

Calculation and application of the Species Synanthropy Index: additional example

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This second tutorial demonstrates the applicability of the SSI function to larger datasets, such as GBIF data.

We load necessary packages

```
library(SynAnthrop)
library(dplyr)
library(magrittr)
library(ggplot2)
```

Species Synanthropy Index: an example with GBIF data of amphibian populations in France

Setup

The raster map used here is extracted from the French Naturalness Map, developed by Guetté et al.(2021). This raster layer is not loaded with the `Synanthrop` package. It can be downloaded here and must be put in the `data/amphibiansGBIF` folder of this project under the name `Naturalness_France.tif`.

```
ras_raw <- raster::raster(file.path(here::here(), "data", "amphibiansGBIF", "Naturalness_France.tif"))
rast_to_plot <- terra::rast(ras_raw)
```

Next, we load the occurrence data to be evaluated and check for missing coordinates.

```
sp0cc <- read.csv(file.path(here::here(),
                             "data",
                             "amphibiansGBIF",
                             "amphibiansOccurrencesGBIF.csv"),
                  sep = ";", h=T, na.strings=c("(vide)"))

# eliminate points with missing coordinates
missingcoord <- dim(sp0cc %>% filter(is.na(Y) | is.na(Y)))[1]
sp0cc %>% filter(!is.na(Y) | !is.na(Y))
cat(paste(missingcoord, "point(s) were eliminated because of missing coordinates"))
```

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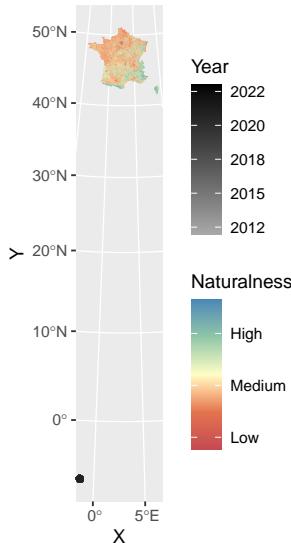
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```
## 1 point(s) were eliminated because of missing coordinates
```

We plot the data to make sure the two datasets use the same coordinate system and everything looks as expected.

```
ggplot() +
  tidyterra::geom_spatraster(data = rast_to_plot) +
  geom_point(data = sp0cc, aes(x = X, y = Y, color = Year)) +
  scale_colour_gradient(labels = function(x) sprintf("%.0f", x),
                        low = "darkgray", high = "black") +
  tidyterra::scale_fill_whitebox_c(palette = "muted", direction = -1,
                                    breaks = c(100, 325, 550),
                                    labels = c("Low", "Medium", "High"),
                                    name = "Naturalness")
```

