Assessing ButterfLies in Europe (ABLE)

New indicators and their implications

Chris van Swaay

Emily Dennis

29 October 2020

Two types of indicators

- Multi-species Indicators (MSI)
  - All Butterfly Indicator
  - Grassland butterfly indicator
  - Woodland butterfly indicator
  - Urban butterfly indicator
  - Natura 2000 butterfly indicator
  - (wetland)
- Community indicator: Climate change indicator (CTI)

All information available on the web

- www.butterfly-monitoring.net
- Choose eBMS background → outputs
- Workshop plus Rcode and video

Workshop 1 April 2020

BMS Workshop

Home | WS1 | WS2 | WS3 | WS4

- Motivation
- Schedule
- Before the workshop
- Computer and software
- Download Data
- Reading

Calculating butterfly trends, indexes and indicators

Reto Schmucki, Emily Dennis, David Roy and Chris Van Swaay

April 1st, 2020

Motivation

In the ABLE project new tools have been developed to make it easier for regional and national coordinators of Butterfly Monitoring Schemes to calculate indexes and trends as well as build indicators. This workshop will focus on the background of the method and learning how to use the tools. This workshop is open by invitation only to all co-ordinators of European Butterfly Monitoring Schemes as well as other people actively involved in the analysis and assessment of butterfly monitoring.

Schedule

Time	Topic	Instructor
9:30 - 9:40	login to virtual workshop (Zoom meeting)	David
9:40 - 10:00	Introduction and participant presentation	Chris
10:00 - 11:00	BMS and count data in R, data wrangling and mapping	Reto
Break		
11:15 - 12:15	Modelling Butterfly Abundance (GAI)	Emily
Lunch		
13:30 - 14:30	Flight curve and Site & collated indices	Reto
Break		
14:45 - 15:45	Trends and Multi-Species Indices	Emily
Break		
Q&A (30 min)		Reto, Emily, David & Chris

Workshop 1 April 2020: R code

BMS Workshop

Home | WS1 | WS2 | WS3 | WS4

- Generalized Abundance Index (2)
- Impute & Site index
- Collated index
- Bootstrap CI
- Figure with CI

Code

Computing site and collated indices

Reto Schmucki

29 March 2020

Generalized Abundance Index (2)

After having successfully computed estimates of the regional flight curve, you can now use this information together with your count data to estimate a total number of butterfly per monitoring site over a season. This will provide you with an estimated abundance for each site that can be used to compute a collated index over the entire regions or a group of sites.

For this task, we will used the flight curve computed earlier and the `impute_count`, `site_index` and finally `collated_index` functions available in `rbms` package

Hide

```
library(data.table)
library(rbms)
library(ggplot2)
```

Here we will use the count and visit data.

Hide

```
# s_sp <- "Maniola jurtina"
s_sp <- "Polyommatus icarus"
region_bms <- c("NLBMS", "FRBMS")

b_count_sub <- readRDS("bms_workshop_data/work_count.rds")
m_visit_sub <- readRDS("bms_workshop_data/work_visit.rds")

setnames(m_visit_sub, c("transect_id_serial", "visit_date"), c("SITE_ID", "DATE"))
names(m_visit_sub) <- toupper(names(m_visit_sub))

setnames(b_count_sub, c("transect_id_serial", "visit_date", "species_name"), c("SITE_ID", "DATE", "SPECIES"))
names(b_count_sub) <- toupper(names(b_count_sub))

ts_date <- rbms::ts_dwmy_table(InitYear = 2008,
                               LastYear = 2017,
                               WeekDay1 = "monday")
```

Building Indicators

- Step 1 - produce species site indices
- Step 2 - species collated indices
- Step 3 - species collated indices for EU27 and Europe
- Step 4 - producing EU27/European indicators

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Step 1 – produce species site indices

- Estimate flight periods using GAI method
- By Climate zone
- Bootstrapping
- Result: density per transect per year

Estimating flight period by climate region

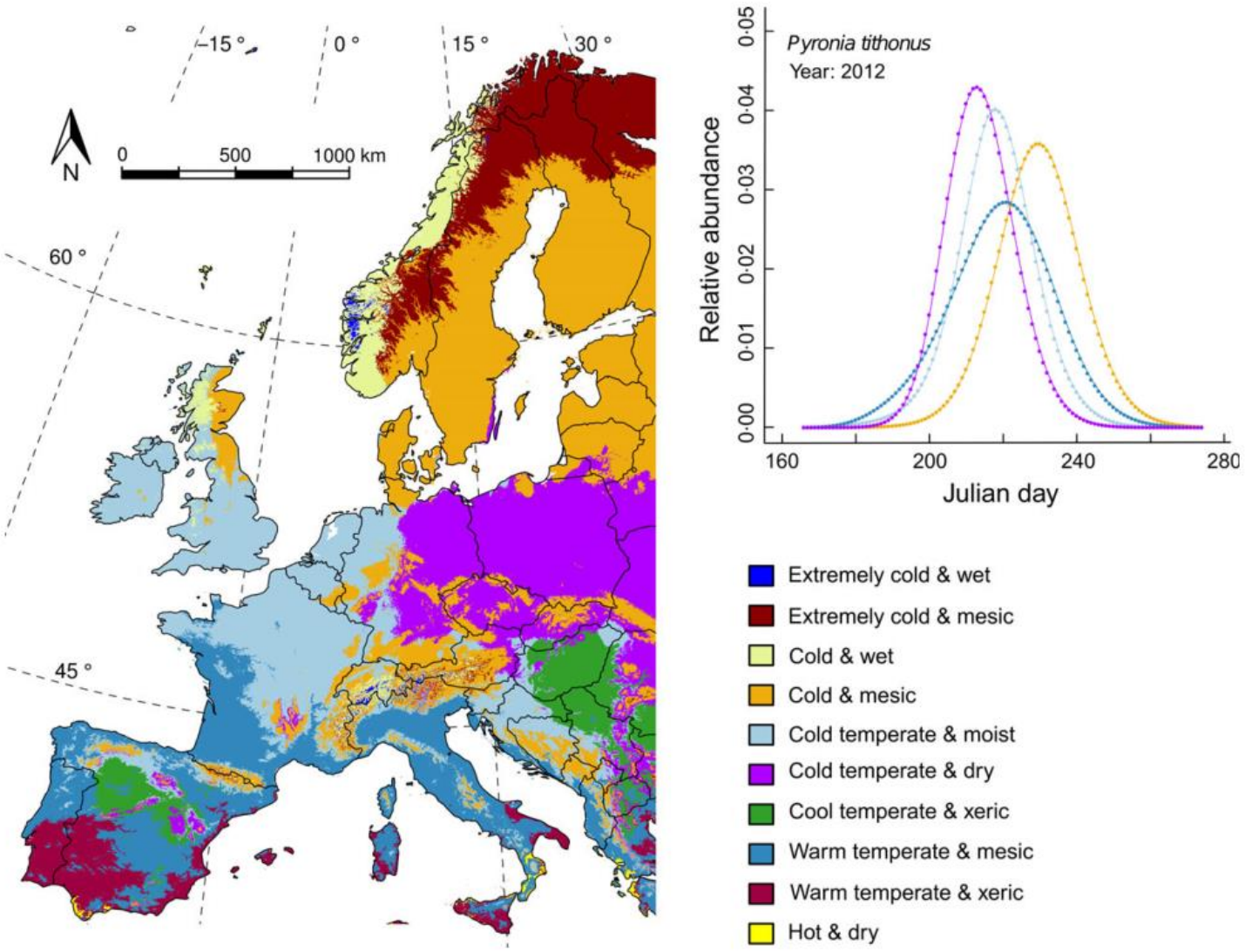
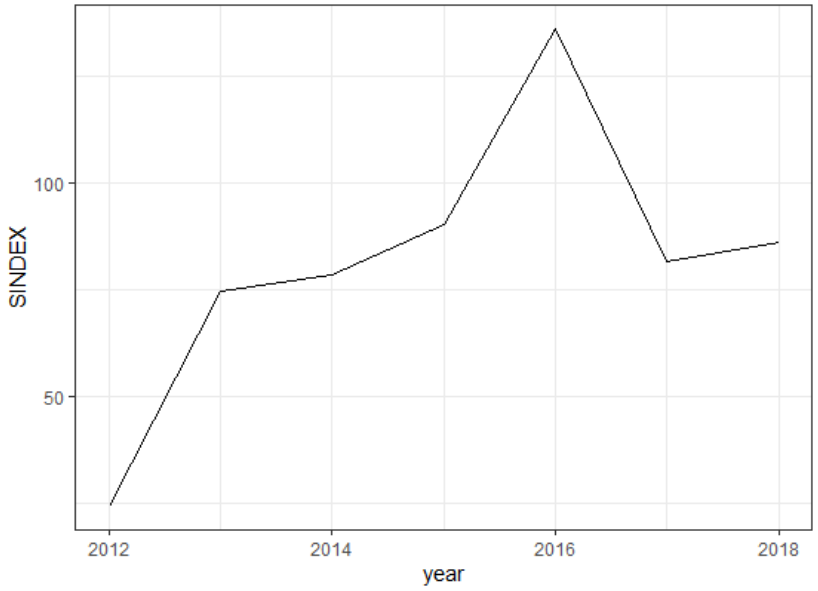


Fig. 1. Climate regions across Europe as defined in Metzger *et al.* (2013) with the flight curve of *Pyronia tithonus* observed in 2012 within four regions (Cold & mesic [yellow], Cold temperate & moist [pale blue], Cold temperate & dry [purple], Warm temperate & mesic [blue]).

