Aula 04 - Mapas

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Contents

1 Introdução ao R - Mapas

1.1 Ajustes iniciais

Antes de tudo, iremos carregar pacotes necessarios para importar dados, produzir mapas e realizar as análises

Caso nao tenha os pacotes instalados pode instalar aqui

```
#Para instalar os pacotes caso seja necessário. Lembre-se de tirar os "#"
#install.packages(c("adehabitatHR",
 #                  "colorRamps",
  #                 "colorspace",
   #                #"GISTools",
    #               "maps",
     #              "maptools",
      #             "raster",
       #            "rgbif",
        #           "CoordinateCleaner",
         #          "dplyr",
          #         "prettymapr")) #nos tambem podemos concatenar a instalacao dos pacotes
```

```
# Apos a instalacao dos pacotes basta carregar os pacotes
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(colorRamps)
library(colorspace)
#library(GISTools)
library(maps)
library(maptools)
```

```
## Checking rgeos availability: TRUE
## Please note that 'maptools' will be retired by the end of 2023,
## plan transition at your earliest convenience;
## some functionality will be moved to 'sp'.
```

```
library(raster)
```

```
##
## Attaching package: 'raster'
```

```
## The following object is masked from 'package:MASS':
##
##     select
```

```
library(rgbif) #para baixar dados do gbif
library(ggplot2)
library(CoordinateCleaner)
```

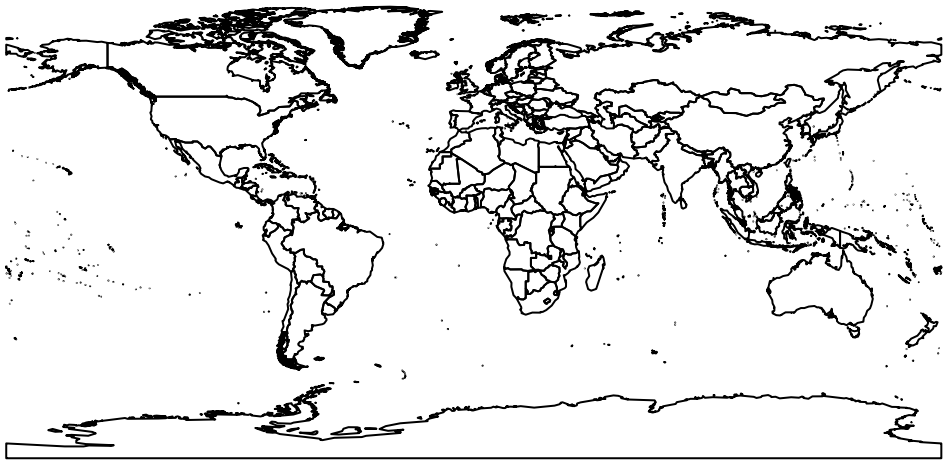
```
## Warning in fun(libname, pkgname): rgeos: versions of GEOS runtime 3.10.2-CAPI-1.16.0
## and GEOS at installation 3.10.1-CAPI-1.16.0differ
```

1.2 Mundo divisao politica

Que tal produzirmos uma mapa simples com divisao politica dos paises no mundo?Para isso eh muito simples basta carregar a base de dados e posteriormente imprimir (plotar) em sua tela

```
data(wrld_simpl) # carrega a base de dados
?wrld_simpl # aqui apresenta uma descricao do conjunto de dados
```

