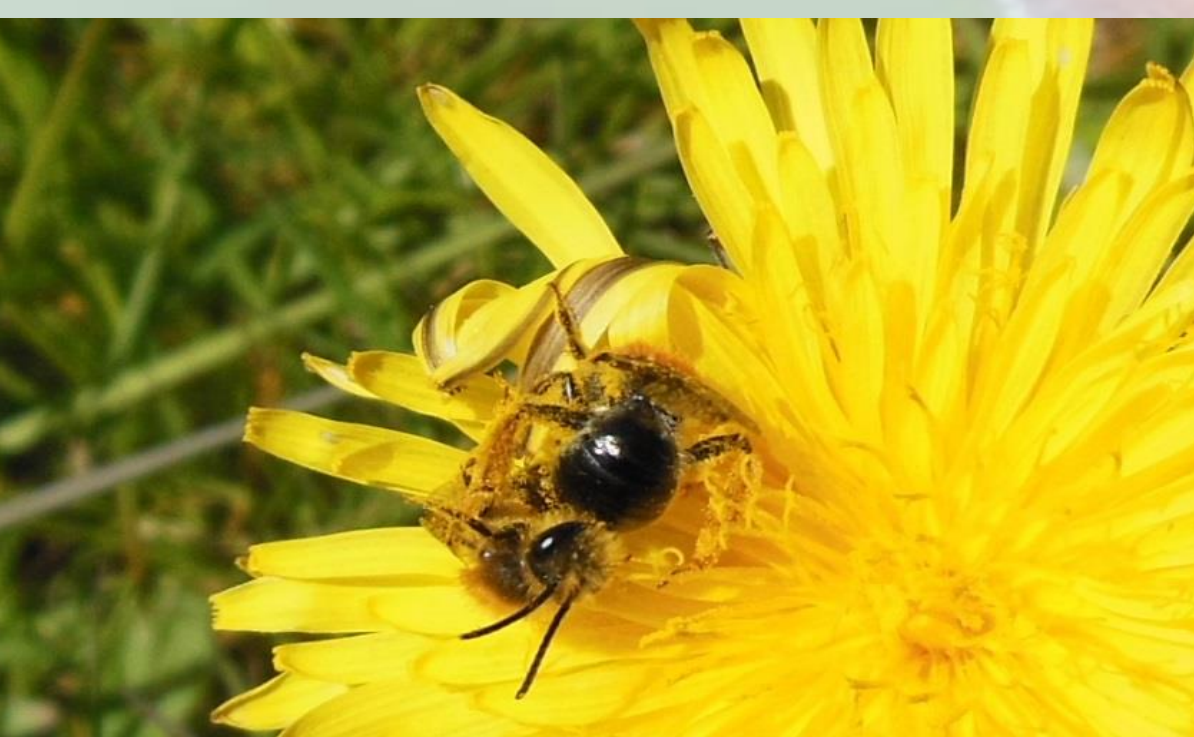


# Diversity and abundance of pollinators in chlorpyrifos-treated cider apple orchards in Herefordshire UK

## Introduction

The aim of the study was to monitor the diversity and abundance of the bee pollinator populations on cider apple orchards in Herefordshire, UK, treated with chlorpyrifos.

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Copulation *Andrena* sp. on a dandelion flower between tree rows. *Andrena* were the most abundant pollinators in the study



Orchard 5: Grass between trees with dandelion.