Result: density per transect per year (sindex)

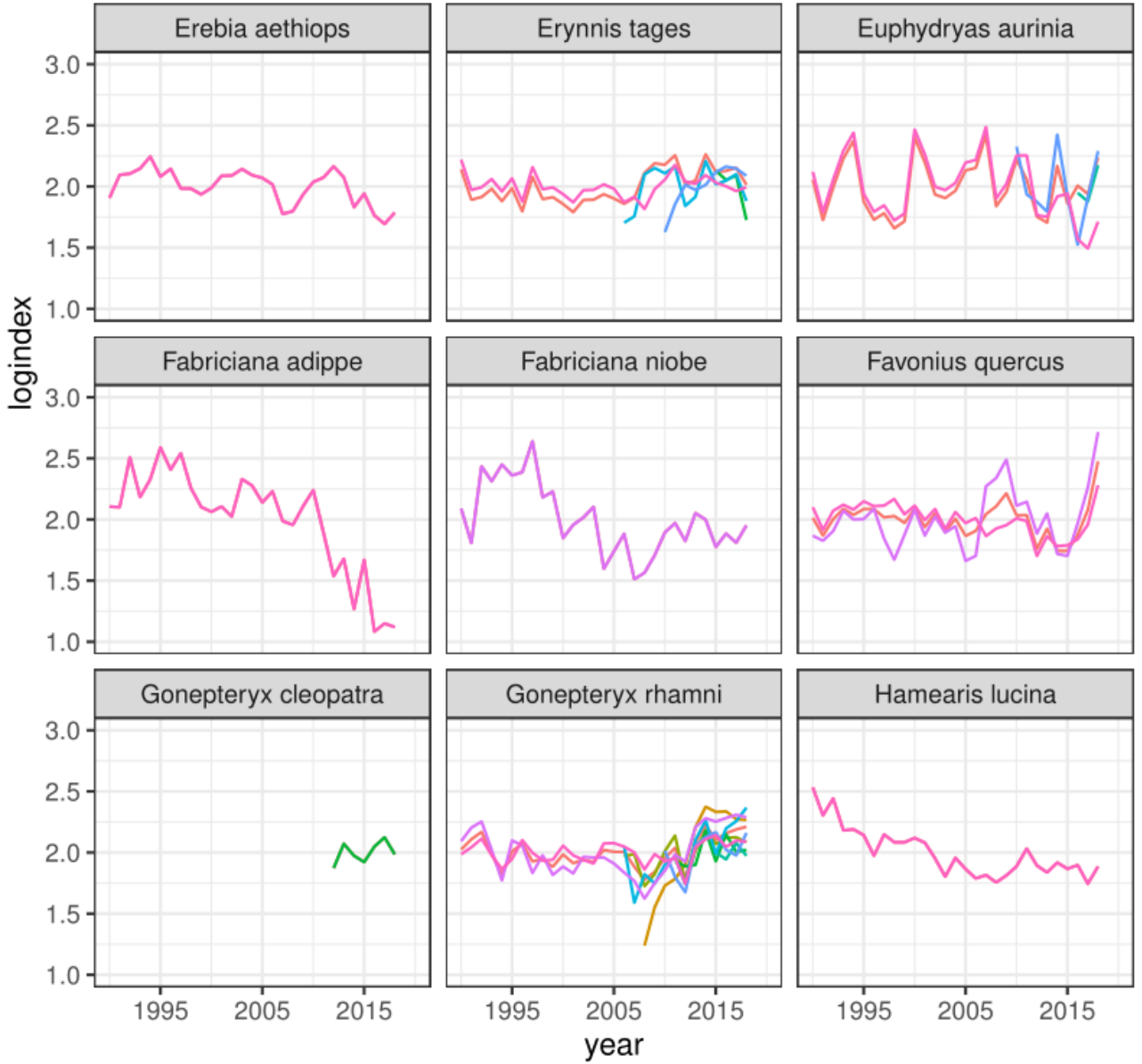
BMS_ID	SITE_ID	SPECIES	M_YEAR	SINDEX	BIOGEO
DEBMS	DEBMS.100179	Maniola jurtina	2012	24,33139	Atlantic
DEBMS	DEBMS.100179	Maniola jurtina	2013	74,59015	Atlantic
DEBMS	DEBMS.100179	Maniola jurtina	2014	78,42822	Atlantic
DEBMS	DEBMS.100179	Maniola jurtina	2015	90,25048	Atlantic
DEBMS	DEBMS.100179	Maniola jurtina	2016	136,1184	Atlantic
DEBMS	DEBMS.100179	Maniola jurtina	2017	81,66652	Atlantic
DEBMS	DEBMS.100179	Maniola jurtina	2018	86,18655	Atlantic



Building Indicators

- Step 1 - produce species site indices
- Step 2 - species collated indices per BGR per BMS
- Step 3 - species collated indices for EU27 and Europe
- Step 4 - producing EU27/European indicators

Collated indexes per BMS per BGR → BGR indexes



Building Indicators

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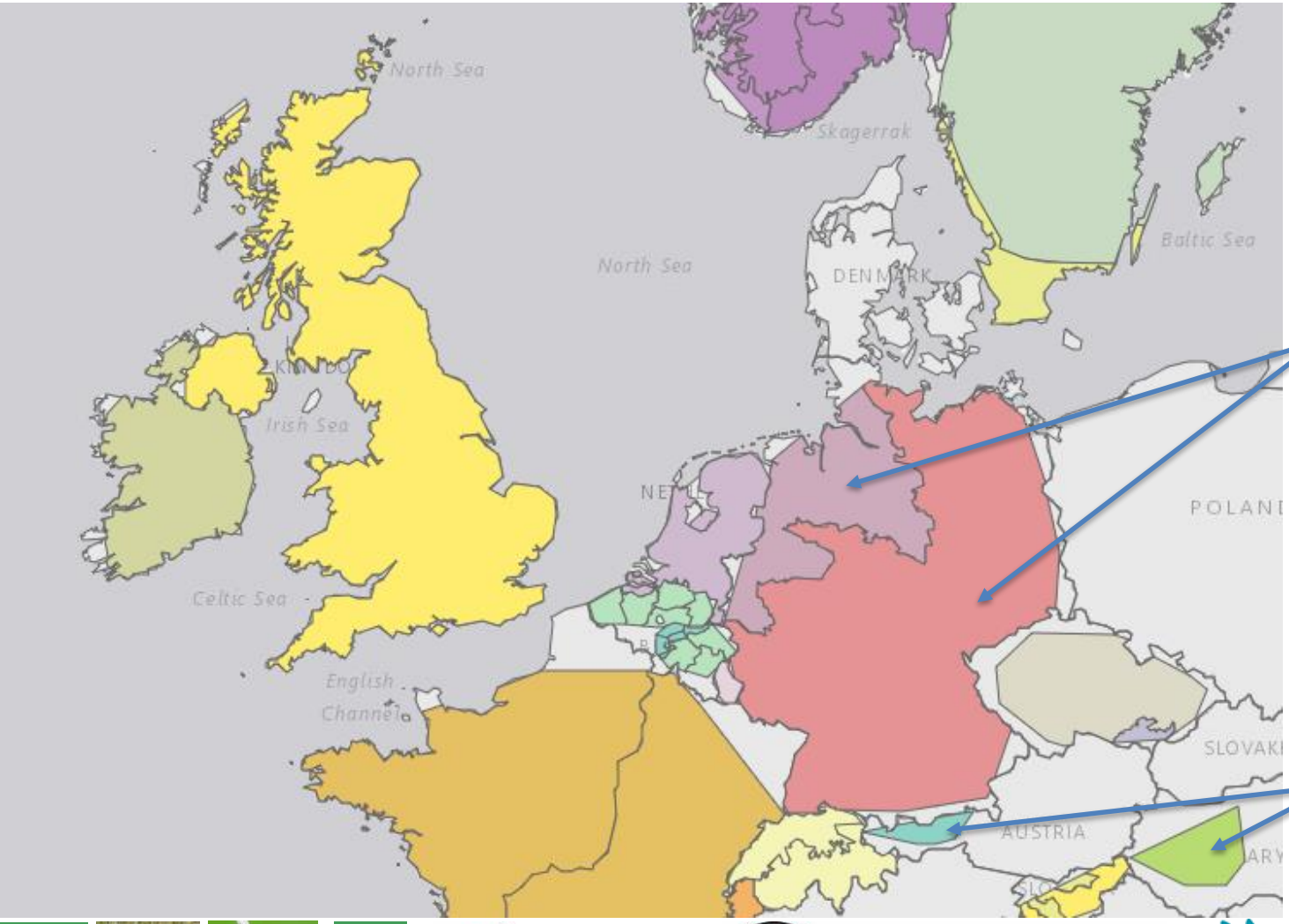
Weighting

- Without weighting the UKBMS and NLBMS would dominate all EU indexes and trends, as they have by far the most transects.
- Weighting is based on the overlay of distribution map with BMS/BGR polygon combined with the density.
- As a consequence transects in the UK and NL are downweighted, and in other parts of Europe upweighted.

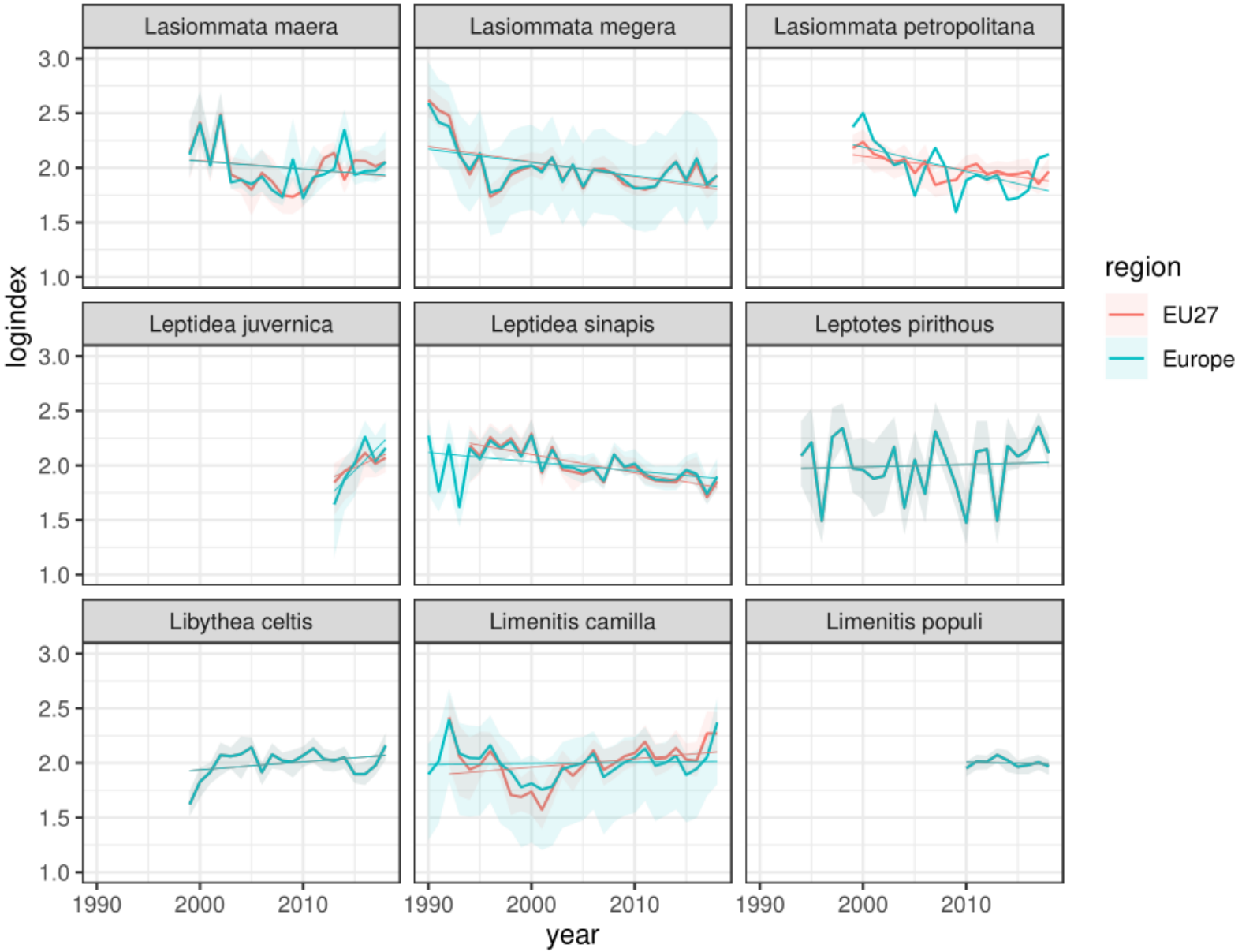
Weighting: area of BGR/BMS



Germany split into an Atlantic and Continental BGR

Only part of the country with transects used, e.g. in Austria and Hungary

Species indexes for EU27 and Europe



Building Indicators

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Building Indicators

- The European or EU indices were combined by taking the geometric mean of the indices (mean of the log of the index). This method is similar to the Living Planet Index.
- The doubling of one species compensates the halving of another species.
- Account for missing values, in particular the late entry of some species

