Invasive index: de-Val et al. 2015)

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El siguiente código replica la metodología propuesta por de-Val y colaboradores (2015) y presenta una agregación para capas políticas y administrativas de Colombia.

Load libraries

```
library(rgdal)
```

```
## Warning: package 'rgdal' was built under R version 3.0.3

## Loading required package: sp

## Warning: package 'sp' was built under R version 3.0.3

## rgdal: version: 0.9-2, (SVN revision 526)
## Geospatial Data Abstraction Library extensions to R successfully loaded
## Loaded GDAL runtime: GDAL 1.11.2, released 2015/02/10
## Path to GDAL shared files: C:/Users/GIC 76/Documents/R/win-library/3.0/rgdal/gdal
## GDAL does not use iconv for recoding strings.
## Loaded PROJ.4 runtime: Rel. 4.9.1, 04 March 2015, [PJ_VERSION: 491]
## Path to PROJ.4 shared files: C:/Users/GIC 76/Documents/R/win-library/3.0/rgdal/proj
```

```
library(raster)
```

```
## Warning: package 'raster' was built under R version 3.0.3
```

```
library(GGally)
```

```
## Warning: package 'GGally' was built under R version 3.0.3
```

Load requiered maps

```
colombia <- readOGR('.','COLOMBIA')
```

```
## OGR data source with driver: ESRI Shapefile
## Source: ".", layer: "COLOMBIA"
## with 1 features
## It has 1 fields
```

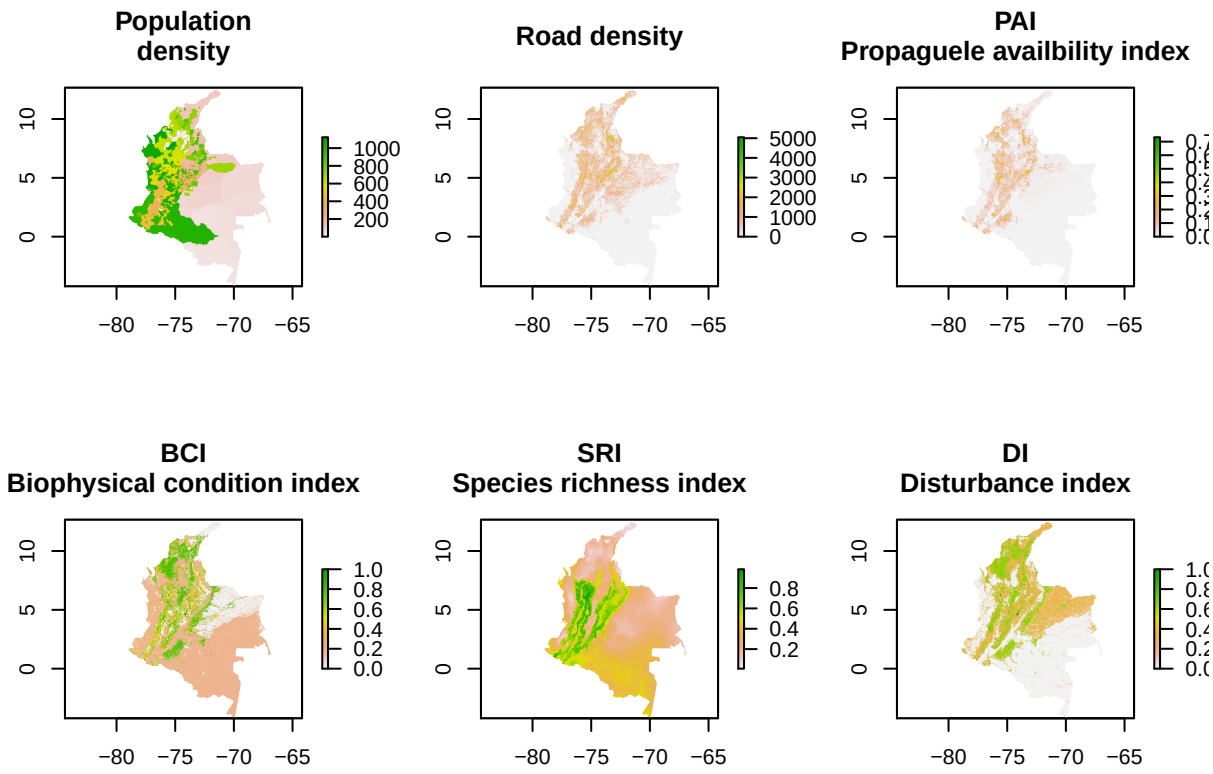
```
mapID <- raster('rasterID_cover.tif')
deptos <- readOGR('.', 'deptos', encoding = 'UTF-8', stringsAsFactors = FALSE)
```

```
## OGR data source with driver: ESRI Shapefile
## Source: ".", layer: "deptos"
## with 33 features
## It has 3 fields
```

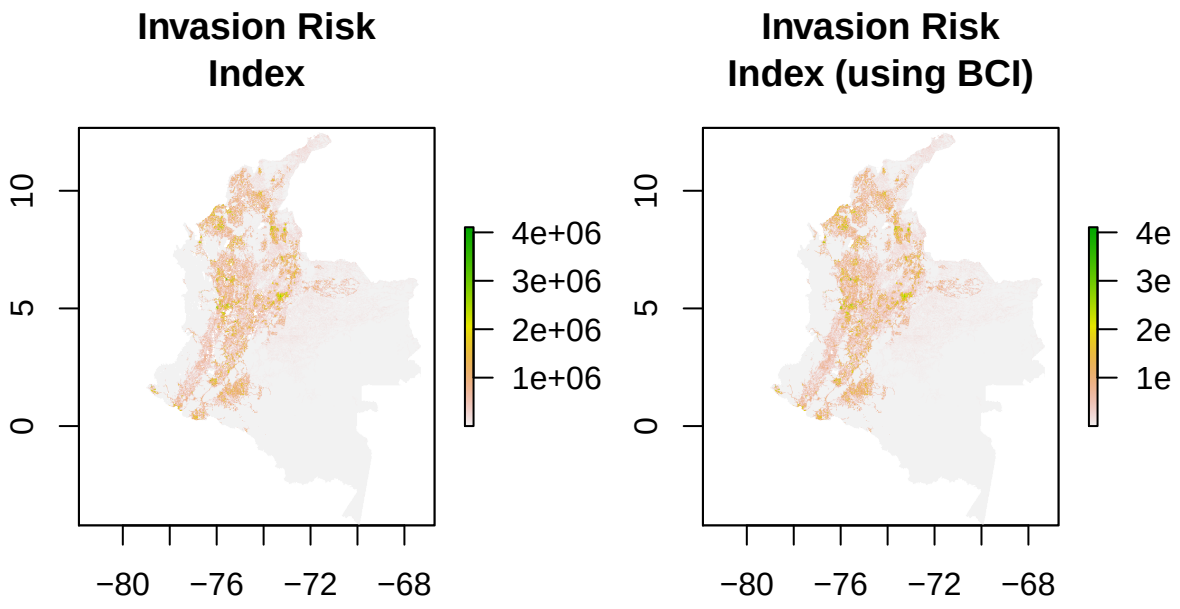
