Effects of Climate Change on *Apis mellifera* and *Lavandula angustifolia*

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Introduction

The animal species and plant species that were focussed on during this study: the western bumble bee, *Apis mellifera*, and the common lavender, *lavandula angustifolia.* Both species occupy similar niches in the Mediterranean. The majority of Mediterranean ecosystems are pollinated purely by insects, *Apis mellifera* being the most dominant pollinator in the mediterranean (Vergara Lopez, 2013). The mediterranean has two different seasons, a hot dry summer and a cold wet winter with extremely heavy rainfall. According to the University of Balearic Islands in Palma de Mallorca, Spain weather and summer drought "may condition the polleniferous potential of vegetation by affecting its flowering phenology" (Vergara Lopez, 2013). This experiment set out the effects of climate change on the relationship between *Apis mellifera* and *Lavandula angustifolia.*

Fig 1A *A. mellifera* (oregonconservationstrategy.org)
Fig 1B *L. angustifolia* (gardenia.net)

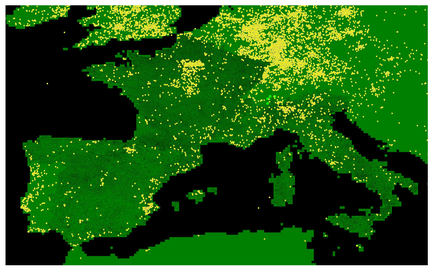

Fig. 2. *Apis mellifera* range (DIVA.GIS,2020 & GBIS)

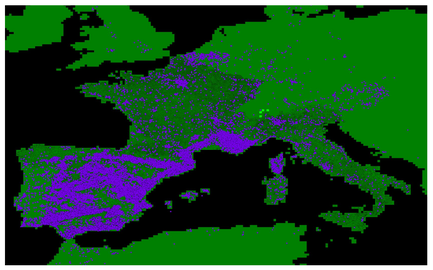

Fig 3. *Lavandula angustifolia* range (DIVA.GIS,2020 & GBIS)

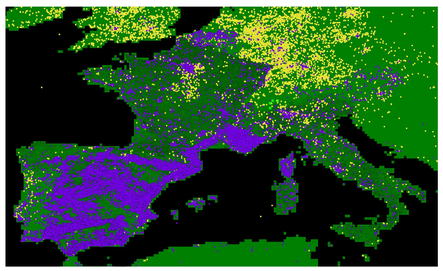

Fig 4. *A. mellifera* and *L. angustifolia* distribution overlapped (DIVA.GIS,2020 & GBIS)

Methods

This research was conducted with data collected from the Global Biodiversity Information Facility (http://www.gbif.org), DIVA-GIS, and Maxent (Phillips et al., 2004; 2006). We first input the data we gathered from GBIF into DIVA-GIS along with precipitation levels. Next, modeling of the predicted distribution of *Apis mellifera* and *Lavandula angustifolia* was accomplished using Maxent, which predicts and produces images of expected current environmental change and expected environmental change for the species in question in using input of estimated climate patterns (worldclim.org) as well as the coordinates we found for the *Apis mellifera* and *Lavandula angustifolia.* We will compared both of these graphs of the countries of Italy, France, and Spain to see if there will be a change in climate in Mediterranean that would cause either *Apis mellifera* or *Lavandula angustifolia* to have to migrate or potentially die out.

Results

Figures 2 and 3 are showing the current distribution of *Apis mellifera* and *Lavandula angustifolia.* Within the maxent program and DIVA-GIS, we created a map with the current and future climates overlapped for both *Apis mellifera* and *Lavandula angustifolia*; figures 5 and 6. For *Apis mellifera,* figure 5, the current distribution is the yellow points. The future distribution *Apis mellifera* is shown in blue. Based on this, the future distributions of *Apis mellifera* are moving more South as well as more inland. In figure 6, the current distribution of *Lavandula angustifolia* is represented by the purple points. The future distribution is shown in blue. Based on this figure the *Lavandula angustifolia*, will continue to expand toward the South, but also increase more in the East as well as trend more inland. There will be an overlap in the East of the current and future distribution of *Lavandula angustifolia*.

