Movement patterns of peacock bass Cichla spp. (Perciformes, Cichlidae) and their implications for conservation and management in the middle Rio Negro, Central Amazon, Brazil

Mario J. F. Thomé-Souza; Michael J. Maceina; Bruce R. Forsberg; Álvaro C. Lima; Carla Sardelli; Bruce G. Marshall

Supplement S2

```
library(adehabitatHR)
```

```
## Loading required package: sp
```

```
## Loading required package: deldir
```

```
## deldir 1.0-6      Nickname: "Mendacious Cosmonaut"
```

```
##
##      The syntax of deldir() has had an important change.
##      The arguments have been re-ordered (the first three
##      are now "x, y, z") and some arguments have been
##      eliminated.  The handling of the z ("tags")
##      argument has been improved.
##
##      The "dummy points" facility has been removed.
##      This facility was a historical artefact, was really
##      of no use to anyone, and had hung around much too
##      long.  Since there are no longer any "dummy points",
##      the structure of the value returned by deldir() has
##      changed slightly.  The arguments of plot.deldir()
##      have been adjusted accordingly; e.g. the character
##      string "wpoints" ("which points") has been
##      replaced by the logical scalar "showpoints".
##      The user should consult the help files.
```

```
## Loading required package: ade4
```

```
## Loading required package: adehabitatMA
```

```
## Registered S3 methods overwritten by 'adehabitatMA':
##   method                     from
##   print.SpatialPixelsDataFrame sp
##   print.SpatialPixels          sp
```

```
## Loading required package: adehabitatLT
```

```
## Loading required package: CircStats
```

```
## Loading required package: MASS
```

```
## Loading required package: boot
```

```
library(rgdal)
```

```
## Please note that rgdal will be retired during 2023,
## plan transition to sf/stars/terra functions using GDAL and PROJ
## at your earliest convenience.
## See https://r-spatial.org/r/2022/04/12/evolution.html and https://github.com/r-spatial/evolution
## rgdal: version: 1.6-5, (SVN revision 1199)
## Geospatial Data Abstraction Library extensions to R successfully loaded
## Loaded GDAL runtime: GDAL 3.4.2, released 2022/03/08
## Path to GDAL shared files: /Library/Frameworks/R.framework/Versions/4.2/Resources/library/rgdal/gdal
## GDAL binary built with GEOS: FALSE
## Loaded PROJ runtime: Rel. 8.2.1, January 1st, 2022, [PJ_VERSION: 821]
## Path to PROJ shared files: /Library/Frameworks/R.framework/Versions/4.2/Resources/library/rgdal/proj
## PROJ CDN enabled: FALSE
## Linking to sp version:1.6-0
## To mute warnings of possible GDAL/OSR exportToProj4() degradation,
## use options("rgdal_show_exportToProj4_warnings"="none") before loading sp or rgdal.
```

```
library(maptools)
```

```
## Checking rgeos availability: FALSE
## Please note that 'maptools' will be retired during 2023,
## plan transition at your earliest convenience;
## some functionality will be moved to 'sp'.
##       Note: when rgeos is not available, polygon geometry     computations in maptools depend on gpclib,
##       which has a restricted licence. It is disabled by default;
##       to enable gpclib, type gpclibPermit()
```

Data: RT experiment

```
radio<-read.table("radio.txt", header=T)
```

```
attach(radio)
```

```
## The following object is masked _by_ .GlobalEnv:
##
##     radio
```

The minimum convex polygon area estimator

```
radio<-radio[3:25,]
radio<-radio[-which(radio$radio=="R07"),]
xy<-radio[,c(1,4,5)]
xy
```

```
##    radio      long       lat
## 3    R06 -63.73265 -0.415367
## 4    R06 -63.73293 -0.418717
## 5    R06 -63.73290 -0.418667
## 6    R06 -63.73225 -0.416850
## 7    R06 -63.73392 -0.407583
## 8    R06 -63.74186 -0.414090
## 9    R06 -63.74125 -0.414200
## 10   R06 -63.74080 -0.413888
## 11   R06 -63.74183 -0.414300
## 12   R06 -63.74180 -0.414313
## 17   R10 -63.73122 -0.409567
## 18   R10 -63.73228 -0.408250
## 19   R10 -63.73652 -0.414850
## 20   R10 -63.73637 -0.421433
## 21   R10 -63.73392 -0.407583
## 22   R10 -63.73325 -0.408130
## 23   R10 -63.73060 -0.406170
## 24   R10 -63.73071 -0.418455
## 25   R10 -63.73062 -0.423250
```

```
cord.dec = SpatialPoints(xy[,2:3], proj4string=CRS("+proj=longlat"))
cord.UTM <- spTransform(cord.dec, CRS("+init=epsg:32720"))
xy<-as.data.frame(cord.UTM)

id<-radio[,1]

idsp<-data.frame(id)
coordinates(idsp) <- xy
class(idsp)
```

```
## [1] "SpatialPointsDataFrame"
## attr(,"package")
## [1] "sp"
```

```
clu<-clusthr(idsp)
class(clu)
```

```
## [1] "MCHu"
```

```
clu
```

```
## ********** Multiple convex hull Home range of several Animals ************
##
## This object is a list with one component per animal.
## Each component is an object of class SpatialPolygonsDataFrame
## The home range has been estimated for the following animals:
## [1] "R06" "R10"
```

```
length(clu)
```

```
## [1] 2
```

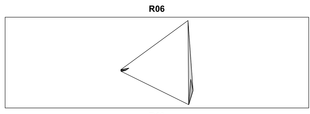
```
class(clu[[1]])
```

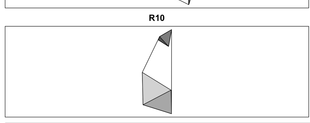
```
## [1] "SpatialPolygonsDataFrame"
## attr(,"package")
## [1] "sp"
```

```
class(clu[[2]])
```

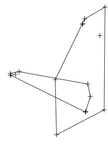
```
## [1] "SpatialPolygonsDataFrame"
## attr(,"package")
## [1] "sp"
```

```
plot(clu)
```





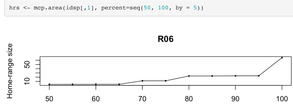

```
cp<-mcp(idsp[,1], percent = 95)

plot(cp)
plot(idsp, add=T)
```

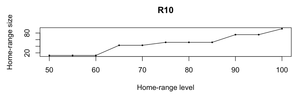


```
as.data.frame(cp)
```

```
##       id     area
## R06 R06 23.13850
## R10 R10 75.07983
```

```
hrs <- mcp.area(idsp[,1], percent=seq(50, 100, by = 5))
```






```
hrs
```

```
##          R06      R10
## 50   3.055215 12.31608
## 55   3.055215 12.31608
## 60   3.195723 12.31608
## 65   3.195723 42.94262
## 70  11.347102 42.94262
## 75  11.347102 51.89262
## 80  22.775250 51.89262
## 85  22.775250 51.89262
## 90  23.138503 75.07983
## 95  23.138503 75.07983
## 100 66.068929 92.91373
```