



# Investigations on colonization pathways and ecological factors promoting the invasion of the Asian wild bee species, *Megachile sculpturalis*, in Europe



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## Citizen Science Monitoring Program

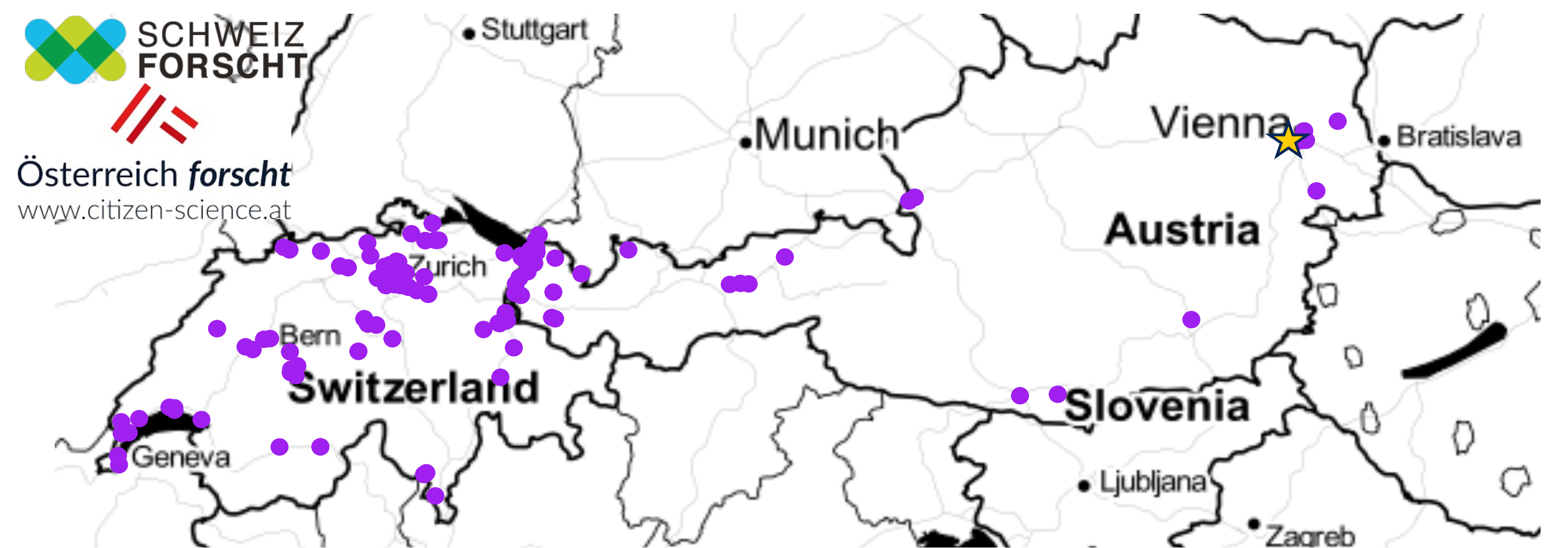


Fig. 1: By establishing a participatory study design, we track the first and so far, only invasive wild bee species in Europe ([www.beeradar.info](http://www.beeradar.info)). Besides occurrence data, participants report observations on biological interactions and take part in experiments, e.g., home range measurements and collect samples for population genetics.

Fig. 2: Map representing records gathered by Citizen Scientists from 2018 until 2020. The star highlights the first record in Austria from 2017. While Switzerland seems to be colonized over large areas, occurrence patterns in Austria indicate an early invasion stage with jump-dispersals over large distances <sup>1</sup>.

