

vulture_megamatrix_only.R

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```
# MATRIX POPULATION MODEL FOR AFRICAN WHITE BACKED VULTURES

# link http://www.mbr-pwrc.usgs.gov/workshops/uf2016/

# clean everything first
rm(list=ls())

# load required packages
library(popbio)
library(diagram)

## Loading required package: shape

# PARAMETERS

# fecundity calculation, (Gauthier & Lebreton (2004) Population models for Greater Snow Geese)
bp <- 0.85 # breeding propensity
cs <- 1 # clutch size
hs <- 0.76 # hatching success
fs <- 0.6 # fledging success
f1 <- bp * (cs/2) * hs * fs # divide by 2 to get females only

# survival rate common to both
s0 <- 0.42 # first year survival
# this value should probably be modified to account for
# lower adult survival in KZN

# KRUGER SURVIVAL RATES

s1Kr <- 0.82 # juvenile survival Kruger
s2Kr <- 0.89 # subadult survival Kruger
s3Kr <- 1.0 # adult survival Kruger

# KZN SURVIVAL RATES

s1Kz <- 0.86 # juvenile survival KZN
s2Kz <- 0.51 # subadult survival KZN
s3Kz <- 0.57 # adult survival KZN

# MEGAMATRIX TEST FOR AGE-SPECIFIC EMIGRATION/IMMIGRATION

# Effective migration rates
gb0 <- 0.05 # 1st year migration Kruger to KZN
bg0 <- 0.05 # 1st year migration KZN to Kruger
gb <- 0.02 # 2nd year to 5th year migration Kruger to KZN
bg <- 0.02 # 2nd year to 5th year migration KZN to Kruger
gbA <- 0.05 # adult migration Kruger to KZN
bgA <- 0.05 # adult round
```

```
Amig <- matrix(c(
  0, 0, 0, 0, s0*(1-gb0)*f1, 0, 0, 0, 0, s0*bg0,
  s1Kr*(1-gb), 0, 0, 0, 0, s1Kz*bg, 0, 0, 0, 0,
  0, s1Kr*(1-gb), 0, 0, 0, 0, s1Kz*bg, 0, 0, 0,
  0, 0, s2Kr*(1-gb), 0, 0, 0, 0, s2Kz*bg, 0, 0,
  0, 0, 0, s2Kr*(1-gb), s3Kr*(1-gbA), 0, 0, 0, s2Kz*bg, s3Kz*bgA,
  0, 0, 0, 0, s0*gb0, 0, 0, 0, 0, s0*(1-bg0)*f1,
  s1Kr*gb, 0, 0, 0, 0, s1Kz*(1-bg), 0, 0, 0, 0,
  0, s1Kr*gb, 0, 0, 0, 0, s1Kz*(1-bg), 0, 0, 0,
  0, 0, s2Kr*gb, 0, 0, 0, 0, s2Kz*(1-bg), 0, 0,
  0, 0, 0, s2Kr*gb, s3Kr*gbA, 0, 0, 0, s2Kz*(1-bg), s3Kz*(1-bgA)), nrow = 10, byrow = TRUE)
```

```
round(Amig,3)
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
## [1,] 0.000 0.000 0.000 0.000 0.077 0.000 0.000 0.00 0.00 0.021
## [2,] 0.804 0.000 0.000 0.000 0.000 0.017 0.000 0.00 0.00 0.000
## [3,] 0.000 0.804 0.000 0.000 0.000 0.000 0.017 0.00 0.00 0.000
## [4,] 0.000 0.000 0.872 0.000 0.000 0.000 0.000 0.01 0.00 0.000
## [5,] 0.000 0.000 0.000 0.872 0.950 0.000 0.000 0.00 0.01 0.028
## [6,] 0.000 0.000 0.000 0.000 0.021 0.000 0.000 0.00 0.00 0.077
## [7,] 0.016 0.000 0.000 0.000 0.000 0.843 0.000 0.00 0.00 0.000
## [8,] 0.000 0.016 0.000 0.000 0.000 0.000 0.843 0.00 0.00 0.000
## [9,] 0.000 0.000 0.018 0.000 0.000 0.000 0.000 0.50 0.00 0.000
## [10,] 0.000 0.000 0.000 0.018 0.050 0.000 0.000 0.00 0.50 0.542
```

```
lambda(Amig)
```

```
## [1] 0.9947857
```