Package 'redlistr'

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Title Tools for the IUCN Red List of Ecosystems and Species

Version 1.0.4

Description A toolbox created by members of the International Union for
Conservation of Nature (IUCN) Red List of Ecosystems Committee for
Scientific Standards. Primarily, it is a set of tools suitable for
calculating the metrics required for making assessments of species and
ecosystems against the IUCN Red List of Threatened Species and the
IUCN Red List of Ecosystems categories and criteria. See the IUCN
website for detailed guidelines, the criteria, publications and other
information.

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URL https://github.com/red-list-ecosystem/redlistr

BugReports https://github.com/red-list-ecosystem/redlistr/issues

Depends R (>= 3.3.0), raster (>= 2.5-8), sp (>= 1.2-4)

Imports plyr, sf, terra

Suggests devtools, knitr, rmarkdown, testthat

VignetteBuilder knitr

Encoding UTF-8

RoxygenNote 7.2.1

NeedsCompilation no

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Repository CRAN

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R topics documented:

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createGrid   *Create empty Area of Occupancy (AOO) Grid.*

Description

createGrid produces empty grid which can be used as the basis to help compute AOO.

Usage

```
createGrid(input.data, grid.size)
```

Arguments

input.data	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
grid.size	A number specifying the width of the desired grid square (in same units as your coordinate reference system)

Value

A regular grid raster with extent input.data and grid size grid.size. Each grid square has a unique identification number.

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other AOO functions: getAOOSilent(), getAOO(), makeAOOGrid()

---

extrapolateEstimate	*Extrapolate Estimate*

Description

extrapolateEstimate uses rates of decline from getDeclineStats to extrapolate estimates to a given time

Usage

```
extrapolateEstimate(A.t1, year.t1, nYears, ARD = NA, PRD = NA, ARC = NA)
```

Arguments

A.t1	Area at time t1
year.t1	Year of time t1
nYears	Number of years since t1 for prediction. Use negative values for backcasting
ARD	Absolute rate of decline
PRD	Proportional rate of decline
ARC	Annual rate of change

Value

A dataframe with the forecast year, and a combination of:

- Values as extrapolated with absolute rate of decline (ARD)
- Values as extrapolated with proportional rate of decline (PRD)
- Values as extrapolated with annual rate of change (ARC)

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other change_functions: futureAreaEstimate(), sequentialExtrapolate()

Examples

```
a.r1 <- 23.55
a.r2 <- 15.79
decline.stats <- getDeclineStats(a.r1, a.r2, year.t1 = 1990, year.t2 = 2012,
                                  methods = 'PRD')
a.2040.PRD <- extrapolateEstimate(a.r1, a.r2, year.t1 = 1990, nYears = 50,
                                   PRD = decline.stats$PRD)
```

---

futureAreaEstimate   *Future Area Estimate*

Description

futureAreaEstimate is now deprecated, please use extrapolateEstimate instead

Usage

```
futureAreaEstimate(A.t1, year.t1, nYears, ARD = NA, PRD = NA, ARC = NA)
```

Arguments

A.t1	Area at time t1
year.t1	Year of time t1
nYears	Number of years since t1 for area prediction
ARD	Absolute rate of decline
PRD	Proportional rate of decline
ARC	Annual rate of change

Value

A dataframe with the forecast year, and a combination of:

- Future area as estimated with absolute rate of decline (ARD)
- Future area as estimated with proportional rate of decline (PRD)
- Future area as estimated with annual rate of change (ARC)

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other change_functions: extrapolateEstimate(), sequentialExtrapolate()

---

getAOO   *Compute Area of Occupancy (AOO)*

Description

getAOO determines the number of area of occupancy (AOO) grid cells occupied by a species or ecosystem. It includes capability for specifying whether at least one percent of the grid cell needs to be occupied before it is counted in the AOO. This functionality is important for assessing the IUCN Red List of Ecosystems Criteria B.

Usage

```
getAOO(input.data, grid.size, min.percent.rule = FALSE, percent = 1)
```

Arguments

input.data	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
grid.size	A number specifying the width of the desired grid square (in same units as your coordinate reference system)
min.percent.rule	
	Logical. If TRUE, a minimum area threshold must be passed before a grid is counted as an AOO grid.
percent	Numeric. The minimum percent to be applied as a threshold for the min.percent.rule

Value

The number of grid cells occupied by the ecosystem or species

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other AOO functions: createGrid(), getAOOSilent(), makeAOOGrid()

Examples

```
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- raster(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
extent(r1) <- extent(0, 6100, 0, 8700)
AOO <- getAOO(r1, 1000, min.percent.rule = TRUE, percent = 1)
```

---

getAOOSilent   *Alternate function for getting AOO (with custom grid)*

Description

getAOOSilent is identical to getAOO, but allows the custom input of the grid parameter. Used for gridUncertainty.