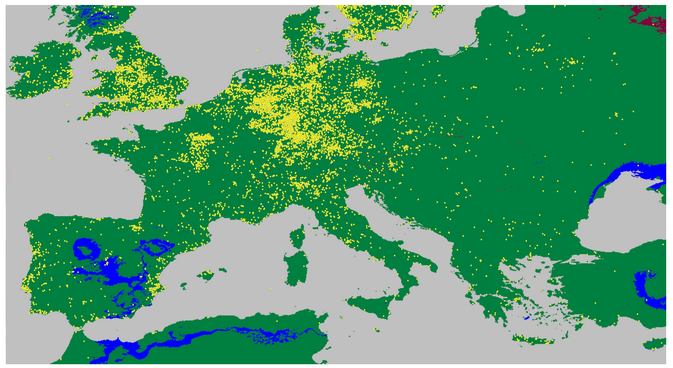

Fig. 5. *Apis mellifera* current and future distribution based on climate (DIVA.GIS,2020 & GBIS)

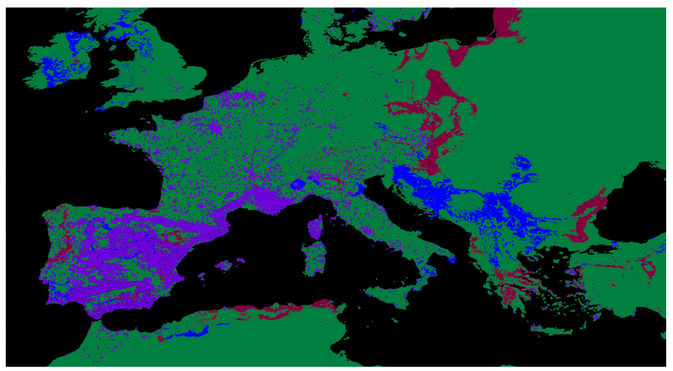

Fig. 6. *Lavandula angustifolia* current and future distribution based on climate (DIVA.GIS,2020 & GBIS)

Discussion

The climate of the Mediterranian supports both the *Apis mellifera* and *Lavandula angustifolia,* which thrive in especially dry, warm habitats (Bruck, S. R. (2017), Böcher, J., et. al., (2015)). The weather changing patterns of the Mediterranian will still support the life of the two species. A future trend in the climate that will affect the Honey Bee is the rising sea levels. Because these species are found along coastal regions, the rising sea level will take away from some of their habitat. A study completed with *A. mellifera* in Greenland showed that the bees will have a larger survival rate when they are farmed even if the climates are cooler in nature (Pape, 1983). This shows that climate change may not be the demise of the bees, but farming may be a way to prolong the life of bees in a world with a changing climate. According to the maps, both species will move toward the Southern part of the Mediterranian, and go further inland. Additionally, *Lavandula angustifolia*, will migrate toward the Eastern part of the Mediterranian, where it will most likely be pollinated by other organisms in addition to *Apis mellifera*. The movement of *Apis mellifera* south could indicate a growing dependence on lavender as a resource. Currently, their primary resource is a multitude of species but the future projections of the distribution of *Apis mellifera* could indicate a growing dependence of *Lavandula angustifolia* as a resource (Böcher, J. 2015). This could be due to a dwindling of species diversity as the ecosystem no longer can support the fauna that exist in these European countries.

Conclusions

- *Apis mellifera* and *Lavandula angustifolia* prefer areas with a dry, warm habitat, which could cause a harmful effect on both in the future.
- The ranges of both species will likely shift with climate change. Both will tend to shift toward the South together.
- *Lavandula angustifolia* will also trend toward the East, but most likely be pollinated by other organisms.
- *Apis mellifera* may be tending south due to an increased dependence on *Lavandula angustifolia.*

Fig. 7. *Apis mellifera on Lavandula angustifolia* (sussex.ac.uk)

Works Cited

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