Geometric mean

Species	Year 1	Year 2
Species A	10	5
Species B	500	1000
Arithmetic mean	255	502.5
Geometic mean	70.7	70.7
Indexes		
Species A	100	50
Species B	100	200
Arithmetic mean	100	125
Geometric mean	100	100

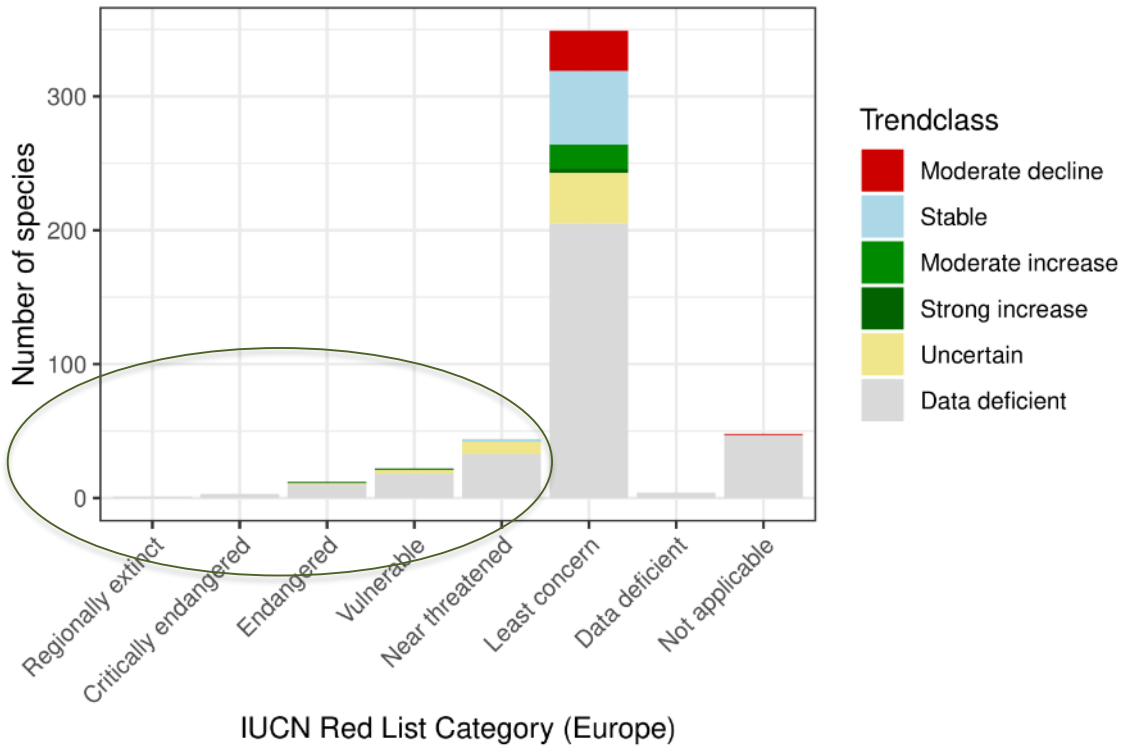
Effect of weighting on indexes and trends

- Weights of transects in existing BMS's will be affected by new BMS's joining in.
- As a result European/EU indexes and trends will change when new BMS's join.
- And as a results the indicators will change when new BMS's join.