Usage

```
getAOOSilent(input.data, grid, min.percent.rule = FALSE, percent = 1)
```

Arguments

input.data	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
grid	Custom grid to be used to calculate AOO. Usually the output of gridUncertainty
min.percent.rule	
	Logical. If TRUE one percent of the grid cell must be occupied before it is counted in the AOO.
percent	Numeric. The minimum percent to be applied as a threshold for the min.percent.rule

Value

Value. The AOO calculated with the input distribution and grid.

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other AOO functions: createGrid(), getAOO(), makeAOOGrid()

---

getArea   *Calculates the Area of a Raster.*

Description

`getArea` reports the area of a RasterLayer object using the pixel counting method, or terra::expanse for SpatRaster and SpatVector objects, or the area of a SpatialPolygons or sf object using sf::st_area

Usage

```
getArea(x, ...)
```

Arguments

x   Either a RasterLayer or SpatialPolygons object. For a RasterLayer, no data value
                should be NA

...   Addition arguments based on input format

Value

The total area of the cells of interest in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: getArea.RasterLayer(), getArea.SpatRaster(), getArea.SpatVect(),
getArea.SpatialPolygons(), getArea.sf(), getAreaLoss(), getDeclineStats()

Examples

```
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- raster(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
extent(r1) <- extent(0, 6100, 0, 8700)
a.r1 <- getArea(r1) # area of all non-NA cells in r1
```

---

getArea.RasterLayer   *Calculates the Area of a Raster from RasterLayer.*

Description

getArea reports the area of a RasterLayer object using the pixel counting method.

Usage

```
## S3 method for class 'RasterLayer'
getArea(x, value.to.count, ...)
```

Arguments

x	Either a RasterLayer object. No data value should be NA
value.to.count	Optional. Value of the cells in a RasterLayer to be counted
...	Addition arguments based on input format

Value

The total area of the cells of interest in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: `getArea.SpatRaster()`, `getArea.SpatVect()`, `getArea.SpatialPolygons()`, `getArea.sf()`, `getAreaLoss()`, `getArea()`, `getDeclineStats()`

---

getArea.sf   *Calculates the Area of a Raster from sf object*

Description

getArea reports the area of a sf object using sf::st_area

Usage

```
## S3 method for class 'sf'
getArea(x, ...)
```

Arguments

x	A sf object
...	Addition arguments based on input format

Value

The total area of the cells of interest in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: `getArea.RasterLayer()`, `getArea.SpatRaster()`, `getArea.SpatVect()`, `getArea.SpatialPolygons()`, `getAreaLoss()`, `getArea()`, `getDeclineStats()`

---

getArea.SpatialPolygons

Calculates the Area of a Raster from SpatialPolygons.

Description

getArea reports the area of a SpatialPolygons object using sf::st_area

Usage

```
## S3 method for class 'SpatialPolygons'
getArea(x, ...)
```

Arguments

x	A SpatialPolygons object.
...	Addition arguments based on input format

Value

The total area of the cells of interest in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: `getArea.RasterLayer()`, `getArea.SpatRaster()`, `getArea.SpatVect()`, `getArea.sf()`, `getAreaLoss()`, `getArea()`, `getDeclineStats()`

---

getArea.SpatRaster   *Calculates the Area of a Raster from SpatRaster.*

Description

getArea reports the area of a SpatRaster object using terra::expanse

Usage

```
## S3 method for class 'SpatRaster'
getArea(x, byValue, ...)
```

Arguments

x	SpatRaster
byValue	Logical. If TRUE, the area for each unique cell value is returned.
...	Addition arguments based on input format

Value

The total area of the cells of interest in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: `getArea.RasterLayer()`, `getArea.SpatVect()`, `getArea.SpatialPolygons()`, `getArea.sf()`, `getAreaLoss()`, `getArea()`, `getDeclineStats()`

