Structured monitoring of wild flora in France demonstrates 15 years of plant community changes related to climate change and pollinator loss

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Collège de France 23/05/2024


Clisson (44), 05/07/2014


Chalus (24), 21/05/2018


Relevés Vigie-flore île-de-France, juillet 2012


Bramans (73), 15/07/2017

To monitor biodiversity

Rare species

- Reduced distribution area
- Small populations

- The effects of pressure are more easily perceived

Spiranthes spiralis, Cavaillon (84), 12/10/2019

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Spiranthes spiralis, Cavaillon (84), 12/10/2019

Milium effusum, Raizeux, 13/06/2017

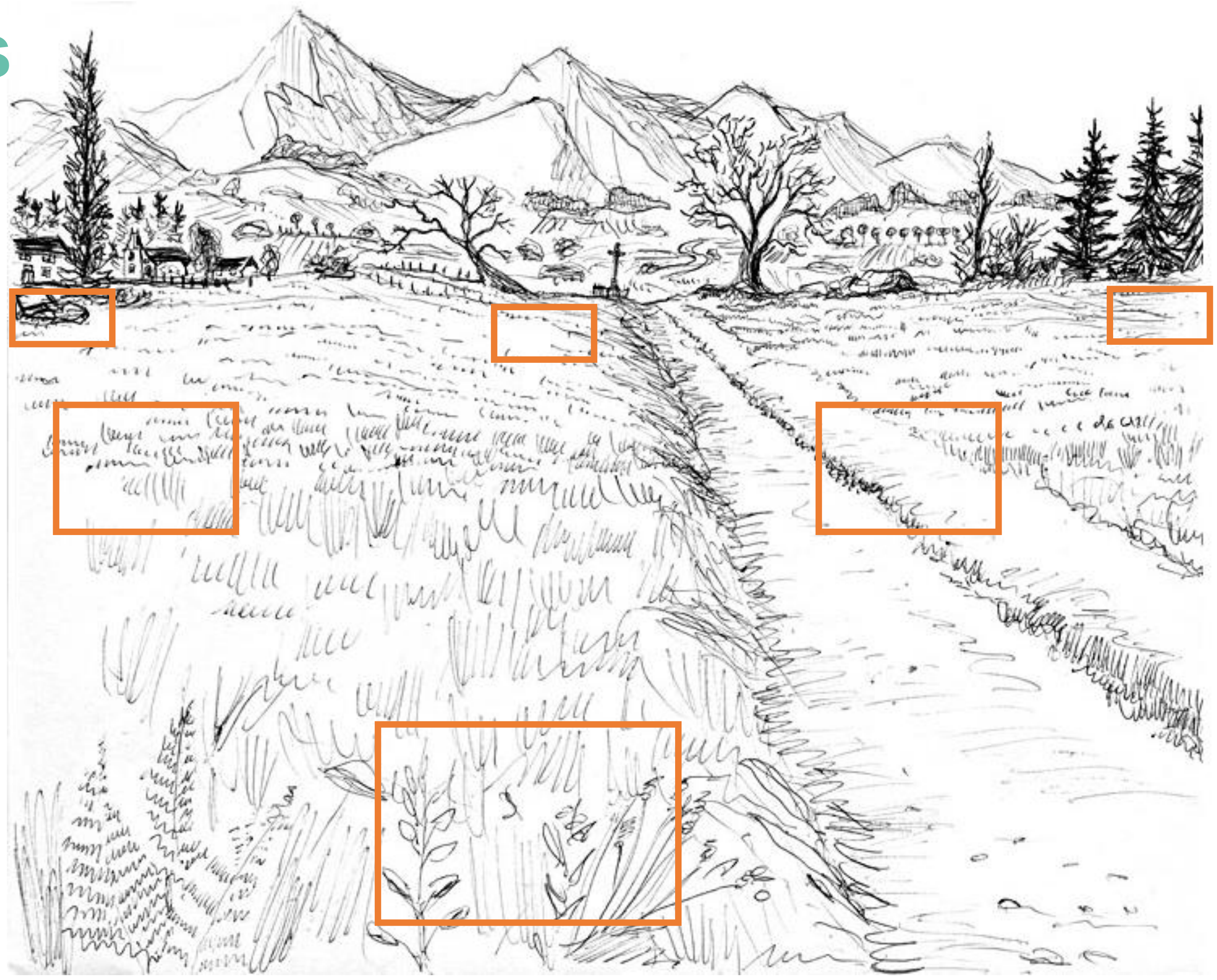
Common species

- Wide range
- Occupies several types of habitats
- At least one large population
- Significant proportion of total biomass
- Central role in the functioning of ecosystems

- Variations in abundance less perceptible
- Need for a large amount of spatially distributed data

Standardised monitoring schemes of biodiversity

- a network of permanent sites (plots or transects)
- a representative sample of the territory (or habitat) based on random or systematic sampling
- repeated visits to fixed sites
- A standardized protocol to collect presence and abundance data (or species frequency)



Structured monitoring of wild flora in France

Objectives

Detect, measure and understand changes of common flora:

- Temporal trends of common species (decrease / increase of species frequency)
- Changes in plant community composition

Detect relations between changes and human / environmental factors

Produce biodiversity indicators

- Species or multi-species frequency
- Species richness/diversity/beta-diversity
- Functional traits / ecological preferences
- Ecological functions (eutrophication, food for insects)

Asplenium septentrionale, Gavarnie, 07/07/2018

Goodyera repens, Fontainebleau, 01/07/2018

Stipa capillata, Bramans, 16/07/2016

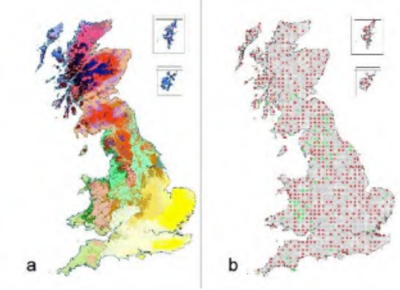
Millium effusum, Raizeux, 13/06/2017

Structured monitoring of wild flora in France

Principles

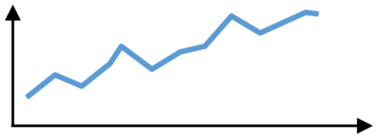
- A representative sampling of the territory (systematic)