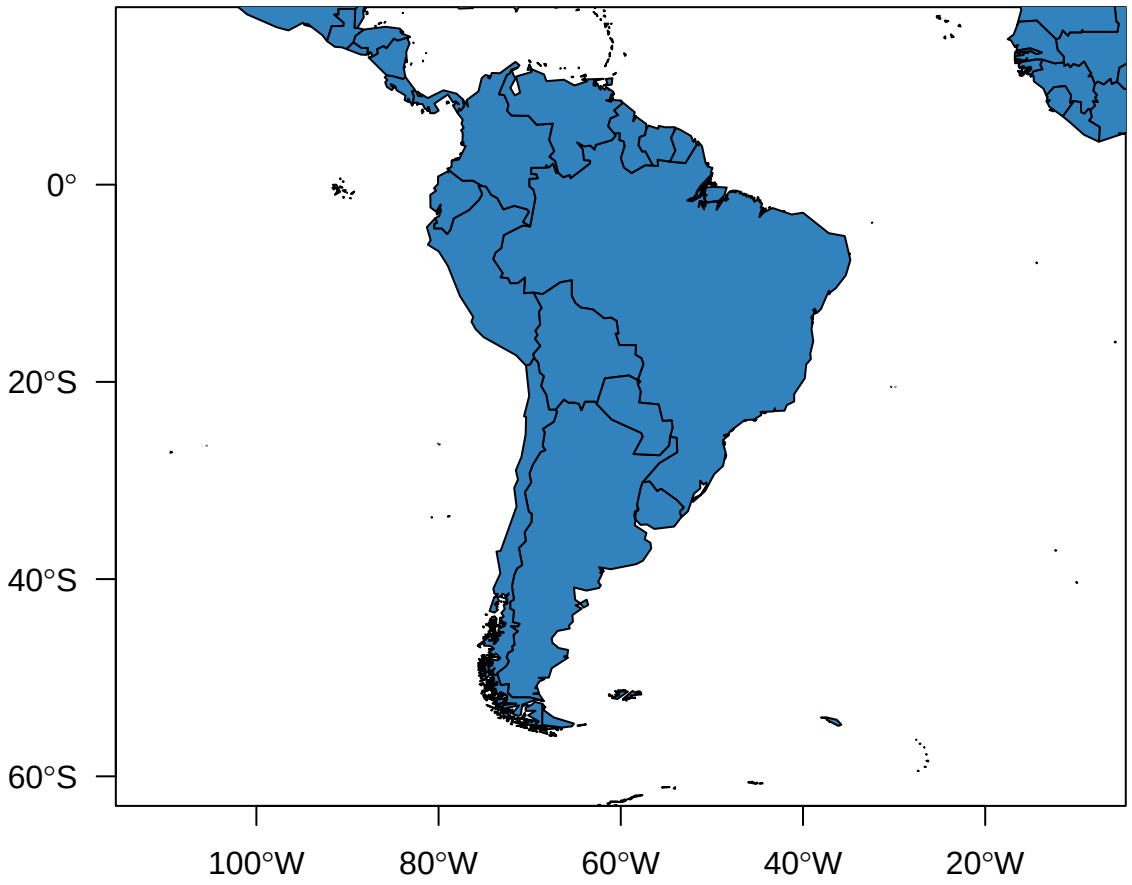
```
plot(wrld_simpl) # cria grafico
```



1.3 América do Sul: politico

A partir do conjunto de dados de divisao politica global podemos fazer um recorte para America do sul e para isso eh muito simples, pois basta especificar as coordenadas geograficas latitude (eixo y) e longitude (eixo x) para a area de interesse. Aqui nos iremos escolher os limites da America do Sul/Central

```
plot(wrld_simpl,
     xlim = c(-90, -30),
     ylim = c(-60, 15),
     col = "#3182bd",
     axes = T,
     las = 1)
```



1.4 Mapa simples de distribuicao de especies

O gênero Hypostomus é de uma espécie de cascudinho. Amplamente distribuído pela América do Sul, com mais de 150 espécies descritas.

```
#Aqui nos utilizamos o pacote rgbif
Hypostomus <- occ_data(scientificName="Hypostomus", hasCoordinate=TRUE)
```

Seleciona apenas coordenadas geográficas

```
Hypostomus <- Hypostomus$data[, c("scientificName","decimalLongitude", "decimalLatitude")]
```

Quantas linhas e colunas?

```
dim(Hypostomus)
```

```
## [1] 500   3
```

Quantos registros por spp?

```
table(Hypostomus$scientificName)
```

```
##
##                                                                         BOLD:AAB9690
##                                                                                    4
##                                                Hypostomus affinis (Steindachner, 1877)
##                                                                                    4
##                                                Hypostomus albopunctatus (Regan, 1908)
##                                                                                    1
##                                                Hypostomus ancistroides (Ihering, 1911)
##                                                                                    3
##                                                     Hypostomus annectens (Regan, 1904)
##                                                                                    1
##                                                   Hypostomus aspilogaster (Cope, 1894)
##                                                                                    1
##                              Hypostomus basilisko Tencatt, Zawadzki & Froehlich, 2014
##                                                                                    1
##                                   Hypostomus boulengeri (Eigenmann & Kennedy, 1903)
##                                                                                    3
##                                                    Hypostomus cochliodon Kner, 1854
##                                                                                    2
##                                           Hypostomus commersoni Valenciennes, 1836
##                                                                                   34
##                                                   Hypostomus cordovae (Günther, 1880)
##                                                                                    2
##                              Hypostomus delimai Zawadzki, de Oliveira & Debona, 2013
##                                                                                    1
## Hypostomus formosae Cardoso, Brancolini, Paracampo, Lizzaralde, Covain & Montoya-Burgos, 2016
##                                                                                    2
##                                Hypostomus froehlichi Zawadzki, Nardi & Tencatt, 2021
##                                                                                    1
##                                                        Hypostomus hondae (Regan, 1912)
##                                                                                  318
##                                  Hypostomus isbrueckeri Reis, Weber & Malabarba, 1990
##                                                                                    1
##                              Hypostomus khimaera Tencatt, Zawadzki & Froehlich, 2014
##                                                                                    1
##                                                             Hypostomus Lacepède, 1803
##                                                                                   80
##                                                 Hypostomus laplatae (Eigenmann, 1907)
##                                                                                    2
##                                                    Hypostomus latifrons Weber, 1986
##                                                                                    1
##                                             Hypostomus luetkeni (Steindachner, 1877)
##                                                                                    1
##                                        Hypostomus luteomaculatus (Devincenzi, 1942)
##                                                                                    1
##                                                        Hypostomus luteus (Godoy, 1980)
##                                                                                    2
##                                                      Hypostomus myersi (Gosline, 1947)
```

```
##                                                                        10
##                                       Hypostomus niceforoi (Fowler, 1943)
##                                                                         6
##                                         Hypostomus oculeus (Fowler, 1943)
##                                                                         1
##                                Hypostomus plecostomoides (Eigenmann, 1922)
##                                                                         2
##                                    Hypostomus plecostomus (Linnaeus, 1758)
##                                                                         7
##                                         Hypostomus regani (Ihering, 1905)
##                                                                         2
##                    Hypostomus roseopunctatus Reis, Weber & Malabarba, 1990
##                                                                         1
##                          Hypostomus soniae Hollanda Carvalho & Weber, 2005
##                                                                         1
##                                        Hypostomus spiniger (Hensel, 1870)
##                                                                         2
##                                     Hypostomus ternetzi (Boulenger, 1895)
##                                                                         1
```

Filtrando as spp - retorna os nomes únicos

```
(unique(Hypostomus$scientificName))
```

```
##  [1] "Hypostomus cordovae (Günther, 1880)"
##  [2] "Hypostomus myersi (Gosline, 1947)"
##  [3] "Hypostomus Lacepède, 1803"
##  [4] "Hypostomus ancistroides (Ihering, 1911)"
##  [5] "Hypostomus albopunctatus (Regan, 1908)"
##  [6] "Hypostomus regani (Ihering, 1905)"
##  [7] "Hypostomus luteus (Godoy, 1980)"
##  [8] "Hypostomus hondae (Regan, 1912)"
##  [9] "Hypostomus boulengeri (Eigenmann & Kennedy, 1903)"
## [10] "Hypostomus commersoni Valenciennes, 1836"
## [11] "Hypostomus oculeus (Fowler, 1943)"
## [12] "Hypostomus plecostomus (Linnaeus, 1758)"
## [13] "Hypostomus latifrons Weber, 1986"
## [14] "Hypostomus niceforoi (Fowler, 1943)"
## [15] "BOLD:AAB9690"
## [16] "Hypostomus cochliodon Kner, 1854"
## [17] "Hypostomus khimaera Tencatt, Zawadzki & Froehlich, 2014"
## [18] "Hypostomus delimai Zawadzki, de Oliveira & Debona, 2013"
## [19] "Hypostomus plecostomoides (Eigenmann, 1922)"
## [20] "Hypostomus laplatae (Eigenmann, 1907)"
## [21] "Hypostomus affinis (Steindachner, 1877)"
## [22] "Hypostomus luteomaculatus (Devincenzi, 1942)"
## [23] "Hypostomus ternetzi (Boulenger, 1895)"
## [24] "Hypostomus annectens (Regan, 1904)"
## [25] "Hypostomus spiniger (Hensel, 1870)"
## [26] "Hypostomus basilisko Tencatt, Zawadzki & Froehlich, 2014"
## [27] "Hypostomus soniae Hollanda Carvalho & Weber, 2005"
```

```
## [28] "Hypostomus froehlichi Zawadzki, Nardi & Tencatt, 2021"
## [29] "Hypostomus luetkeni (Steindachner, 1877)"
## [30] "Hypostomus formosae Cardoso, Brancolini, Paracampo, Lizzaralde, Covain & Montoya-Burgos, 20
## [31] "Hypostomus aspilogaster (Cope, 1894)"
## [32] "Hypostomus roseopunctatus Reis, Weber & Malabarba, 1990"
## [33] "Hypostomus isbrueckeri Reis, Weber & Malabarba, 1990"
```

