Workshop - SECR no Ambiente R

"Modelo Espacialmente Explícito de Captura e Recaptura"

Efford, M. 2014. Package "secr".

PRÁTICA 1

1. Dados de *input*
2. Leitura das planílhas no 'R'
3. Criação da *capthist*
4. Sumário das estatísticas de captura
5. Teste de população fechada

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Atividade prática com modelo SECR

Package 'secr'

April 30, 2014

Type Package

Title Spatially explicit capture-recapture

Version 2.8.2

Depends R (>= 3.0.0)

Imports abind, MASS, utils, parallel, nlme, sp

Suggests maptools, spsurvey, rgdal, rgeos, raster

Date 2014-04-30

Author Murray Efford

Maintainer Murray Efford <murray.efford@otago.ac.nz>

Description Functions to estimate the density and size of a spatially distributed animal population sampled with an array of passive detectors, such as traps, or by searching polygons or transects. Models incorporating distance-dependent detection are fitted by maximizing the likelihood. Tools are included for data manipulation and model selection.

License GPL (>= 2)

LazyData yes

LazyDataCompression xz

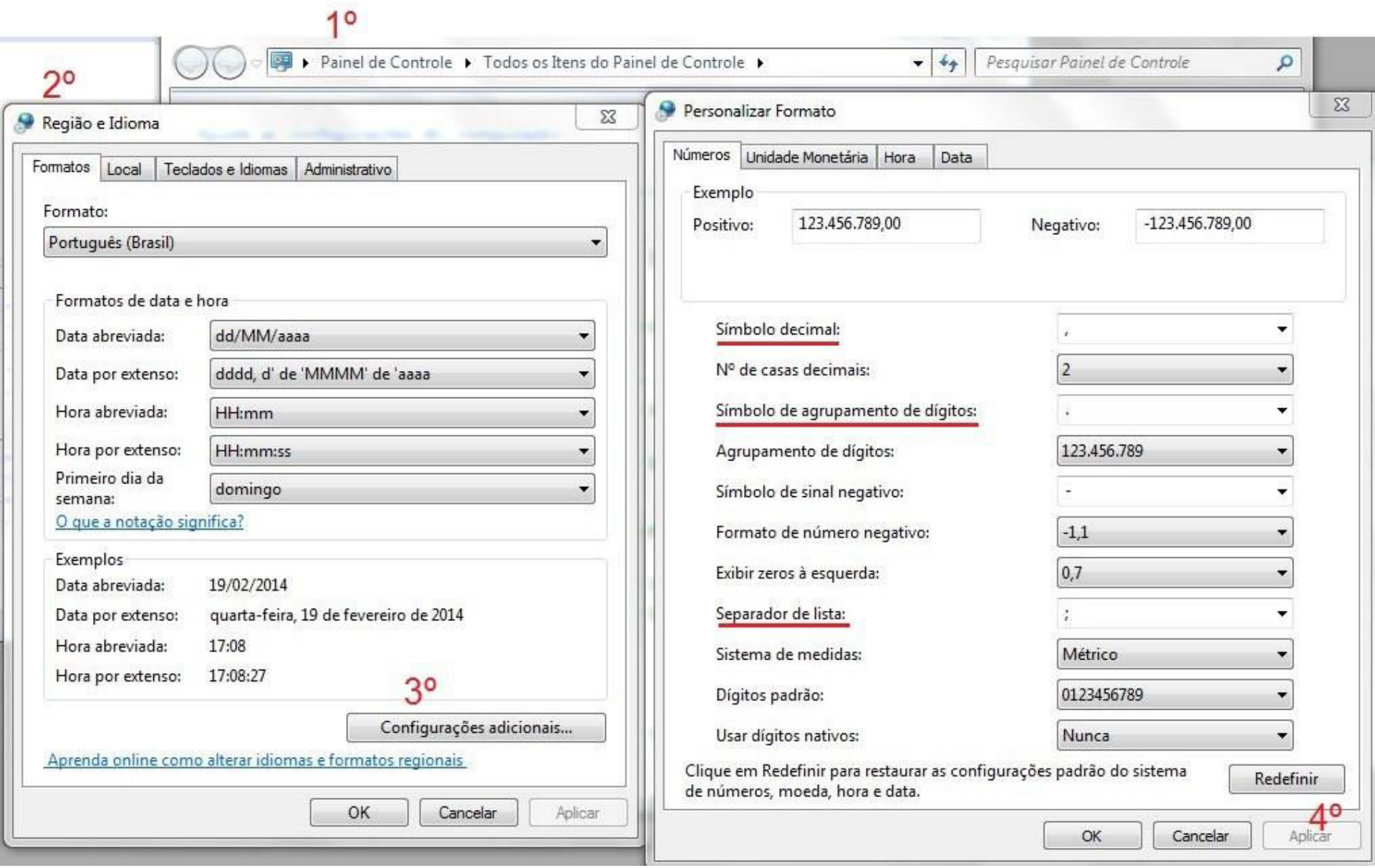
URL http://www.otago.ac.nz/density

NeedsCompilation yes

Repository CRAN

Date/Publication 2014-04-30 07:49:49

Configurações do sistema



Identificando os Detectores

Exemplos

Sherman ← single

Pitfall ← multi

AF ← proximity

Transectos ← transect

Telemetria ← telemetry

Table 3: Detector types

single	traps that catch one animal at a time