British Countryside Survey
25 plots (10m2) in 257 squares (1km2)



Switzerland Biodiversity Monitoring
1600 plots (10m2)

- A standardised protocol (comparisons in space and time)



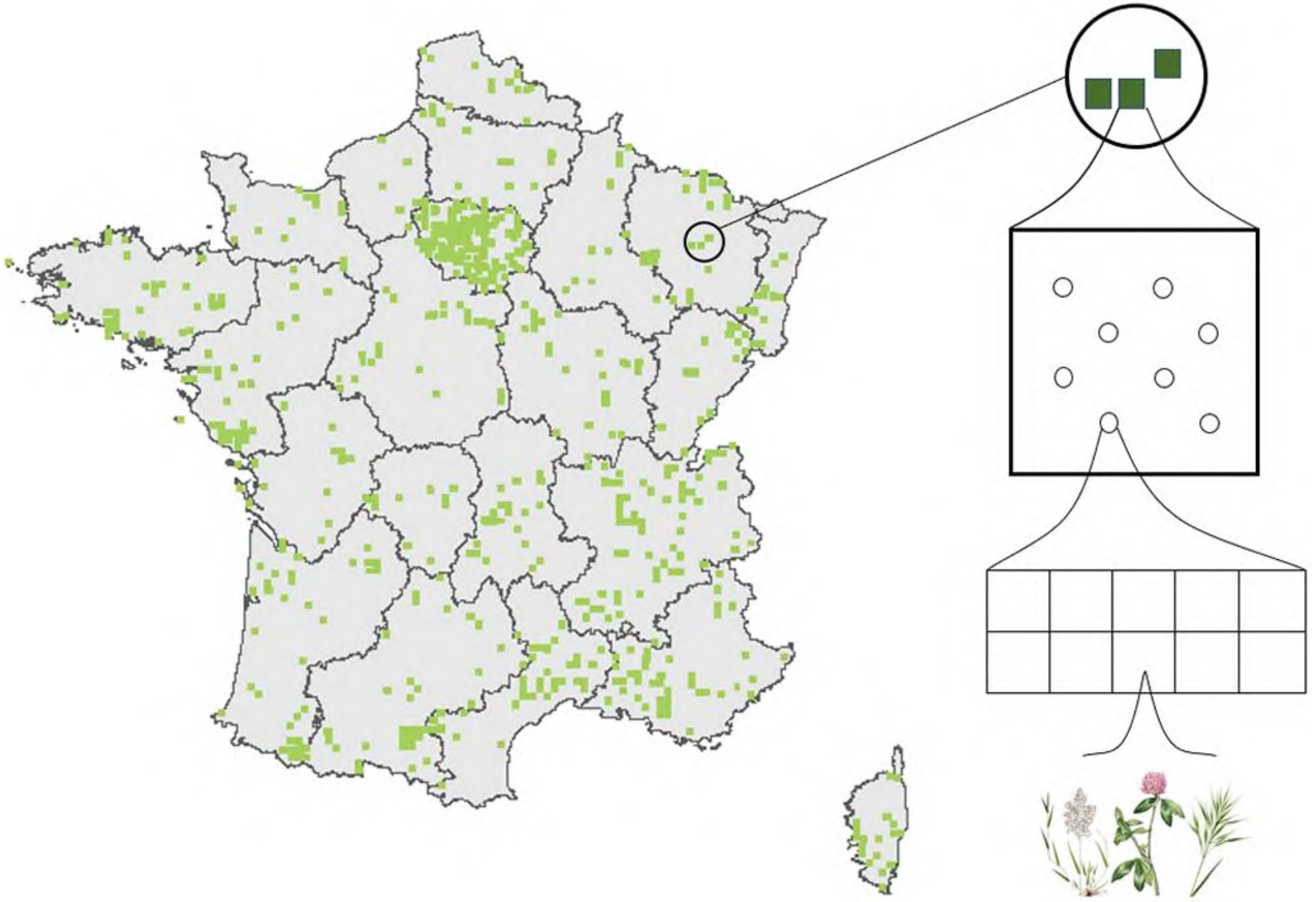
- Presence and frequency data (as a proxi of abundance data)
- Contributions from volunteer botanists


Bramans (73), 15/07/2017


Station d'écologie forestière de Fontainebleau, 15/11/2014


Chalus (24), 21/05/2018

A standardized protocol



Map of the 715 Vigie-flore squares sampled between 2009 and 2023

PARTICIPATION
428 observers/volunteers

FIXED SQUARE
1 km X 1 km
715 squares
8 plots per square

FIXED PLOT
5 m X 2 m
3820 plots
10 quadrats per plots
Environmental variables

QUADRAT
1 m X 1 m
Identification of
all plant species

A network of observers, mutual support and sharing scientific results

14 regional referents

- Help with setting up the protocol
- Help with species identification
- Checking data

National and regional meetings each year

Regional meeting Vigie-flore to sample wild flora on a square, Sainte-Victoire, 05/05/2024

www.vigienature.fr/fr/referents-regionaux-3475

The French monitoring scheme of wild flora in France

147 444 observations, 13 698 records
2 623 species, 856 genera, 158 botanical families
89 % identification at the specific level

Most sampled species

Hedera helix, Rubus sp., *Lolium perenne, Dactylis glomerata, Plantago lanceolata, Galium aparine*