## Species Distribution Modeling

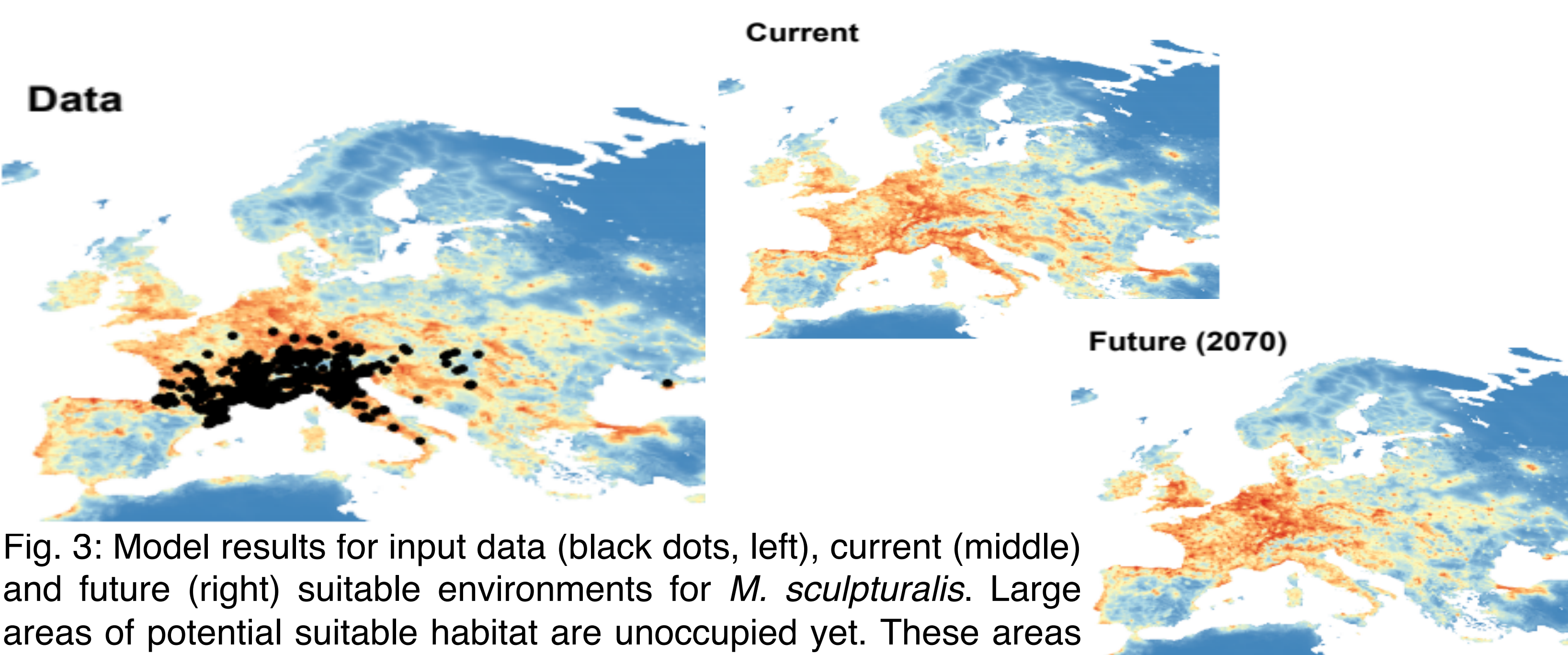


Fig. 3: Model results for input data (black dots, left), current (middle) and future (right) suitable environments for *M. sculpturalis*. Large areas of potential suitable habitat are unoccupied yet. These areas remain under future climate change scenarios.

### Potential habitats and key drivers

Although the population progressed remarkably fast, the invasion of Europe seems to be in its early stages. We showed that its current distribution is largely explained by anthropogenic factors, suggesting that its spread is facilitated by road and maritime traffic, largely beyond its intrinsic dispersal ability<sup>2</sup>. Distribution gaps are best explained by human mediated jump-dispersals travelling long distances on major European trading routes<sup>1</sup>.

## Population Genetics

### Multiple introduction events

We conducted a genotyping-by-amplicon sequencing approach to track its colonization history as well as connectivity between populations in Europe. A set of 46 co-dominant markers were applied to four European populations. We detected a distinct cluster formation with an east-west differentiation. This cluster formation is best explained by multiple introduction events in Europe. Such events might explain its fast dispersal<sup>3</sup>.

