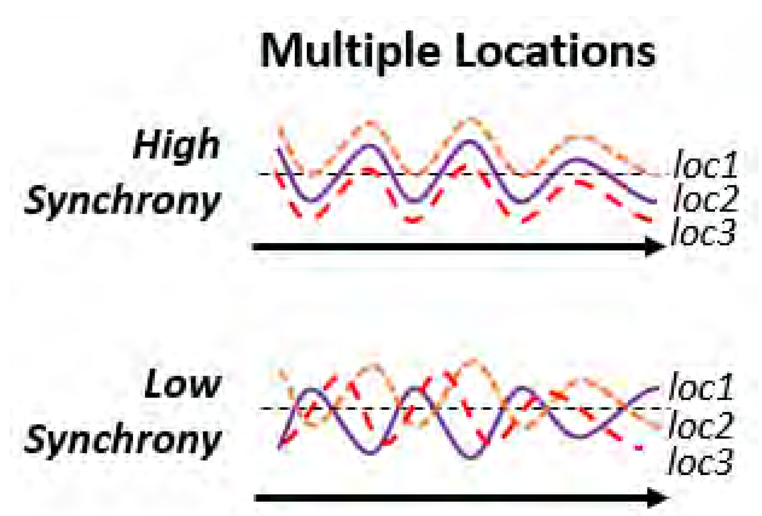
Spatial synchrony of ground beetle communities in Phoenix, AZ

Buchanan, J. D.[1] and McCluney, K. E.[1]

[1]Life Sciences Building, Bowling Green State University, Bowling Green, OH, 43403

Introduction



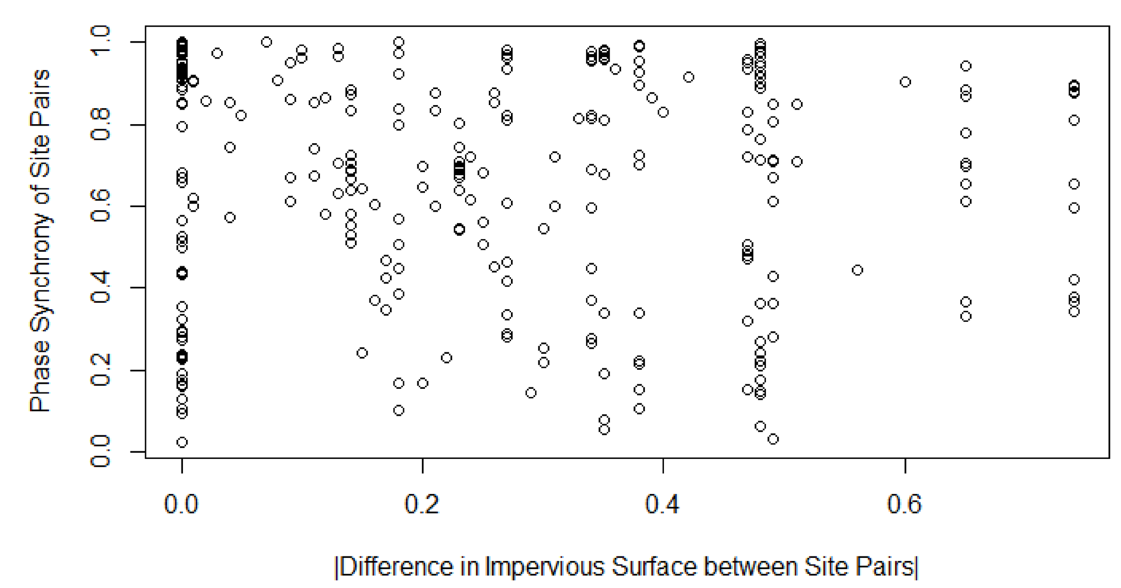
↑Fig. 1: Populations in separate locations may fluctuate through time in phase with one another; a phenomenon known as spatial synchrony.

- Synchrony is thought to be driven by correlated environmental variables (Moran effects), dispersal, and predator-prey interactions.
- Urban landscapes feature a myriad of microhabitats, allowing for geographically disjointed populations to exist under similar environmental conditions based on similar land management practices.
- Spatial synchrony can alter ecological stability at large scales and thus can have important management implications.
- Here we investigated potential drivers of spatial synchrony among ground beetles in Phoenix, AZ.

