Addressing bumblebee faunistic and ecology using Citizen Science – reviewing a 2-year experience

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Introduction: The majority of historical entomological records is derived from the collecting activities of non-professionals, often non-biologists. Some of these "Citizen Scientists" have achieved an excellent knowledge of taxonomy, distribution, and ecology of species (Hopkins and Freckleton, 2002; Pohl, 2009). Modern Citizen Science in entomology uses the opportunities of the Internet to facilitate the identification, transfer records and photographs, and communication between lay observers and specialists. However, only a few insect groups can be reliably identified by observation or photographs, without the necessity of killing and subsequent preparation for identification purposes. Bumblebees (*Bombus*, *Apidae*, and *Hymenoptera*) are such a group, providing a great opportunity to conduct entomological Citizen Science projects. Bumblebees are common, can usually be identified by colour morphs, and identification can be verified using photographs. Last but not least, they evoke positive emotions – a prerequisite to motivate citizen scientists. In contrast to mass partitioning, i.e., Citizen Science projects with very simple observation tasks (e.g., Rüdisser et al., 2015; Roy et al., 2016), this project aims to generate high quality data from Citizen Scientists and to convey know-how in bumblebee identification and biology for participants in an interactive way.

Materials and Methods: Since 2007, distributional data on all kinds of animals and plants have been reported on the Austrian Citizen Science platform www.naturbeobachtung.at, with a particular focus on bumblebees beginning in 2014. A precondition for this approach is the availability of information for interested participants. We provide guidance from the participants' first step to becoming expert knowledge. To facilitate the outreach efforts, a set of supportive materials was developed:

- Free leaflets with basic insights in the recognition of the most common bumblebee species were designed and distributed. The leaflets further include basic, but essential, information on the ecology and biology of the six most common species in Austria.

- A more profound resource is provided by a convenient field identification key (Gokcezade et al., 2010, 2015). It is primarily based on colour patterns and hence

allows an intuitive, but scientifically accurate, identification of the bumblebees of Austria, Germany, and Switzerland.

- To provide hands-on experiences, 14 one-day workshops on bumblebee identification, biology, and ecology were conducted in Austria over the past 2 years. The free-of-charge courses were led by the authors and accompanied carefully designed presentation materials, which were fully accessible to the participants.

However, the most important educational resource is provided by the online platform www.naturbeobachtung.at. Besides accessible learning materials, this platform hosts a frequently used online forum, which aims at bumblebee identification *via* photographs. As it is maintained by recognized bee biologists, reliable identification and accurate scientific data collection is ensured. Besides the emphasis on data acquisition, we further addressed the question if faunistic data achieved by Citizen Scientists can be used to meet applied ecological questions. Bumblebee data were collected under standardised conditions in 32 private gardens in 2015 and 2016 using the available facilities and guidance of the platform. The first results of 2015 are shown in Figure 2.

Results and Discussion: Since the start of the project, an increasing number of participants and records was achieved (Table 1). Moreover, the percentage of evaluable data with attached photograph that allows verification and geographical coordinates increased significantly. A total of 29 out of 42 bumblebee species occurring in Austria could be successfully recorded using Citizen Science. Among these were rare species such as the arctic-alpine *Bombus alpinus* or *Bombus haematurus* (see Figure 1). The first species is very rare and considered highly threatened by changing climatic conditions (Rasmont et al., 2015), whereas the latter species is rapidly spreading in the last decades (Bossert and Schneller, 2014). In total, 23.6% of all records were not identified correctly or not validated for lack of photographic support. In a few cases, an exact identification was possible, although only a species group had been recorded. Methods for facilitating recording in the database after asking for identification should be taken into account.

Presently, the bumblebee records of Citizen Scientists contribute about 1/3 of the annually recorded bumblebee data of Austria. Accordingly, Citizen Science delivers a notable amount of data, allowing the detection of ongoing trends in species composition among bumblebee communities. Moreover, ecological information about phenology and flower visits could be extracted from photographic documentation. By the end of the past season, a total of 142 visited plant species could be recorded, mostly with additional information about the flower visiting behaviour such as nectar and pollen foraging. Nonetheless, the maintenance of the online platform requires a considerable amount of working time. Validating observations required 30–50 h annually, and the guidance of ongoing Citizen Scientists required another 80 h.

The recorded datasets of the bumblebees in private gardens show that the conducted method is well suited to answer applied ecological questions. Thereby it was shown that *Bombus hortorum* is the most frequent bumblebee species in private gardens. *Rubus idaeus* and *Fabaceae*, such as red clover, are the most frequently visited plant taxa and attracted a number of different bumblebee species (Figure 2). Flower richness and bumblebee friendly plants turned out to be of great importance in private gardens.

Conclusion: The presented applied model of Citizen Science has the advantage that people get training that allows them to act as lay experts. The constant feedback provided by the experts *via* www.naturbeobachtung.at represents a main pillar for the motivation of long-term citizen scientists. Additional possibilities exist to expand monitoring of bumblebees to include qualitative and quantitative observational data about bumblebees. Such data about quality of various biotope types for wild bees and long-term trends in pollinator availability and species composition would provide important insights into local and global change.