22.2% of species have been observed only once since 2009

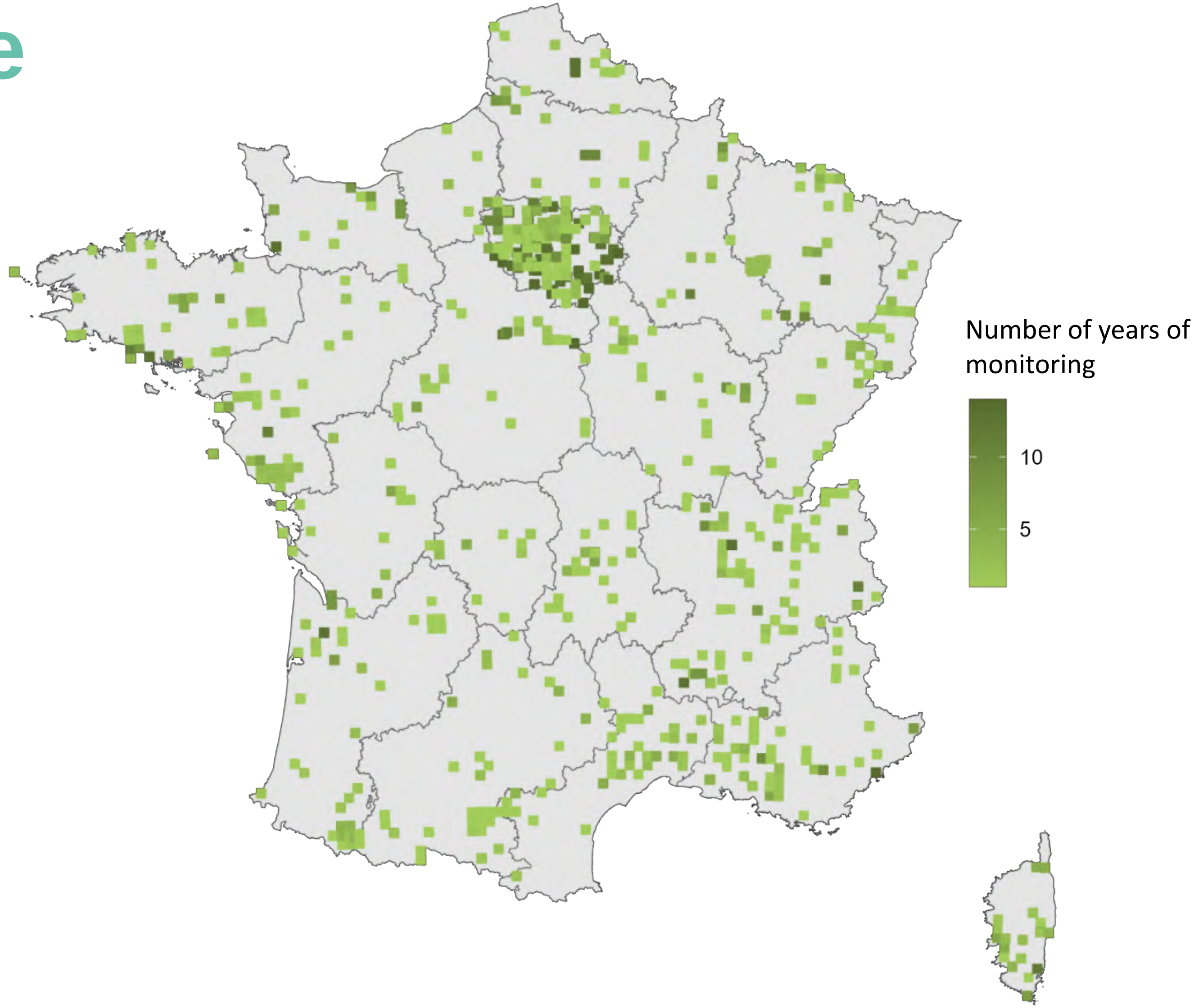
Neatostema apulum, Taeniatherum caput-medusae, Xeranthemum cylindraceum

The French monitoring scheme of wild flora in France

- Squares and plots are monitored for an average of 3-4 years

- 5 plots are sampled per square on average

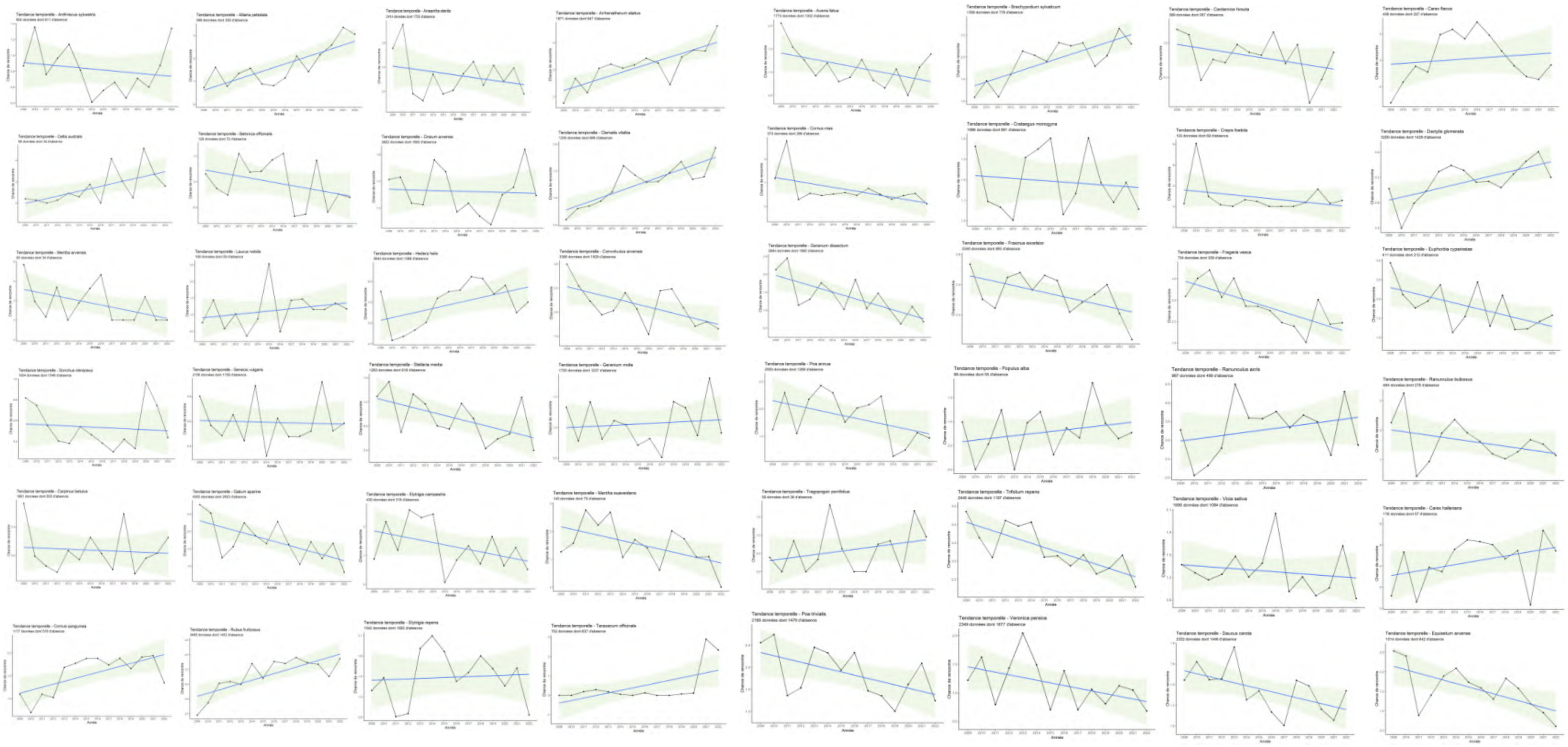
- Some environments are under-represented in relation to the surface area they occupy on a national scale (the case of agricultural areas), while others are over-represented (the case of urban areas)