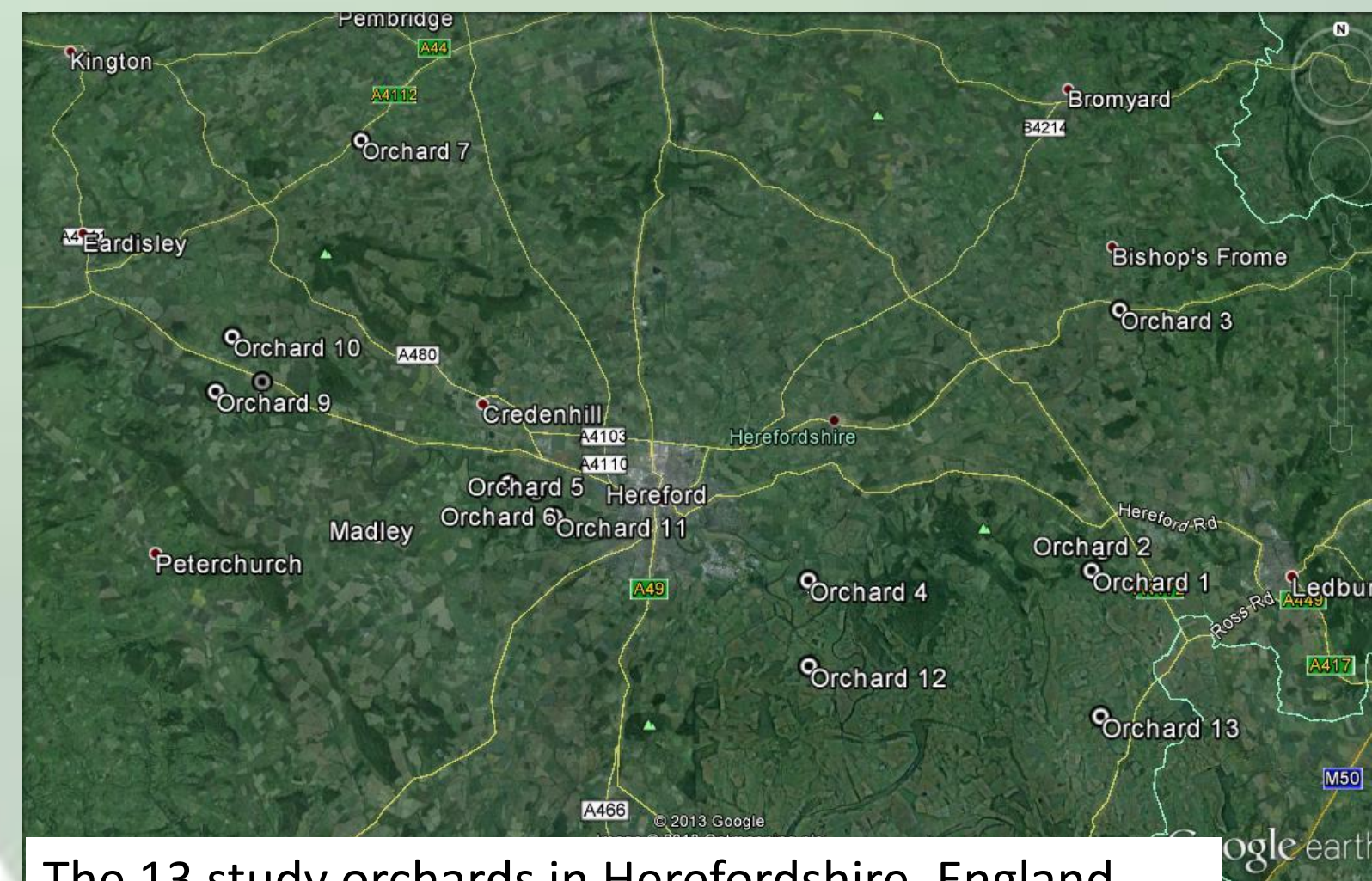


*Andrena haemorrhoa* on *Bellis perennis*



study region:  
Herefordshire.

According to normal practice in this region, chlorpyrifos was applied to the study orchards (no. 1 – 10) once before apple flowering and once after flowering, for the control of apple blossom weevil



The 13 study orchards in Herefordshire, England.

& sawfly both of which substantially impact apple tonnage. Risk to pollinators is managed by never spraying during blossom-time.

## Materials and methods

Ten (no. 1-10) **commercially-managed ‘bush orchards’** were monitored before and after **application of chlorpyrifos**. Three (no. 11-13) untreated traditional ‘standard orchards’ were also assessed to provide a species inventory. Surroundings were other orchards, grassland, arable crops, and also hedgerows & non-managed areas with high densities of wild flowers. Pollinators in the bush orchards were counted in 100 m ‘**transect-walks**’ and 1 m x 1 m ‘**observation-patches**’ of flowing plants, before and after application. **Nests were counted.**