Uma das colunas com especies tem um nome que nao existe. “BOLD:AAB9690”

- Provavelmente eh uma amostra de tecido (DNA) ou algum erro
- Vamos elimina-la? Como poderiamos fazer isso?

```
hypo <- Hypostomus[Hypostomus$scientificName != "BOLD:AAB9690", ]
```

Busca os pontos problemáticos conforme os parâmetros definidos - pode demorar um pouquinho!

```
limpaCoordenadas  <-  CoordinateCleaner::clean_coordinates(
  x = hypo,
  species = "scientificName",
  lon = "decimalLongitude",
  lat = "decimalLatitude",
  tests = c("duplicates", #duplicatas
            "equal", #coordenadas iguais
            "seas", #pontos no mar
            "zeros" #zeros e pontos em que lat = lon
  )
)
```

```
## Testing coordinate validity

## Flagged 0 records.

## Testing equal lat/lon

## Flagged 0 records.

## Testing zero coordinates

## Flagged 0 records.

## Testing sea coordinates

## OGR data source with driver: ESRI Shapefile
## Source: "/tmp/Rtmp9LuajV", layer: "ne_50m_land"
## with 1420 features
## It has 3 fields
## Integer64 fields read as strings:  scalerank

## Flagged 1 records.
```

```
## Testing duplicates

## Flagged 248 records.

## Flagged 249 of 496 records, EQ = 0.5.
```

Resultado da marcação de pontos problemáticos

```
limpaCoordenadas %>% head
```

```
##                            scientificName decimalLongitude decimalLatitude .val
## 1     Hypostomus cordovae (Günther, 1880)        -64.47334       -32.21312 TRUE
## 2       Hypostomus myersi (Gosline, 1947)        -54.44773       -25.68590 TRUE
## 3       Hypostomus myersi (Gosline, 1947)        -54.44237       -25.69912 TRUE
## 4               Hypostomus Lacepède, 1803        -56.38833       -20.26306 TRUE
## 5 Hypostomus ancistroides (Ihering, 1911)        -55.14050       -22.25988 TRUE
## 6       Hypostomus myersi (Gosline, 1947)        -54.44676       -25.68640 TRUE
##   .equ .zer .sea .dpl .summary
## 1 TRUE TRUE TRUE TRUE     TRUE
## 2 TRUE TRUE TRUE TRUE     TRUE
## 3 TRUE TRUE TRUE TRUE     TRUE
## 4 TRUE TRUE TRUE TRUE     TRUE
## 5 TRUE TRUE TRUE TRUE     TRUE
## 6 TRUE TRUE TRUE TRUE     TRUE
```

```
summary(limpaCoordenadas)
```

```
##     .val     .equ     .zer     .sea     .dpl .summary
##        0        0        0        1      248      249
```

Para excluir os pontos marcados como problemáticos:

- TRUE = coordenadas limpas
- FALSE = coordenadas potencialmente problemáticas

```
hypo_limpo <- hypo %>% dplyr::filter(limpaCoordenadas$.summary==TRUE)
hypo_limpo
```

```
## # A tibble: 247 x 3
##    scientificName                          decimalLongitude decimalLatitude
##    <chr>                                              <dbl>           <dbl>
##  1 Hypostomus cordovae (Günther, 1880)                -64.5           -32.2
##  2 Hypostomus myersi (Gosline, 1947)                  -54.4           -25.7
##  3 Hypostomus myersi (Gosline, 1947)                  -54.4           -25.7
##  4 Hypostomus Lacepède, 1803                          -56.4           -20.3
##  5 Hypostomus ancistroides (Ihering, 1911)            -55.1           -22.3
##  6 Hypostomus myersi (Gosline, 1947)                  -54.4           -25.7
##  7 Hypostomus albopunctatus (Regan, 1908)             -54.4           -25.7
##  8 Hypostomus regani (Ihering, 1905)                  -56.8           -29.5
##  9 Hypostomus regani (Ihering, 1905)                  -56.8           -29.5
## 10 Hypostomus luteus (Godoy, 1980)                    -56.8           -29.5
## # ... with 237 more rows
```