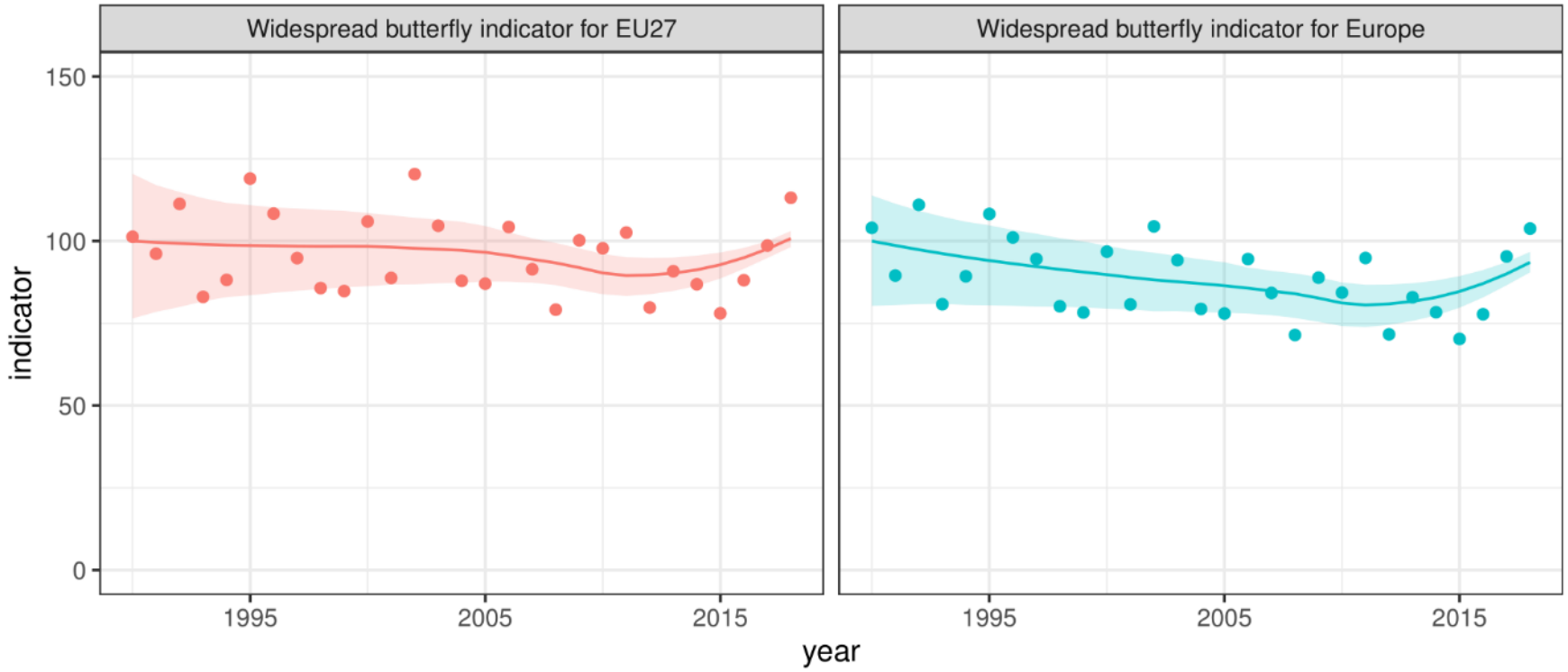
Indicators: species selection

- All species indicator = Widespread species indicator

Rare and threatened species are generally missed in the BMS's



Widespread species indicator



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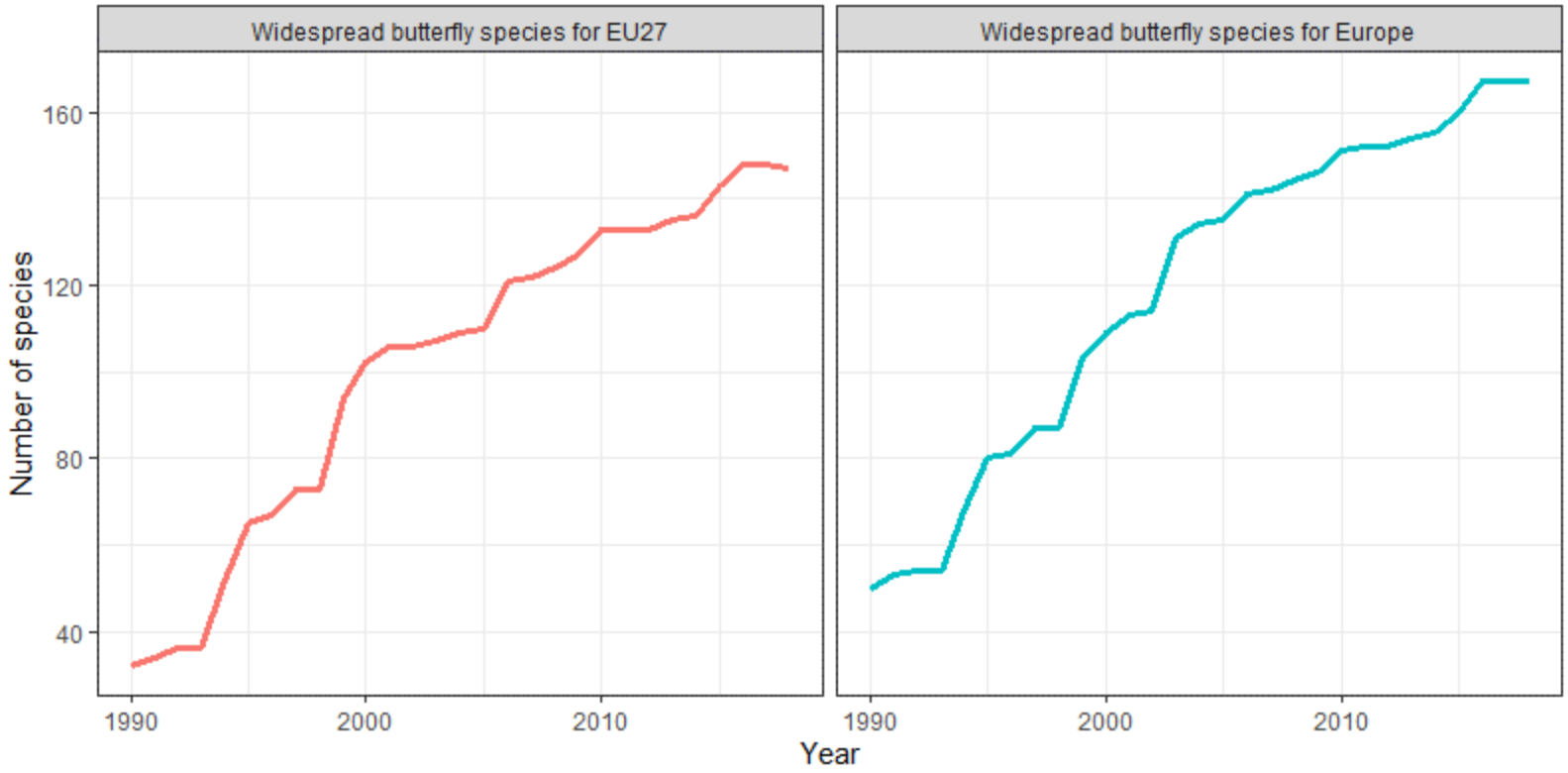
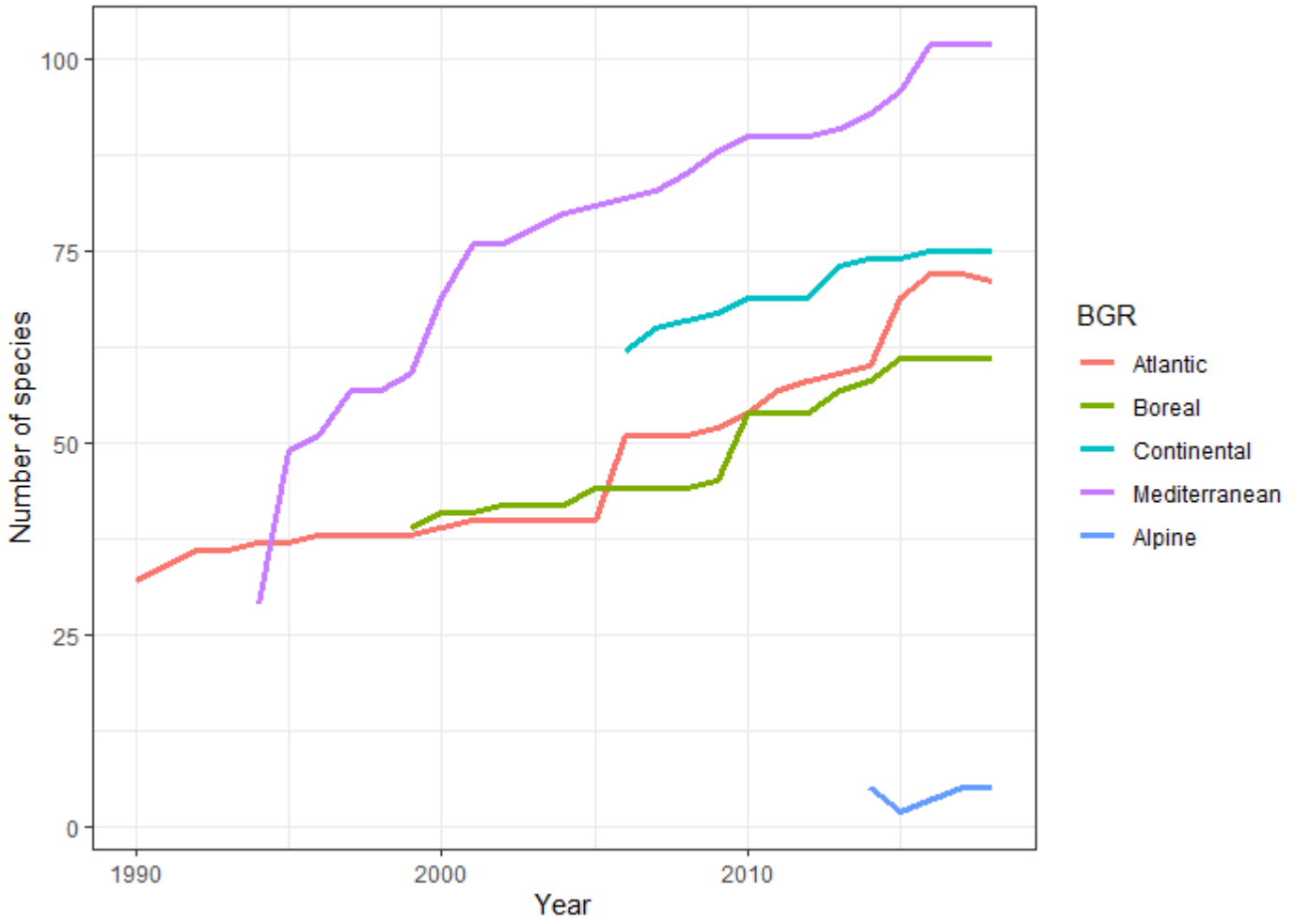
Number of widespread indicator species