Changes of wild flora

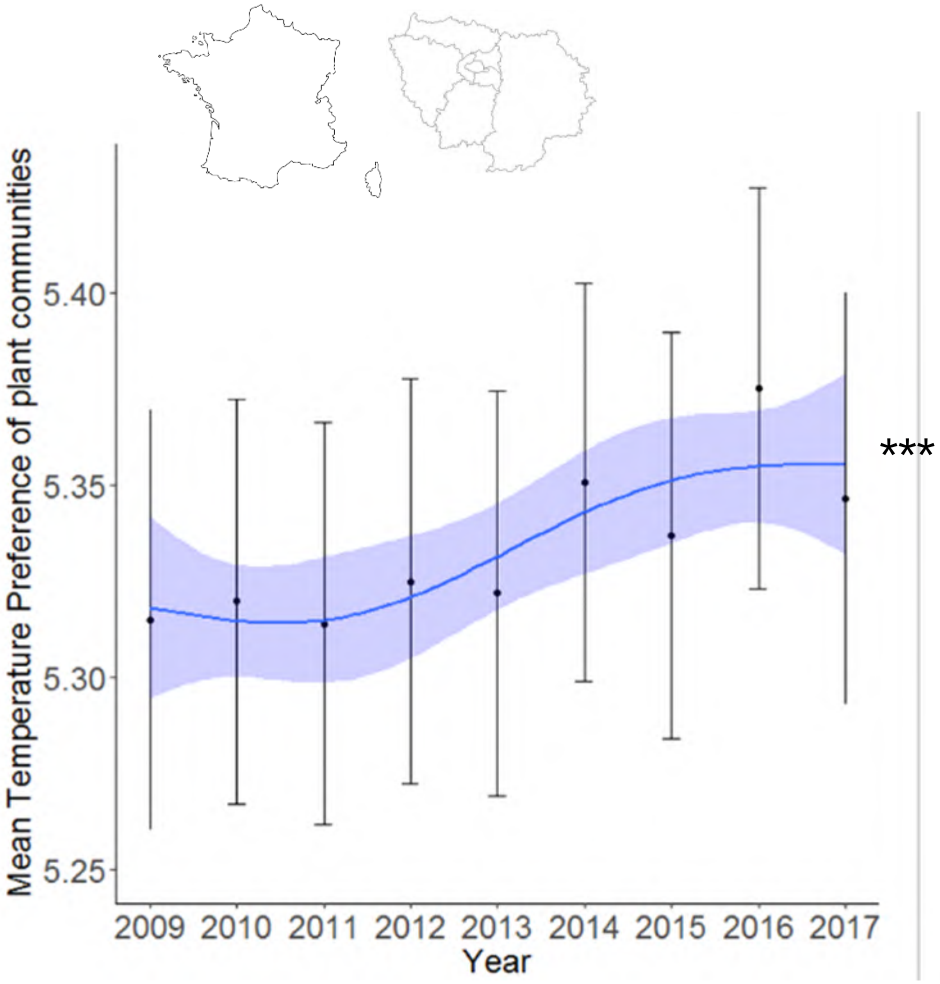
Species versus community analysis
taking into account life history traits of species,
as life cycle, thermal preference of species, dependence on pollinators

Species temporal trends for more than 600 species



Rapid changes of wild flora to climate changes

National and regional scale (Paris region)