Compara os dados de ocorrência por spp (antes, durante e depois do tratamento)

```
table(Hypostomus$scientificName)
```

```
##
##                                                                                        BOLD:AAB9690
##                                                                                                   4
##                                                            Hypostomus affinis (Steindachner, 1877)
##                                                                                                   4
##                                                             Hypostomus albopunctatus (Regan, 1908)
##                                                                                                   1
##                                                            Hypostomus ancistroides (Ihering, 1911)
##                                                                                                   3
##                                                                 Hypostomus annectens (Regan, 1904)
##                                                                                                   1
##                                                               Hypostomus aspilogaster (Cope, 1894)
##                                                                                                   1
##                                      Hypostomus basilisko Tencatt, Zawadzki & Froehlich, 2014
##                                                                                                   1
##                                             Hypostomus boulengeri (Eigenmann & Kennedy, 1903)
##                                                                                                   3
##                                                                  Hypostomus cochliodon Kner, 1854
##                                                                                                   2
##                                                       Hypostomus commersoni Valenciennes, 1836
##                                                                                                  34
##                                                               Hypostomus cordovae (Günther, 1880)
##                                                                                                   2
##                                       Hypostomus delimai Zawadzki, de Oliveira & Debona, 2013
##                                                                                                   1
## Hypostomus formosae Cardoso, Brancolini, Paracampo, Lizzaralde, Covain & Montoya-Burgos, 2016
##                                                                                                   2
##                                         Hypostomus froehlichi Zawadzki, Nardi & Tencatt, 2021
##                                                                                                   1
##                                                                    Hypostomus hondae (Regan, 1912)
##                                                                                                 318
##                                          Hypostomus isbrueckeri Reis, Weber & Malabarba, 1990
##                                                                                                   1
##                                        Hypostomus khimaera Tencatt, Zawadzki & Froehlich, 2014
##                                                                                                   1
##                                                                          Hypostomus Lacepède, 1803
##                                                                                                  80
##                                                               Hypostomus laplatae (Eigenmann, 1907)
##                                                                                                   2
##                                                                  Hypostomus latifrons Weber, 1986
##                                                                                                   1
##                                                           Hypostomus luetkeni (Steindachner, 1877)
##                                                                                                   1
##                                                     Hypostomus luteomaculatus (Devincenzi, 1942)
##                                                                                                   1
##                                                                   Hypostomus luteus (Godoy, 1980)
##                                                                                                   2
##                                                                 Hypostomus myersi (Gosline, 1947)
```

```
##                                                                                        10
##                                                             Hypostomus niceforoi (Fowler, 1943)
##                                                                                         6
##                                                              Hypostomus oculeus (Fowler, 1943)
##                                                                                         1
##                                                     Hypostomus plecostomoides (Eigenmann, 1922)
##                                                                                         2
##                                                         Hypostomus plecostomus (Linnaeus, 1758)
##                                                                                         7
##                                                              Hypostomus regani (Ihering, 1905)
##                                                                                         2
##                                          Hypostomus roseopunctatus Reis, Weber & Malabarba, 1990
##                                                                                         1
##                                                Hypostomus soniae Hollanda Carvalho & Weber, 2005
##                                                                                         1
##                                                             Hypostomus spiniger (Hensel, 1870)
##                                                                                         2
##                                                          Hypostomus ternetzi (Boulenger, 1895)
##                                                                                         1
```

```
table(hypo$scientificName)
```

```
##
##                                                        Hypostomus affinis (Steindachner, 1877)
##                                                                                         4
##                                                         Hypostomus albopunctatus (Regan, 1908)
##                                                                                         1
##                                                        Hypostomus ancistroides (Ihering, 1911)
##                                                                                         3
##                                                             Hypostomus annectens (Regan, 1904)
##                                                                                         1
##                                                            Hypostomus aspilogaster (Cope, 1894)
##                                                                                         1
##                                         Hypostomus basilisko Tencatt, Zawadzki & Froehlich, 2014
##                                                                                         1
##                                                Hypostomus boulengeri (Eigenmann & Kennedy, 1903)
##                                                                                         3
##                                                               Hypostomus cochliodon Kner, 1854
##                                                                                         2
##                                                       Hypostomus commersoni Valenciennes, 1836
##                                                                                        34
##                                                            Hypostomus cordovae (Günther, 1880)
##                                                                                         2
##                                          Hypostomus delimai Zawadzki, de Oliveira & Debona, 2013
##                                                                                         1
## Hypostomus formosae Cardoso, Brancolini, Paracampo, Lizzaralde, Covain & Montoya-Burgos, 2016
##                                                                                         2
##                                            Hypostomus froehlichi Zawadzki, Nardi & Tencatt, 2021
##                                                                                         1
##                                                                Hypostomus hondae (Regan, 1912)
##                                                                                       318
```

```
##                                                 Hypostomus isbrueckeri Reis, Weber & Malabarba, 1990
##                                                                                                    1
##                                               Hypostomus khimaera Tencatt, Zawadzki & Froehlich, 2014
##                                                                                                    1
##                                                                                 Hypostomus Lacepède, 1803
##                                                                                                   80
##                                                                      Hypostomus laplatae (Eigenmann, 1907)
##                                                                                                    2
##                                                                           Hypostomus latifrons Weber, 1986
##                                                                                                    1
##                                                                     Hypostomus luetkeni (Steindachner, 1877)
##                                                                                                    1
##                                                                  Hypostomus luteomaculatus (Devincenzi, 1942)
##                                                                                                    1
##                                                                       Hypostomus luteus (Godoy, 1980)
##                                                                                                    2
##                                                                         Hypostomus myersi (Gosline, 1947)
##                                                                                                   10
##                                                                       Hypostomus niceforoi (Fowler, 1943)
##                                                                                                    6
##                                                                         Hypostomus oculeus (Fowler, 1943)
##                                                                                                    1
##                                                                   Hypostomus plecostomoides (Eigenmann, 1922)
##                                                                                                    2
##                                                                      Hypostomus plecostomus (Linnaeus, 1758)
##                                                                                                    7
##                                                                         Hypostomus regani (Ihering, 1905)
##                                                                                                    2
##                                                 Hypostomus roseopunctatus Reis, Weber & Malabarba, 1990
##                                                                                                    1
##                                                       Hypostomus soniae Hollanda Carvalho & Weber, 2005
##                                                                                                    1
##                                                                     Hypostomus spiniger (Hensel, 1870)
##                                                                                                    2
##                                                                      Hypostomus ternetzi (Boulenger, 1895)
##                                                                                                    1
```

```
table(Hypostomus$scientificName)
```

```
##
##                                                                                 BOLD:AAB9690
##                                                                                            4
##                                                                Hypostomus affinis (Steindachner, 1877)
##                                                                                            4
##                                                                 Hypostomus albopunctatus (Regan, 1908)
##                                                                                            1
##                                                                Hypostomus ancistroides (Ihering, 1911)
##                                                                                            3
##                                                                     Hypostomus annectens (Regan, 1904)
##                                                                                            1
##                                                                   Hypostomus aspilogaster (Cope, 1894)
```

```
##                                                                                          1
##                                 Hypostomus basilisko Tencatt, Zawadzki & Froehlich, 2014
##                                                                                          1
##                                        Hypostomus boulengeri (Eigenmann & Kennedy, 1903)
##                                                                                          3
##                                                         Hypostomus cochliodon Kner, 1854
##                                                                                          2
##                                                 Hypostomus commersoni Valenciennes, 1836
##                                                                                         34
##                                                     Hypostomus cordovae (Günther, 1880)
##                                                                                          2
##                                  Hypostomus delimai Zawadzki, de Oliveira & Debona, 2013
##                                                                                          1
## Hypostomus formosae Cardoso, Brancolini, Paracampo, Lizzaralde, Covain & Montoya-Burgos, 2016
##                                                                                          2
##                                     Hypostomus froehlichi Zawadzki, Nardi & Tencatt, 2021
##                                                                                          1
##                                                              Hypostomus hondae (Regan, 1912)
##                                                                                        318
##                                      Hypostomus isbrueckeri Reis, Weber & Malabarba, 1990
##                                                                                          1
##                                 Hypostomus khimaera Tencatt, Zawadzki & Froehlich, 2014
##                                                                                          1
##                                                                Hypostomus Lacepède, 1803
##                                                                                         80
##                                                     Hypostomus laplatae (Eigenmann, 1907)
##                                                                                          2
##                                                          Hypostomus latifrons Weber, 1986
##                                                                                          1
##                                                 Hypostomus luetkeni (Steindachner, 1877)
##                                                                                          1
##                                            Hypostomus luteomaculatus (Devincenzi, 1942)
##                                                                                          1
##                                                            Hypostomus luteus (Godoy, 1980)
##                                                                                          2
##                                                          Hypostomus myersi (Gosline, 1947)
##                                                                                         10
##                                                        Hypostomus niceforoi (Fowler, 1943)
##                                                                                          6
##                                                          Hypostomus oculeus (Fowler, 1943)
##                                                                                          1
##                                            Hypostomus plecostomoides (Eigenmann, 1922)
##                                                                                          2
##                                                Hypostomus plecostomus (Linnaeus, 1758)
##                                                                                          7
##                                                          Hypostomus regani (Ihering, 1905)
##                                                                                          2
##                                  Hypostomus roseopunctatus Reis, Weber & Malabarba, 1990
##                                                                                          1
##                                        Hypostomus soniae Hollanda Carvalho & Weber, 2005
##                                                                                          1
##                                                       Hypostomus spiniger (Hensel, 1870)
```

```
##                                                                                   2
##                                                Hypostomus ternetzi (Boulenger, 1895)
##                                                                                   1
```