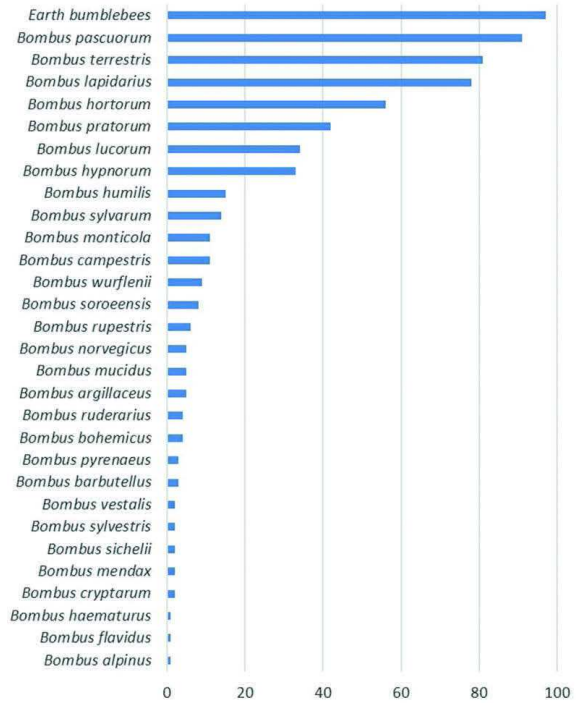

FIGURE 1: Frequency of the recorded bumblebee species. Mostly, *Bombus terrestris, B. cryptarum* und *B. lucorum* females cannot be identified reliably by means of photographs. Therefore, these species have been recorded under their trivial name "Earth bumblebees".

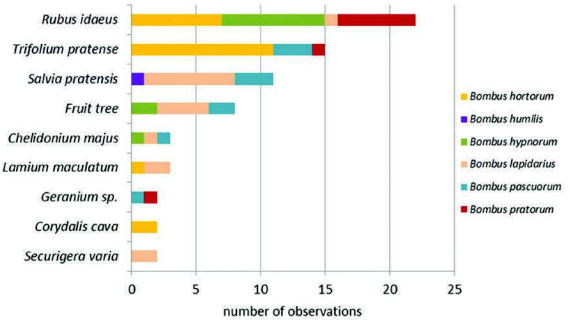

FIGURE 2: Recorded bumblebee species and respective flower visits in private gardens.

TABLE 1: The table summarizes the increasing number of recorded bumblebee individuals and participants of the past 10 years.

Years	Sum of	Evaluable	% evaluable	Species	Participants
2006–2013	45	17	37.8	1	13
2014	367	138	37.6	15	11
2015	1081	651	60.2	29	35

Keywords: pollination, monitoring, bumblebees, Citizen Science, nature conservation, *Bombus*

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REFERENCES

Bossert, S., and Schneller, B. (2014). First records of *Bombus haematurus* Kriechbaumer, 1870 and *Nomada moeschleri* Alfken, 1913 (*Hymenoptera*: *Apidae*) for the state of Vienna (Austria). *Beiträge zur Entomofaunistik* 15, 95–100. doi: NODOI PMID:NOPMID

Gokcezade, J. F., Gereben-Krenn, B.-A., Neumayer, J., and Krenn, H. W. (2010). Feldbestimmungsschlüssel der Hummeln Deutschlands, Österreichs und der Schweiz. *Linzer Biol. Beitr.* 42, 5–42. doi: NODOI (2. edition: Linzer biologische Beiträge 47/1 (2015): 5–42), PMID:NOPMID

Hopkins, G. W., and Freckleton, R. P. (2002). Declines in the numbers of amateur and professional taxonomists: implications for conservation. *Anim. Conserv.* 5, 245–249. doi: 10.1017/S1367943002002299 PMID:NOPMID

Pohl, G. R. (2009). Why we kill bugs – the case for collecting insects. *Newsl. Biol. Surv. Can. (Terr. Arthropods)* 28, 10–17. doi: NODOI PMID:NOPMID

Rasmont, P., Franzén, M., Lecocq, T., Harpke, A., Roberts, S. P. M., Biesmeijer, J. C., et al. (2015). Climatic risk and distribution Atlas of European bumblebees. *Biorisk* 10, 1–236. doi: 10.3897/biorisk.10.4749 PMID:NOPMID

Roy, H. E., Baxter, E., Saunders, A., and Pocock, M. J. O. (2016). Focal plant observations as a standardised method for pollinator monitoring: opportunities and limitations for mass participation citizen science. *PLoS ONE* 11:e0150794. doi: 10.1371/journal.pone.0150794 PMID:26985824

Rüdisser, J., Tasser, E., Kapelari, S., Huemer, P., and Tappeiner, U. (2015). Viel-Falter: can schools contribute to biodiversity monitoring? *Verhandlungen der Gesellschaft für Ökologie* 45, 319–320. doi: NODOI PMID:NOPMID

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