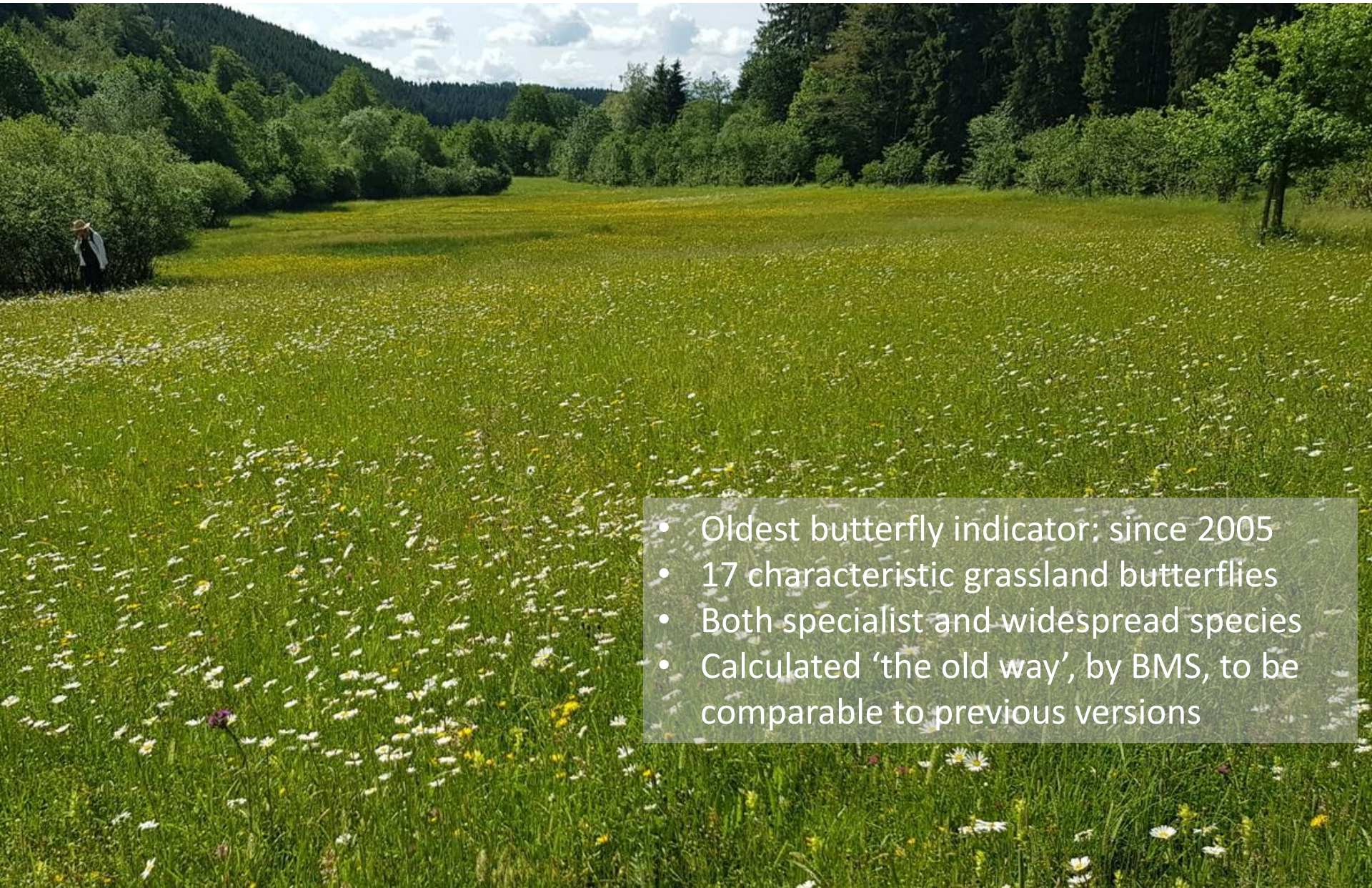


Widespread species indicators per BGR

Number of widespread indicators species per BGR



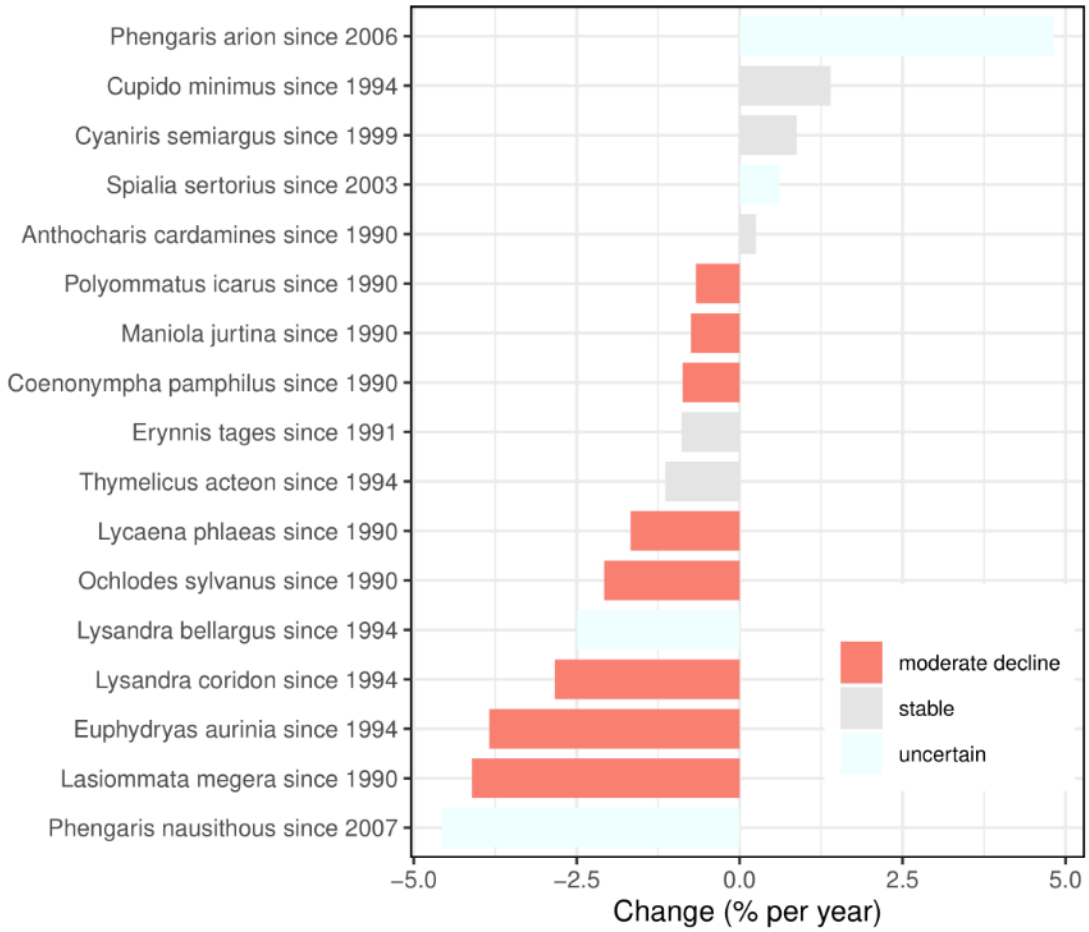
European Grassland Butterfly Indicator



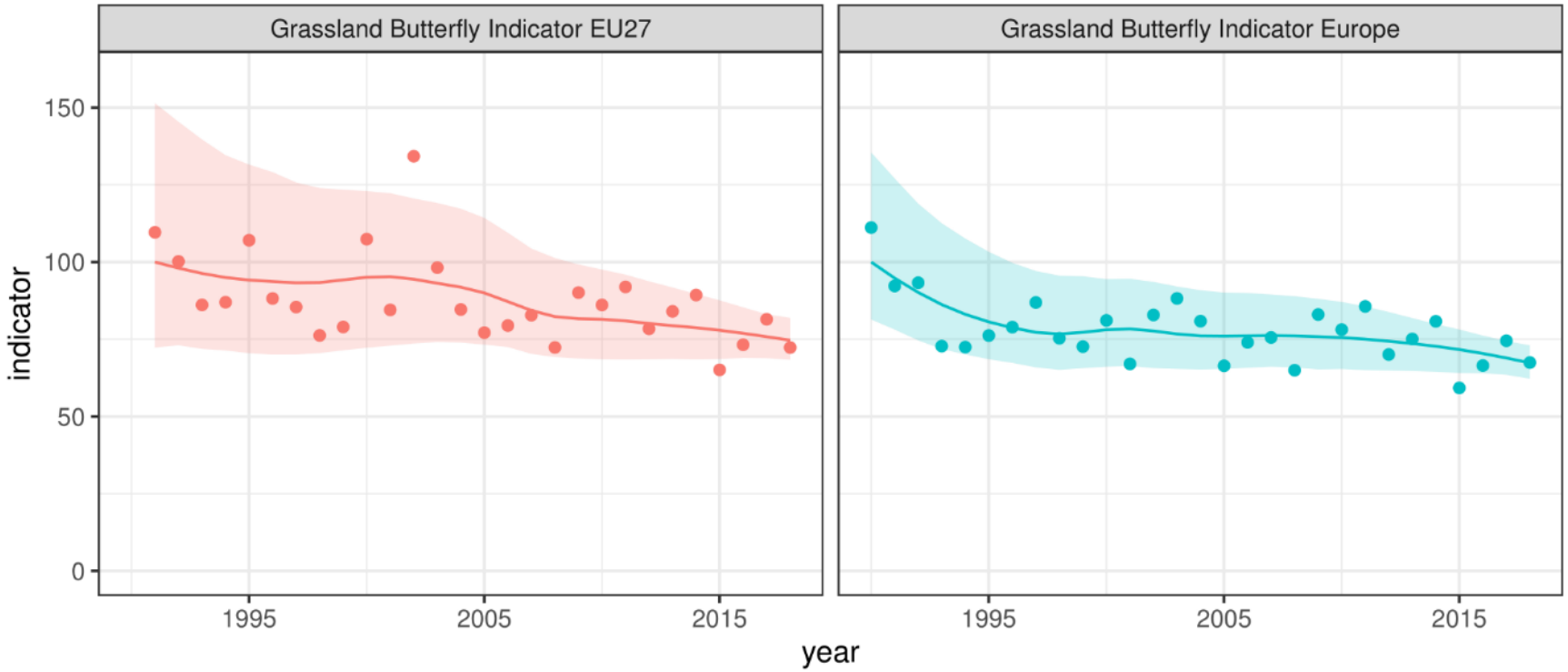
- Oldest butterfly indicator: since 2005
- 17 characteristic grassland butterflies
- Both specialist and widespread species
- Calculated ‘the old way’, by BMS, to be comparable to previous versions

European Grassland Butterfly Indicator

European Grassland Butterfly Indicator



European Grassland Butterfly Indicator



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Woodland Butterfly indicator

- 67 species occurring more in woodland than in any other habitat (Van Swaay et al., 2006)

Woodland Butterfly indicator

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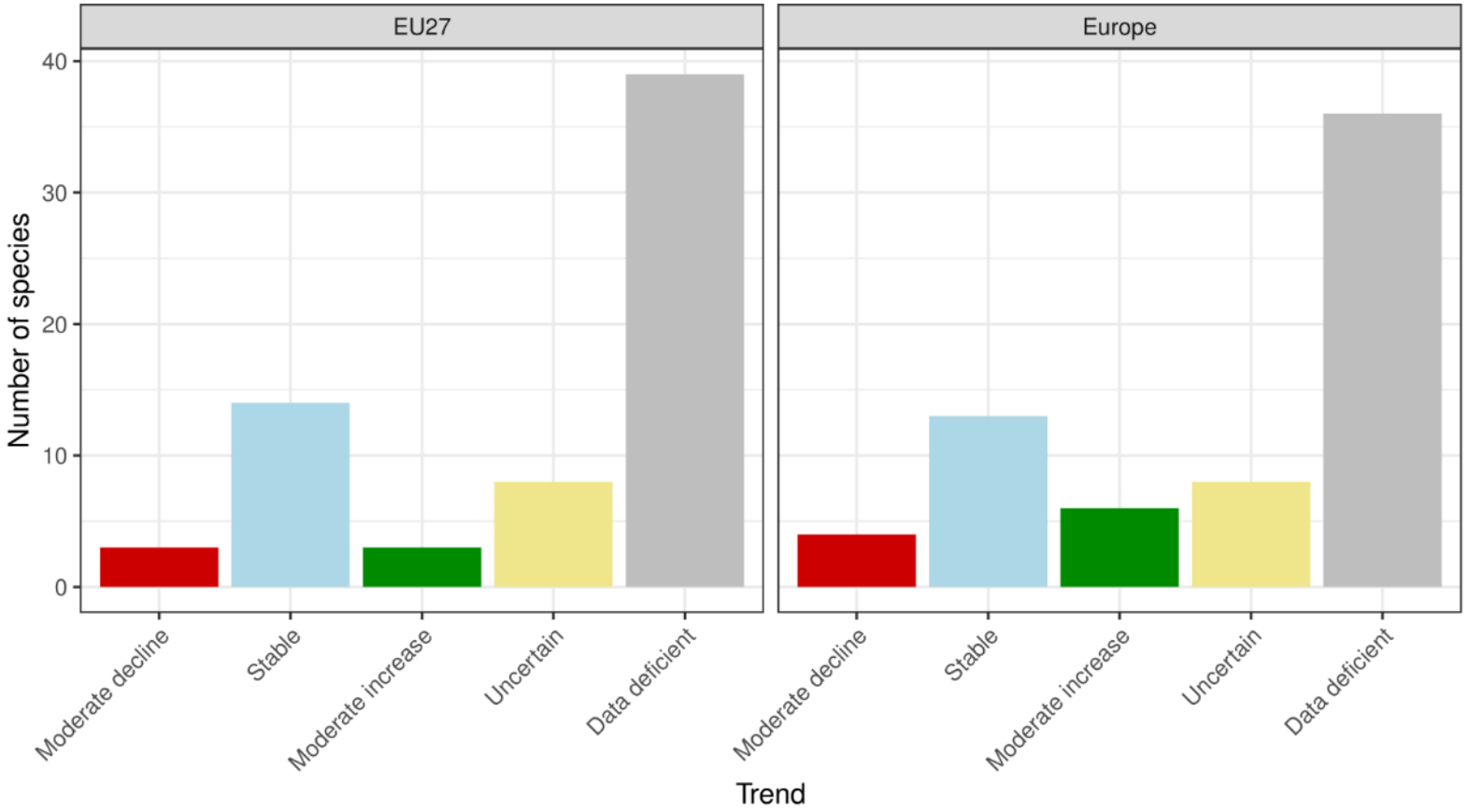
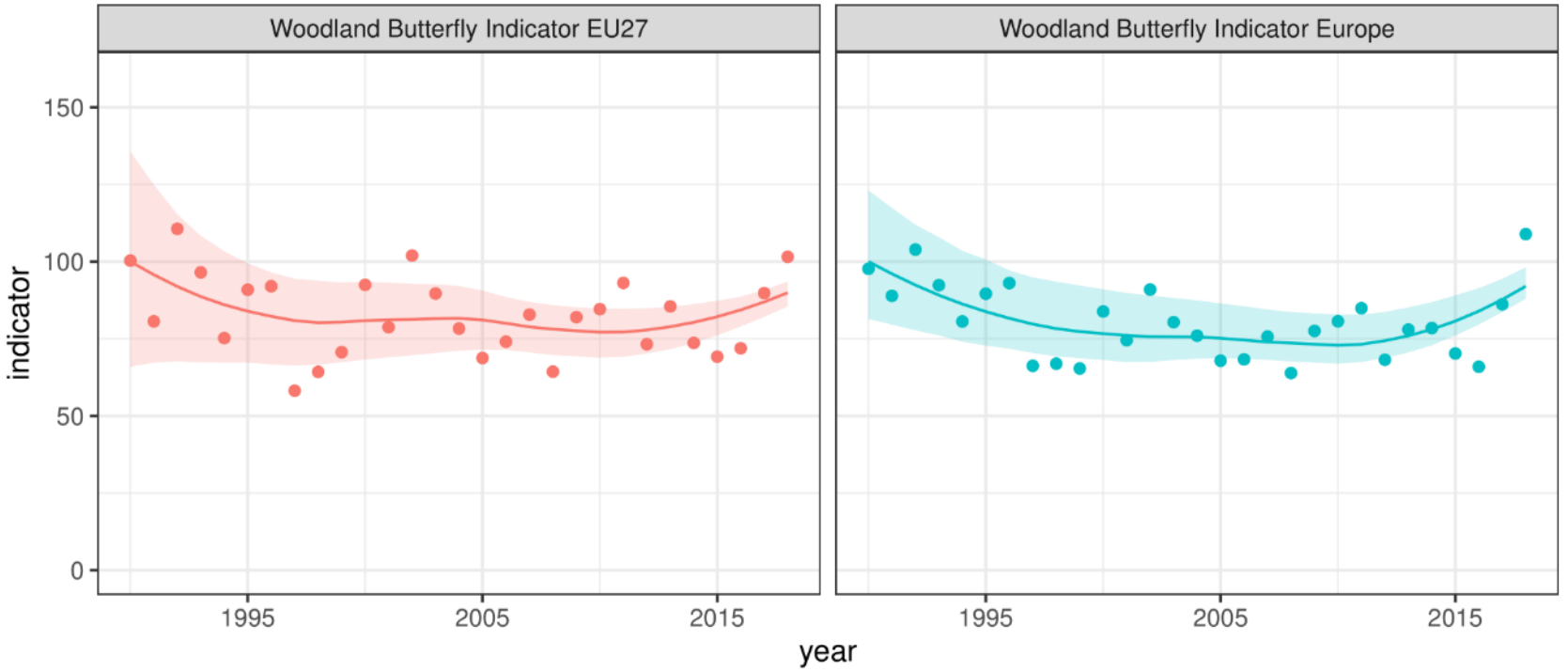
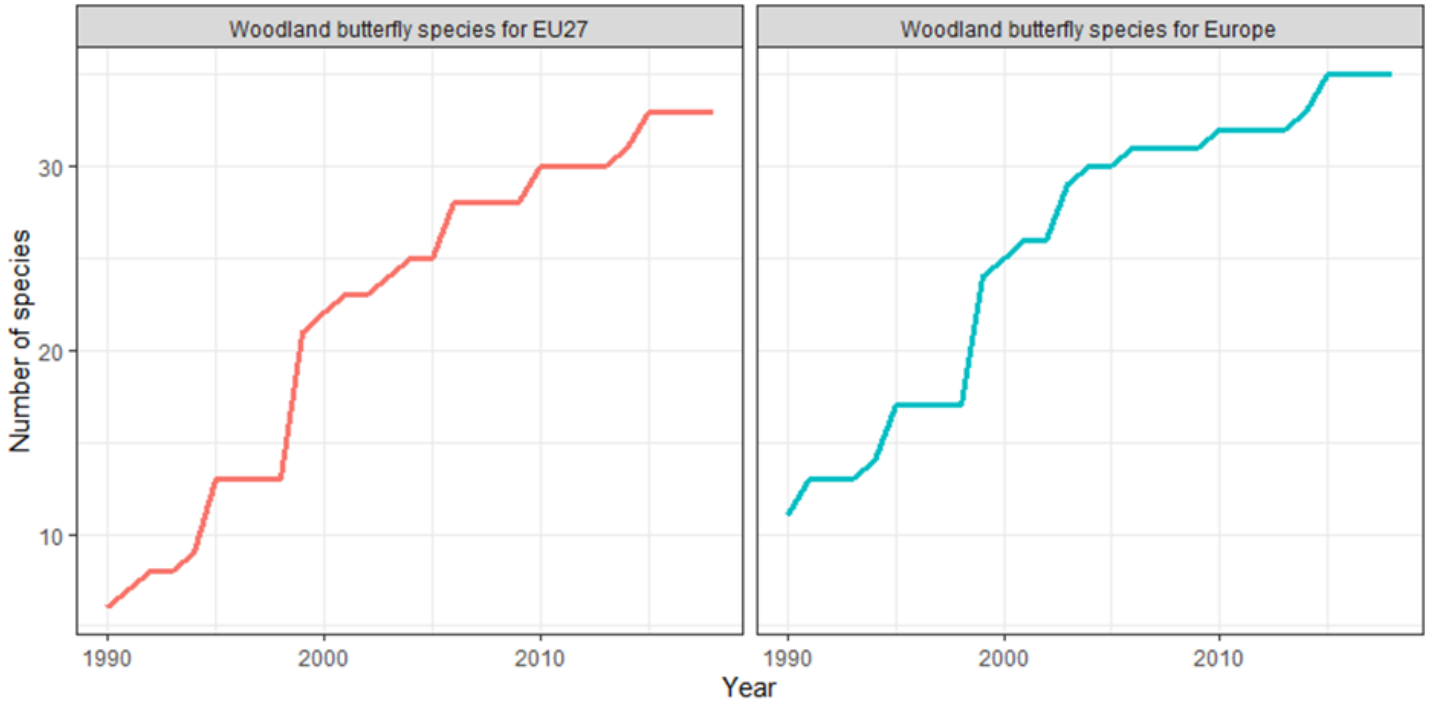
Woodland Butterfly indicator: trends