```r
deptos <- spTransform(deptos, mapID@crs)

## Propaguele availbility index (PAI)
popRaster <- raster('popDens.tif')
nrowRoadDensity <- 117920
pxRaster <- raster('roadDensity.tif')
roadRaster <- pxRaster * (nrowRoadDensity - 1)
roadRaster@crs <- popRaster@crs
rm(pxRaster)

projRoad <- raster('projRoad.tif')
roadRaster <- raster('roadDens.tif')

pai1 <- projRoad * popRaster
pai2 <- log(projRoad) * popRaster
pai3 <- projRoad * log(popRaster)
pai4 <- log(projRoad) * log(popRaster)

paiStack <- stack(pai1, pai2, pai3, pai4)
names(paiStack) <- c('PAI1', 'PAI2', 'PAI3', 'PAI4')
paiDF <- as.data.frame(paiStack)
paiDF <- na.omit(paiDF)
inf <- which(paiDF[, 2] != -Inf & paiDF[, 1] != 0, arr.ind = TRUE)
paiDF <- paiDF[inf, ]

# pairs(paiDF) # Avoid run due overload pdf plots

## Biophysical condition index (BCI)
bci <- raster('reclassImpact.tif')

## Disturbance index (DI)
di <- raster('reclassDist.tif')

## Species richness index (SRI)
sri <- raster('alphaBiomod.tif')
```

```r
## Invasion risk index (IRI)
paiMask <- raster('mask_pai.tif')
bciMask <- raster('mask_bci.tif')
diMask <- raster('mask_di.tif')
sriMask <- raster('mask_sri.tif')

paiNorm <- (paiMask - paiMask@data@min)/(paiMask@data@max - paiMask@data@min)
bciNorm <- (bciMask - bciMask@data@min)/(bciMask@data@max - bciMask@data@min)
sriNorm <- (sriMask - sriMask@data@min)/(sriMask@data@max - sriMask@data@min)
diNorm <- (diMask - diMask@data@min)/(diMask@data@max - diMask@data@min)

par(mfrow = c(2, 3))
plot(popRaster, main = 'Population\ndensity')
plot(roadRaster, main = 'Road density')
plot(paiNorm, main = 'PAI\nPropaguele availbility index')