Martin et al. 2019 *Biology Letters*

Rapid changes of wild flora to climate changes

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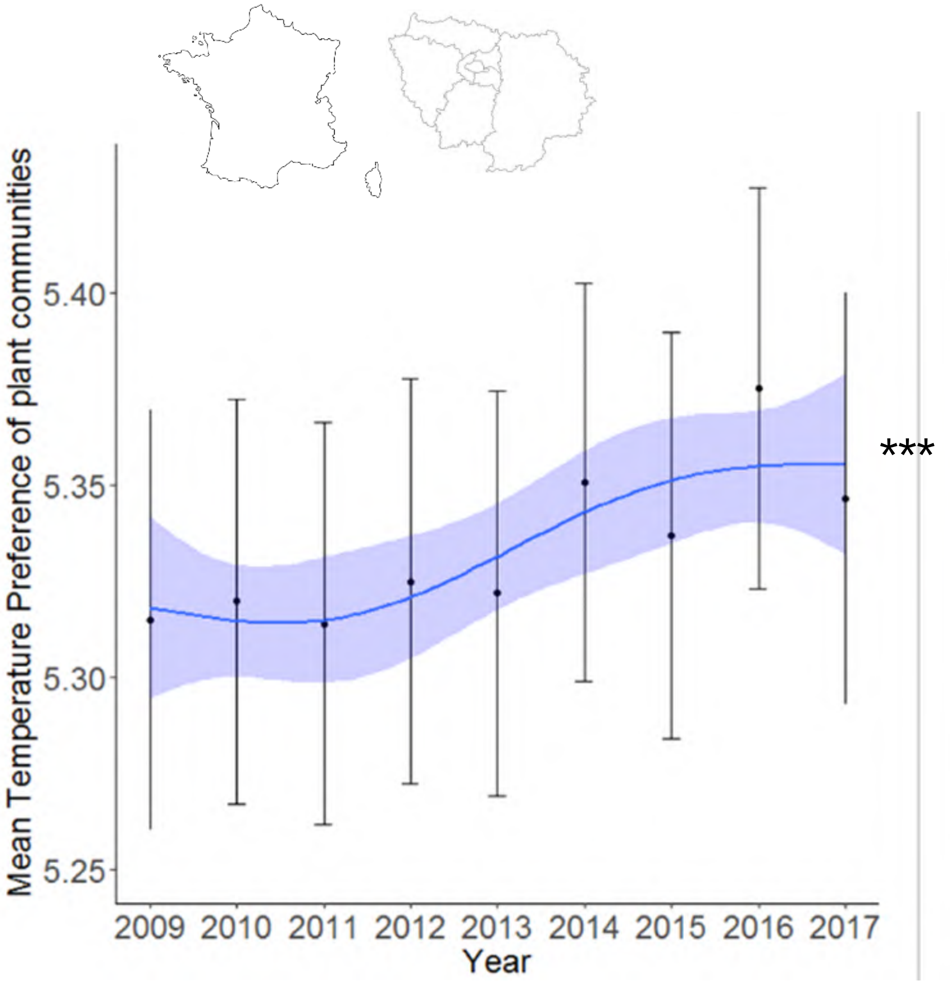
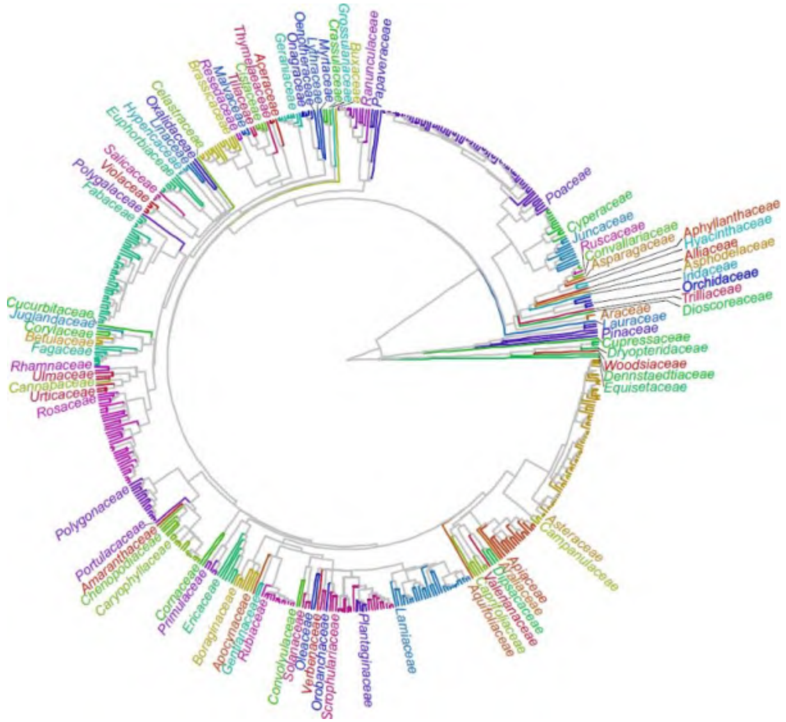
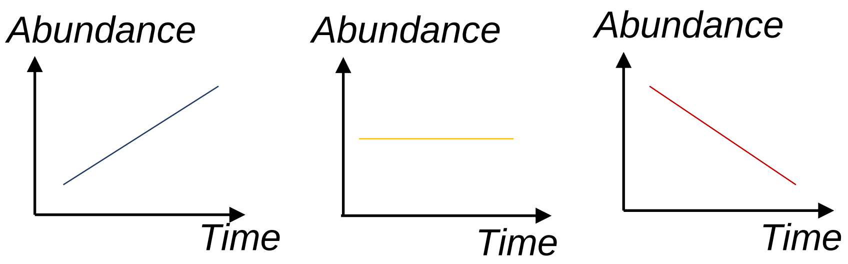


