AN EXPERT-ASSISTED CITIZEN SCIENCE PROGRAM PROVIDES GENERAL PATTERNS ON BEE ASSEMBLAGES AT A NATIONAL SCALE

Violette Le Féon[1*], Mickaël Henry[1], Eric Dufrêne[2], Laurent Guilbaud[1], Emilie Kolodziejczyk[3,4], Fabrice Requier[1], Bernard E. Vaissière[1*]

[1] INRA, UR 406 Abeilles et Environnement, AVIGNON, FRANCE; [2] Observatoire des Abeilles, FORGES-LES-BAINS, FRANCE; [3] CEZ - Bergerie Nationale, RAMBOUILLET, FRANCE; [4] Lycée agricole Reinach, LA MOTTE SERVOLEX, FRANCE

* Contacts: violette.lefeon@gmail.com & bernard.vaissiere@paca.inra.fr

Introduction

Citizen science typically involves citizens that collect data and send them directly to scientists. In the context of global change, resulting data sets have gained importance and recognition to assess the effects of anthropogenic disturbances on biodiversity [1].

Bees have become the focus of much interest over the last decade because of concerns about species decline and the expected consequences on plant pollination. Yet data are strongly lacking regarding species distribution and community composition to understand the effects of global change on populations and thereby be able to design meaningful conservation strategies [2, 3].

As they are difficult to identify (many cryptic species) and very diverse, bees are poorly suited for classical citizen science. We present here the first results of a monitoring program (called the "Réseau Apiformes") at the national scale involving scientists and citizens (here teachers from 20 agricultural high schools in France), linked by bee expert taxonomists (Fig. 1).

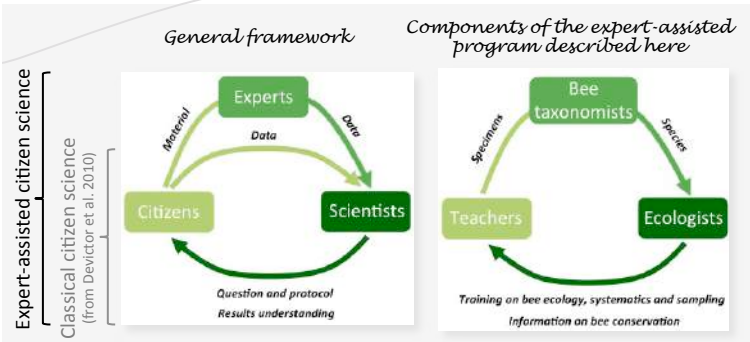

Figure 1

The expert-assisted citizen science: the conceptual framework

Figure 2

Location of the 20 agricultural high schools involved in the study. The number of collections is given for each school (n = 70 collections in total)

Materials and methods

Bees were sampled with colored pan traps during three years in 20 schools distributed over France (Fig. 2). Overall the dataset included 70 *collections* (year × sampling site combinations) and 4574 specimens belonging to 195 species.

Considering both **taxonomic and functional responses of bee assemblages** and using generalized linear mixed models, we analysed this dataset with **environmental data freely available** at the national scale on **agricultural practices** (High Nature Value index) and **landscape context** (Corine Land Cover).

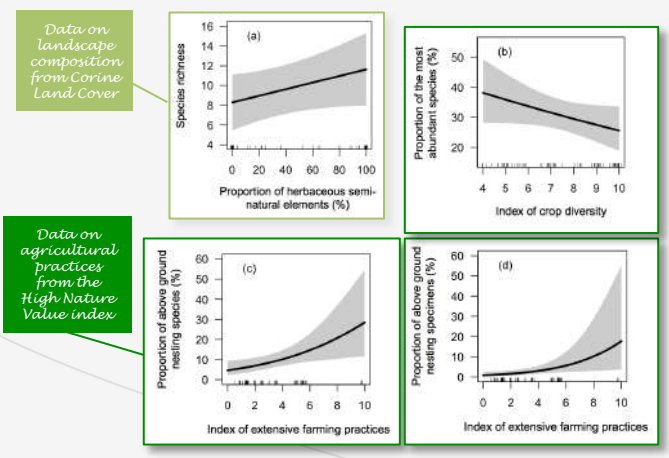

Figure 3

Relationships between bee assemblage attributes and environmental covariates. Increasing values of the index of extensive farming practices indicates decreasing pesticide, irrigation, and mineral fertilizer use. Solid lines show significant trends returned by the model predictions. Small vertical bars along the x-axis of each graph show the original values along this axis. Each bar represents a collection (n = 70)

Results

All collections were dominated by a non-parasitic, soil-nesting bee species. In most cases, this species was eusocial and polylectic. A single species, ***Lasioglossum malachurum***, dominated in 32 collections.

Generalized linear mixed models showed that :

- **Species richness** increased with increasing proportion of herbaceous semi-natural elements in 100-m radius landscape sectors (Fig. 3a);
- **Species dominance** (proportion of the most abundant species) decreased with increasing crop diversity (Fig. 3b);
- **The proportion of above ground nesting species and specimens** increased as the intensity of fertilizer and pesticide use decreased (Fig. 3c, d).

Discussion

This expert-assisted citizen science program combines the **benefits of data collection at a large spatial scale enabled by a national network of volunteers and of data reliability at the species level provided by the contribution of expert taxonomists**. It provided new insights on bee vulnerability to environmental disturbances at a national scale, while raising the **awareness of agricultural teachers, their students and the farming communities they interact with about bee conservation** (Fig. 4).

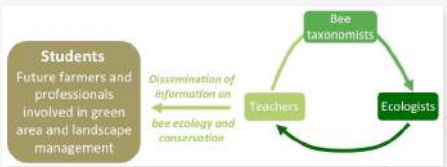

Figure 4

The "Réseau Apiformes": a good example to reconcile science and environmental education [4]

Acknowledgements
Our first thanks go to all the biology and ecology teachers and technicians who took an active and enthusiastic part in this study. We thank the specialists who identified bee specimens: H. Dathe, E. Dufrêne, D. Genoud, G. Le Goff, G. Mahé, D. Michez, A. Pauly, S. Risch, E. Scheuchl, and R. Fonfria†. We also thank J.-P. Débrosse, L.-M.Voisin, and J.-L. Toullec for their help in coordinating the network, M. Kuhlmann for providing ecological data on bee species, P. Pointereau (Solagro) for providing the data for the High Nature Value index and C. Coiffait-Gombault for her help in analysing the data. This research was funded in part by the European Social Fund of the European Union administered by the Bergerie Nationale, by the French Ministries in charge of Ecology and Agriculture (Biodivea program) and by the not-for-profit organisation Pollinis.

Drawing by Rina François
Photos by Matthieu Aubert and Arnaud Le Nevé

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