---

getArea.SpatVect   *Calculates the Area of a Raster from SpatVect.*

Description

getArea reports the area of a SpatVect. object using terra::expanse

Usage

```
## S3 method for class 'SpatVect'
getArea(x, ...)
```

Arguments

x	A SpatVect object
...	Addition arguments based on input format

Value

The total area of the cells of interest in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: `getArea.RasterLayer()`, `getArea.SpatRaster()`, `getArea.SpatialPolygons()`, `getArea.sf()`, `getAreaLoss()`, `getArea()`, `getDeclineStats()`

---

getAreaEOO *Calculates area of the created EOO polygon.*

Description

`getAreaEOO` calculates the area of the EOO polygon generated from `makeEOO` the provided data

Usage

```
getAreaEOO(EOO.polygon, unit = "km")
```

Arguments

EOO.polygon	An object of class SpatVect, usually the output from `makeEOO`.
unit	Character. Output unit of area. One of "m", "km", or "ha"

Value

The area of the `EOO.polygon` in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other EOO functions: `makeEOO()`

Examples

```
library(terra)
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- rast(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
ext(r1) <- c(0, 6100, 0, 8700)
EOO.polygon <- makeEOO(r1)
EOO.area <- getAreaEOO(EOO.polygon)
```

---

getAreaLoss   *Area change between two inputs in km2*

Description

getAreaLoss reports the difference in area between two inputs. These can be RasterLayers, SpatialPolygons, SpatRaster, SpatVect, sf or numbers. Any combinations of these inputs are valid. If using number as input, ensure it is measured in km2

Usage

```
getAreaLoss(x, y)
```

Arguments

x   Spatial obect or numeric representing area in km2

y   Spatial object or numeric representing area in km2

Value

Returns the difference in area of the two inputs in km2

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

Other Change functions: `getArea.RasterLayer()`, `getArea.SpatRaster()`, `getArea.SpatVect()`, `getArea.SpatialPolygons()`, `getArea.sf()`, `getArea()`, `getDeclineStats()`

Examples

```
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- raster(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
extent(r1) <- extent(0, 6100, 0, 8700)
r2 <- raster(ifelse((volcano<145), NA, 1), crs = crs.UTM55S)
extent(r2) <- extent(0, 6100, 0, 8700)
a.dif <- getAreaLoss(r1, r2) # distribution rasters
```

getDeclineStats *Change statistics.*

Description

getDeclineStats calculates the Proportional Rate of Decline (PRD), Absolute Rate of Decline (ARD) and Annual Rate of Change (ARC), given two areas at two points in time. Also provides the total area difference. Inputs are usually the results from getArea.

Usage

```
getDeclineStats(A.t1, A.t2, year.t1, year.t2, methods)
```

Arguments

A.t1	Area at time t1
A.t2	Area at time t2
year.t1	Year of time t1
year.t2	Year of time t2
methods	Method(s) used to calculate rate of decline. Either 'PRD', 'ARD', and/or 'ARC'. See vignette to see a more detailed explanation for each of them.

Value

A dataframe with absolute differences between the two inputs, and a selection of:

- Proportional Rate of Decline (PRD)
- Absolute Rate of Decline (ARD)
- Annual Rate of Change (ARC)

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/ Puyravaud, J.-P. 2003. Standardizing the calculation of the annual rate of deforestation. Forest Ecology and Management, 177, 593-596.

See Also

Other Change functions: getArea.RasterLayer(), getArea.SpatRaster(), getArea.SpatVect(), getArea.SpatialPolygons(), getArea.sf(), getAreaLoss(), getArea()

Examples

```
a.r1 <- 23.55
a.r2 <- 15.79
decline.stats <- getDeclineStats(a.r1, a.r2, year.t1 = 1990, year.t2 = 2012,
                                 methods = c('ARD', 'ARC'))
```

---

gridUncertainty	*Function to compute AOO with grid uncertainty systematically with stopping rule*

Description

`gridUncertainty` determines the number of area of occupancy (AOO) grid cells occupied by a species or ecosystem systematically. It will only stop when the AOO calculated does not improve (decrease) after a set number of split scenarios.

Usage

```
gridUncertainty(
  input.data,
  grid.size,
  n.AOO.improvement,
  min.percent.rule = FALSE,
  percent = 1
)
```

Arguments

input.data   Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.

grid.size   A number specifying the width of the desired grid square (in same units as your coordinate reference system)

n.AOO.improvement

                Specifies the minimum number of rounds the calculated AOO is not improved before stopping the function.

min.percent.rule

                Logical. If TRUE, a minimum area threshold must be passed before a grid is counted as an AOO grid.

percent   Numeric. The minimum percent to be applied as a threshold for the min.percent.rule.