1.4.0.1 Exportar os dados de ocorrencia processados

Ordena a planilha a partir do nome das spp

```
geodataHypostomus <- hypo_limpo %>% dplyr::arrange(desc(scientificName))
```

Exporta a planilha em .csv

```
write.csv(geodataHypostomus, "geodataHypostomus.csv")
```

1.4.0.2 Prepara os dados para gerar o MAPA

define os limites para o mapa

```
xlim = range(geodataHypostomus$decimalLongitude, na.rm=TRUE) + c(-6,6)
ylim = range(geodataHypostomus$decimalLatitude, na.rm=TRUE) + c(-6,6)
```

Filtro contendo as coordenadas geográficas de cada sp

```
table(geodataHypostomus$scientificName)
```

```
##
##                                              Hypostomus affinis (Steindachner, 1877)
##                                                                                   2
##                                               Hypostomus albopunctatus (Regan, 1908)
##                                                                                   1
##                                              Hypostomus ancistroides (Ihering, 1911)
##                                                                                   3
##                                                   Hypostomus annectens (Regan, 1904)
##                                                                                   1
##                                                 Hypostomus aspilogaster (Cope, 1894)
##                                                                                   1
##                               Hypostomus basilisko Tencatt, Zawadzki & Froehlich, 2014
##                                                                                   1
##                                      Hypostomus boulengeri (Eigenmann & Kennedy, 1903)
##                                                                                   3
##                                                     Hypostomus cochliodon Kner, 1854
##                                                                                   2
##                                             Hypostomus commersoni Valenciennes, 1836
##                                                                                  29
##                                                  Hypostomus cordovae (Günther, 1880)
##                                                                                   2
##                                Hypostomus delimai Zawadzki, de Oliveira & Debona, 2013
##                                                                                   1
## Hypostomus formosae Cardoso, Brancolini, Paracampo, Lizzaralde, Covain & Montoya-Burgos, 2016
##                                                                                   2
##                                   Hypostomus froehlichi Zawadzki, Nardi & Tencatt, 2021
##                                                                                   1
##                                                     Hypostomus hondae (Regan, 1912)
```

```
##                                                                      103
##                                  Hypostomus isbrueckeri Reis, Weber & Malabarba, 1990
##                                                                        1
##                                Hypostomus khimaera Tencatt, Zawadzki & Froehlich, 2014
##                                                                        1
##                                                      Hypostomus Lacepède, 1803
##                                                                       56
##                                                 Hypostomus laplatae (Eigenmann, 1907)
##                                                                        2
##                                                      Hypostomus latifrons Weber, 1986
##                                                                        1
##                                                 Hypostomus luetkeni (Steindachner, 1877)
##                                                                        1
##                                               Hypostomus luteomaculatus (Devincenzi, 1942)
##                                                                        1
##                                                   Hypostomus luteus (Godoy, 1980)
##                                                                        2
##                                                  Hypostomus myersi (Gosline, 1947)
##                                                                       10
##                                                Hypostomus niceforoi (Fowler, 1943)
##                                                                        6
##                                                  Hypostomus oculeus (Fowler, 1943)
##                                                                        1
##                                               Hypostomus plecostomoides (Eigenmann, 1922)
##                                                                        2
##                                                Hypostomus plecostomus (Linnaeus, 1758)
##                                                                        4
##                                                  Hypostomus regani (Ihering, 1905)
##                                                                        2
##                                  Hypostomus roseopunctatus Reis, Weber & Malabarba, 1990
##                                                                        1
##                                       Hypostomus soniae Hollanda Carvalho & Weber, 2005
##                                                                        1
##                                                   Hypostomus spiniger (Hensel, 1870)
##                                                                        2
##                                                 Hypostomus ternetzi (Boulenger, 1895)
##                                                                        1
```

```
ancistroides <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus ancistroides (Iherin
boulengeri <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus boulengeri (Eigenmann
commersoni <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus commersoni Valencienne
hondae <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus hondae (Regan, 1912)", c("
myersi <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus myersi (Gosline, 1947)", c
niceforoi <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus niceforoi (Fowler, 1943
plecostomus <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus plecostomus (Linnaeus
spiniger <- geodataHypostomus[geodataHypostomus$scientificName=="Hypostomus spiniger (Hensel, 1870)"
```