### Observation-patches:

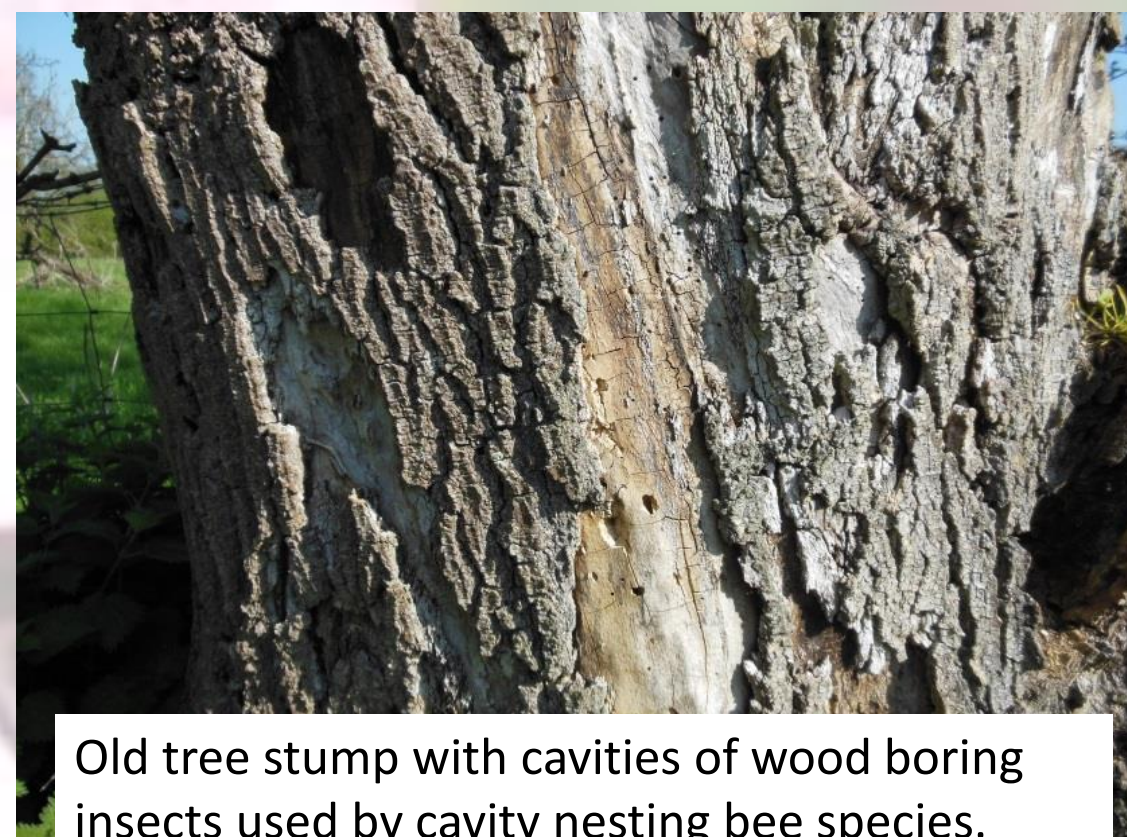
1m x 1m squares of high floral abundance were defined in  
i) field margins;  
ii) grass strips between rows;  
iii) under the trees.  
All pollinator activity was recorded during 5 minutes.