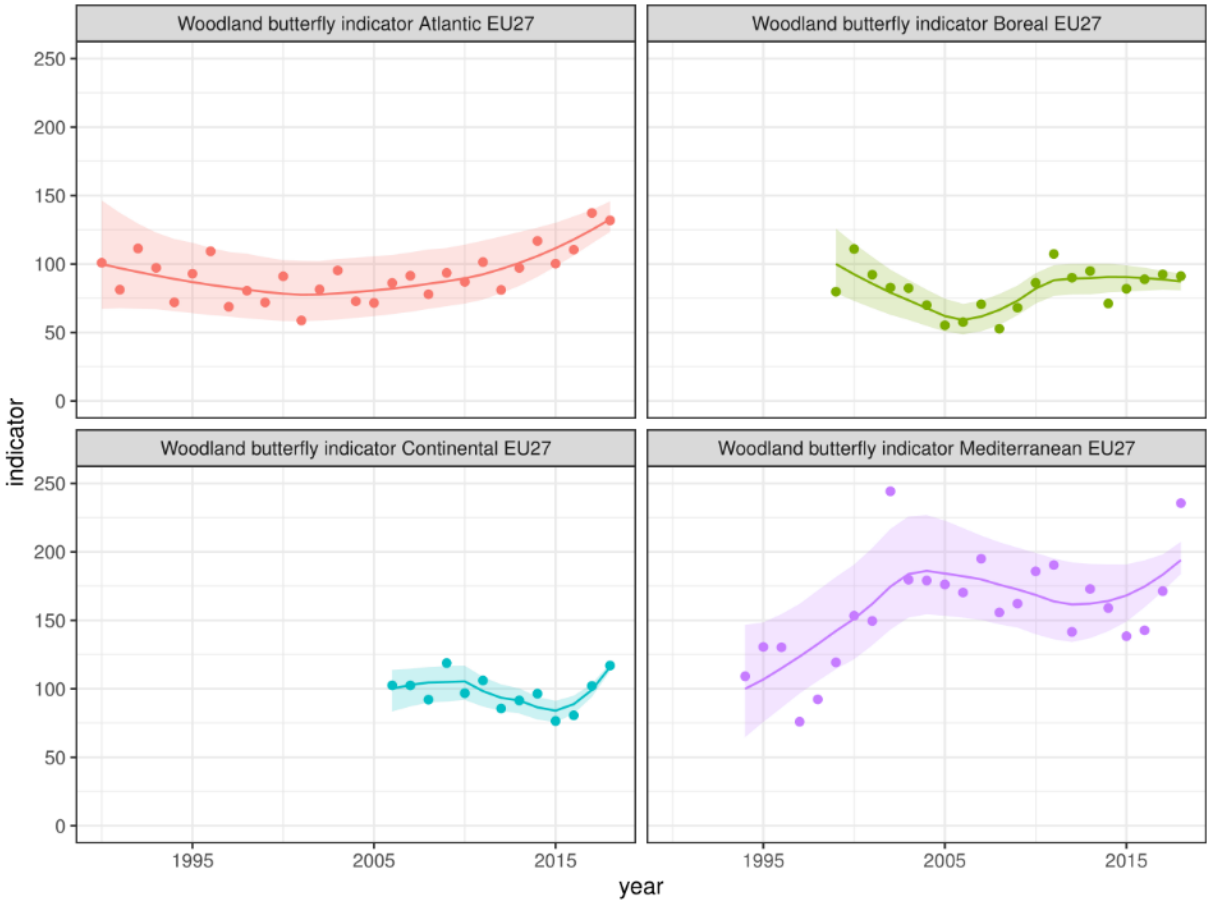
Woodland Butterfly indicator



Number of woodland indicator species



Woodland Butterfly indicator



Wetland Butterfly indicator

Wetland Butterfly indicator

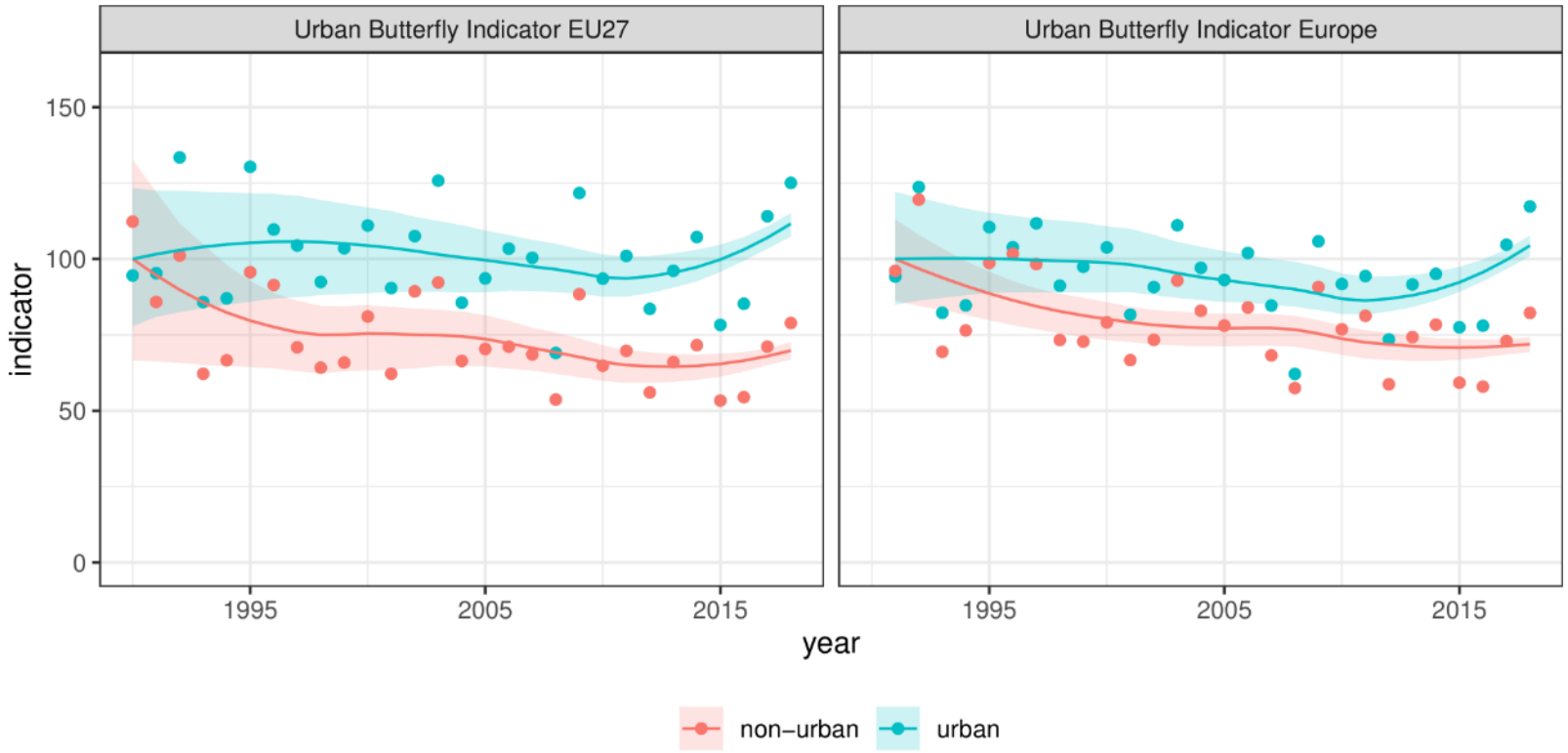
Agriades optilete
Boloria aquilonaris
Boloria eunomia
Boloria freija
Boloria frigga
Coenonympha oedippus
Coenonympha tullia
Colias palaeno
Erebia disa
Erebia embla
Oeneis jutta
Pyrgus centaureae

All rare and local species → not enough data yet to make an indicator

Urban Butterfly indicator

- Not based on a group of indicator species, but on all widespread butterflies inside urban areas.

