Phenology, monitoring and landscape utilisation of bumblebees

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The last few decades the abundance of many bumblebee species in Europe has declined, likely as a result of agricultural intensification leading to habitat destruction and fragmentation (Stoate et al. 2001). A decline in abundance and diversity of bumblebees may have serious consequences for plant community compositions and thus negatively affect other species in the pollination systems (Kearns et al. 1998). However, since bumblebees are not only important pollinators of wild flowers but also of crops, the decline in bumblebee abundance could have long-term economic as well as ecological implications (Allen-Wardell et al. 1998). For these reasons it is important to monitor bumblebees in terms of species occurrence, diversity and changes in abundance. To do this, the bumblebees' preferred landscape elements must be known, as well as how many inventory-sites to use and when and how often inventories should be performed.

This study shows that flower-rich landscape elements like unfertilised pastures, undisturbed wood verges and uncropped field verges are important for bumblebee abundance and diversity. Totally 1053 bumblebees belonging to 17 species were found, and 70% of all observations were made in these three landscape elements. Were they to disappear due to intensification of agriculture or forestry, it would have serious implication on the bumblebee abundance. However, the results also point out the importance of a diverse landscape. As also found by Teräs (1985), bumblebee species preferred partly different landscape elements and showed a clear seasonal variation in habitat preferences. If the landscape elements with less abundance of bumblebees, as road verges and leys, were to disappear it could cause gaps in the flower supply leading to a decline in bumblebee abundance. Bumblebees do not store nutrients as honeybees do so to survive they require a continuous succession of flowers during the summer (Goulson 2003a). As found in other studies not all plant species available were used by bumblebees, and a few species received almost all visits (Teräs 1985). The five most visited plant species received over 50% of all bumblebee visits.

Monitoring is important in order to evaluate the condition of a certain area in terms of species occurrence, diversity and changes in abundance. The findings of this study show that monitoring of bumblebees can be performed over the whole day, independent of temperature, cloudiness and wind speed as long as the temperature is above 17 ˚C and the wind speed below five on Beaufort's scale. The fact that bumblebees are so indifferent to weather conditions and not affected by time of the day make them easy to monitor in the field, which considerably facilitates survey and follow-ups on different bumblebee species and habitat conditions.

Power analyses were used to examine monitoring methodology. It is recommended that sites are visited at the beginning of the summer due to lower variation in bumblebee abundance. The number of bumblebees and species were found to be relatively stable between the middle of June and the middle of July and peaked at the beginning of August. The probability of detecting a certain change in abundance was not much affected by varying the number of visits per season, and as long as it occurs at the beginning of the summer it is sufficient with one visit per season. The number of sites, on the other hand, had a large effect on the probability of detecting changes in abundance. It was found that in order to detect a significant change in abundance, large scale monitoring is necessary. Generally, common species required fewer visited sites than less common species. To detect a 50% change in abundance of *Bombus pascuorum*, the most common species in this study, 295 sites must be

monitored and for less common species, like *B. pratorum* and *B. soroeensis,* over 2000 sites must be monitored in order to detect a significant change in abundance.

References

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