

Honors thesis projects 2009

Analysing bumble bee pollen basket contents in a landscape perspective

Theoretical background

To meet their needs most organisms require many different qualities from a landscape. For bees the foraging, nesting or hibernation sites are not necessarily to be found in the same type of habitat (Meek et al. 2002, Goulson 2003). For example, the locally superabundant flower resources in the form of crops may not be associated with available sites to build nests. Effects of loss of heterogeneity may differ between species (e.g. Steffan-Dewenter et al. 2002, Goulson et al. 2005). Different species integrate the landscape at species-specific spatial scales. Some species have the ability to fly long distances to collect food and for them, landscape characteristics at large spatial scales are most likely to affect population dynamics (Westphal et al. 2003). In contrast, several other bumblebee species and solitary bees are often active at relatively small spatial scales and forage at distances up to 100-600 m from their nest sites (Walther-Hellwig & Frankl 2000, Gathmann & Tschardt 2002).

Furthermore, a decreased spatial heterogeneity in food availability may result in an increased temporal heterogeneity. In other words, in a more homogeneous agricultural landscape without remnant habitats, there may not be a continuous supply of food resources throughout the season. This may disrupt the possibilities for bees and bumblebees to supply their offspring because bumblebee colonies depend on a continuous food supply over a prolonged time to sustain their colonies (Goulson 2003). Also the temporal variation of nectar and pollen supply at the appropriate spatial scale may be important. In addition, bee species including bumble bees, differ in their foraging specialisation and ability to utilize different flowers efficiently (e.g. Peat et al. 2005). Thus, if landscape homogenisation results in changes in the spatial and temporal distribution of flower resources, bee species may be differentially affected. Declines in bumble bees are not equal over all species or all functional groups and different explanations for this exist; phenology (Fitzpatrick et al. 2007), climatic ranges of the bees (Williams et al. 2007), tongue length/flower preferences (Benton 2006), flight/foraging distances (Steffan-Dewenter et al. 2002, Westphal 2003) and colony size (Rundlöf et al. 2007). Bees depend on nectar for their daily energy expenditure, but use pollen as the sole protein source for their growing larvae (Benton 2006). To find pollen is therefore just as crucial for a colony as is finding nectar flowers.

Bumblebees and solitary bees provide an essential ecosystem service by pollinating agricultural crops (Klein et al. 200X, Kremen et al. 2002). Vast numbers of wild plants also depend on insect pollinators (Buchmann & Nabhan 1996). However, pollination is poorly understood both ecologically and economically (Myers 1996, Daily 1997). The recent decline in population sizes of many bees has been associated with intensified farming methods and changes of agricultural landscapes in northern Europe (Kearns et al. 1998, Goulson 2003, Kells & Goulson 2003) and it is also possible that a coupled decline in at least some plants and pollinator groups is taking place (Biesmeijer et al. 2006).

Study system

In this study you will use landscapes from a system developed for the 2007 studies, where landscapes were selected depending on the amount of pasture and the size of farmland fields (blocks), and the occurrence of organic farms. We have selected 6 landscapes of each of the categories “**large scale**” and “**small scale**”.

In each landscape in total 16 plots of ca 100m² each scattered over the landscape, have been surveyed during 10 minutes each and all bumblebees found collected by hand netting. This way we have standardised the catch both by area and time. The sites to be sampled are as follows: **A.** 4 gardens, **B.** Edge-zones to flowering crops (e.g. clover, spring sown canola or pea), **C.** 4 semi-natural elements (e.g. permanent pasture or other permanent habitat). The habitats surveyed were chosen because we deemed it likely to find bumble bees there.

All bees were preserved in ethanol for later analysis and pollen baskets were either removed in the field or later in the lab.

Work plan

It is possible to identify the pollen carried by different bumblebees, sometimes to family and sometimes to species. This is done by preparing pollen slides in the lab via acetolysis, mounting it on glass slides and using the microscope, literature and a reference collection of pollen (available at the dept of Geology) for identification.

Expectations

Flower usage by bees may differ in landscape types so that crops and garden plants are more important in homogeneous than in heterogeneous landscapes. We may also expect a higher diversity of pollen species per colony or per bee species in heterogeneous landscapes, simply because we expect the flora to be more diverse there.

The pollen usage may also differ between bee species, based on preferences related to body morphology. It might be that a larger bee cannot move around the flowers in the same way as a small be and thus efficient pollen collection would depend on the right combination of bee and flower morphology. Just as the theory of niche separation when it comes to preference for nectar flowers and the length of the tongue of bees. Alternatively, pollen collection is not at all tricky and all bees depend on about the same plants. In that case we may have a situation of competition both between colonies and between species.

Contact: Anna Persson anna.persson@zooekol.lu.se