Phylogeny of the 600 most common species in France





Martin et al. 2019 *Biology Letters*

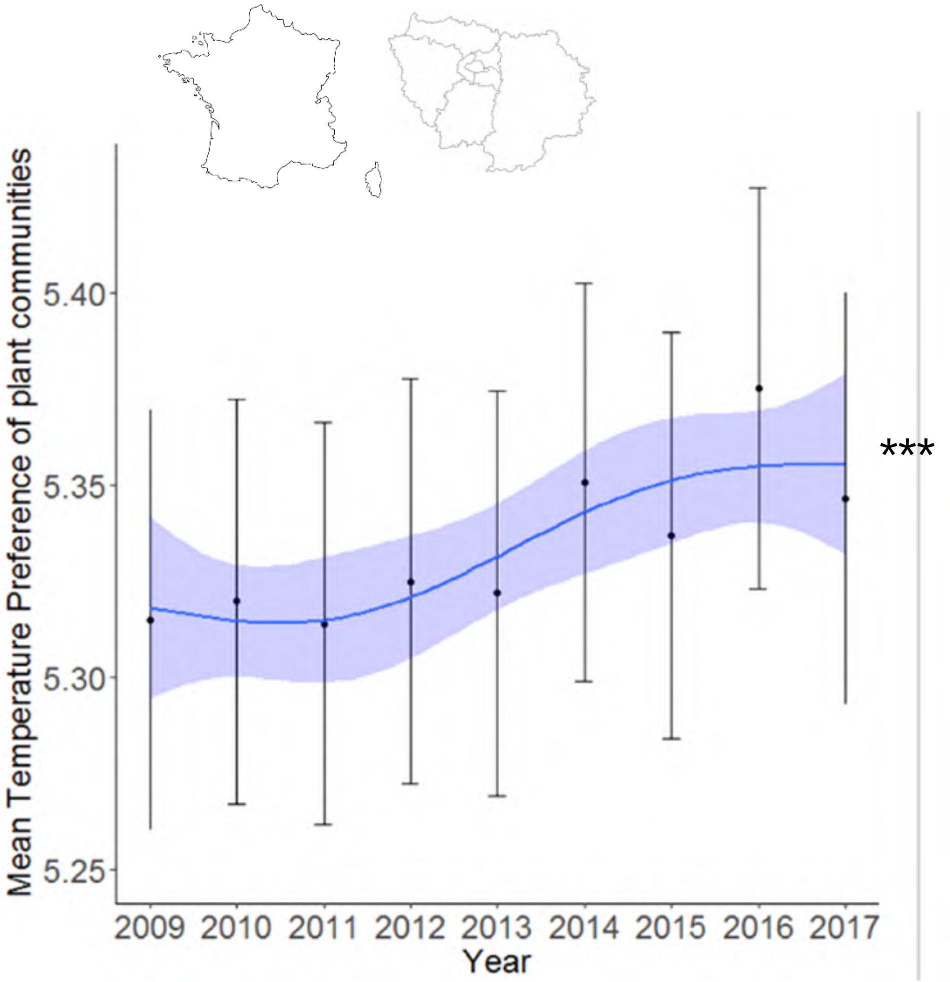
Rapid changes of wild flora to climate changes


Avena barbata (Tela Botanica)

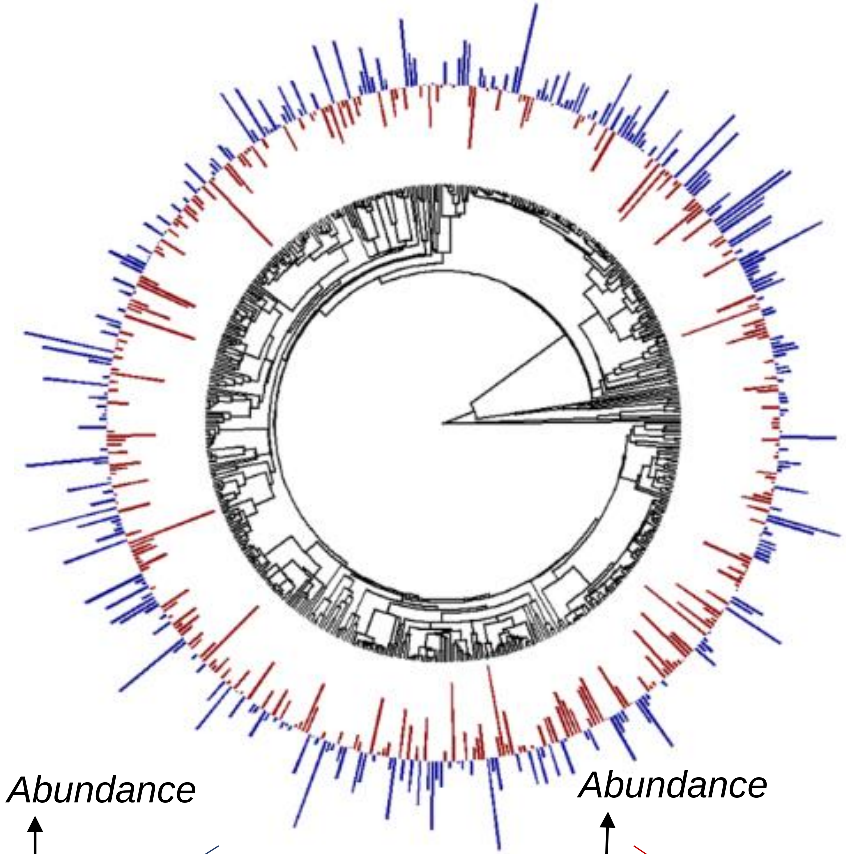

Echium vulgare (Tela Botanica)

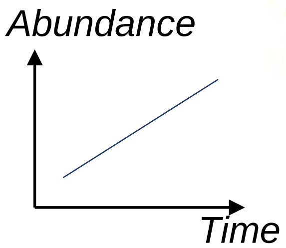
Martin et al. 2019 *Biology Letters*

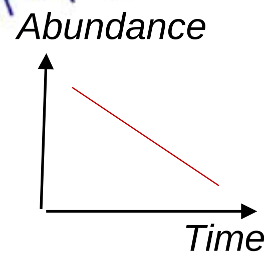
National and regional scale (Paris region)



