XLSX, CSV or vector files</i>
------------------	--

Description

Imports occurrence records from a spreadsheet (.xlsx/.xls), delimited text (.csv/.tsv/.txt) or a vector file (.shp, .gpkg, .geojson; for shapefiles you may also pass a .zip containing the .shp/.shx/.dbf/.prj set) and returns a clean point sf in WGS84 (EPSG:4326) with a standardised species column.

Usage

```
read_occurrences(
  path,
  species_col = NULL,
  lon_col = NULL,
  lat_col = NULL,
  crs = 4326,
  sheet = NULL,
  sep = NULL,
  dec = NULL,
  encoding = "UTF-8",
  default_species = "sp1"
)
```

Arguments

path	Path to the input file.
species_col, lon_col, lat_col	Optional column names to override auto-detection. lon_col/lat_col are ignored for vector files that already carry geometry.
crs	Input CRS for tabular coordinates (default 4326). Output is always reprojected to WGS84.
sheet	For Excel inputs, the sheet name or index (default first sheet).
sep	For delimited text, the field separator. If NULL (default) it is auto-detected from the header line (;, , or tab).
dec	Decimal mark for delimited text. If NULL (default) it is inferred from sep (, when sep is ;, else .), matching Brazilian Excel exports.

encoding	File encoding for delimited text (default "UTF-8"; use e.g. "latin1" for Windows-1252 files).
default_species	Species label used when no species column is found (default "sp1").

Details

Longitude, latitude and species columns are auto-detected from common header names (Darwin Core decimalLongitude/decimalLatitude, lon/lat, x/y, scientificName, etc.). You can override the detection with the corresponding arguments. Rows with missing or out-of-range coordinates are dropped with a message.

For delimited text the field separator and decimal mark are auto-detected, so Brazilian-style CSVs exported from Excel (; separator, , decimals, optional UTF-8 BOM) are read correctly without extra arguments.

Value

An sf of POINT geometries in EPSG:4326 with a species column plus all original attributes.

Examples

```
f <- system.file("extdata", "example_occurrences.csv", package = "mappingAS")
occ <- read_occurrences(f)
table(occ$species)
```

run_app

Launch the mappingAS Shiny application

Description

Starts the interactive app for uploading occurrences, computing EOO/AOO and MapBiomass habitat conversion, and exploring/exporting the results.

Usage

```
run_app(launch.browser = TRUE, max_upload_mb = 500, ...)
```

Arguments

launch.browser	Logical; open in the default browser (default TRUE).
max_upload_mb	Maximum size, in megabytes, of a file that can be uploaded in the app (default 500). Shiny's own default is only 5 MB, which rejects large occurrence tables before they can be read; raise this for very large datasets. Set to NULL to leave any pre-existing shiny.maxRequestSize option untouched.
...	Passed to shiny::runApp().

Value

Invisibly NULL; called for its side effect.

Examples

```
if (interactive()) {
  run_app()
  # allow uploads up to 2 GB
  run_app(max_upload_mb = 2048)
}
```

s2_raster_local	<i>Crop a Sentinel-2 / Esri LULC mosaic to an area of interest</i>
-----------------	--

Description

Global analogue of [mb_raster_local](#) for the Esri / Impact Observatory 10 m Annual Land Use Land Cover product. Determines the MGRS grid-zone tile(s) intersecting `aoi`, streams a windowed read of each via GDAL's `/vsicurl/` driver (no Google Earth Engine, no account), masks to the polygon and, when the AOI spans more than one tile, merges the pieces (reprojected to geographic coordinates for display). For accurate area statistics the assessment path tabulates each tile in its native projection and sums, rather than reprojecting; use [summarise_conversion](#) on the class areas for that.