Observation-patch in field margin

### Nests:

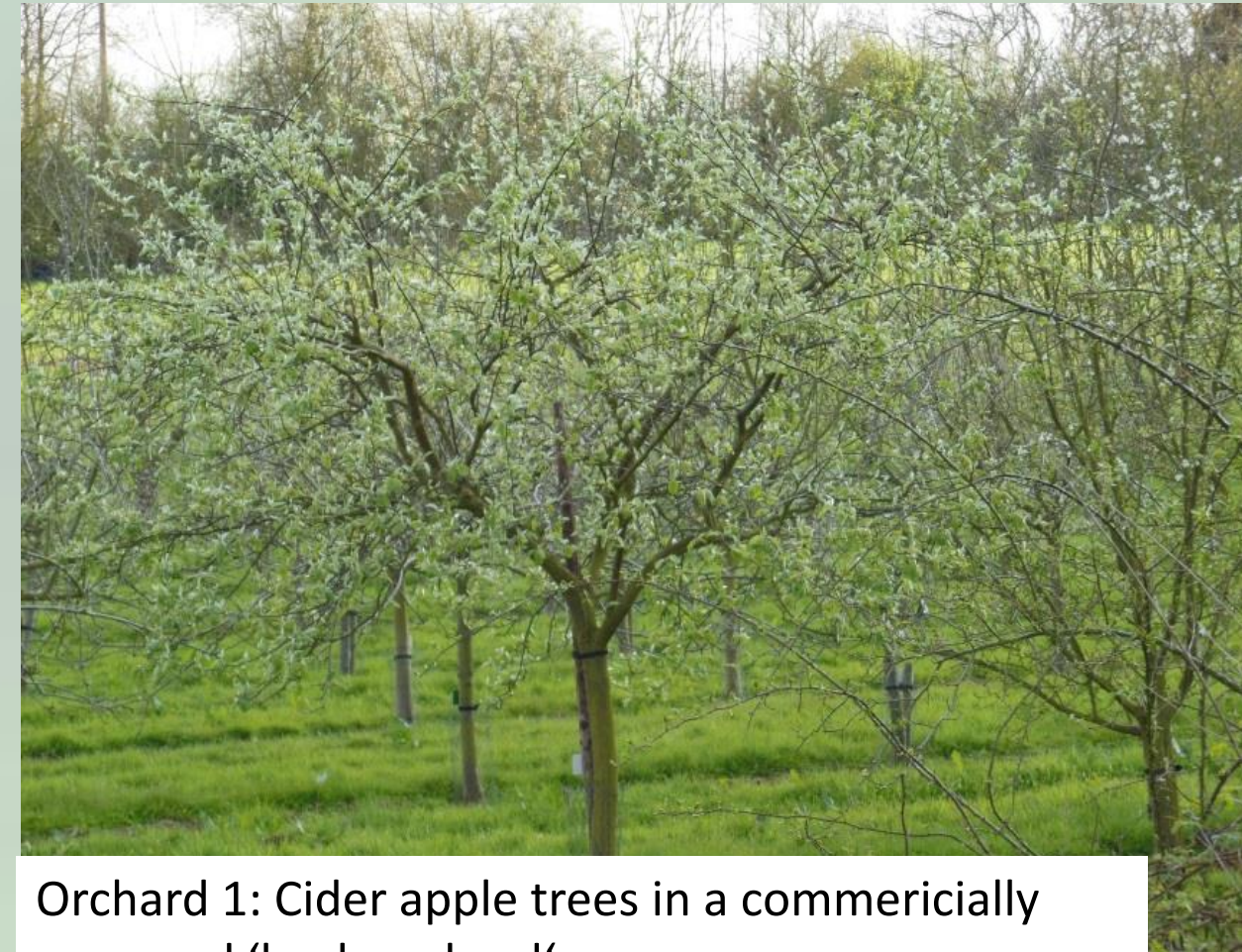
Orchards were searched for nests of ground-nesting and cavity nesting bees. Nests were mapped for each orchard.



Old tree stump with cavities of wood boring insects used by cavity nesting bee species.



Bumblebee *Bombus pascorum* on apple blossom



Orchard 1: Cider apple trees in a commercially managed ‘bush orchard’.



Orchard 3: Earth path: good for ground-nesting bees.