plot(bciNorm, main = 'BCI\nBiophysical condition index')
plot(sriNorm, main = 'SRI\nSpecies richness index')
```

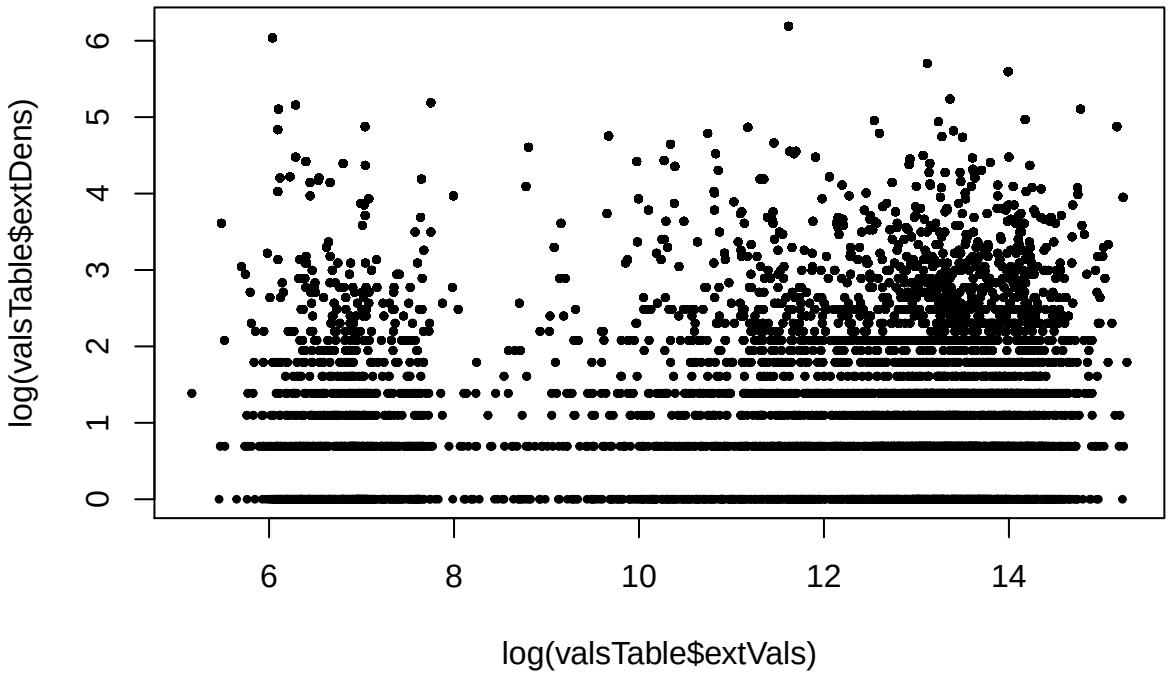
```
plot(diNorm, main = 'DI\nDisturbance index')
```



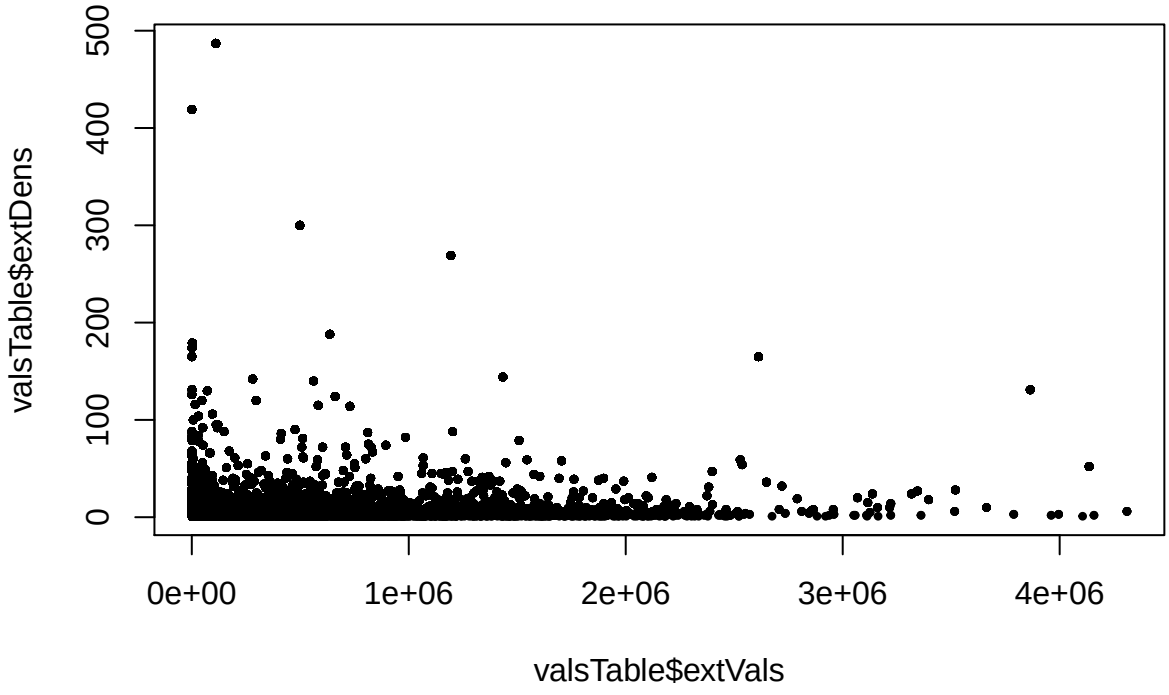

```
iri <- paiMask + bciMask + diMask + sriMask
iri2 <- paiMask + diMask + sriMask
writeRaster(iri, 'IRI.tif', overwrite = TRUE)
writeRaster(iri2, 'IRI2.tif', overwrite = TRUE)

par(mfrow = c(1, 2))
plot(iri, main = 'Invasion Risk\nIndex')
plot(iri2, main = 'Invasion Risk\nIndex (using BCI)')
```




```
invCoords <- read.csv('invasiveCoords.csv', stringsAsFactors = FALSE)
invCoords <- SpatialPointsDataFrame(coords = cbind(invCoords$lon, invCoords$lat),
                                    data = invCoords, proj4string = mapID@crs)
densRegistros <- rasterize(invCoords, iri, field = invCoords$invasive, fun = sum, na.rm = TRUE)
invCoords@proj4string <- iri@crs

extVals <- raster:::extract(iri, invCoords)
extDens <- raster:::extract(densRegistros, invCoords)

valsTable <- na.omit(data.frame(extVals, extDens))
plot(log(valsTable$extVals), log(valsTable$extDens), pch = 20, cex = .7)
```




```
plot(valsTable$extVals, valsTable$extDens, pch = 20, cex = .7)
```




```
recordsByDepto <- over(invCoords, deptos)
deptoTableSp <- table(recordsByDepto$NOM_DPTO, invCoords$acceptedNameUsage)
deptoTable <- data.frame(deptoTableSp)
recordsCount <- rowSums(deptoTableSp)
spCount <- apply(deptoTableSp, 1, function(x) length(which(x != 0)))

deptoTable0 <- data.frame(Depto = names(recordsCount), records = recordsCount, logrecords = log(records