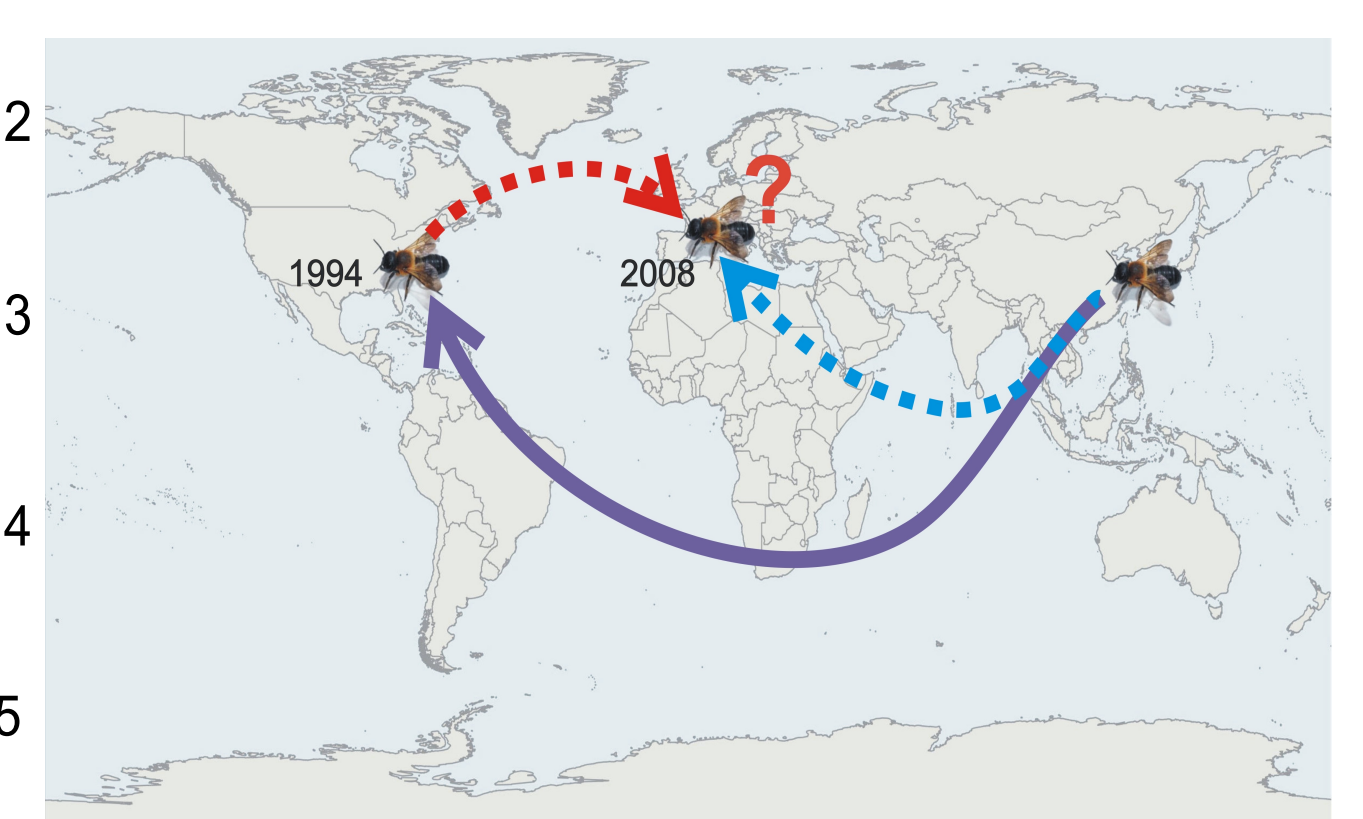
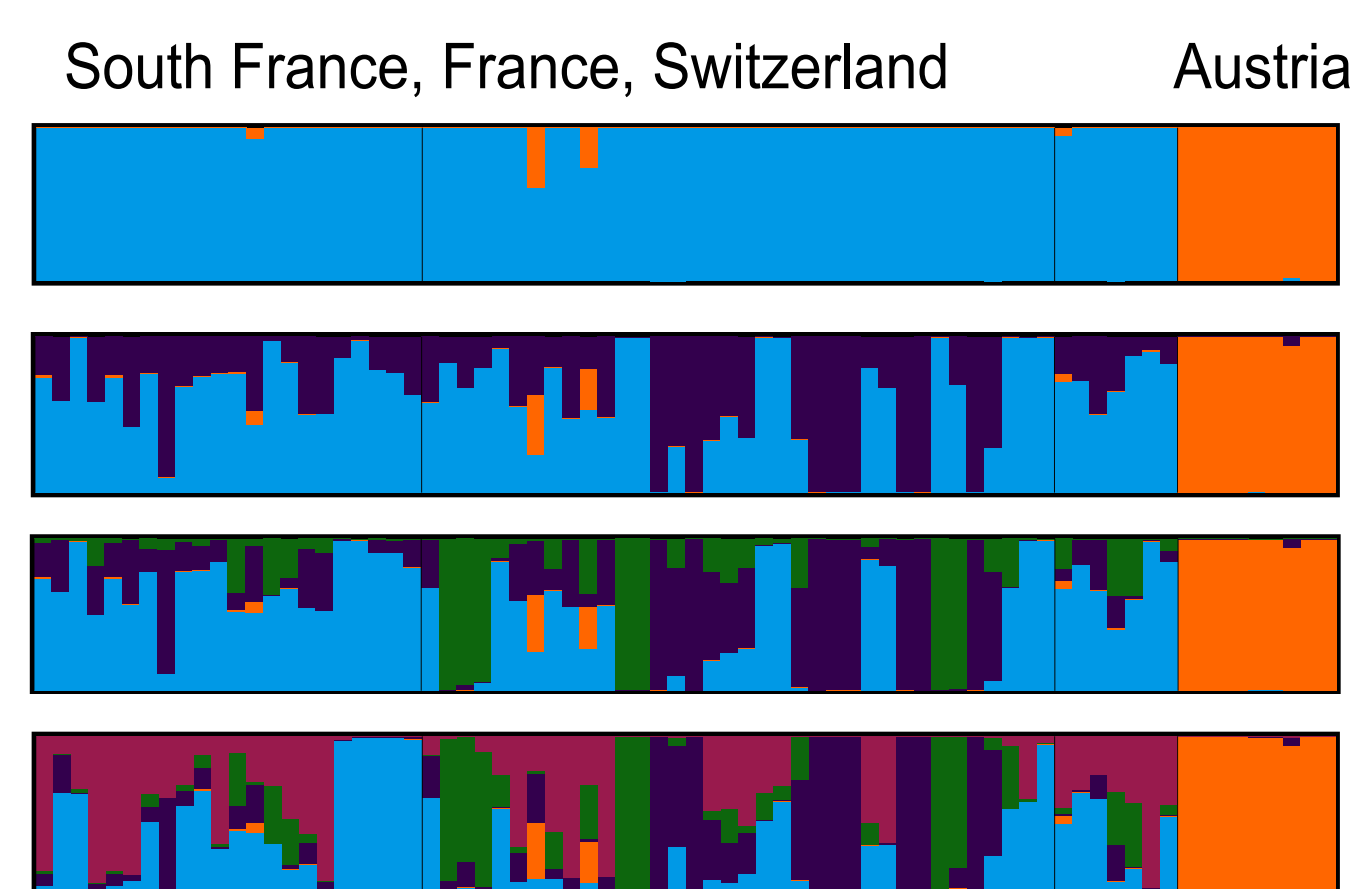