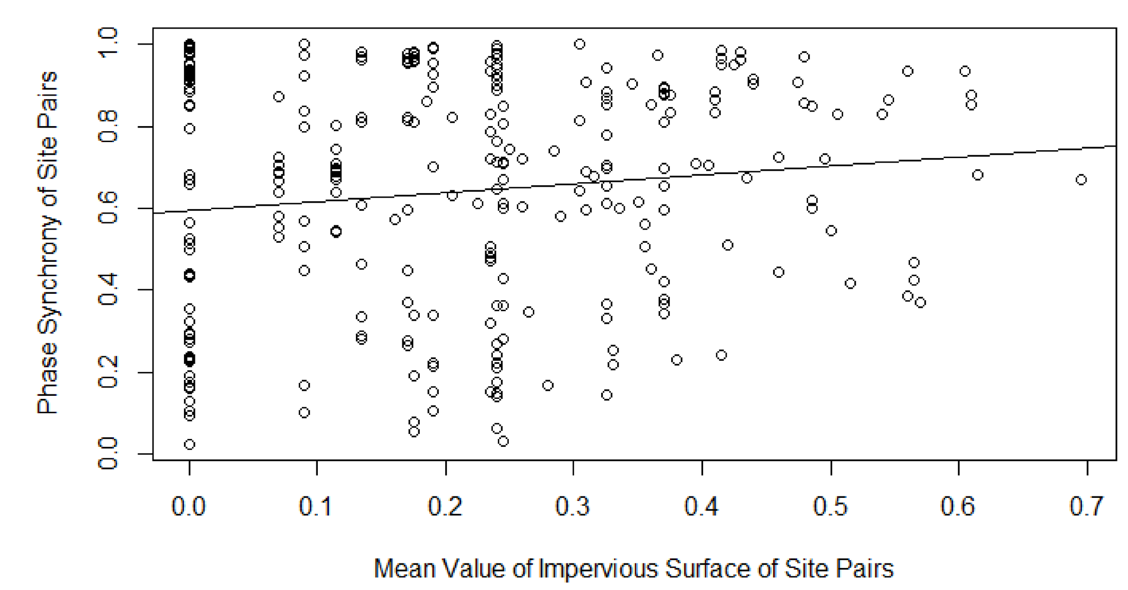
Methods

- We used the existing CAP LTER pitfall trap data to examine the spatial synchrony of ground beetles at 24 sites across Phoenix, AZ over nine years (2006-2014). Mean annual precipitation values from downscaled PRISM data were also included.
- Percent impervious surface in 2011, at 30m resolution, was obtained from the National Land Cover Database.
- The ncLISA function, a variant of the LISA.nc function from the ncf R package, was used to calculate time averaged phase synchrony between pairs of sites.
- Synchrony values were obtained for every two-pair combination of the 24 sites.

