Impacts of Austrian Climate Variability on Honey Bee Mortality

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Global food production, as it is today, is not possible without pollinators such as the honey bee. It is therefore alarming that honey bee populations across the world have seen increased mortality rates in the last few decades. The challenges facing the honey bee calls into question the future of our food supply. Beside various infectious diseases, *Varroa destructor* is one of the main culprits leading to increased rates of honey bee mortality. *Varroa destructor* is a parasitic mite which strongly depends on honey bee brood for reproduction and can wipe out entire colonies. However, climate variability may also importantly influence honey bee breeding cycles and bee mortality rates. Persistent weather events affects vegetation and hence foraging possibilities for honey bees. This study first defines critical statistical relationships between key climate indicators (e.g., precipitation and temperature) and bee mortality rates across Austria, using 6 consecutive years of data. Next, these leading indicators, as they vary in space and time, are used to build a statistical model to predict bee mortality rates and the respective number of colonies affected. Using leave-one-out cross validation, the model reduces the Root Mean Square Error (RMSE) by 21% with respect to predictions made with the mean mortality rate and the number of colonies. Furthermore, a Monte Carlo test is used to establish that the model's predictions are statistically significant at the 99.9% confidence level. These results highlight the influence of climate variables on honey bee populations, although variability in climate, by itself, cannot fully explain colony losses. This study was funded by the Austrian project "Zukunft Biene".