multi	traps that may catch more than one animal at a time
proximity	records presence at a point without restricting movement
count	proximity detector allowing >1 detection per animal per time
polygon	counts from searching one or more areas
transect	counts from searching one or more transects
polygonX	binary data from mutually exclusive areas
transectX	binary data from mutually exclusive transects
signal	detections and signal strengths at multiple microphones
telemetry	locations from radiotelemetry

Matriz de captura (*input*)

Duas tabelas (.txt ou .csv)

Capturas - no formato trapID

```
session,id,occasion,trapid, sex
F1,1F,3,2,f
F1,1F,3,3,f
F1,2M,1,2,m
F1,3F,6,2,f
F1,4M,5,2,m
F1,5F,1,8,f
F1,5F,4,9,f
F1,5F,6,8,f
F1,5F,9,9,f
F1,6M,3,5,m
```

(...)

Co-variável (hcov)

Detectores- (AF)

	A	B
1	detector,id,x,y	
2	1,TS1,358597,8914064	
3	2,TS2,360498,8913916	
4	3,TS3,362555,8913760	
5	4,TS4,362500,8912302	
6	5,TS6,359707,8911736	
7	6,TS7,357769,8910418	

(...)

Duas tabelas (.txt ou .csv) no formato trapID

Duas tabelas (.txt ou .csv)

Capturas - no formato trapID

```
session,id,occasion,trapid, sex
F1,1F,3,2,f
F1,1F,3,3,f
F1,2M,1,2,m
F1,3F,6,2,f
F1,4M,5,2,m
F1,5F,1,8,f
F1,5F,4,9,f
F1,5F,6,8,f
F1,5F,9,9,f
F1,6M,3,5,m
```

(...)

Detectores- *proximity* (AF)

	A	B
1	detector,id,x,y	
2	1,TS1,358597,8914064	
3	2,TS2,360498,8913916	
4	3,TS3,362555,8913760	
5	4,TS4,362500,8912302	
6	5,TS6,359707,8911736	
7	6,TS7,357769,8910418	

(...)