Urban Butterfly indicator



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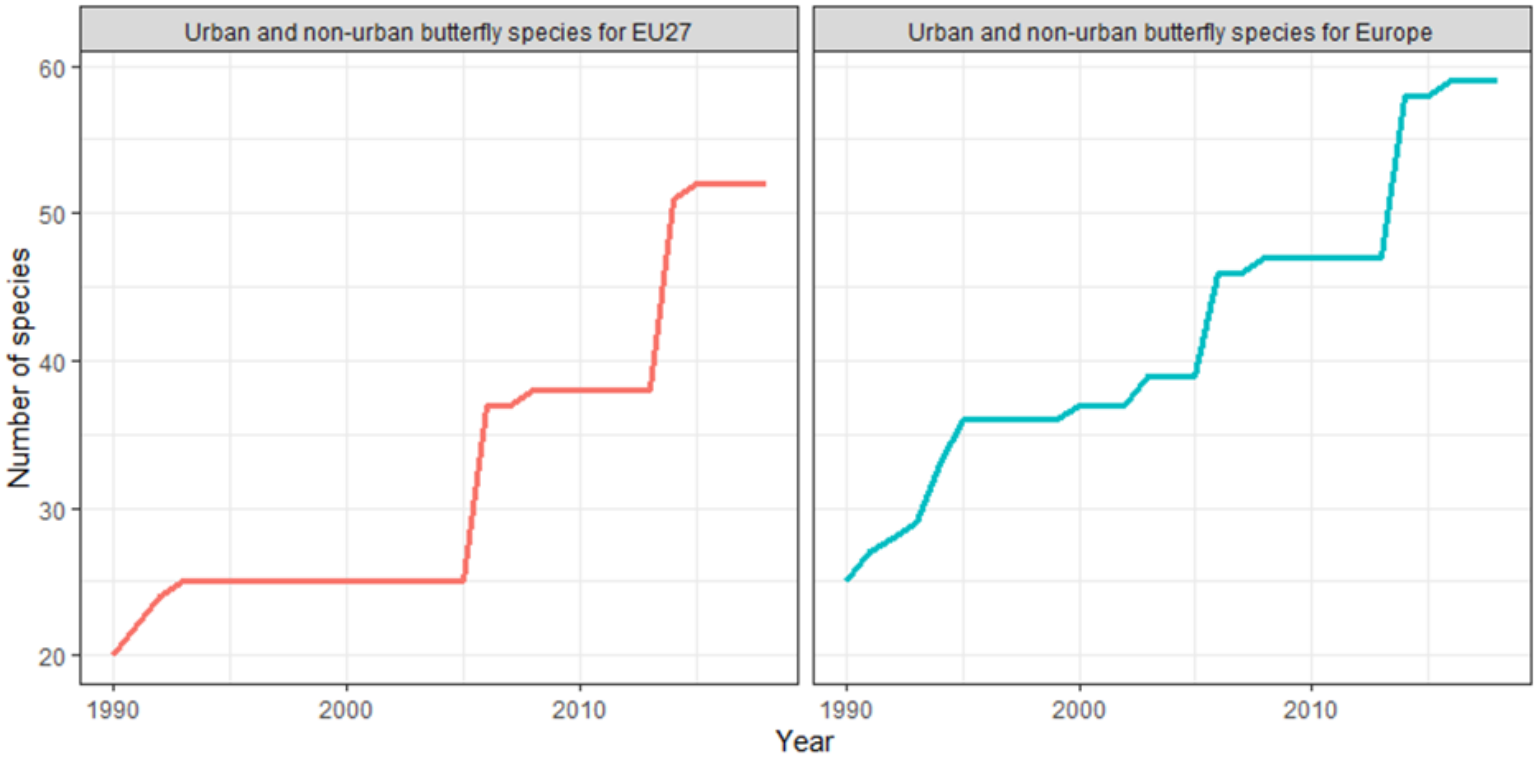
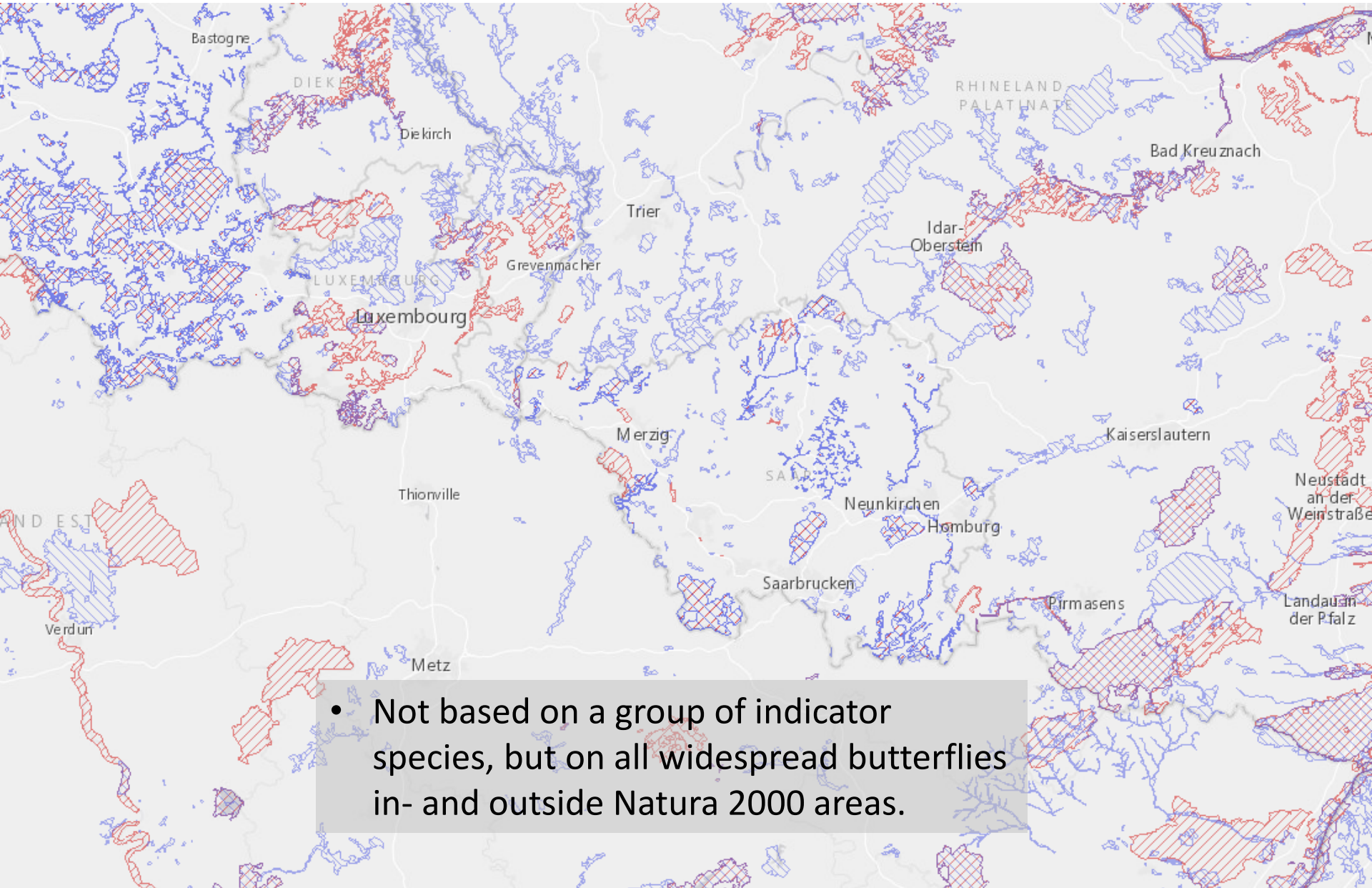
Number of urban butterfly indicator species

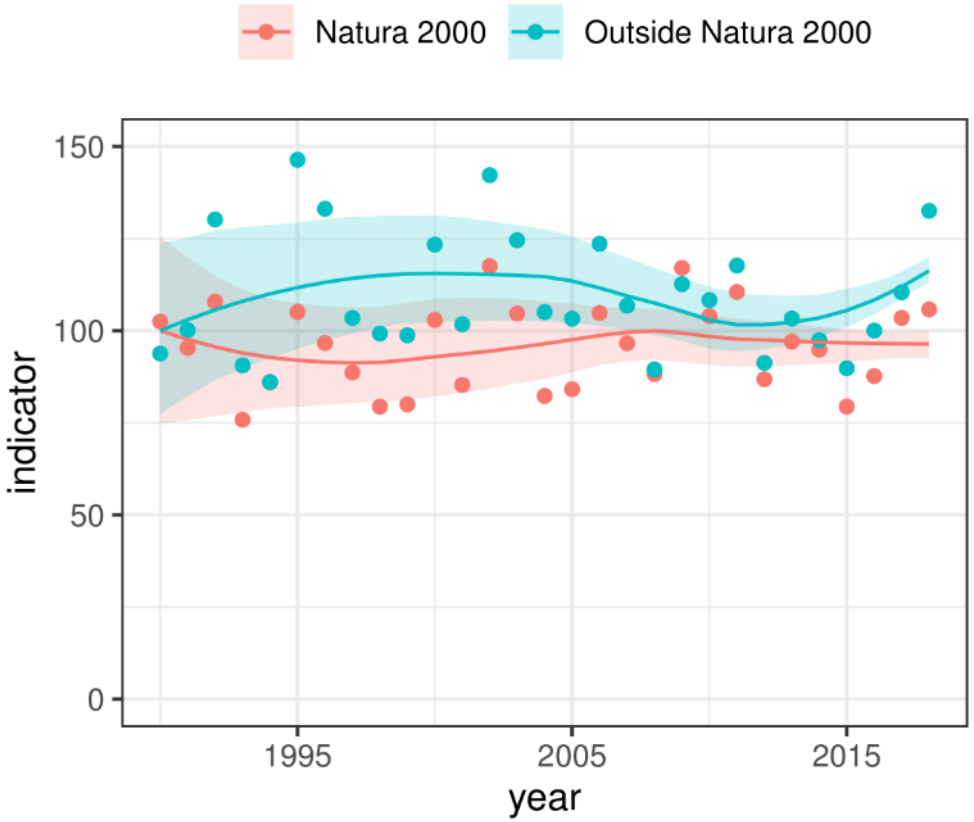


Natura 2000 Butterfly indicator



- Not based on a group of indicator species, but on all widespread butterflies in- and outside Natura 2000 areas.