Value

A list containing the following:

- Data frame of results showing the minimum AOO calculated for each shift scenario
- Single SpatialPolygonsDataFrame containing the AOO grid which would produce the minimum AOO calculated

Author(s)

Calvin Lee `<calvinkflee@gmail.com>`

See Also

Other gridUncertainty functions: `gridUncertaintyBase()`, `gridUncertaintyRandomManual()`, `gridUncertaintyRandom()`, `gridUncertaintyRestricted()`, `gridUncertaintySimulation()`

Examples

```
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- raster(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
extent(r1) <- extent(0, 6100, 0, 8700)
x <- gridUncertainty(r1, grid.size = 1000, n.AOO.improvement = 5,
                        min.percent.rule = FALSE, percent = 1)
```

---

gridUncertaintyBase   *Base function to compute AOO with grid uncertainty systematically*

Description

`gridUncertaintyBase` helps determine the minimum number of area of occupancy (AOO) grid cells occupied by a species or ecosystem. It varies the location of the AOO grid by shifting in systematically in both x- and y- axes, adding a small amount of random movement (five percent of the `grid.size`) at each point. It then returns summary statistics for the range of AOOs calculated, and the RasterLayer(s) containing the grids with the minimum AOO. It is the base function which is used by `gridUncertainty`, `gridUncertaintySimulation`, and `gridUncertaintyRestricted`

Usage

```
gridUncertaintyBase(
  input.data,
  grid.size,
  splits,
  min.percent.rule = FALSE,
  percent = 1,
  restriction = FALSE,
  min.grids.shift
)
```

Arguments

input.data	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
grid.size	A number specifying the width of the desired grid square (in same units as your coordinate reference system)
splits	Specifies the number of ways to split the grid in ONE axis.

min.percent.rule

> Logical. If `TRUE`, a minimum area threshold must be passed before a grid is counted as an AOO grid.

percent   Numeric. The minimum percent to be applied as a threshold for the `min.percent.rule`.

restriction   Logical. If `TRUE`, allows user to specify areas to focus where grid search is done. Used in gridUncertaintyRestricted.

min.grids.shift

> Dataframe object with two columns (x.shift and y.shift) specifying the coordinates to restrict the AOO grid placement.

Value

List containing the following:

- Vector of length split*split of calculated AOO for each shifted grid

- Data frame of summary statistics for the results create the AOO grid(s) which return the smallest AOO

- Data frame of the shift(s) required to create the AOO grid(s) with the smallest AOO

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

[createGrid()](#) [getAOOSilent()](#)

Other gridUncertainty functions: [gridUncertaintyRandomManual](#)(), [gridUncertaintyRandom](#)(), [gridUncertaintyRestricted](#)(), [gridUncertaintySimulation](#)(), [gridUncertainty](#)()

---

gridUncertaintyRandom   *Function to compute AOO with grid uncertainty randomly with stop rule*

Description

`gridUncertaintyRandom` helps determine the minimum number of area of occupancy (AOO) grid cells occupied by a species or ecosystem. It varies the location of the AOO grid by shifting in randomly in both x- and y- axes, returning summary statistics for the range of AOOs calculated, and the RasterLayer(s) containing the grids with the minimum AOO. It automatically stops when the AOO no longer improves after a specified number of rounds.

Usage

```
gridUncertaintyRandom(
  input.data,
  grid.size,
  n.AOO.improvement,
  min.percent.rule = FALSE,
  percent = 1,
  max.n.rounds = 1000
)
```

Arguments

input.data	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
grid.size	A number specifying the width of the desired grid square (in same units as your coordinate reference system)
n.AOO.improvement	
	Specifies the minimum number of rounds the calculated AOO is not improved before stopping the function.
min.percent.rule	
	Logical. If TRUE, a minimum area threshold must be passed before a grid is counted as an AOO grid.
percent	Numeric. The minimum percent to be applied as a threshold for the min.percent.rule.
max.n.rounds	Specifies the maximum number of rounds to calculate AOOs. Generally unused except to limit computation time.

