Package 'redlistr'

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Title Tools for the IUCN Red List of Ecosystems and Species

Version 1.0.3

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.

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

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

Imports grDevices, methods, plyr, rgeos

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

Suggests devtools, knitr, rgdal, rmarkdown, testthat

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LazyData true

RoxygenNote 6.1.1

VignetteBuilder knitr

NeedsCompilation no

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Repository CRAN

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R topics documented:

`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`	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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, 10000, 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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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 the area of a SpatialPolygons object using rgeos::gArea

Usage

```
getArea(x, value.to.count)
```

Arguments

x	Either a RasterLayer or SpatialPolygons object. For a RasterLayer, no data value should be NA
value.to.count	Optional. Value of the cells in a RasterLayer to be counted

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: 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
```

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)
```

Arguments

EOO.polygon	An object of class SpatialPolygons, usually the output from makeEOO.

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

```
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)
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, 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	RasterLayer or SpatialPolygons object of distribution or Numeric representing area in km2
y	RasterLayer or SpatialPolygons object of distribution 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, 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: 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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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 = 10000, 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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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, gridUncertaintyRestrict
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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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 = 10000, 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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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

---

gridUncertaintyRestricted

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

---

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	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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`

---

gridUncertaintySimulation

Function to investigate behaviour of AOO under various split scenarios

---

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`
: Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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

---

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

Description

`makeAOOGrid` creates grids for species presence based on the presented raster object. 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`	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. 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, 10000, min.percent.rule = TRUE, percent = 1)
```

---

makeEOO *Creates Extent of occurrence (EOO) Polygon*

Description

makeEOO creates a minimum convex polygon enclosing all occurrences of the provided data

Usage

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

Arguments

input.data	Object of an ecosystem or species distribution. Accepts either raster or spatial points formats. Please use a CRS with units measured in metres.

Value

An object of class SpatialPolygons 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

```
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)
EOO.polygon <- makeEOO(r1)
```

---

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)

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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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