Fig. 4: Samples were partly provided by participants of the citizen science project (left). Structure bar plots (middle) unveiled a western genotype based on samples of Switzerland, France, and South France (putative point of origin) and an eastern type of Vienna. Next step will be to include samples from all continents to locate its origin (right).

## Life History Traits



Fig. 5: A rare finding for bees was captured in 2020, when a female used plastic for its nest construction representing a highly flexible behavior of females within this trait (CC 4.0 Fornoff).

### Home-and-away comparison

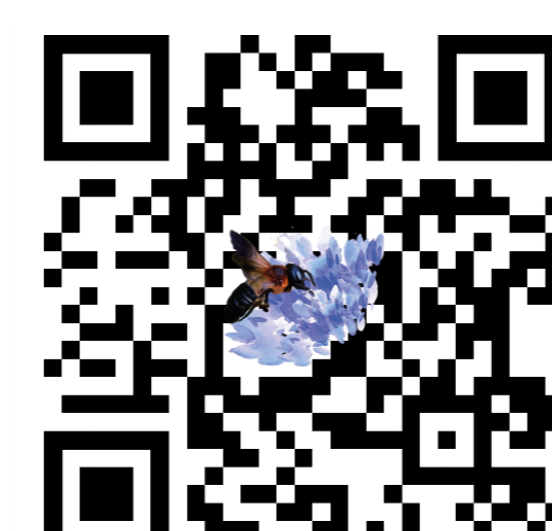
The bionomics of a species influence its invasive ability and the potential impact on its new environment. We investigated its life history traits such as nesting biology, reproduction rate and development, phenology, body size as proxy for flight distance and natural enemies. We found deviations in several traits between its native and new environment and concluded that not a single, but rather several LHT shifts are responsible for the invasion success of the species<sup>4</sup>.

<sup>1</sup> Lanner et al. 2020 Dispersal patterns of an introduced wild bee, *Megachile sculpturalis* Smith, 1853 (Hymenoptera: Megachilidae) in European alpine countries. PlosOne

<sup>2</sup> Lanner & Dubos et al. 2021 On the road: Anthropogenic factors trigger the invasion of a wild solitary bee species. In prep.

<sup>3</sup> Lanner et al. 2021 Evidence for multiple introductions of an invasive wild bee species currently under rapid range expansion in Europe. BMC Ecology and Evolution

<sup>4</sup> Fornoff & Lanner et al. 2021 Bionomics of species explain invasion success and predict its potential severity. in prep.



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