```
## SpatRaster resampled to ncells = 500588
```

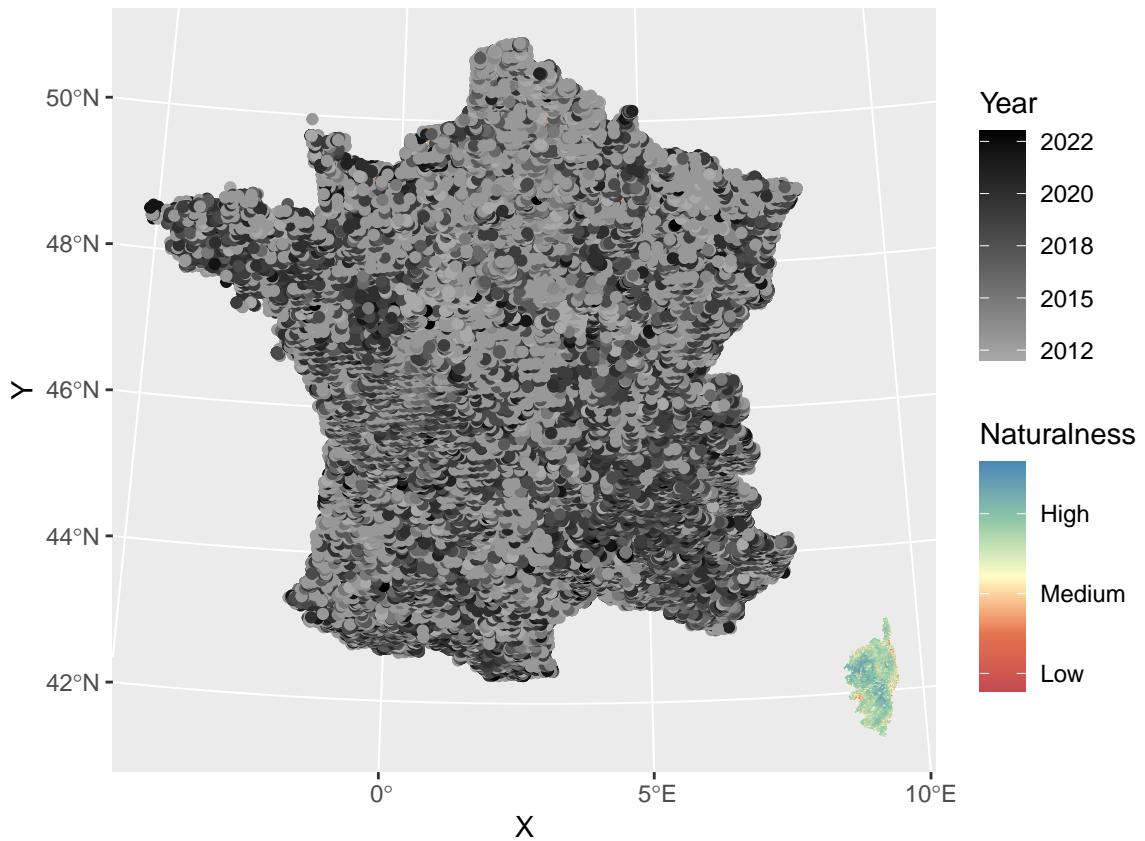


Coordinates seem to be from different coordinate systems. We convert the occurrence data coordinate system (RGF93) to match that of the raster file (WGS84) and check if coordinates now match.

```
sp_map <- sf::st_as_sf(sp0cc, coords = c("X", "Y"), crs = 4326)
LCCcoord <- data.frame(sp_map %>%
                         sf::st_transform(crs = sf::st_crs(ras_raw)) %>%
                         sf::st_coordinates())
sp0cc %>% mutate(X = LCCcoord$X,
                   Y = LCCcoord$Y)

ggplot() +
  tidyterra::geom_spatraster(data = rast_to_plot) +
  geom_point(data = sp0cc, aes(x = X, y = Y, color = Year)) +
  scale_colour_gradient(labels = function(x) sprintf("%.0f", x),
                        low = "darkgray", high = "black") +
  tidyterra::scale_fill_whitebox_c(palette = "muted", direction = -1,
                                    breaks = c(100, 325, 550),
                                    labels = c("Low", "Medium", "High"),
                                    name = "Naturalness")
```

```
## SpatRaster resampled to ncells = 500588
```



SSI calculation

Here, we execute the function for 2 resolutions (500, 1000), with 500 simulations each. Each species must have been found in a minimum of 1000 cells to be evaluated (threshold argument). If you are in interactive mode, you will be prompted to validate the species list detected in the dataset.

```
ssi_results <- ssi(r = ras_raw,
                     resolution = c(200, 300),
                     data = sp0cc,
                     sim = 500,
                     threshold = 1000)
```

```
## Species found in the dataset:
## Alytes almogavarrii
## Alytes obstetricans
## Ambystoma maculatum
## Bombina bombina
## Bombina variegata
## Bufo bufo
## Bufo spinosus
## Bufotes viridis
## Calotriton asper
```