make.capthist

```
Session =  F2
, , 1

    1 2 3 4 5 6 7 8
10M 0 0 0 0 0 0 0 0
11F 0 0 0 0 0 0 0 0
12M 0 0 0 0 0 0 0 0
13F 0 0 0 0 0 0 0 0
14M 0 0 0 0 0 0 0 0
15F 0 0 0 0 0 0 0 0
16F 0 0 0 0 0 0 0 0
17M 0 0 0 0 0 0 0 0
1F  0 0 0 0 0 0 0 0
2M  1 0 0 0 0 0 0 0
3F  0 0 1 0 1 0 0 0
6M  0 0 0 0 0 0 0 0
7F  0 0 0 0 0 0 0 0
8M  0 0 0 0 0 0 0 0
9F  0 0 0 0 0 0 0 0

, , 2

    1 2 3 4 5 6 7 8
10M 0 0 0 0 0 0 0 0
11F 0 0 0 0 0 0 0 0
12M 0 0 0 0 0 0 0 0
13F 0 0 0 0 0 0 0 0
14M 0 0 0 0 0 0 0 0
15F 0 0 0 0 0 0 0 0
16F 0 0 0 0 0 0 0 0
17M 0 0 0 0 0 0 0 0
1F  0 0 0 0 0 0 0 0
2M  1 0 1 0 0 0 0 0
3F  0 0 0 0 0 0 0 0
6M  0 0 0 0 0 0 0 0
7F  0 0 0 0 0 0 0 0
8M  0 0 1 0 0 0 0 0
9F  0 0 0 0 0 0 0 0

, , 3

    1 2 3 4 5 6 7 8
10M 0 1 0 0 1 1 0 0
11F 0 0 0 0 0 0 0 0
12M 0 0 0 0 0 0 0 0
13F 0 0 0 0 0 0 0 0
14M 0 0 0 0 0 0 0 0
15F 0 0 0 0 0 0 0 0
16F 0 0 0 0 0 0 1 1
17M 0 0 0 0 0 0 0 0
1F  0 1 0 0 0 0 0 0
2M  0 0 0 0 0 0 0 0
3F  0 0 0 0 0 0 0 0
6M  0 0 0 0 0 0 0 0
7F  0 0 0 0 0 0 0 0
8M  0 0 0 0 0 0 0 0
9F  0 0 0 0 0 0 0 0

, , 4

    1 2 3 4 5 6 7 8
10M 0 0 0 0 1 1 0 0
11F 0 0 0 0 0 0 0 0
12M 0 0 0 0 0 0 1 0
13F 0 0 0 0 0 0 0 0
14M 0 0 0 0 0 0 0 0
15F 0 0 0 0 0 0 0 0
16F 0 0 0 0 0 0 0 0
17M 0 0 0 0 0 0 0 0
1F  0 0 0 0 0 0 0 0
2M  0 0 0 0 0 0 0 0
3F  0 0 0 0 0 0 0 0
6M  0 0 0 0 0 0 0 0
7F  0 0 0 0 0 0 0 0
8M  0 0 0 0 0 0 0 0
9F  0 0 0 0 0 0 0 0
```

5 tabelas omitidas

(...)

```
, , 10

    1 2 3 4 5 6 7 8
10M 0 0 1 0 0 0 0 1
11F 1 0 0 0 0 0 0 0
12M 0 0 0 0 0 0 0 0
13F 0 0 0 0 0 0 0 0
14M 0 0 0 0 0 0 0 0
15F 0 0 0 1 1 0 0 0
16F 0 0 0 0 0 0 0 0
17M 0 0 0 0 0 1 0 0
1F  0 0 0 0 0 0 0 0
2M  0 0 0 0 0 0 0 0
3F  0 0 0 0 0 0 0 0
6M  0 0 0 0 0 0 0 0
7F  1 0 0 0 1 0 0 0
8M  0 0 0 0 0 0 0 0
9F  1 1 0 0 1 0 1 0
```

MÉTODOS – Duas tabelas (.txt ou .csv) no formato trapID

Duas tabelas (.txt ou .csv)

Capturas - no formato trapID

```
session,id,occasion,trapid, sex
F1,1F,3,2,f
F1,1F,3,3,f
F1,2M,1,2,m
F1,3F,6,2,f
F1,4M,5,2,m
F1,5F,1,8,f
F1,5F,4,9,f
F1,5F,6,8,f
F1,5F,9,9,f
F1,6M,3,5,m
```

(...)