Natura 2000 Butterfly indicator

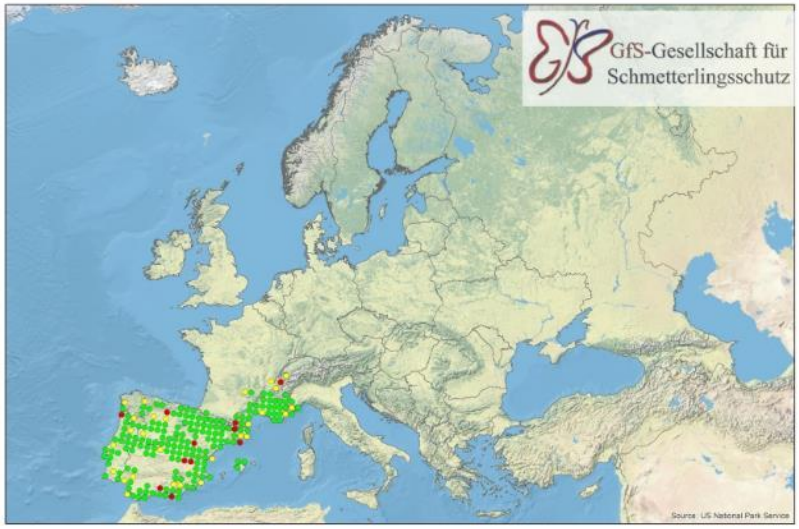


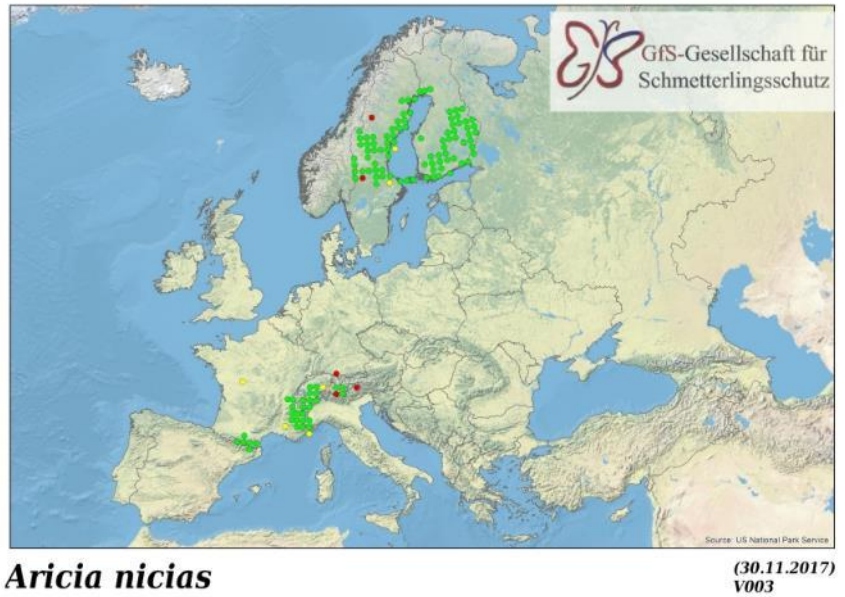
Butterfly Climate Change Indicator

- Based on the composition of the butterfly community by mean temperature of distribution area
- No indicator for the effects of drought yet

Butterfly Climate Change Indicator

Hipparchia fidia: 13.6 C





Aricia nicias: 4.1 C

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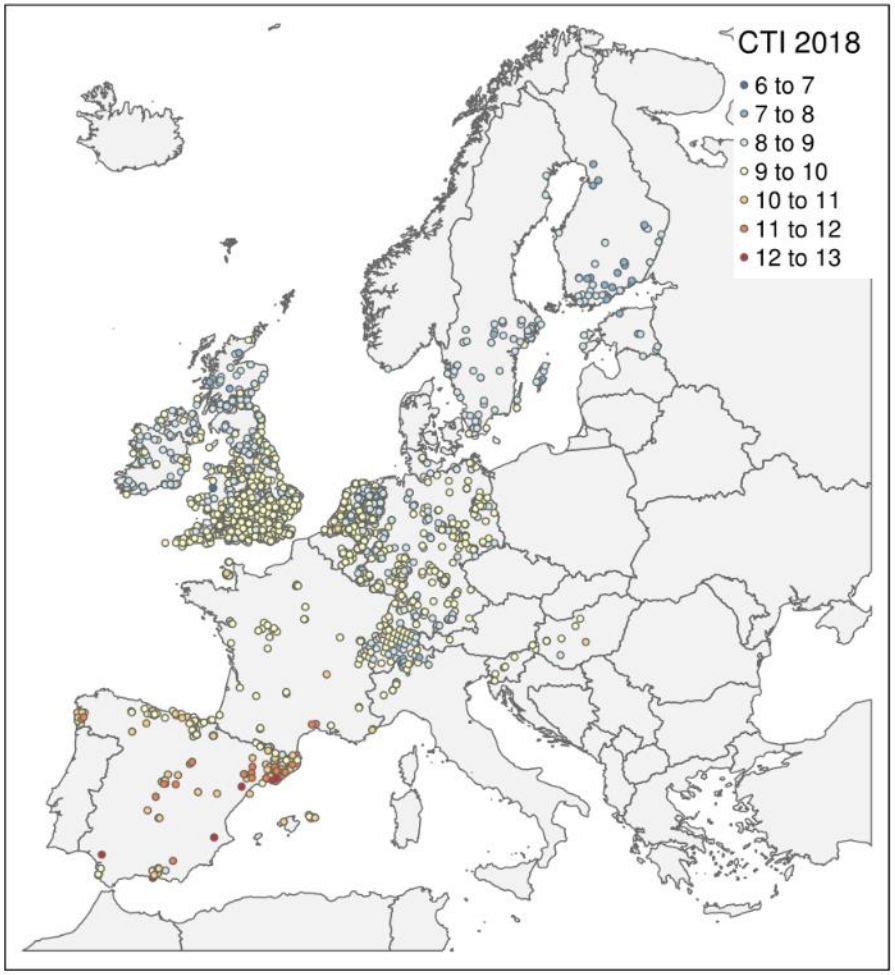
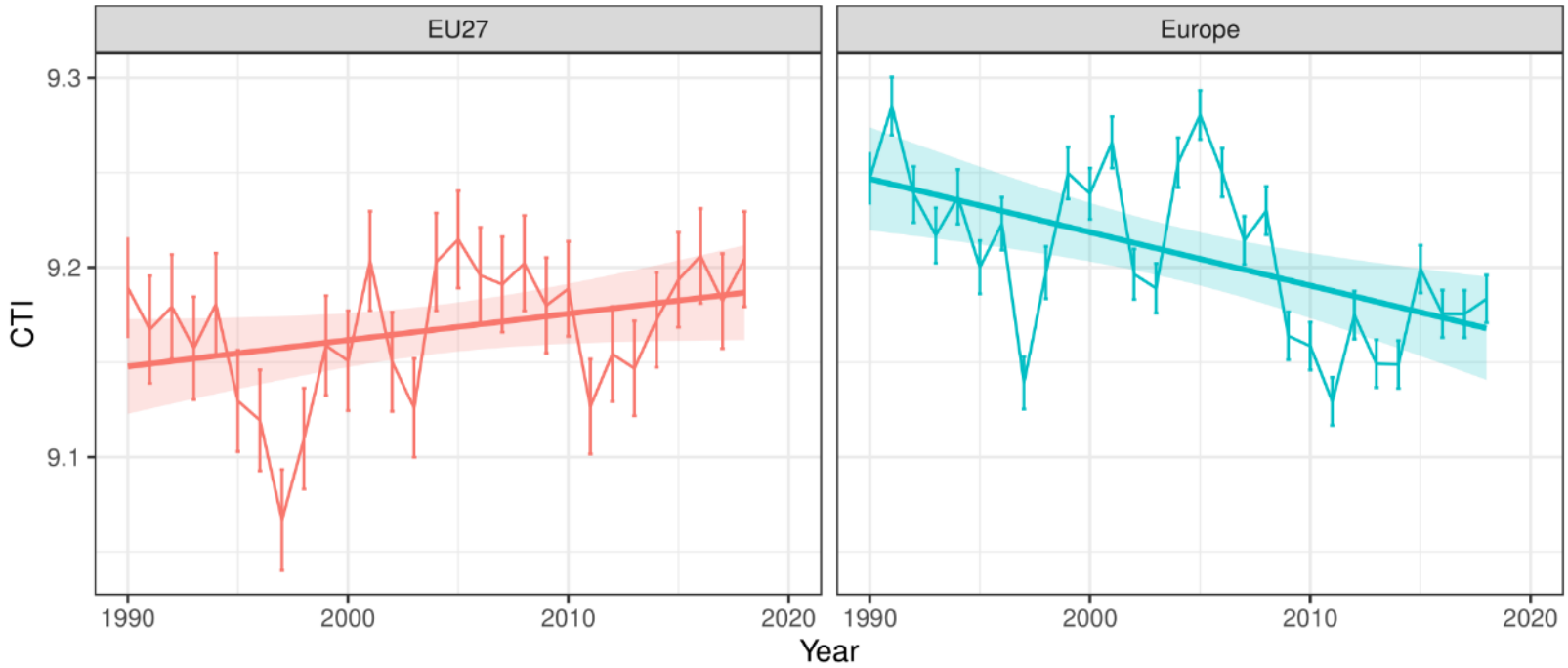
Butterfly Climate Change Indicator



Butterfly Climate Change Indicator



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ABLE

- Rare and threatened species were under-represented, resulting in indicators which are mainly based on widespread species
- By 2018, the indicator for these widespread species was stable with respect to 1990 levels, both in Europe and in the EU27
- The index of grassland butterfly abundance has declined by 30% across pan-Europe and was broadly stable in the EU27
- Woodland butterflies are stable over the last 30 years, with a decline in the 1990s and an increase in the last ten years
- The Butterfly Climate Change Indicator does not provide a clear message