



Fig 1 *Solenopsis Invicta*
(Red Imported Fire Ant)

Comparison of Geographic Similarities and Differences and Environmental Needs of *Solenopsis invicta* (Red Imported Fire Ant) and *Pogonomyrmex barbatus* (Red Harvester Ant)

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Fig 2 *Pogonomyrmex barbatus*
(Red Harvester Ant)

Introduction

Two ant species were the focus of this study: the red imported fire ant, *Solenopsis invicta*, and the red harvester ant, *Pogonomyrmex barbatus*. The red harvester ant is native to southwestern United States and the red imported fire ant is native to South America and is also known as the invasive species of this study (1). *S. Invicta* is native to South America. This species is considered an invasive species and was introduced to the United States in the 1900s. Because *S. invicta* does not have any natural predators, it has grown without many hinderance and has caused some economic and ecological concern (2). *S. invicta* is aggressive and reproduce at a high rate which also give allow it to spread so quickly (3). The genus *Pogonomyrmex* comprises a large group of harvesting ants in North America reaching regions of Mexico and the western US. These ants collect seeds for food or "harvest" the plants in their nesting areas by snipping seeds with their mandibles. Some harvester ants are extremely hostile and sting invaders while other ants are inoffensive. Harvester ants have the potential to damage range land where nests are numerous due to their seed harvesting characteristics. *Pogonomyrmex barbatus* is one of four outstanding harvester ant species in the US (4, 5). This research used GIS data to gather information on the environmental needs, climate and geographical boundaries of both of the species. This study also takes a look at niche modeling which is used in order to predict the potential current, and future environmental niches. More specifically, to be able to determine what are the environmental preferences of the two species. Due to the fact that *S. Invicta* is capable of living in conditions similar to *P. barbatus*, it is expected that *S. invicta*, the invasive species, will be able to withstand differing environmental niches.

Methods

Data was collected from the Global Biodiversity Information Facility (<https://www.gbif.org/>). The latitudes and longitudes for *Solenopsis invicta* and *Pogonomyrmex barbatus* were collected for biological records in order to superimpose the information to form distribution maps over the United States. A total of 3,473 data sets were utilized to ensure accurate distribution of the two ant species. 1,142 and 1,731 locations were recorded for *Pogonomyrmex barbatus* and *Solenopsis invicta* respectively. This collected data was used and logged into the software Maxent. Maxent software was downloaded from https://biodiversityinformatics.amnh.org/open_source/maxent/. Maxent transformed this data along with algorithms to compare locations of our species that have been found relative to the environments that are available in the study region. The environmental distribution and suitability were accounted for to form distribution maps of our species. DIVA-GIS software was downloaded from <https://www.diva-gis.org/>. DIVA-GIS was utilized in order to take the recorded distributions and transmit this information to regiment information on the biodiversity for both *Solenopsis invicta* and *Pogonomyrmex barbatus* (6). Using the DIVA-GIS software, the longitudes and latitudes coordinates for biological records were translated to a shapefile that were then superimposed over other open source data layers, creating a distribution map for both species. When using these softwares in conjunction, the environmental niches and geographic distributions were calculated and further analyzed to compare similarities and environmental needs of both *Solenopsis invicta* and *Pogonomyrmex barbatus*.

Results

The current distribution of the species are shown in the blue and purple regions from Mexico up into the southern and central United States. The future distribution is seen where the purple turns to red residing in the south eastern United States for *S. invicta*. *Solenopsis invicta* is projected to expand its range through the SE United States into Florida. The future distribution for *Pogonomyrmex barbatus* resides in southern Mexico stretching into south/central United States. The projection for *P. barbatus* overlaps with the current distribution for *S. Invicta*. We took this data and also used a geothermal map showing the temperature ranges in the continental united states shown in figure 5.

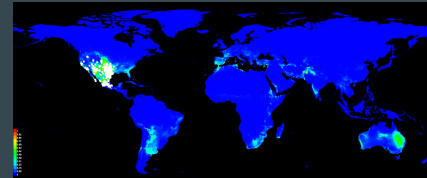


Fig 3. Favorable climate condition map of *P. barbatus*

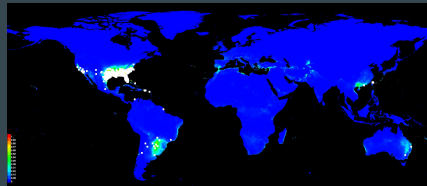


Fig 4 Favorable climate condition map of *S. invicta*

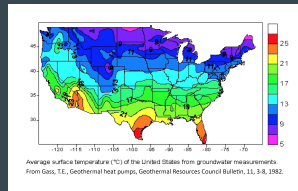


Fig. 5 Geothermal map of the United States (9).

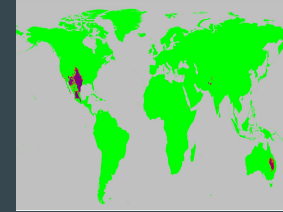


Fig. 6 Distribution map of *P. barbatus*

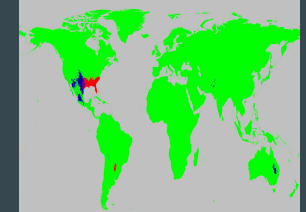


Fig. 7 Distribution map of *Solenopsis invicta*.

Discussion

We know that *Solenopsis invicta* organially were imported from the southern hemisphere where the area is dry and warm climates (7). Once the invicta was introduced into the southern United States, they quickly spread across from the eastern coast to the central United States as figure 7 shows. Looking at the environmental niche of barbatus, they are mainly found in areas with a lot of shrubs and arid location (8). Because the environment of barbatus and the natural environment invicta are similar, the introduction of invicta quickly spread and competed directly with barbatus. Based on figure 5, we know that the areas of composing of both invicta and barbatus usually live in 18-25 degrees celsius. Taking this present data and comparing it to expected future data, the invicta is expected to spread towards the east and barbatus is expected expand into the central and southern United States. Looking at figure 3, the geothermal map shows the warm favorable conditions. This supports the data from figure 6 when showing that they are expected to spread into central United States. This is also the case when observing figure 4 that shows the current latitudinal and longitudinal locations invicta and their favorable climate conditions being in the eastern United States. Taking this data into consideration, our hypothesis is not supported because invicta and barbatus are indeed expected to expand to different regions of the United States; East and West respectively.

Conclusion

Both *S. invicta* and *P. barbatus* are expected to expand their environmental niches in the future. *S. invicta* will expand further east and *P. barbatus* will expand toward in central United States. With warming climates, *S. invicta* is expected to continue grow at a rapid pace. Because both *S. invicta* and *P. barbatus* share similar environments, they are competing with each other and thus beginning to migrate away from each other.

References

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