Detectores- *multi* (*live traps*)

	A	B
1	detector,id,x,y	
2	1,TS1,358597,8914064	
3	2,TS2,360498,8913916	
4	3,TS3,362555,8913760	
5	4,TS4,362500,8912302	
6	5,TS6,359707,8911736	
7	6,TS7,357769,8910418	

(...)

make.capthist

```
Session =  F2
     1  2 3  4  5  6  7  8
10M  0  3 9  0  3  3  9 10
11F 10  0 0  0  0  0  0  0
12M  0  0 0  0  0  0  4  0
13F  8  0 0  0  0  0  0  0
14M  0  8 0  0  7  0  0  0
15F  0  0 0 10 10  0  0  0
16F  0  0 0  0  0  0  3  3
17M  0  0 0  0  0 10  0  0
1F   0  3 0  0  0  0  0  0
2M   1  0 2  0  0  0  0  0
3F   0  0 1  0  1  0  0  0
6M   0  0 5  0  5  0  0  0
7F  10  0 0  0 10  0  0  0
8M   0  0 2  0  0  0  0  7
9F   9 10 0  0 10  0 10  0
```

MÉTODOS – Telemetria - Uma tabela (.txt ou .csv) no formato trapID

Arquivo Editar Formatar Exibir

```
#Session ID Occasion X Y
temp 1 1 361709 8901680
temp 1 2 361519 8901814
temp 1 3 359831 8902184
temp 1 4 362380 8903722
temp 1 5 358315 8903781
temp 1 6 362450 8903892
temp 1 7 356631 8904064
temp 2 4 358411 8904641
temp 2 5 369796 8904995
temp 2 6 361662 8905039
temp 2 7 364502 8905161
temp 2 8 360409 8905315
temp 2 9 354878 8905326
temp 3 1 363043 8905441
temp 3 2 361538 8905780
temp 3 3 362180 8905893
temp 3 4 362662 8905943
temp 3 5 371935 8905954
temp 3 6 368401 8906284
temp 3 7 363893 8906415
temp 3 8 359806 8906748
temp 3 9 369556 8906962
temp 4 1 364109 8907384
temp 4 2 357771 8907548
temp 4 3 355924 8907576
temp 4 4 366980 8907629
temp 4 5 367148 8907698
```

(...)

56 linhas omitidas

read.telemetry

ou

read.capthist
(detector=telemetry, fmt="XY")

```
Session =  temp
, , 1

  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1 1 1 1 1 1 1 0 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
2 0 0 0 1 1 1 1 1 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
3 1 1 1 1 1 1 1 1 1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
4 1 1 1 1 1 1 1 1 1  1  1  1  1  1  1  1  1  1  1  1  0  0  0
5 0 0 0 1 1 1 1 1 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
6 0 0 0 1 1 1 1 1 1  1  1  1  1  1  1  1  1  1  1  1  1  0  0
```

ETAPA 1

Retorna o diretório onde o ‘R’ reconhece o local de trabalho

```
> getwd()
[1] "C:/Users/Cristiano/Documents"
```

Define o diretório – Local onde você deseja trabalhar

#e criar as pastas

```
> setwd("/Users/Cristiano/Desktop/EXPL")
```

ETAPA 2

Carrega o pacote necessário

> library (secr)

```
This is secr 2.7.0. For overview type ?secr
```

ETAPA 3

Leitura das planilhas

```
> captura<-read.csv(“capturas.txt", header=T,  sep=",", dec=".")
> captura

> coord2 <-read.csv(“coord.csv",header=T, sep=",",dec=".")
> coord2
```

ETAPA 3

Armadilha-fotográfica

Detectores

```
> traps <-read.traps(data=coord2, detector="proximity")
> traps
```