Usage

```
s2_raster_local(
  aoi,
  year = 2023,
  src = NULL,
  base_url = NULL,
  mask = TRUE,
  cache = TRUE,
  cache_dir = NULL
)
```

Arguments

<code>aoi</code>	An <code>sf/sfc</code> polygon (any CRS), e.g. an EOO hull or the union of AOO cells.
<code>year</code>	Integer year (2017-2023, default 2023).
<code>src</code>	Optional path/URL to a single Esri LULC GeoTIFF (ends in <code>.tif</code> , used as-is), or a base-URL prefix that replaces the default bucket. If NULL (default) the public bucket is used through <code>/vsicurl/</code> .
<code>base_url</code>	Base URL of the public bucket (see s2_source_url).
<code>mask</code>	Logical; if TRUE (default) pixels outside the polygon are set to NA.
<code>cache</code>	Logical; cache the windowed crops on disk (default TRUE).
<code>cache_dir</code>	Directory for the crop cache (default under <code>tempdir()</code>).

Value

A **terra** SpatRaster of Esri land-cover codes for the AOI.

See Also

[esri_legend](#), [s2_source_url](#), [mb_raster_local](#)

s2_source_url	<i>Build the Sentinel-2 / Esri land-cover GeoTIFF URL for a tile and year</i>
---------------	---

Description

Returns the public Cloud-Optimized GeoTIFF URL of one MGRS grid-zone tile of the Esri / Impact Observatory 10 m Annual Land Use Land Cover product. The global mosaic is tiled by MGRS grid-zone designator (e.g. "47P"); an area of interest usually intersects one or a few tiles, which the local backend resolves automatically (see [s2_raster_local](#)).

Usage

```
s2_source_url(tile, year = 2023, base_url = NULL)
```

Arguments

tile	MGRS grid-zone designator (UTM zone number + latitude band letter), e.g. "47P". The public bucket zero-pads the zone to two digits (e.g. "01C").
year	Integer year (2017-2023).
base_url	Base URL of the public bucket holding the per-tile COGs. Defaults to the public AWS Open Data bucket <code>io-10m-annual-lulc</code> ; kept overridable so a mirror or an updated layout can be used without changing the package.

Value

A length-1 character URL of the form `<base>/<tile>_<year>.tif`.

See Also

[s2_raster_local](#), [esri_legend](#)

Examples

```
s2_source_url("47P", 2023)
```

s2_years

Years available for the global Sentinel-2 / Esri land-cover series

Description

Years available for the global Sentinel-2 / Esri land-cover series

Usage

```
s2_years()
```

Value

An integer vector of the years covered by the Esri / Impact Observatory 10 m Annual Land Use Land Cover product (currently 2017-2023).

See Also

[esri_legend](#), [s2_source_url](#), [assess_species](#)

Examples

```
range(s2_years())
```

summarise_conversion

Summarise habitat conversion from MapBiomass class areas

Description

Aggregates a table of per-class areas into conservation groups and computes the percentage of converted (anthropic) versus remaining natural habitat.

Usage

```
summarise_conversion(
  class_areas,
  collection = 10,
  initiative = "brazil",
  water_in_denominator = FALSE
)
```

Arguments

class_areas	Either a <code>data.frame</code> with columns <code>code</code> and <code>area_km2</code> (e.g. from mb_class_areas_gee) or a terra <code>SpatRaster</code> of MapBiomass codes (which is tabulated via mb_class_areas_raster).
collection	Integer collection number (default 10).
initiative	One of "brazil" (default), "amazonia" or "colombia"; selects the standardised legend context (see mb_legend).
water_in_denominator	Logical; if TRUE, water is treated as natural and included in the terrestrial denominator (default FALSE).

Details

The headline metrics use a *terrestrial* denominator (natural + anthropic), excluding water, not-observed and ambiguous "other" classes, which is the most defensible measure of habitat conversion. A total-area version (denominator = everything except not-observed) is also returned for transparency.

Value

A list with: `converted_pct`, `natural_pct` (terrestrial, the headline numbers), `converted_pct_total`, `natural_pct_total`, the group areas (`natural_km2`, `anthropic_km2`, `water_km2`, `other_km2`, `not_observed_km2`, `total_km2`) and `by_class` (the per-class table joined to the legend).