Nomes das spp personalizados para a legenda - nomes científicos em itálico

```
nomeSpp_legenda <- c(expression(paste(italic("Hypostomus ancistroides"))),
                     expression(paste(italic("Hypostomus boulengeri"))),
```

```
                    expression(paste(italic("Hypostomus commersoni"))),
                    expression(paste(italic("Hypostomus hondae"))),
                    expression(paste(italic("Hypostomus myersi"))),
                    expression(paste(italic("Hypostomus niceforoi"))),
                    expression(paste(italic("Hypostomus plecostomus"))),
                    expression(paste(italic("Hypostomus spiniger")))
)
```

2 cria uma paleta de cores para representar cada sp

ColorBrewer https://colorbrewer2.org/#type=sequential&scheme=BuGn&n=3

O ColorBrewer é um site que permite criar paletas de cores. Ele permite criar paletas de cores que podem ser facilmente distinguidas por pessoas daltonicas, por exemplo. As cores utilizadas para esse exemplo foram escolhidas a partir do ColorBrewer

```
paletaCustomizada <- c("#9e0142",
                       "#d53e4f",
                       "#f46d43",
                       "#fdae61",
                       "#e6f598",
                       "#66c2a5",
                       "#3288bd",
                       "#5e4fa2")
```

Plota o mapa

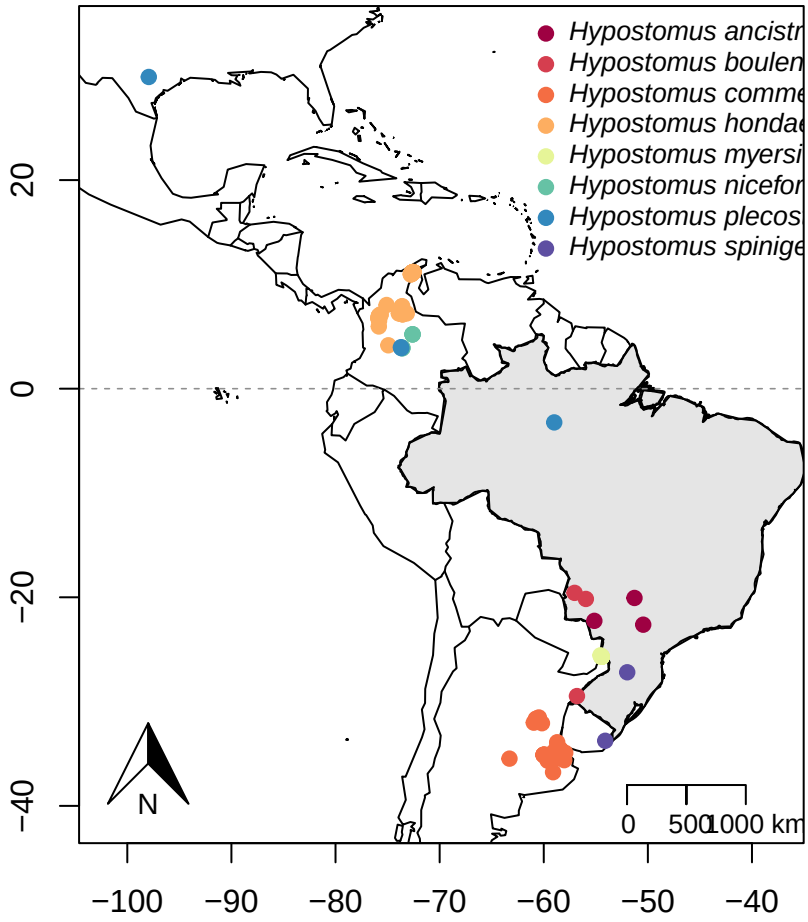
```
# plota as camadas
map("world", "Brazil", fill=T, col="grey90", xlim = xlim, ylim = ylim)
map(,,add=T,xlim=xlim, ylim=ylim)

#plota o conjunto de pontos por espécie
points(ancistroides, pch=19, cex=1, col=paletaCustomizada[1])
points(boulengeri, pch=19, cex=1, col=paletaCustomizada[2])
points(commersoni, pch=19, cex=1, col=paletaCustomizada[3])
points(hondae, pch=19, cex=1, col=paletaCustomizada[4])
points(myersi, pch=19, cex=1, col=paletaCustomizada[5])
points(niceforoi, pch=19, cex=1, col=paletaCustomizada[6])
points(plecostomus, pch=19, cex=1, col=paletaCustomizada[7])
points(spiniger, pch=19, cex=1, col=paletaCustomizada[8])

#plota alguns elementos de mapa
abline(h=0, lwd=0.8, lty=2, col="gray56") #adiciona uma linha para representar a do equador (opcion
prettymapr::addnortharrow("bottomleft", scale=0.7) #adiciona o símbolo do Norte
maps::map.scale(x=-52,y=-38, ratio=FALSE, cex=0.8) #adiciona escala; em x e y você também pode alte
map.axes() #delimita a figura

#plota a legenda
legend(x=-62, y=37, #aqui você pode alterar a posição da legenda
       legend=nomeSpp_legenda, #nomes das espécies
```

```
       col=paletaCustomizada, #cores definidas anteriormente
       pch=19,
       pt.cex=1, inset=0.05, cex=0.8, bty="n") #outros parâmetros da legenda
```