```

## Discoglossus pictus
## Discoglossus sardus
## Epidalea calamita
## Hyla arborea
## Hyla meridionalis
## Hyla molleri
## Ichthyosaura alpestris
## Lissotriton helveticus
## Lissotriton vulgaris
## Lithobates catesbeianus
## Pelobates cultripes
## Pelobates fuscus
## Pelodytes punctatus
## Pelophylax bergeri
## Pelophylax kurtmuelleri
## Pelophylax lessonae
## Pelophylax perezi
## Pelophylax ridibundus
## Proteus anguinus
## Rana arvalis
## Rana dalmatina
## Rana pyrenaica
## Rana temporaria
## Ranoidea aurea
## Salamandra atra
## Salamandra corsica
## Salamandra lanzai
## Salamandra salamandra
## Speleomantes strinatii
## Triturus carnifex
## Triturus cristatus
## Triturus cristatus x T. marmoratus
## Triturus marmoratus
## Xenopus laevis
## 2023-08-25 09:40:35 - Aggregate naturalness raster cells at resolution 200 (this step may take a few
## 1 observation(s) were eliminated because of mismatch with the raster file

## Warning in ks.defaults(x = x, w = w, binned = binned, bgridsize = bgridsize, : Weights don't sum to 1

## Species that will be evaluated are:
## Alytes obstetricans
## Bombina variegata
## Bufo bufo
## Bufo spinosus
## Epidalea calamita
## Hyla arborea
## Hyla meridionalis
## Ichthyosaura alpestris
## Lissotriton helveticus
## Lissotriton vulgaris
## Pelodytes punctatus
## Pelophylax lessonae
## Pelophylax ridibundus
## Rana dalmatina

```

```

## Rana temporaria
## Salamandra salamandra
## Triturus cristatus
## Triturus marmoratus
## 2023-08-25 10:05:51 - Generating null distributions for:
## 2023-08-25 10:05:51 Alytes obstetricans (1/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:09:16 Bombina variegata (2/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:10:17 Bufo bufo (3/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:13:00 Bufo spinosus (4/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:14:39 Epidalea calamita (5/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:16:45 Hyla arborea (6/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:18:56 Hyla meridionalis (7/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:20:30 Ichthyosaura alpestris (8/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:21:59 Lissotriton helveticus (9/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:25:08 Lissotriton vulgaris (10/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:25:39 Pelodytes punctatus (11/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:26:43 Pelophylax lessonae (12/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:27:21 Pelophylax ridibundus (13/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:29:21 Rana dalmatina (14/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:32:55 Rana temporaria (15/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:36:40 Salamandra salamandra (16/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:39:59 Triturus cristatus (17/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:41:13 Triturus marmoratus (18/18)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 10:42:43 - Calculating effect sizes...
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:14:53 Analysis finished for resolution 200
## 2023-08-25 11:14:53 - Aggregate naturalness raster cells at resolution 300 (this step may take a few
## 1 observation(s) were eliminated because of mismatch with the raster file