Value

List containing the following:

- Data frame of summary statistics for the results

- Data frame showing the distance shifted in x and y directions used to create the AOO grid(s) and their associated AOOs

- List of RasterLayer(s) containing the AOO grid(s) which return the smallest AOO

Author(s)

Calvin Lee <calvinkflee@gmail.com>. Nicholas Murray <murr.nick@gmail.com>

See Also

[createGrid()](#) [getAOOSilent()](#)

Other gridUncertainty functions: [gridUncertaintyBase()](#), [gridUncertaintyRandomManual()](#), [gridUncertaintyRestricted()](#), [gridUncertaintySimulation()](#), [gridUncertainty()](#)

Examples

```
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- raster(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
extent(r1) <- extent(0, 6100, 0, 8700)
x <- gridUncertaintyRandom(r1, grid.size = 1000, n.AOO.improvement = 50,
                           min.percent.rule = TRUE, percent = 1)
```

---

gridUncertaintyRandomManual

Manual function to compute AOO with grid uncertainty randomly

---

Description

gridUncertaintyRandomManual helps determine the minimum number of area of occupancy (AOO) grid cells occupied by a species or ecosystem. It varies the location of the AOO grid by shifting in randomly in both x- and y- axes, returning summary statistics for the range of AOOs calculated, and the RasterLayer(s) containing the grids with the minimum AOO. Requires manual input for the number of simulations to perform.

Usage

```
gridUncertaintyRandomManual(
  input.data,
  grid.size,
  n.sim = 10,
  min.percent.rule = FALSE,
  percent = 1
)
```

Arguments

input.data	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
grid.size	A number specifying the width of the desired grid square (in same units as your coordinate reference system)
n.sim	Specifies the number of random grids to be created and tested.
min.percent.rule	
	Logical. If TRUE, a minimum area threshold must be passed before a grid is counted as an AOO grid.
percent	Numeric. The minimum percent to be applied as a threshold for the min.percent.rule.

Value

List containing the following:

- Data frame of summary statistics for the results

- Data frame showing the distance shifted in x and y directions used to create the AOO grid(s) and their associated AOOs

- List of RasterLayer(s) containing the AOO grid(s) which return the smallest AOO

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

See Also

[createGrid()](#) [getAOOSilent()](#)

Other gridUncertainty functions: [gridUncertaintyBase()](#), [gridUncertaintyRandom()](#), [gridUncertaintyRestricted()](#) [gridUncertaintySimulation()](#), [gridUncertainty()](#)

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gridUncertaintyRestricted

Function to compute AOO with grid uncertainty systematically with stopping rule and restrictions

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Description

`gridUncertaintyRestricted` determines the number of area of occupancy (AOO) grid cells occupied by a species or ecosystem systematically. It will only stop when the AOO calculated does not improve (decrease) after a set number of split scenarios. The number of grids within each split is restricted to only include those which are already found nearby to ones already with the minimum AOO.

Usage

```
gridUncertaintyRestricted(
  input.data,
  grid.size,
  n.AOO.improvement,
  min.percent.rule = FALSE,
  percent = 1
)
```

Arguments

`input.data`	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
`grid.size`	A number specifying the width of the desired grid square (in same units as your coordinate reference system)
`n.AOO.improvement`	
	Specifies the minimum number of rounds the calculated AOO is not improved before stopping the function.
`min.percent.rule`	
	Logical. If `TRUE`, a minimum area threshold must be passed before a grid is counted as an AOO grid.
`percent`	Numeric. The minimum percent to be applied as a threshold for the `min.percent.rule`.

Value

A list containing the following:

- Data frame of results showing the minimum AOO calculated for each shift scenario

- Single SpatialPolygonsDataFrame containing the AOO grid which would produce the minimum AOO calculated

Author(s)

Calvin Lee <calvinkflee@gmail.com>

See Also

Other gridUncertainty functions: [gridUncertaintyBase](), [gridUncertaintyRandomManual](), [gridUncertaintyRandom](), [gridUncertaintySimulation](), [gridUncertainty]()

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gridUncertaintySimulation

Function to investigate behaviour of AOO under various split scenarios

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Description

`gridUncertaintySimulation` returns the maximum and minimum number of area of occupancy (AOO) grid cells occupied by a species or ecosystem in incremental splits using `gridUncertaintyBase`.

Usage

```
gridUncertaintySimulation(
  input.data,
  grid.size,
  simulations,
  min.percent.rule = FALSE,
  percent = 1
)
```

Arguments

`input.data`	Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.
`grid.size`	A number specifying the width of the desired grid square (in same units as your coordinate reference system)
`simulations`	Specifies the maximum number of splits to be performed on the generated grid
`min.percent.rule`	
	Logical. If `TRUE`, a minimum area threshold must be passed before a grid is counted as an AOO grid.
`percent`	Numeric. The minimum percent to be applied as a threshold for the `min.percent.rule`.