Caso queira evitar sobreposição de pontos, você pode plotar a distribuição das espécies separadamente usando o código abaixo

```
listaSpp = list(ancistroides=ancistroides,
                boulengeri=boulengeri,
                commersoni=commersoni,
                hondae=hondae,
                myersi=myersi,
                niceforoi=niceforoi,
                plecostomus=plecostomus,
                spiniger=spiniger)
```

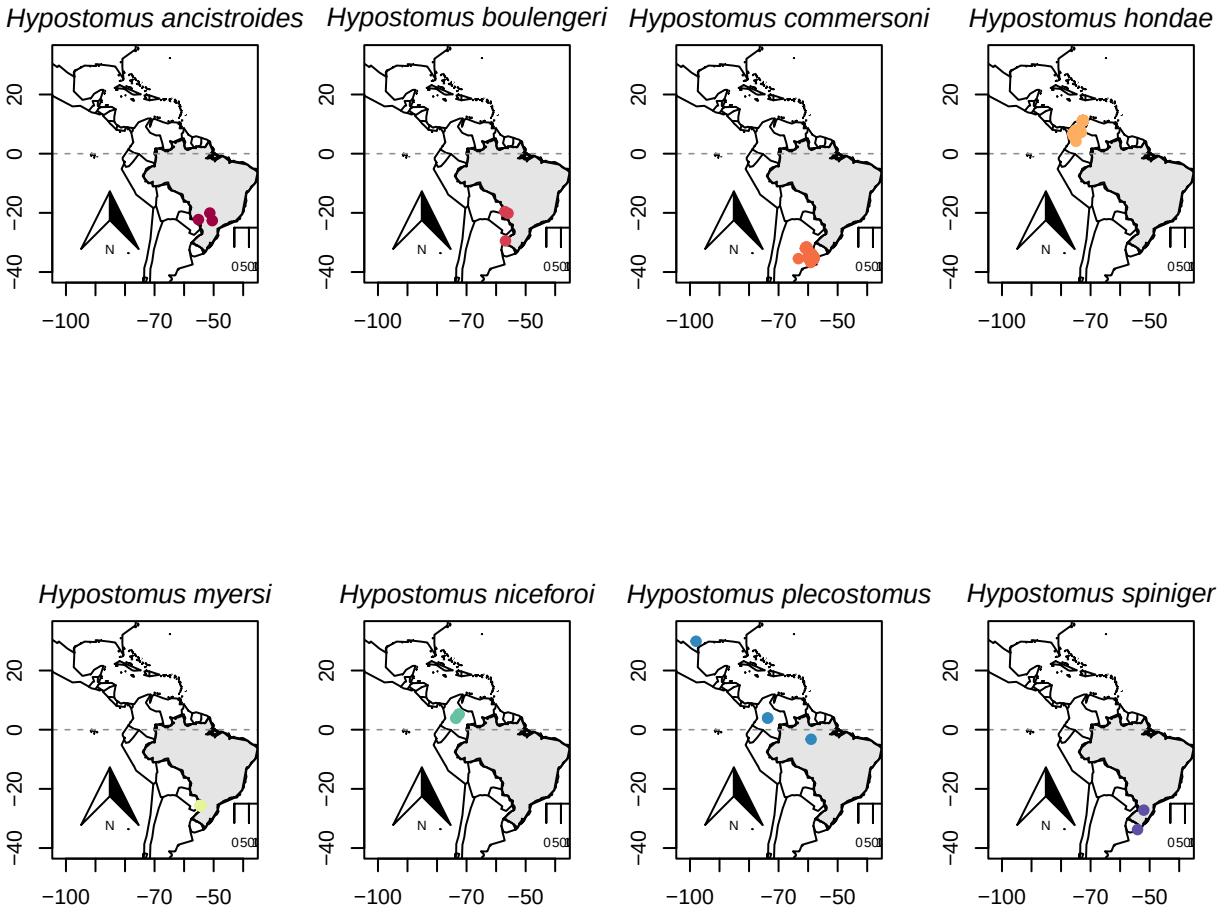
```
#define alguns parâmetros gráficos (linhas, colunas, margem)

par(mfrow=c(2,4), mar=c(0,0,0,0))

#plota os mapas de cada sp dentro de um loop

for(i in 1:length(listaSpp)){
  map("world", "Brazil", fill=T, col="grey90", xlim=xlim, ylim=ylim)
  title(nomeSpp_legenda[i], line=1) #optei por não plotar a legenda e sim o nome das spp no título
```

```
  map(,,add=T,xlim=xlim, ylim=ylim)
  points(listaSpp[[i]], pch=19, cex=1, col=paletaCustomizada[i])
  abline(h=0, lwd=0.8, lty=2, col="gray56")
  prettymapr::addnortharrow("bottomleft", scale=0.5) #altere os argumentos que envolvem posição e t
  maps::map.scale(x=-43,y=-25, ratio=FALSE, cex=0.6)
  map.axes()
}
```



2.1 2.3-America do Sul: altitude ——

Aqui nos vamos utilizar funcoes do pacote “raster” para baixarmos dados de altitude diretamente da base dados do [WorldClim] (https://www.worldclim.org)

Baixa raster de altitude do WorldClim

```
altitude2.5 <- raster::getData("worldclim", var = "alt", res = 2.5)
```

```
## Warning in raster::getData("worldclim", var = "alt", res = 2.5): getData will be removed in a fut
## . Please use the geodata package instead
```

Recorta o raster para os limites da America do Sul

```
ext <- raster::extent(-90, -35, -60, 15)
altitude.crop <- raster::crop(altitude2.5, ext)
```

Baixa mapa político do Brasil do

[Database of Global Administrative Areas - GADM] (https://gadm.org)

```
brasil <- raster::getData("GADM", country = "BRA", level = 1)
```