## Warning in ks.defaults(x = x, w = w, binned = binned, bgridsize = bgridsize, : Weights don't sum to 1

## Species that will be evaluated are:
## Alytes obstetricans
## Bombina variegata
## Bufo bufo
## Bufo spinosus

```

```

## Epidalea calamita
## Hyla arborea
## Hyla meridionalis
## Ichthyosaura alpestris
## Lissotriton helveticus
## Pelodytes punctatus
## Pelophylax lessonae
## Pelophylax ridibundus
## Rana dalmatina
## Rana temporaria
## Salamandra salamandra
## Triturus cristatus
## Triturus marmoratus
## 2023-08-25 11:44:01 - Generating null distributions for:
## 2023-08-25 11:44:01 Alytes obstetricans (1/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:45:43 Bombina variegata (2/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:46:22 Bufo bufo (3/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:47:47 Bufo spinosus (4/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:48:49 Epidalea calamita (5/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:50:02 Hyla arborea (6/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:51:16 Hyla meridionalis (7/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:52:06 Ichthyosaura alpestris (8/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:53:02 Lissotriton helveticus (9/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:54:52 Pelodytes punctatus (10/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:55:31 Pelophylax lessonae (11/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:55:58 Pelophylax ridibundus (12/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:57:10 Rana dalmatina (13/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 11:59:07 Rana temporaria (14/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 12:01:07 Salamandra salamandra (15/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 12:03:02 Triturus cristatus (16/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 12:03:54 Triturus marmoratus (17/17)
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 12:05:12 - Calculating effect sizes...
## Simulation 1/500... 100/500... 200/500... 300/500... 400/500... 500/500
## 2023-08-25 12:31:39 Analysis finished for resolution 300
## 2023-08-25 12:31:39 All done.

```

Visualise and analyse the SSI results

SSI and effect sizes per species

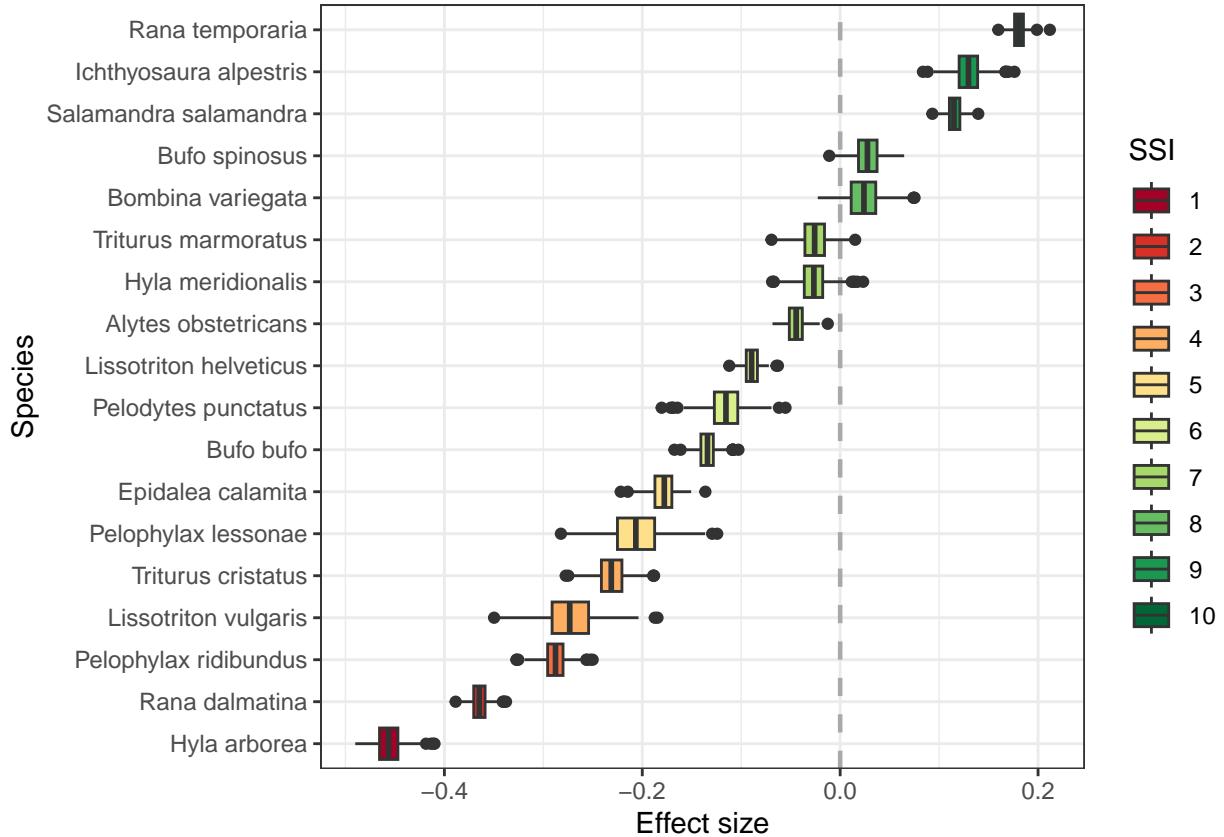
Here we visualize effect sizes and SSI obtained with the resolution 200.