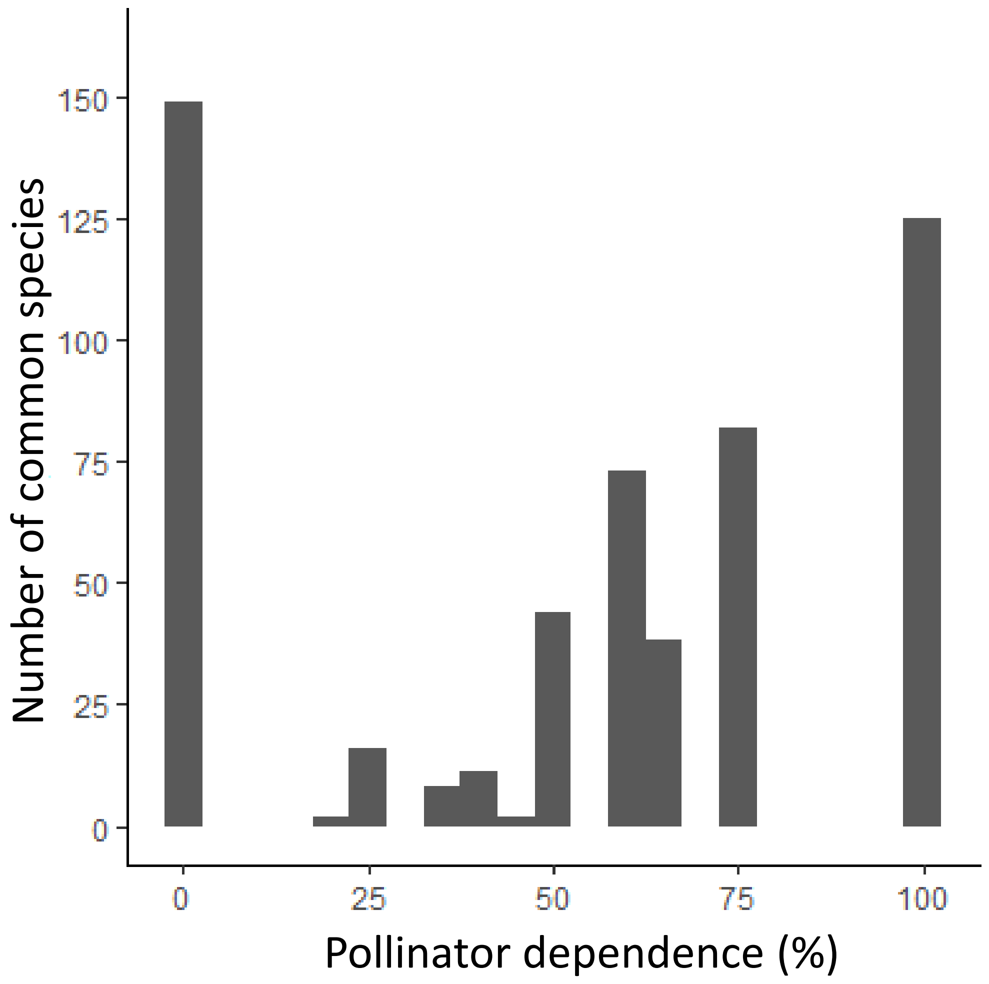
Phylogeny of the 600 most common species in France







Relationship between species temporal trends and pollination syndrome



Relationship between species temporal trends and pollination syndrome

Average increase in all pollinator-independent species (0.024)

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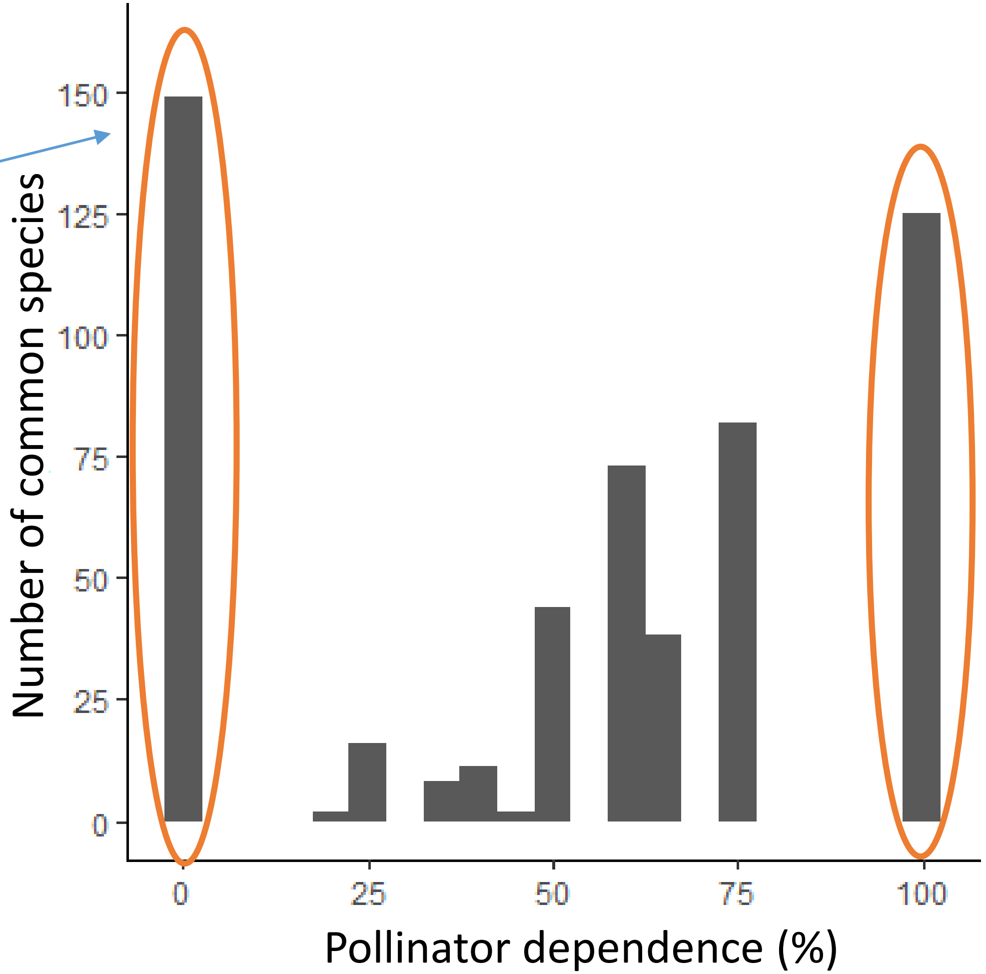