Value

Data frame of results showing the minimum and maximum AOO calculated for each grid shift scenario.

Author(s)

Calvin Lee <calvinkflee@gmail.com>

See Also

Other gridUncertainty functions: [gridUncertaintyBase](), [gridUncertaintyRandomManual](), [gridUncertaintyRandom](), [gridUncertaintyRestricted](), [gridUncertainty]()

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makeAOOGrid	*Create Area of Occupancy (AOO) grid for an ecosystem or species distribution*

Description

`makeAOOGrid` is a generic function that creates grids representing the area of occupancy for distributions based on the input spatial data. It includes capability for specifying whether a minimum percent of the grid cell needs to be occupied before it is counted in the AOO. This functionality is important for assessing the IUCN Red List of Ecosystems Criteria B.

Usage

```
makeAOOGrid(input.data, grid.size, min.percent.rule = FALSE, percent = 1)
```

Arguments

input.data
: Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.

grid.size
: A number specifying the width of the desired grid square (in same units as your coordinate reference system)

min.percent.rule
: Logical. If TRUE, a minimum area threshold must be passed before a grid is counted as an AOO grid.

percent
: Numeric. The minimum percent to be applied as a threshold for the min.percent.rule

Value

A shapefile of grid cells occupied by an ecosystem or species

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other AOO functions: createGrid(), getAOOSilent(), getAOO()

Examples

```
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- raster(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
extent(r1) <- extent(0, 6100, 0, 8700)
AOO_grid <- makeAOOGrid(r1, 1000, min.percent.rule = TRUE, percent = 1)
```

makeEOO   *Creates Extent of occurrence (EOO) Polygon*

Description

makeEOO is a generic function that creates a minimum convex polygon enclosing all occurrences of the provided spatial data. If the input provided is a raster layer, the points are taken from a buffer that has the radius of half of the shorter edge of the pixel around the centroid.

Usage

```
makeEOO(input.data)
```

Arguments

input.data   Spatial object of an ecosystem or species distribution. Please use a CRS with units measured in metres.

Value

An object of class SpatVect representing the EOO of input.data. Also inherits its CRS.

Author(s)

Nicholas Murray <murr.nick@gmail.com>, Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other EOO functions: getAreaEOO()

Examples

```
library(terra)
crs.UTM55S <- '+proj=utm +zone=55 +south +ellps=WGS84 +datum=WGS84 +units=m +no_defs'
r1 <- rast(ifelse((volcano<130), NA, 1), crs = crs.UTM55S)
ext(r1) <- c(0, 6100, 0, 8700)
EOO.polygon <- makeEOO(r1)
```

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sequentialExtrapolate   *Sequential extrapolation estimate*

Description

sequentialExtrapolate uses rates of decline from getDeclineStats and generates a sequence of estimates at regular time-steps. Useful for generating a sequence for plotting graphs.

Usage

```
sequentialExtrapolate(A.t1, year.t1, nYears, ARD = NA, PRD = NA, ARC = NA)
```

Arguments

A.t1	Area at time t1
year.t1	Year of time t1
nYears	Number of years since t1 for prediction. Use negative values for backcasting
ARD	Absolute rate of decline
PRD	Proportional rate of decline
ARC	Annual rate of change

Value

A dataframe with the forecast year, and a combination of:

- Sequence of values as extrapolated with absolute rate of decline (ARD)
- Sequence of values as extrapolated with proportional rate of decline (PRD)
- Sequence of values as extrapolated with annual rate of change (ARC)

Author(s)

Calvin Lee <calvinkflee@gmail.com>

References

Bland, L.M., Keith, D.A., Miller, R.M., Murray, N.J. and Rodriguez, J.P. (eds.) 2016. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0. Gland, Switzerland: IUCN. ix + 94pp. Available at the following web site: https://iucnrle.org/

See Also

Other change_functions: extrapolateEstimate(), futureAreaEstimate()

Examples

```
a.r1 <- 23.55
a.r2 <- 15.79
decline.stats <- getDeclineStats(a.r1, a.r2, year.t1 = 1990, year.t2 = 2012,
                                 methods = 'PRD')
a.2040.PRD.seq <- sequentialExtrapolate(a.r1, a.r2, year.t1 = 1990, nYears = 50,
                                        PRD = decline.stats$PRD)
```

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