May land use and climate changes threaten bumblebee populations (*Bombus* spp.) in Belgium ?

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Introduction

Bumblebees are among the most essential pollinators for their services to both natural ecosystems and agricultural production [1,2]. However they are currently undergoing a strong decline [3-6] fostered by habitat loss, fragmentation and degradation through agricultural intensification [7-11]. More recently, several studies have also implicated climate change in their decline [12,13].

Figure 1. *Bombus lapidarius* on *Trifolium repens*.

Figure 2. *Bombus pascuorum* on *Symphytum officinale*.

The aims of this project are to :

1) Collect and analyze data on **changes in bumblebee populations** in Belgium during the last century ;
2) Assess the respective **roles of landscape and climate changes** in the decline of bumblebee populations.

Here, we present preliminary results about the land use changes and the changes of bumblebee communities.

Methodology

We use a comparative approach based on past and present land use and bumblebees data in Belgium, between 1910 and nowadays.

Species richness and Hurlbert's index are computed for both periods. The formula for Hurlbert's index used here is the simplified version proposed by Rasmont *et al.* 1990 [14].

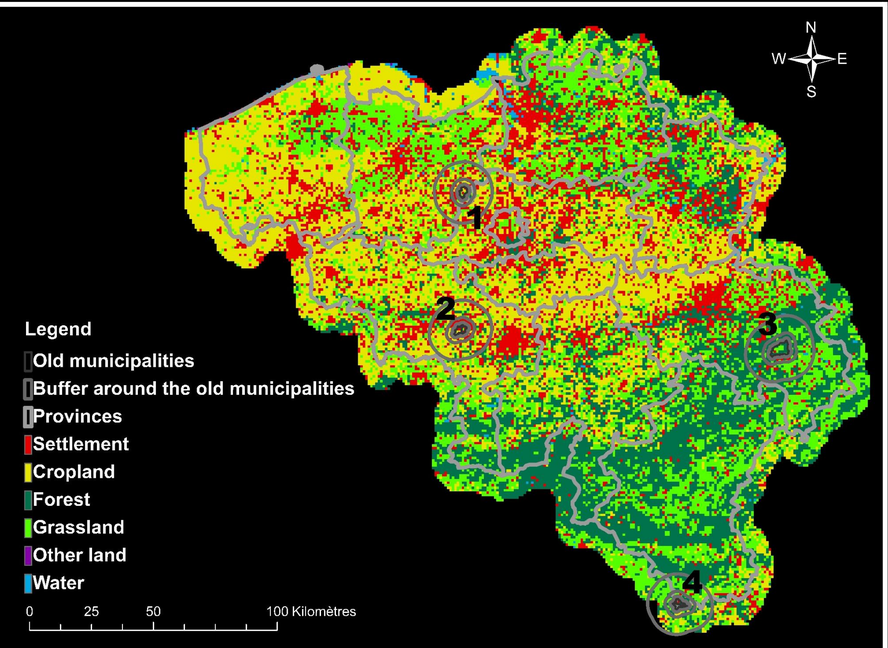

Figure 3. Localisation of the old municipalities, with a buffer of 1, 3 and 10 km. 1= Moorsel; 2= Trivières and St-Vaast; 3= Francorchamps; 4= Torgny and Lamorteau. The background map represents land use for the year 2010 and is from the HILDA project, at a 1 km spatial scale [15,16].

Origin of the data	Old	Recent
Bumblebees	1910-1930 : Ball's collection (RBINS)	2013-2014 : Fieldwork (Fig. 4)
Land use	1910 : HILDA project [15,16]	2010: HILDA project [15,16]

Figure 4. Fieldwork : new samplings of bumblebees are done in each old municipality.

Preliminary results and perpectives

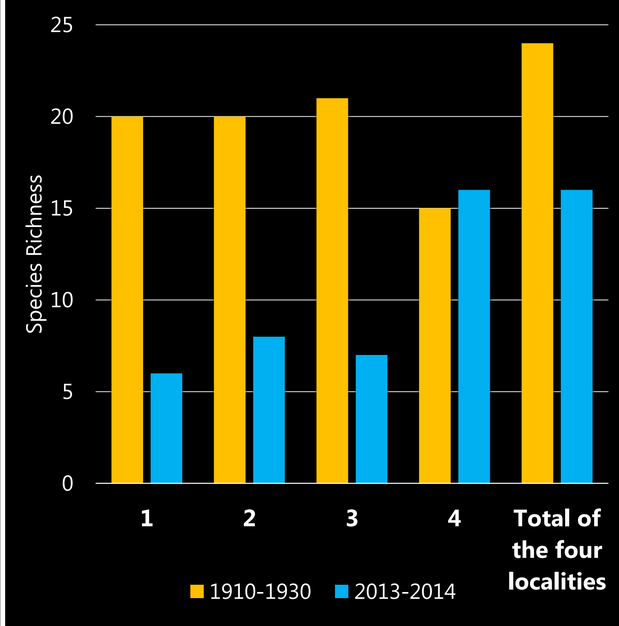

Figure 5. Species richness for the four localities and both time periods.