Exemplos

Table 3: Detector types

Sherman ←	single	traps that catch one animal at a time
Pitfall ←	multi	traps that may catch more than one animal at a time
AF ←	proximity	records presence at a point without restricting movement
	count	proximity detector allowing >1 detection per animal per time
	polygon	counts from searching one or more areas
	transect	counts from searching one or more transects
	polygonX	binary data from mutually exclusive areas
Transectos ←	transectX	binary data from mutually exclusive transects
	signal	detections and signal strengths at multiple microphones
Telemetria ←	telemetry	locations from radiotelemetry

ETAPA 3

Detector tipo *telemetry*
?read.telemetry

Não há necessidade de inserir a matriz do detector.
Incluso na matriz de captura

ETAPA 4.a

Criação e leitura da *capthist* (detectores = “multi”, “proximity”)
Componentes da função
?make.capthist

make.capthist (captures, traps, fmt = ("trapID“), noccasions = NULL,
covnames = NULL, bysession = TRUE, sortrows = TRUE,
cutval = NULL, tol = 0.01, noncapt = "NONE", signalcovariates)

> capthist <-make.capthist(captura, traps, fmt = “trapID”, noccasions
= NULL, covnames=“sex”)
> capthist

ETAPA 4.b

Criação e leitura da *capthist*
Para dados de telemetria

read.telemetry (file = NULL, data = NULL, noccasions = NULL, covnames = NULL, verify = TRUE, ...)

> tele <-read.telemetry(“sim.ocelot2.txt”)
> tele

ETAPA 4.b

Criação e leitura da *capthist* - utilizando a função read.capthist
Para dados de telemetria

```
read.capthist (captfile, detector = “telemetry", fmt = c("XY"),
noccasions = NULL, covnames = NULL, trapcovnames = NULL,
cutval = NULL, verify = TRUE, noncapt = "NONE", ...)
```

```
> capthist<-read.capthist ("sim.ocelot2.txt", fmt="XY", detector =
          "telemetry")
> capthist
```

ETAPA 5.a

Primeiras estatísticas – detector = proximity

?summary.capthist

> summary(capthist)

```
Object class       capthist
Detector type      proximity
Detector number    10
Average spacing    1970.541 m
x-range            357769 366270 m
y-range            8908010 8914064 m
Counts by occasion
                     1  2  3  4  5  6  7  8 Total
n                    5  4  5  1  7  2  4  3    31
u                    5  3  3  1  0  1  2  0    15
f                    5  8  0  1  0  1  0  0    15
M(t+1)               5  8 11 12 12 13 15 15    15
losses               0  0  0  0  0  0  0  0     0
detections           7  4  6  1  9  3  4  3    37
detectors visited    5  3  5  1  7  3  4  3    31
detectors used      10 10 10 10 10 10 10 10    80
```

ETAPA 5.b

Primeiras estatísticas – detector = telemetry

> summary(capthist)

```
Object class       capthist
Detector type      telemetry
Number vertices    15
Number polygons    1
Total area         23716.85 ha
x-range            351357 372608 m
y-range            8901680 8916453 m
Counts by occasion
```

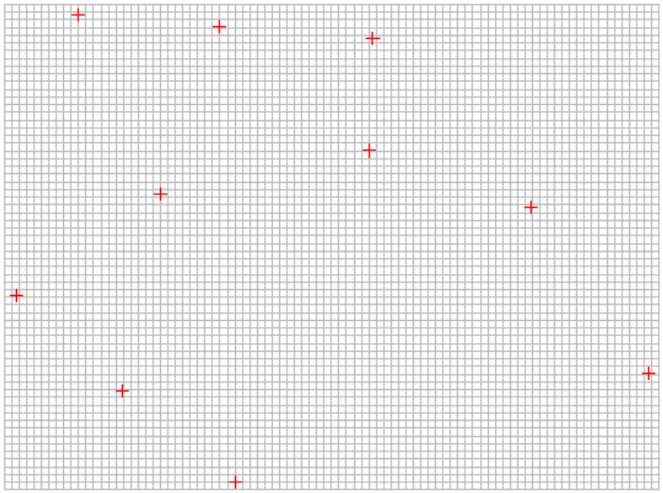
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
n	3	3	3	6	6	6	6	5	5	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	83
u	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
f	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	6
M(t+1)	3	3	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
losses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
detections	3	3	3	6	6	6	6	5	5	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	83
detectors visited	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
detectors used	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24