                          sp = spCount, logsp = log(spCount), stringsAsFactors = FALSE)

layerStack <- stack(popRaster, roadRaster, paiMask, bciMask, diMask, sriMask, paiNorm, bciNorm, sriNorm
names(layerStack) <- c('POP', 'ROAD', 'PAI', 'BCI', 'DI', 'SRI', 'PAIn', 'BCIn', 'SRIn', 'DIn', 'IRI',

deptoTable <- data.frame(deptoTable0, matrix(0, nrow(deptoTable0), length(names(layerStack))))
colnames(deptoTable) <- c(colnames(deptoTable0), names(layerStack))

for(d in 1:nrow(deptoTable)){
  dept.d <- deptoTable$Depto[d]
  shape.d <- deptos[deptos$NOM_DPTO == dept.d, ]
  stack.d <- crop(layerStack, y = shape.d)
  mask.d <- mask(stack.d, shape.d)
  vasl.d <- sapply(1:length(names(stack.d)), function(x) { mean(mask.d[[x]][], na.rm = TRUE) })
  deptoTable[d, c(names(layerStack))] <- vasl.d
  cat(d, '-', nrow(deptoTable), '|| ')
}
```

```
## 1 - 32 || 2 - 32 || 3 - 32 || 4 - 32 || 5 - 32 || 6 - 32 || 7 - 32 || 8 - 32 || 9 - 32 || 10 - 32 ||
```

```r
write.csv(deptoTable, 'deptoTable.csv', row.names = FALSE)
#deptoTable <- read.csv('deptoTable.csv', as.is = TRUE)
#ggpairs(deptoTable[, -c(1)])
#pairs(deptoTable[, -c(1)], pch = 20, col = rgb(0.5, 0.5, 1, 0.5))
corDeptoTable <- cor(deptoTable[, -c(1)])
round(corDeptoTable, 2)
```

```
##            records logrecords   sp logsp  POP ROAD  PAI  BCI   DI  SRI
## records       1.00       0.83 0.90  0.73 0.20 0.21 0.24 0.22 0.17 0.32
## logrecords    0.83       1.00 0.86  0.86 0.30 0.36 0.38 0.30 0.33 0.41
## sp            0.90       0.86 1.00  0.93 0.29 0.10 0.18 0.15 0.05 0.46
## logsp         0.73       0.86 0.93  1.00 0.36 0.04 0.19 0.12 0.02 0.52
## POP           0.20       0.30 0.29  0.36 1.00 0.29 0.57 