Examples

```
ca <- data.frame(code = c(3, 15, 24, 33), area_km2 = c(60, 30, 10, 5))
summarise_conversion(ca)$converted_pct
```

summarise_fire	<i>Summarise fire pressure inside a range</i>
----------------	---

Description

Fire analogue of [summarise_conversion](#). Pass the known range area (`range_km2`, e.g. `eo0$area_km2`) as denominator so the percentage is exact and robust to the raster's NoData handling.

Usage

```
summarise_fire(fire_areas, range_km2 = NULL)
```

Arguments

fire_areas	A <code>data.frame</code> from fire_areas .
range_km2	Total range area (km ²). If NULL, the sum of all tabulated cells is used (valid only when unburned pixels are coded 0).

Value

A list with burned_km2, total_km2, burned_pct, freq_mean, freq_max and by_freq.

summarise_protected	<i>Overlap between a species' range and federal Protected areas</i>
---------------------	---

Description

Given a species' occurrence points and (optionally) its EOO and AOO, plus a UC layer from [protected_areas\(\)](#), computes how much of the range is legally protected: the share of occurrences inside UCs, the percentage/area of the EOO and AOO that fall within UCs, and the list of UCs touched.

Usage

```
summarise_protected(points, pa, eoo = NULL, aoo = NULL)
```

Arguments

- points An sf of POINT geometries (one species).
- pa A UC sf from [protected_areas\(\)](#) (standardised columns).
- eoo, aoo The eoo/aoo sublists produced by [assess_species\(\)](#) (or [calc_eoo\(\)](#)/[calc_aoo\(\)](#)). Either may be NULL.

Details

Percentages are computed on the species' equal-area projection so ratios are exact; the reported eoo_km2/aoo_km2 inside UCs are derived from the headline EOO/AOO so they stay consistent with [assess_species\(\)](#). The AOO overlap follows the grid nature of the metric: an occupied 2-km cell counts as protected when it intersects any UC.

Value

A list: n_occ, n_occ_in, occ_pct; eoo_pct, eoo_km2; aoo_pct, aoo_km2, aoo_cells_in; n_uc; list (per-UC data.frame) and layer (the UC sf).

timeseries_for_species

Land-cover time series for one assessed species (EOO or AOO)

Description

Convenience wrapper that pulls the stored EOO hull or AOO geometry from an assessment and runs [cover_timeseries](#) on it, reusing the assessment's collection and backend by default.

Usage

```
timeseries_for_species(
  assessment,
  species = NULL,
  range = c("eoo", "aoo"),
  years = NULL,
  by = c("class", "group"),
  src = NULL,
  verbose = TRUE,
  max_pixels = 8e+06
)
```

Arguments

assessment	A geoconv_assessment from assess_species .
species	Species name (default: first assessed species).
range	"eoo" (default) or "aoo".
years, by, src, verbose	Passed to cover_timeseries .
max_pixels	Pixel budget per year, passed to cover_timeseries . Defaults to 8e6 (~8 million) - much lower than the single-snapshot assessment, because a composition <i>trend</i> is a ratio and needs far less resolution, and every year is a separate read: the coarser budget makes a multi-year series over a large range several times faster with no meaningful change to the percentages.

Value

The long data frame from [cover_timeseries](#), with attributes species and range set.

vouchers_from_occ	<i>Build examined-voucher strings from occurrence attributes</i>
-------------------	--

Description

Derives a character vector of herbarium-style voucher citations from the attribute columns of an occurrence table (or the sf returned by [read_occurrences](#)), so the "Examined vouchers" box of the factsheet can be filled automatically instead of by hand.

Usage

```
vouchers_from_occ(
  occ,
  species = NULL,
  voucher_col = NULL,
  collector_col = NULL,
  number_col = NULL,
  herbarium_col = NULL,
  unique = TRUE,
  sort = TRUE
)
```

Arguments

<code>occ</code>	A data frame or an sf of occurrence records. Geometry, if present, is ignored.
<code>species</code>	Optional species name (or vector) to filter the rows before building the vouchers, matched against the species column when it exists. NULL (default) uses every row.
<code>voucher_col, collector_col, number_col, herbarium_col</code>	Optional column names overriding the automatic detection. Set a column to NA to disable that part of the detection.
<code>unique</code>	Collapse duplicate vouchers to a single entry (default TRUE).
<code>sort</code>	Sort the returned vouchers alphabetically (default TRUE).