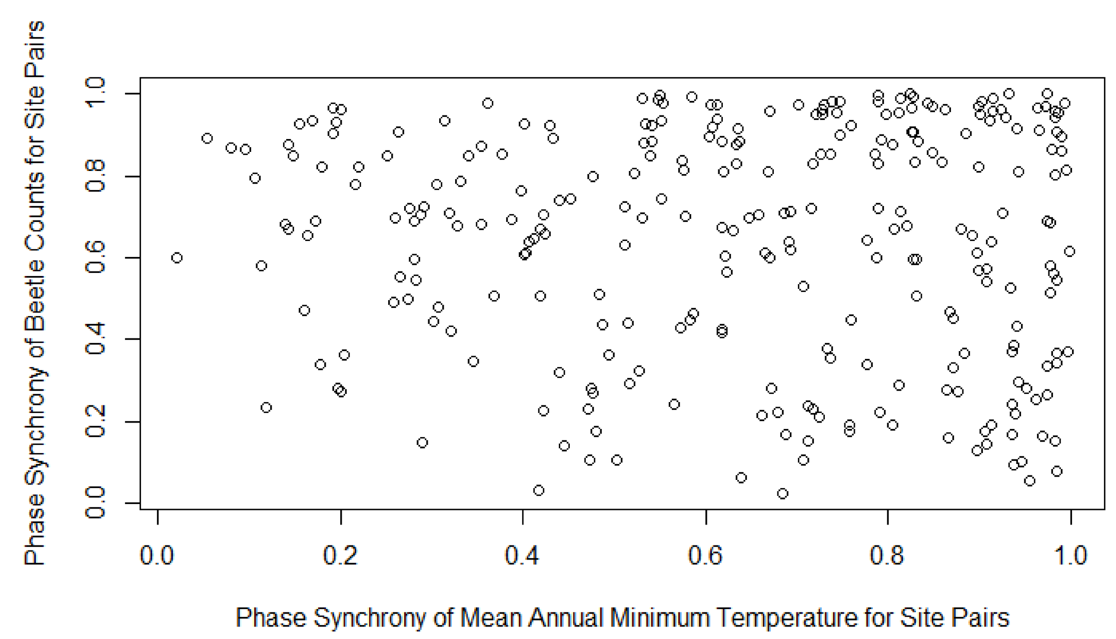
Preliminary Results



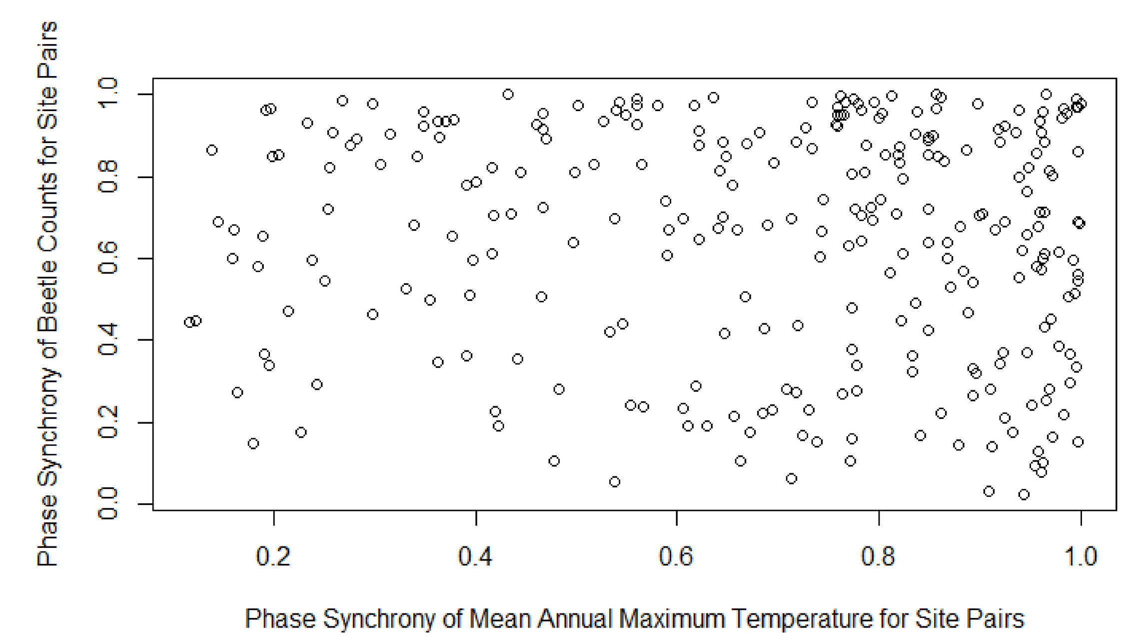
↑Fig. 2: Scatter plot of phase synchrony of beetle counts for pairs of sites vs. the absolute value of the difference in impervious surface between each site pair.