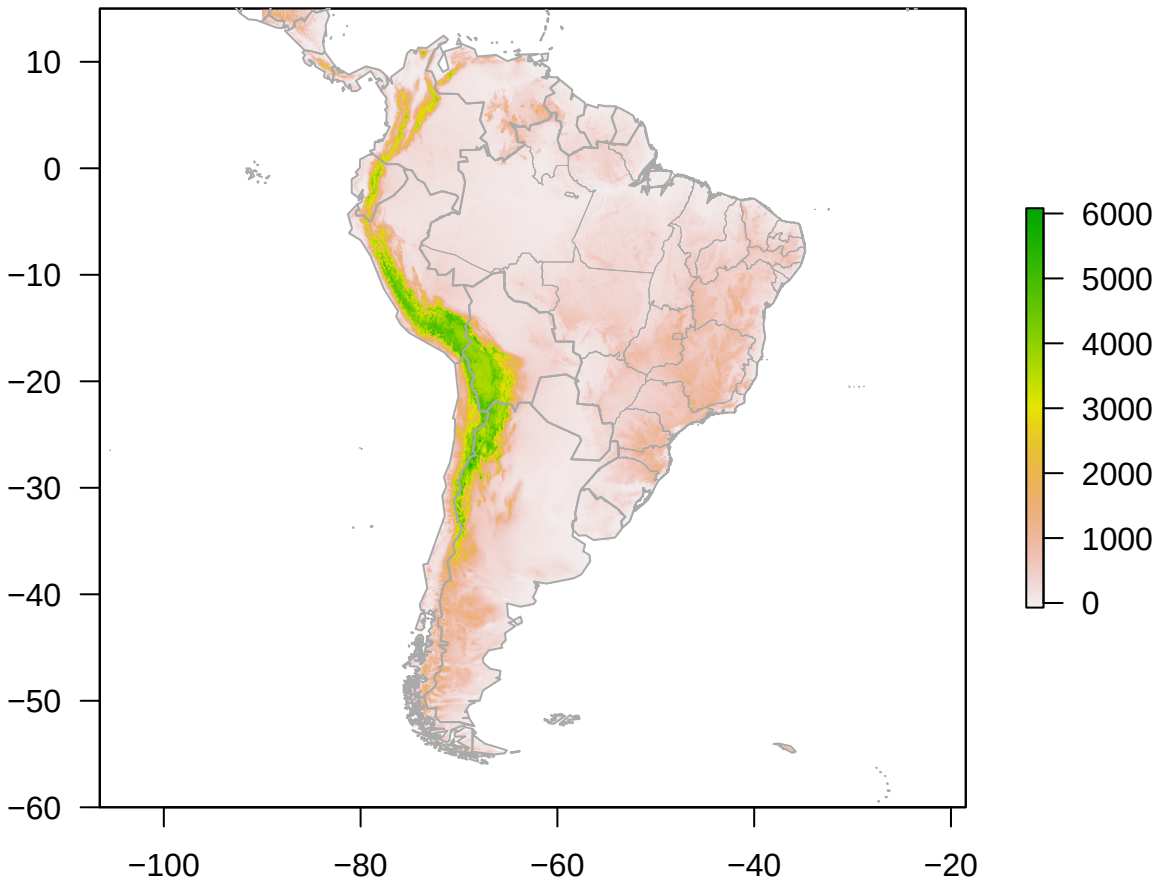
```
## Warning in raster::getData("GADM", country = "BRA", level = 1): getData will be removed in a futu
## . Please use the geodata package instead
```

Aqui faz mapa de altitude

```
# Faz mapa de altitude
plot(altitude.crop, las = 1)

# Adiciona limites dos países da América do Sul
plot(wrld_simpl, add = TRUE, border = "dark grey")

#Adiciona limites dos estados do Brasil
plot(brasil, lwd = 0.2, border = "dark grey", add = T)
```



2.2 Polígonos dos Biomas Brasileiros (IBGE)

Arquivos vetoriais (shapefiles) do Mapa de Biomas do Brasil podem ser baixados do sítio do IBGE.

2.2.1 Baixando arquivos vetoriais e criando o mapa

Baixa arquivo vetorial (notem como quebrar uma url longa!)

```
urlRemote <- "http://geoftp.ibge.gov.br/"
pathRemote <- "informacoes_ambientais/estudos_ambientais/biomas/vetores/"
fileName <- "Biomas_250mil.zip"

url <- paste0(urlRemote, pathRemote, fileName)
file <- basename(url)
download.file(url, file)
```

Descomprime arquivo zip em nova pasta (criada agora "Biomas_250mil")

```
biomas.unzip <- unzip("Biomas_250mil.zip", exdir = "Biomas_250mil")
biomas.unzip
```

```
## [1] "Biomas_250mil/lm_bioma_250.CPG"     "Biomas_250mil/lm_bioma_250.dbf"
## [3] "Biomas_250mil/lm_bioma_250.prj"     "Biomas_250mil/lm_bioma_250.sbn"
## [5] "Biomas_250mil/lm_bioma_250.sbx"     "Biomas_250mil/lm_bioma_250.shp"
## [7] "Biomas_250mil/lm_bioma_250.shp.xml" "Biomas_250mil/lm_bioma_250.shx"
```

Agora vamos carregar o arquivo vetorial

```
biomas <- rgdal::readOGR("Biomas_250mil/lm_bioma_250.shp", verbose = F)
```

```
## Warning in OGRSpatialRef(dsn, layer, morphFromESRI =
## morphFromESRI, dumpSRS = dumpSRS, : Discarded datum
## Sistema_de_Referencia_Geocentrico_para_las_AmericaS_2000 in Proj4 definition:
## +proj=longlat +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +no_defs
```

```
biomas@data
```

```
##            Bioma CD_Bioma
## 0       Amazônia        1
## 1       Caatinga        2
## 2        Cerrado        3
## 3 Mata Atlântica        4
## 4          Pampa        5
## 5       Pantanal        6
```

Salva poligono do Cerrado

```
cerrado <- subset(biomas, Bioma == "Cerrado")
```

Plota mapa de altitude e adiciona poligono do Cerrado

```
#windows(8,8) #windows
#quartz(8,8) #mac
#X11(8,8) #linux

plot(altitude.crop,
     col = colorspace::diverge_hcl(1024,
                                   h = c(110, 30),
                                   c = 130,
                                   l = c(30, 90),
                                   power = 1,
                                   fixup = TRUE,
                                   alpha = 1),
     legend.args = list(text = "Altitude (m)",
                        cex = 1,
                        line = 1,
                        adj = 0),
     axes = F,
     box = F,
     las = 1)
plot(cerrado,
     col = rgb(1, 0, 0, alpha = 0.2),
     lwd = 0.4,
     add = T)
```