Nest of *Andrena* sp. on earthpath

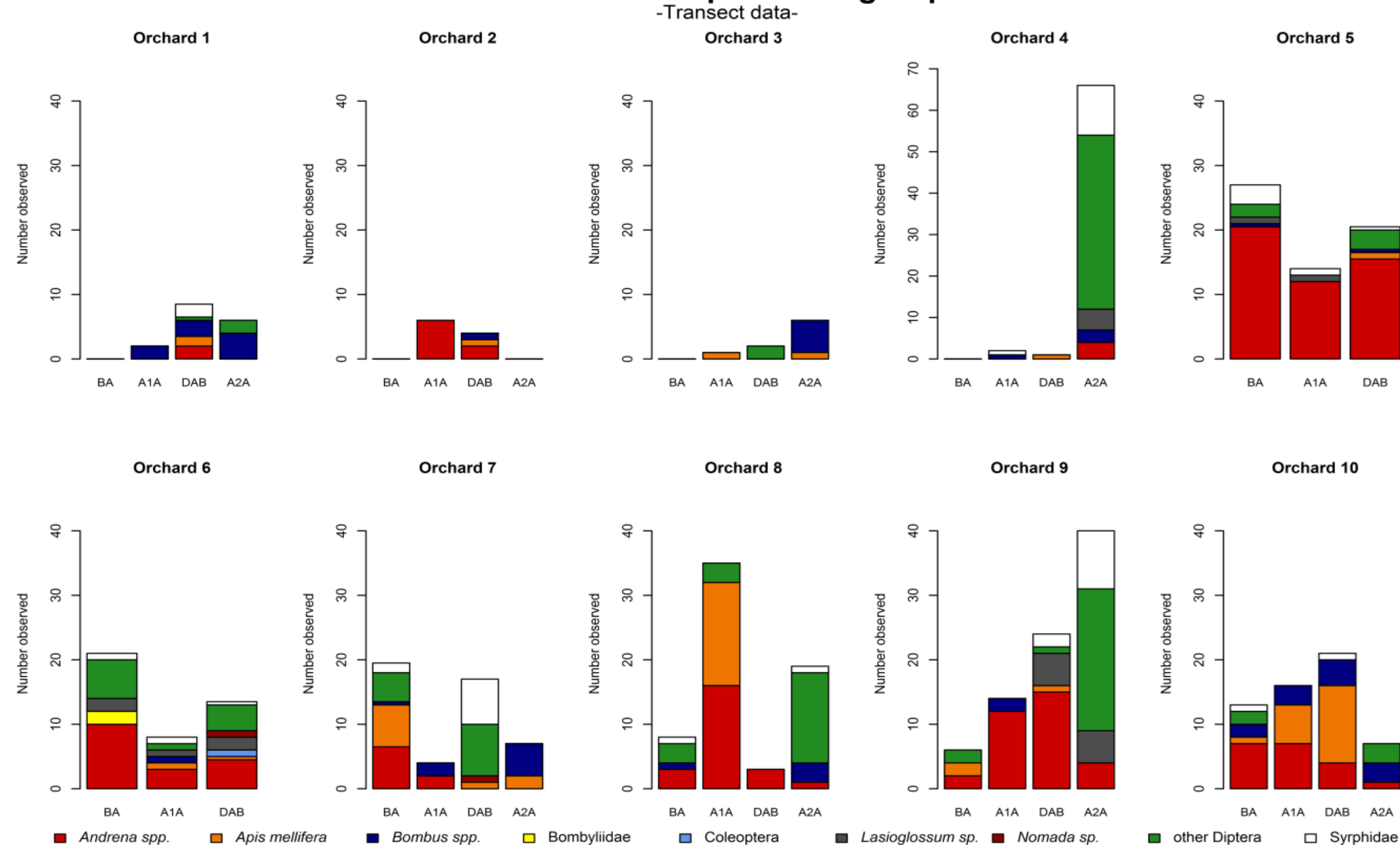


*Andrena* nests (holes) under an apple tree. It is normal practice to use herbicide under the canopy. This has a positive side-effect of creating nesting opportunities.

**Transect-walks:** Two transect-walks were done at every assessment, one in peripheral area of the orchard and one in the centre. Every transect was 100 m long. Flower-visiting pollinators were recorded by an observer walking along the transect observing plants on the ground within a distance of 1 m either side. Special transects were done for the apple trees during blossom-time.

## Results and discussion

### Abundance of pollinator groups



**Figure 1:** Abundances of pollinators in transect-walks for each experimental phase: Before 1<sup>st</sup> application of chlorpyrifos (BA), after 1<sup>st</sup> application (A1A), during apple blossom (DAB), after 2<sup>nd</sup> application (A2A). [note different scale for Orchard 4]

Three growers were ‘interviewed’. They were well aware of the importance of pollination and were willing to collaborate in projects to enhance non-managed pollinators in their orchards. They had not experienced any problems with insecticide usage and pollinators.

