

Package ‘pop.lion’

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Type Package

Title Models for Simulating Lion Populations

Version 1.0

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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

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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

Package: pop.lion
 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 vulnerable 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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