Package ‘pop.lion’

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Type Package

Title Models for Simulating Lion Populations

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Description Simulate the dynamic of lion populations using a specific Individual-Based Model (IBM) compiled in C.

License GPL-3

Depends parallel, abind, testthat

NeedsCompilation yes

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pop.lion-package *Lion population models*

Description

A package to run simulations of lion populations using an Individual-Based Model compiled in C.

Details

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Type:	Package
Version:	0.2
Date:	2020-04-28
License:	GPL-3

Author(s)

Guillaume Chapron <gchapron@carnivoreconservation.org> with contributions from Matthew Wijers, Andrew Loveridge and David Macdonald.

plot_projection *Plot population projections*

Description

Plot population projections

Usage

```
plot_projection(projection, title)
```

Arguments

`projection`	A list obtained after running the function `project`.
`title`	A string indicating which variable should be plotted `"NINDIV"`, `"NPRIDES"`, `"NCOALIS"`, `"NCOALIS_RESIDENT"`, `"NCOALIS_VAGRANT"`, `"NPRIDES_RESIDENT"`, `"NPRIDES_VAGRANT"`, `"COALISIZE_RESIDENT"`, `"COALISIZE_VAGRANT"`, `"PRIDESIZE_RESIDENT"`, `"PRIDESIZE_VAGRANT"`, `"NFEMALES"`, `"NMALES"`, `"TAKEOVERS"`, `"LITTERS"`, `"AGE"`.

Details

Plot average projections with 95% confidence interval.

Value

No returned value, plot created

Examples

```
oldpar <- par(mfrow = c(1,1))

years = 25

survival <-  matrix(1, nrow=180, ncol=2)
survival[1:12, 1:2] <- 0.97^(1/12)
survival[13:24, 1:2] <- 0.98^(1/12)
survival[25:96, 1:2] <- 0.99^(1/12)
survival[97:108, 1:2] <- 0.98^(1/12)
survival[109:120, 1:2] <- 0.96^(1/12)
survival[121:132, 1:2] <- 0.94^(1/12)
survival[133:144, 1:2] <- 0.92^(1/12)
survival[145:156, 1:2] <- 0.90^(1/12)
survival[157:168, 1:2] <- 0.87^(1/12)
survival[169:180, 1:2] <- 0.83^(1/12)

litter_distribution <- c(0.10, 0.30, 0.35, 0.20, 0.05)

conflict_age <- array(4*12, dim=c(2), dimnames=list(c("female", "male")))
conflict_mortality <- array(0, dim=c(12*years, 2), dimnames=list(NULL, c("female", "male")))
conflict_mortality[24:36,] <- 15.2

hunting_age <- array(5*12, dim=c(2), dimnames=list(c("female", "male")))
hunting_mortality <- array(0, dim=c(12*years, 2), dimnames=list(NULL, c("female", "male")))
hunting_mortality[72:84,"male"] <- 10

projection <- project(
years = years,
runs = 100,
survival = survival,
litter_distribution = litter_distribution,
pop_initial = 5,
conflict_age = conflict_age,
conflict_mortality = conflict_mortality,
hunting_age = hunting_age,
hunting_mortality = hunting_mortality,
hunter_error = 0,
K_indiv = 400,
K_pride = 20,
K_coali = 20,
K_edged = 10,
seed = 1,
```

```
details = FALSE
)

par(mfrow=c(2,2))
plot_projection(projection, "NINDIV")
plot_projection(projection, "NPRIDES")
plot_projection(projection, "NCOALIS")
plot_projection(projection, "LITTERS")

par(oldpar)
```

`project` *Lion population projections*

Description

Run stochastic lion population projections.

Usage

```
project(years,
     runs,
     survival,
     litter_distribution,
     pop_initial,
     conflict_age,
     conflict_mortality,
     hunting_age,
     hunting_mortality,
     hunter_error,
     K_indiv,
     K_pride,
     K_coali,
     K_edged,
     seed,
     details)
```

Arguments

`years`	A number: number of years to simulate the population.
`runs`	A number: number of times (or Monte Carlo runs) to simulate the population.
`survival`	A matrix: average monthly survival for each sex.
`litter_distribution`	A vector: probability distribution of litter sizes (1-5 cubs) in the population.
`pop_initial`	A number: number of prides (and coalitions). A simulation starts with an equal number of prides and coalitions.

`conflict_age` A vector: the minimum age in months at which lions can be killed by conflict for females and males.

`conflict_mortality`
An array: mortality added at the edge by conflict for every month of the simulation and for females and males. Expressed in percentage, a value of 15.2 will be understood by the model as 15.2 per cent. Values can be double. The array has 12 * years rows.

`hunting_age` A vector: the minimum age in months at which lions can be killed by trophy hunting for females and males.

`hunting_mortality`
An array: mortality added at the edge by trophy hunting for every month of the simulation and for females and males. Expressed in number of individuals, a value of 15 will be understood by the model as 15 killed every month. A value of 0.5 will be understood as 6 lions killed per year. The array has 12 * years rows.

`hunter_error` A number: hunter error.

`K_indiv` A number: maximum number of individuals in the population.

`K_pride` A number: maximum number of prides in the population.

`K_coali` A number: maximum number of coalitions in the population.

`K_edged` A number: number of prides in the population that are located at the edge of the reserve and therefore vulnerabe to hunting and poaching.

`seed` (optional) A number: seed of the random number generator.

`details` (optional) A boolean: indicate whether individual events are exported. This can generate large simulation objects.

Details

Run stochastic lion population projections with an Individual-Based Model (IBM) compiled in C.

Value

`runs` a 3-dimensional array of numbers of individuals with dimension c(years, statistics, runs)

`individuals` a 2-dimensional array of individuals events

`parameters` a list of parameters of the projection

Examples

```
years = 25

survival <-  matrix(1, nrow=180, ncol=2)
survival[1:12, 1:2] <- 0.97^(1/12)
survival[13:24, 1:2] <- 0.98^(1/12)
survival[25:96, 1:2] <- 0.99^(1/12)
survival[97:108, 1:2] <- 0.98^(1/12)
```

```
survival[109:120, 1:2] <- 0.96^(1/12)
survival[121:132, 1:2] <- 0.94^(1/12)
survival[133:144, 1:2] <- 0.92^(1/12)
survival[145:156, 1:2] <- 0.90^(1/12)
survival[157:168, 1:2] <- 0.87^(1/12)
survival[169:180, 1:2] <- 0.83^(1/12)

litter_distribution <- c(0.10, 0.30, 0.35, 0.20, 0.05)

conflict_age <- array(4*12, dim=c(2), dimnames=list(c("female", "male")))
conflict_mortality <- array(0, dim=c(12*years, 2), dimnames=list(NULL, c("female", "male")))
conflict_mortality[24:36,] <- 15.2

hunting_age <- array(5*12, dim=c(2), dimnames=list(c("female", "male")))
hunting_mortality <- array(0, dim=c(12*years, 2), dimnames=list(NULL, c("female", "male")))
hunting_mortality[72:84,"male"] <- 10

projection <- project(
years = years,
runs = 100,
survival = survival,
litter_distribution = litter_distribution,
pop_initial = 5,
conflict_age = conflict_age,
conflict_mortality = conflict_mortality,
hunting_age = hunting_age,
hunting_mortality = hunting_mortality,
hunter_error = 0,
K_indiv = 400,
K_pride = 20,
K_coali = 20,
K_edged = 10,
seed = 1,
details = FALSE
)

# Population size at the end of the simulation:
apply(projection$runs[,"NINDIV",], 1, mean)[12*years+1]
```

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