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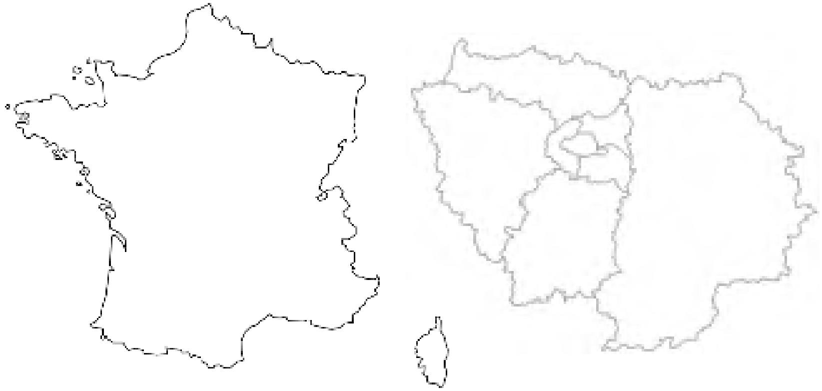
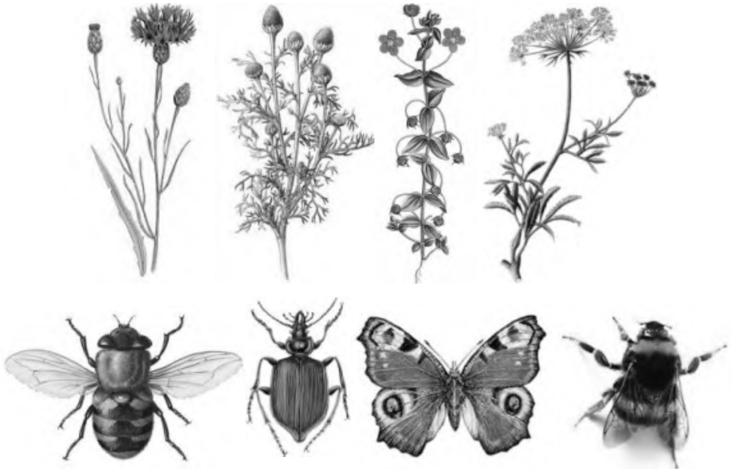
Average decline in all plants totally dependent on pollinators (-0,003)

Solène Agnoux PhD Thesis

Joint temporal variations in plants and insects





Martin et al. 2019
Duchenne et al. 2021
Lenoir et al. 2008
Bertrand et al. 2011
Steinbauer et al. 2018
Alexander et al. 2018
Powney et al. 2019
Seibold et al. 2019
Hallmann et al. 2017
Zattara et al. 2021

- What are the characteristics of declining or increasing plant species?
- What are the consequences of changes in flora on the floral resources availability (nectar and pollen) for pollinating insects?
- What are the relationships between temporal trends in plants and temporal trends in insects, in relation to global changes?

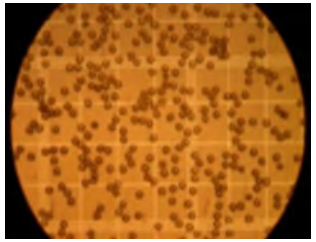
Floral traits

Pictures : Gérard Arnal, Jean-Luc Témoin

Consequences on floral resources

Historical nectar assessment reveals the fall and rise of floral resources in Britain

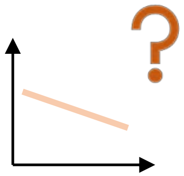
Mathilde Baude[1,2]†, William E. Kunin[3], Nigel D. Boatman[4], Simon Conyers[4], Nancy Davies[1,2], Mark A. K. Gillespie[3]†, R. Daniel Morton[5], Simon M. Smart[5] & Jane Memmott[1,2]

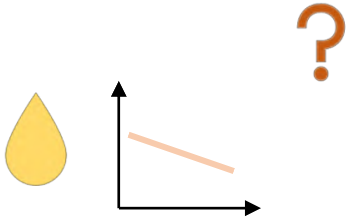


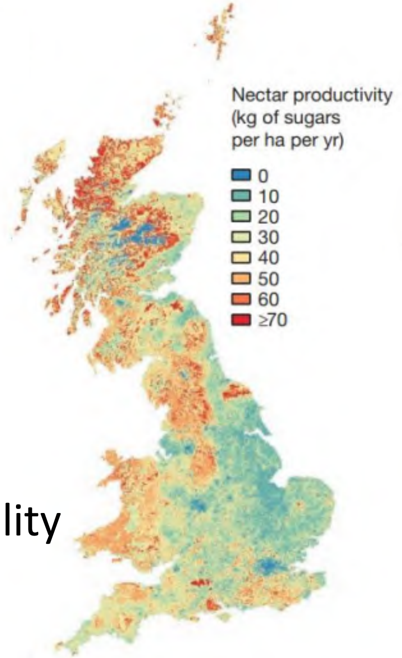
Floral resources databases

vigie-flore

GBIF Global Biodiversity Information Facility







Temporal trends in resource availability

Baude *et al.*, 2019

Data collected in a standardised way, free from bias?

MNHN, 07/04/2018,
©Nicolas Boulain

Behaviour of observers :

- Participant turnover
- Squares with the highest species richness are monitored for longer periods

Data quality (regional referents)

Species detection bias in plant counts (Perret et al. 2023)

Analysis of the sampling pressure required to detect changes in plant communities

Thank you
Vigie-flore@mnhn.fr

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VIGIENATURE

Un réseau de citoyens qui fait avancer la science

MUSÉUM NATIONAL D'HISTOIRE NATURELLE

OFB OFFICE FRANÇAIS DE LA BIODIVERSITÉ

Tela Botanica


Nathalie Machon

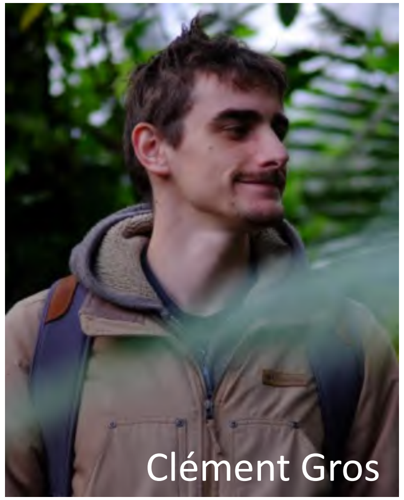

Emmanuelle Porcher


National meeting Vigie-flore 2022, Bergerie Nationale de Rambouillet


Solène Agnoux


Eric Baradat


Vanessa Lainé


Clément Gros


Eric Motard