## Conclusions

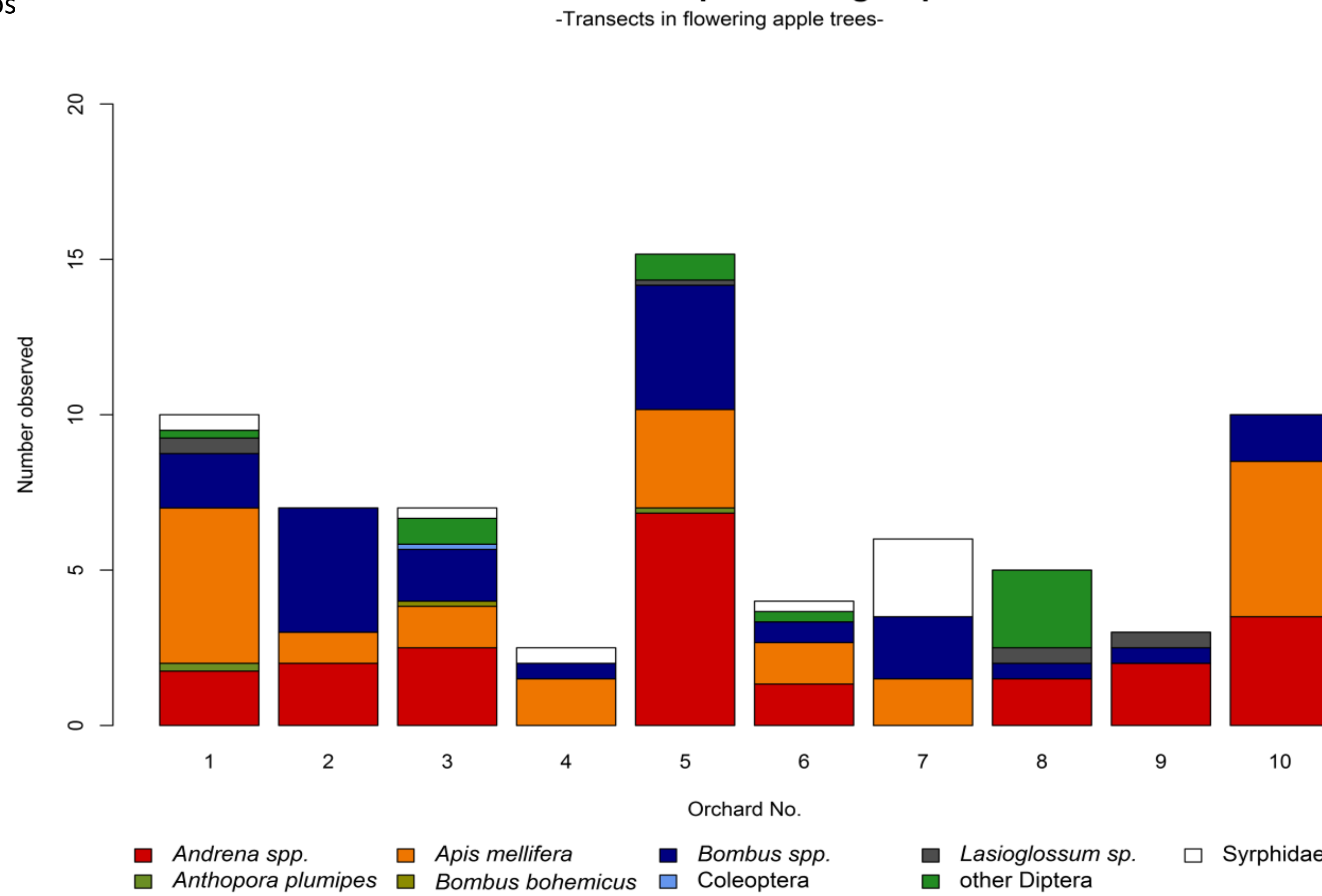
- Most growers in the study did not bring in honeybee hives for pollination. Pollination in those orchards was fully-reliant on *non-managed* species (*Andrena* spp & *Bombus* spp).
- At time of 1<sup>st</sup> spray (May) a larger variety & density of wild flowers was present compared with time of 2<sup>nd</sup> spray (June).
- Pollinator diversity and abundance differed over time and between sites. Differences depended on density of wild flowers **and were not related to chlorpyrifos application.**
- Andrena* spp (solitary bees) were highly abundant on most sites and important for pollination in the orchards - nesting in paths and bare soil under the orchard canopy – the latter resulting from (and depending on) routine herbicide use by the growers.

Present in all 10 bush orchards, in high numbers on most sites (Fig. 1) were solitary bees of genus ***Andrena*** (5-16 mm long). They nest in holes in bare soil & are active in spring & early summer. They were very important pollinators of apple trees in these orchards. Abundance *naturally* declined by the time after 2<sup>nd</sup> application.

While not as abundant as *Andrena*, **bumblebees** (*Bombus* spp.) were the second important pollinators in the orchards. Their ability to fly at much lower temperatures than other bees makes them important pollinators especially in temperate climates.

**Honeybees** (*Apis mellifera*) were present in almost all study orchards. Abundances varied considerably between sites. Only sites 2, 4, 7 & 10 had hives in the vicinity at blossom-time (other growers relied on non-managed pollinators). Honeybee behaviour as social insects is adapted to exploit large aggregations of resources, such as flowering fields of oilseed rape or flowering orchards. Their absence in some of the orchards outside the time of apple blossom suggested that they concentrated on larger resources during this time e.g. flowering oil seed rape.

### Abundance of pollinator groups



**Figure 2:** Abundances of pollinators as recorded on transect walks in flowering apple trees.