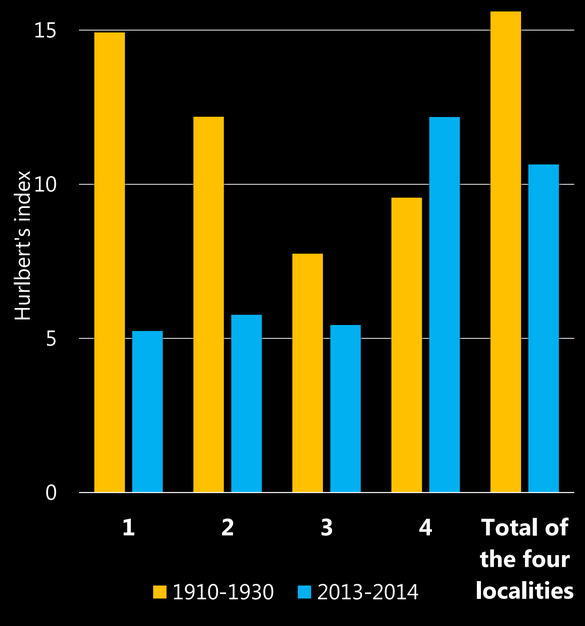

Figure 6. Hurlbert's index (number of species expected in a 100 specimens sample), for the four localities and both time periods.

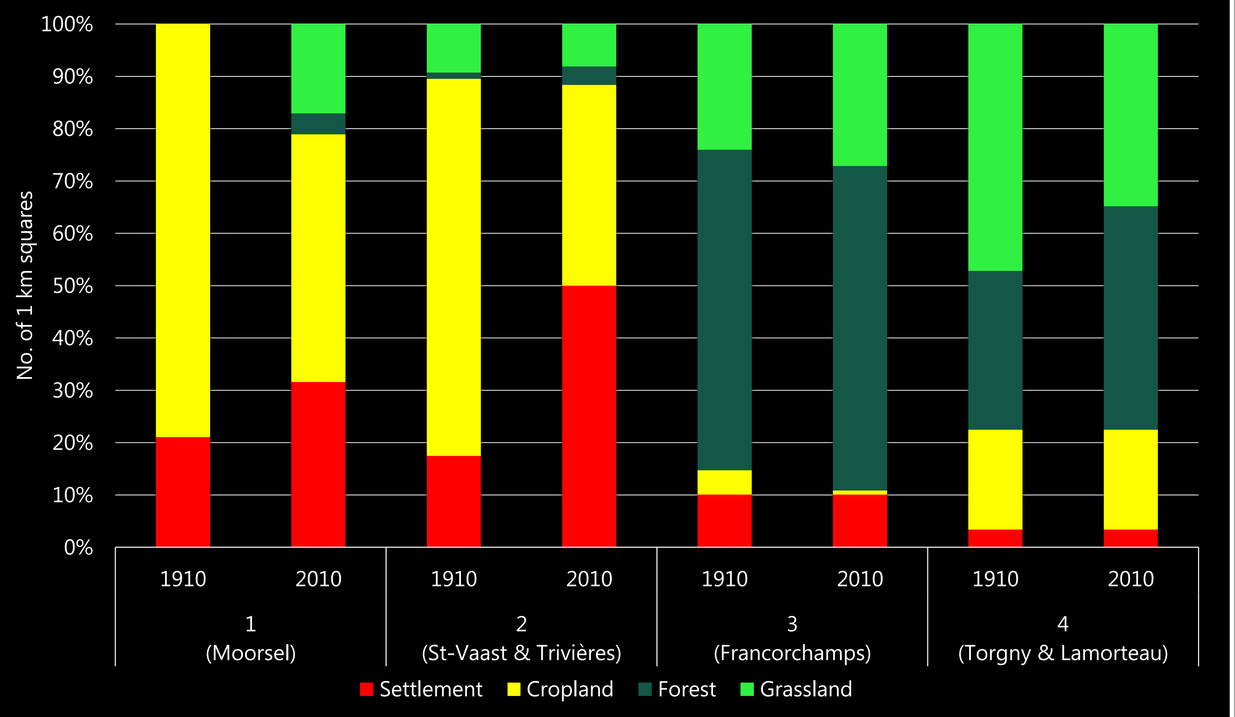

Figure 7. Number of 1 km squares of each land use class in 2010 and in 1910, for the 4 localities with a buffer of 3 km around the old municipalities.

Bumblebee communities

In 100 years, 8 bumblebee species disappeared. Species richness felt sharply in ¾ of the localities (Fig. 5). However, for the 4th in the Belgian Lorraine region, species richness is quite similar or slightly higher than 100 years ago. The same is observed for the expected number of species (Hurlbert's index ; Fig. 6).

Land use

The four localities have very different land use dynamics, similar at the three spatial scales (see Fig. 7 for the 3 km buffer). The localities 1 and 2 are dominated by settlement and cropland areas, the 3rd by forest and the 4th by grassland and forest. Settlement areas increased at the expense of croplands in the eastern localities (Fig. 7).

Bumblebees *vs.* land use

The most preserved bumblebee communities are where grasslands are the most abundant. Localities where species richness decreased the most (Fig. 5) are those where settlement areas increased the most at the expense of croplands (Fig. 7).

Figure 8. *Bombus lapidarius* on a thistle.

These preliminary results only give a small estimate and should be further refined and improved. We plan to use old topographic maps and aerial photographs in order to obtain a much more accurate analysis of the land use and the landscape structure. The intensity of land use will be given by agricultural statistics. Modeling will then assess the respective roles of land use, landscape and climate changes and provide key elements for understanding the processes responsible for the decline of populations of these essential pollinators.

Figure 9. Nature reserve « Raymond Mayné » in Torgny (locality no 4).

References

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