Details

Two strategies are tried, in order:

1. If a ready-made voucher column exists (e.g. `voucher`, `exsiccata`, `material`) its non-empty values are used verbatim.
2. Otherwise a collector column (e.g. `collector`, `recordedBy`) is combined with a collection-number column (e.g. `collectorNumber`, `recordNumber`) into "Collector Number". When a herbarium/institution column is present (e.g. `herbarium`, `institutionCode`) its code is appended in parentheses, giving "Collector Number (RB)".

Column names are matched case-insensitively from a set of common Darwin Core and herbarium aliases; pass the `*_col` arguments to override the detection. When no relevant column is found, an empty character vector is returned (so the caller simply leaves the box empty).

Value

A character vector of voucher strings (possibly empty).

Examples

```
df <- data.frame(
  species = c("Aus bus", "Aus bus"),
  collector = c("Barreira", "Silva"),
  collectorNumber = c("123", "456"),
  herbarium = c("RB", "R"),
  stringsAsFactors = FALSE)
vouchers_from_occ(df)
```

wdpa_areas	<i>Read World Database on Protected Areas polygons intersecting an area</i>
------------	---

Description

Queries the public WDPa ArcGIS FeatureServer for the protected-area polygons whose envelope intersects the bounding box of aoi and returns them as an sf in WGS84 with the same three standardised columns used by [protected_areas\(\)](#): pa_name (WDPA NAME), pa_category (designation / IUCN category) and pa_group (*Strict protection* for IUCN Ia-III, *Sustainable use* for IUCN IV-VI, else the reported status), plus all original WDPa attributes.

Usage

```
wdpa_areas(
  aoi,
  url = wdpa_query_url(),
  marine = c("all", "terrestrial"),
  cache = TRUE,
  cache_dir = NULL,
  quiet = TRUE
)
```

Arguments

aoi	An sf/sfc polygon or point set (any CRS).
url	WDPA query endpoint (default wdpa_query_url()).
marine	One of "all" (default), "terrestrial" (drop purely marine PAs, MARINE = 2) - useful for terrestrial species screening.
cache, cache_dir	Cache the result on disk (default TRUE; folder mappingAS_pa_cache under tempdir()).
quiet	Passed to sf::st_read() (default TRUE).

Details

Only the AOI's bounding box is requested (server-side envelope filter) and the server's transfer limit is followed with pagination, so this stays light even though WDPA is a global dataset. Results are cached on disk by bounding box. This is the recommended protected-area source for the "amazonia" and "colombia" initiatives (and anywhere outside Brazil), where the ICMBio service does not apply.

Value

An sf of WDPA polygons in EPSG:4326 (possibly zero rows), or NULL if the service could not be read.

Examples

```
occ <- read_occurrences(system.file("extdata", "example_occurrences.csv",
                                   package = "mappingAS"))
sp1 <- occ[occ$species == occ$species[1], ]
pas <- wdpa_areas(calc_eoo(sp1)$hull) # reads WDPA over the web
unique(pas$pa_name)
```

wdpa_query_url

Default WDPA ArcGIS FeatureServer query endpoint

Description

The public ArcGIS FeatureServer layer that serves the World Database on Protected Areas (WDPA) polygons, used by `wdpa_areas()` as a global alternative to the Brazil-only ICMBio Conservation Units. This is the layer behind the ArcGIS Living Atlas "WDPA" item and returns GeoJSON on demand, so no Google Earth Engine or bulk download is required.

Usage

```
wdpa_query_url()
```

Value

A length-1 character URL (the /query endpoint).

See Also

<https://www.protectedplanet.net/en>, `wdpa_areas()`

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