ETAPA 6

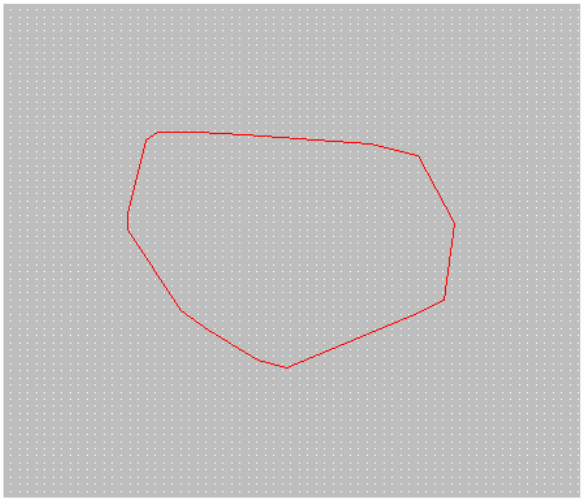
Leitura e plotagem dos detectores

```
> traps(capthist)
> plot(traps(capthist))
```

proximity, multi, single



polygon, telemetry

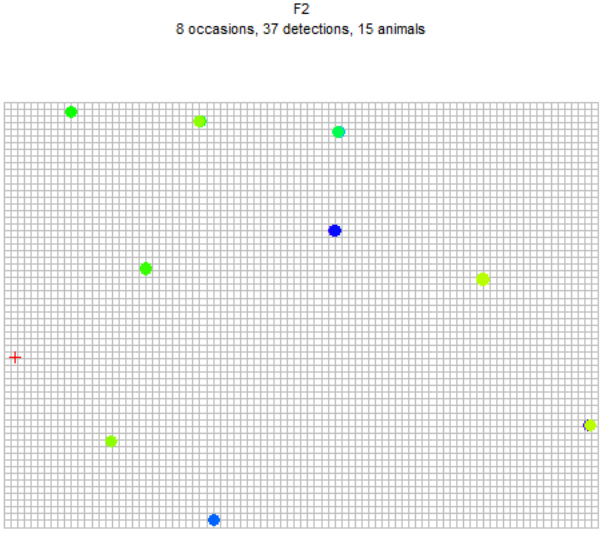


ETAPA 7

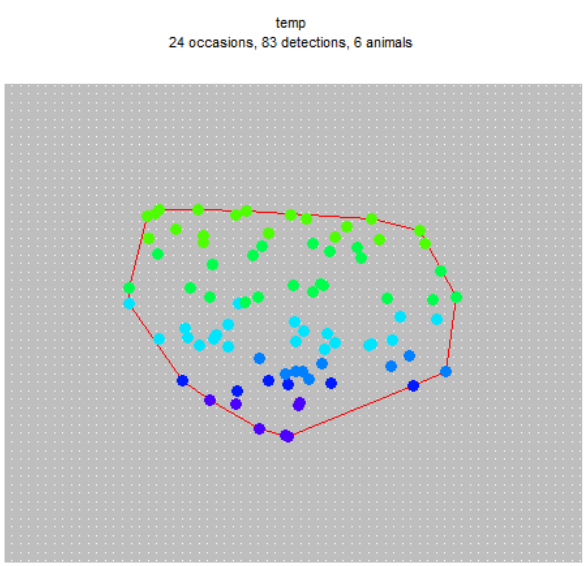
Mapa das detecções

> plot(capthist)

proximity



telemetry



ETAPA 8

Teste de população fechada

?closure.test

> closure.test(capthist, SB = FALSE, min.expected = 2)

```
 statistic           p
-0.2178798   0.4137614
```

SB=FALSE
(Otis et al 1978)
SB=TRUE
(Stanley and Burnham 1999)

O que fazer se o teste de população fechada não der significativo?