```
sp_ssi <- ssi_results$speciesScores
effsize_res <- ssi_results$effSizes

# keep only data for resolution 200
# associate the SSI to the detailed effect sizes
sub_effsize_res <- effsize_res %>%
  filter(Resolution == 200) %>%
  left_join(sp_ssi, by = c("Species", "Resolution"))

# make the score a factor
sub_effsize_res$Index <- as.factor(sub_effsize_res$Index)

# plot the results
ggplot(sub_effsize_res,
       aes(x = reorder(Species, -effsize),
            y = -effsize, fill = Index)) +
  geom_hline(yintercept = 0.0, color = "darkgrey",
             linewidth = 0.8, linetype = "dashed") +
  geom_boxplot() +
  coord_flip() +
  scale_fill_brewer(name = "SSI", palette = "RdYlGn") +
  ylab("Effect size") +
  xlab("Species") +
  theme(axis.title.y = element_blank()) +
  theme(legend.position = c(0.9, 0.2)) +
  theme_bw()
```



Resolution comparison

```

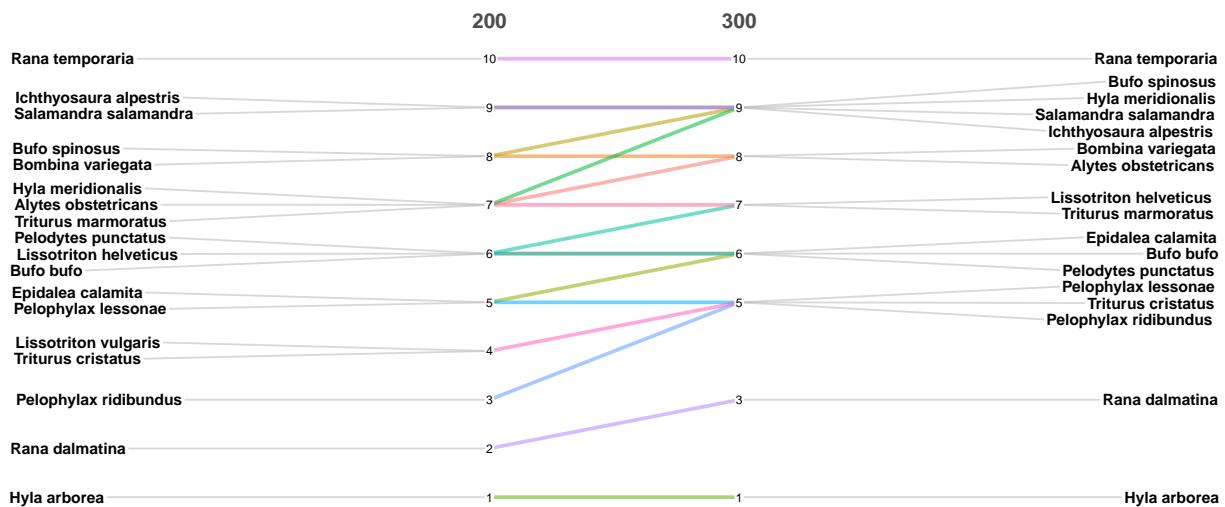
sp_ssi$Resolution <- as.factor(sp_ssi$Resolution)

CGPfunctions::newggslopegraph(dataframe = sp_ssi,
                               Resolution,
                               Index,
                               Grouping = Species,
                               Title = "Synanthropy scores for amphibian species in western France",
                               SubTitle = NULL,
                               Caption = NULL)

##
## Converting 'Resolution' to an ordered factor

```

Synanthropy scores for amphibian species in western France



Distribution map

```

points <- ssi_results$samplesList

# we select one resolution, one set of simulated points, and the observed points
sub_points <- points %>% filter(Resolution == "200",
                                simulation %in% c(1, "no"))

ggplot() +
  geom_point(data = sub_points, aes(x = x, y = y, color = variable),
             size = 1.5, alpha = 0.5) +
  scale_color_manual(values = c("#ff6600", "#660099")) +
  theme(axis.title.x = element_blank(),
        axis.title.y = element_blank()) +
  guides(color = guide_legend(title = "Points")) +
  facet_wrap(. ~ Species) +
  theme_void()

```