0.45 0.19 0.55
## ROAD          0.21       0.36 0.10  0.04 0.29 1.00 0.84 0.70 0.87 0.34
## PAI           0.24       0.38 0.18  0.19 0.57 0.84 1.00 0.76 0.65 0.58
## BCI           0.22       0.30 0.15  0.12 0.45 0.70 0.76 1.00 0.73 0.18
## DI            0.17       0.33 0.05  0.02 0.19 0.87 0.65 0.73 1.00 0.03
## SRI           0.32       0.41 0.46  0.52 0.55 0.34 0.58 0.18 0.03 1.00
## PAIn          0.24       0.38 0.18  0.19 0.57 0.84 1.00 0.76 0.65 0.58
## BCIn          0.22       0.30 0.15  0.12 0.45 0.70 0.76 1.00 0.73 0.18
## SRIn          0.32       0.41 0.46  0.52 0.55 0.34 0.58 0.18 0.03 1.00
## DIn           0.17       0.33 0.05  0.02 0.19 0.87 0.65 0.73 1.00 0.03
## IRI           0.24       0.38 0.18  0.19 0.58 0.84 1.00 0.76 0.65 0.58
## IRI2          0.24       0.38 0.18  0.19 0.57 0.84 1.00 0.76 0.65 0.58
##            PAIn BCIn SRIn  DIn  IRI IRI2
## records    0.24 0.22 0.32 0.17 0.24 0.24
## logrecords 0.38 0.30 0.41 0.33 0.38 0.38
## sp         0.18 0.15 0.46 0.05 0.18 0.18
## logsp      0.19 0.12 0.52 0.02 0.19 0.19
## POP        0.57 0.45 0.55 0.19 0.58 0.57
## ROAD       0.84 0.70 0.34 0.87 0.84 0.84
## PAI        1.00 0.76 0.58 0.65 1.00 1.00
## BCI        0.76 1.00 0.18 0.73 0.76 0.76
## DI         0.65 0.73 0.03 1.00 0.65 0.65
## SRI        0.58 0.18 1.00 0.03 0.58 0.58
## PAIn       1.00 0.76 0.58 0.65 1.00 1.00
## BCIn       0.76 1.00 0.18 0.73 0.76 0.76
## SRIn       0.58 0.18 1.00 0.03 0.58 0.58
## DIn        0.65 0.73 0.03 1.00 0.65 0.65
## IRI        1.00 0.76 0.58 0.65 1.00 1.00
## IRI2       1.00 0.76 0.58 0.65 1.00 1.00
```

```r
write.csv(corDeptoTable, 'corDeptoTable.csv')
```