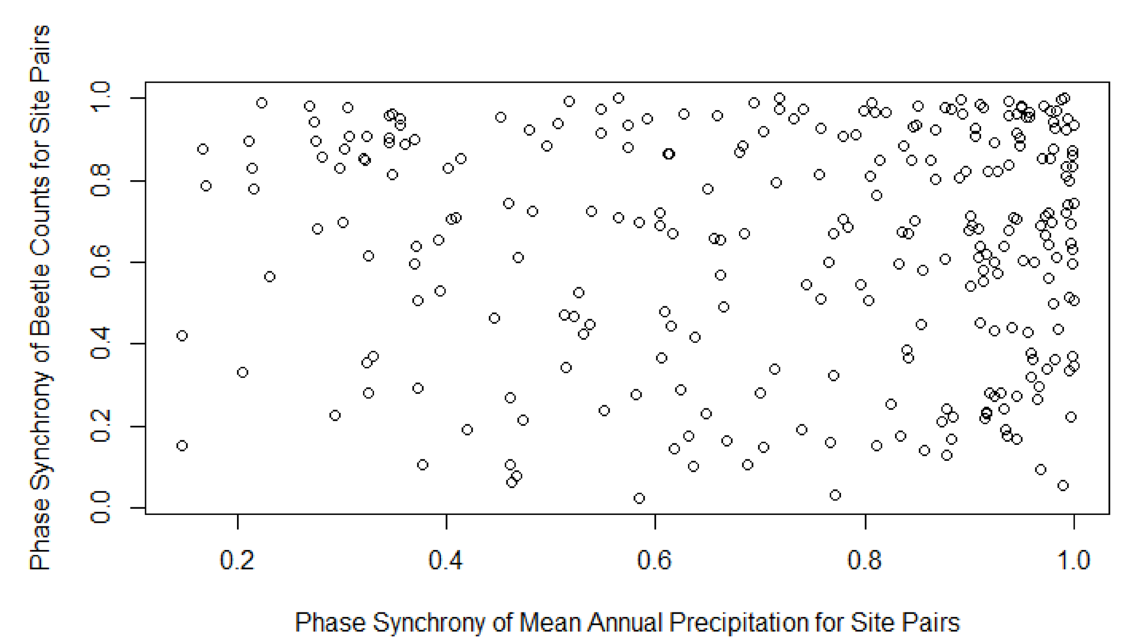
↑Fig. 3 : Scatter plot of phase synchrony of beetle counts for pairs of sites vs. the arithmetic mean of impervious surface between each site pair.



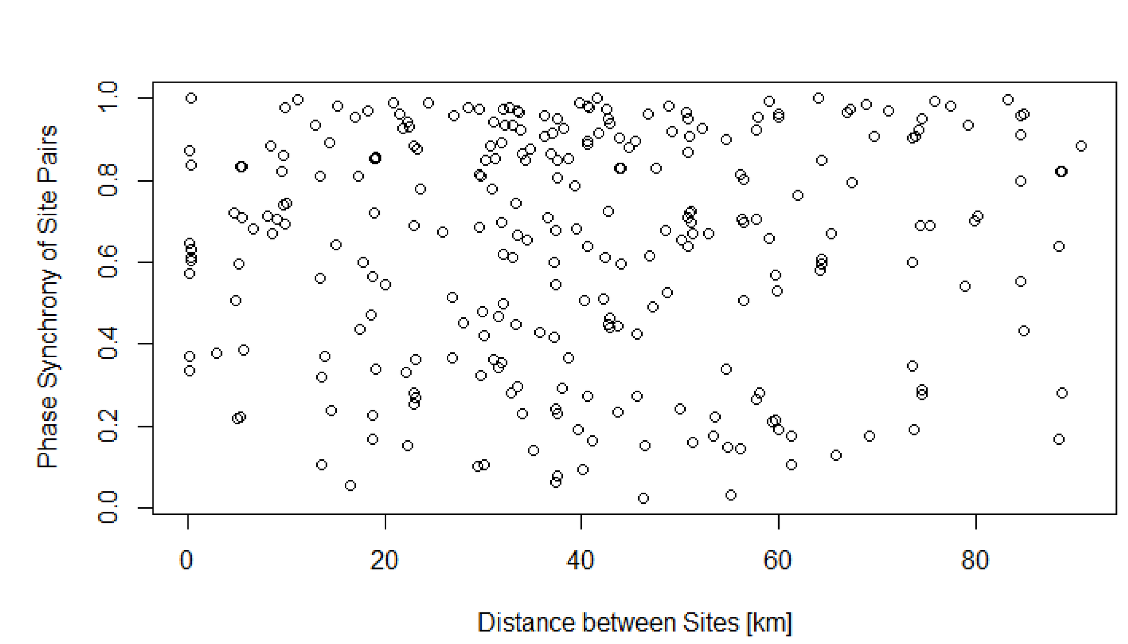
↑Fig. 4: Scatter plot of phase synchrony of beetle counts for pairs of sites vs. phase synchrony of mean annual minimum temperature for pairs of sites.



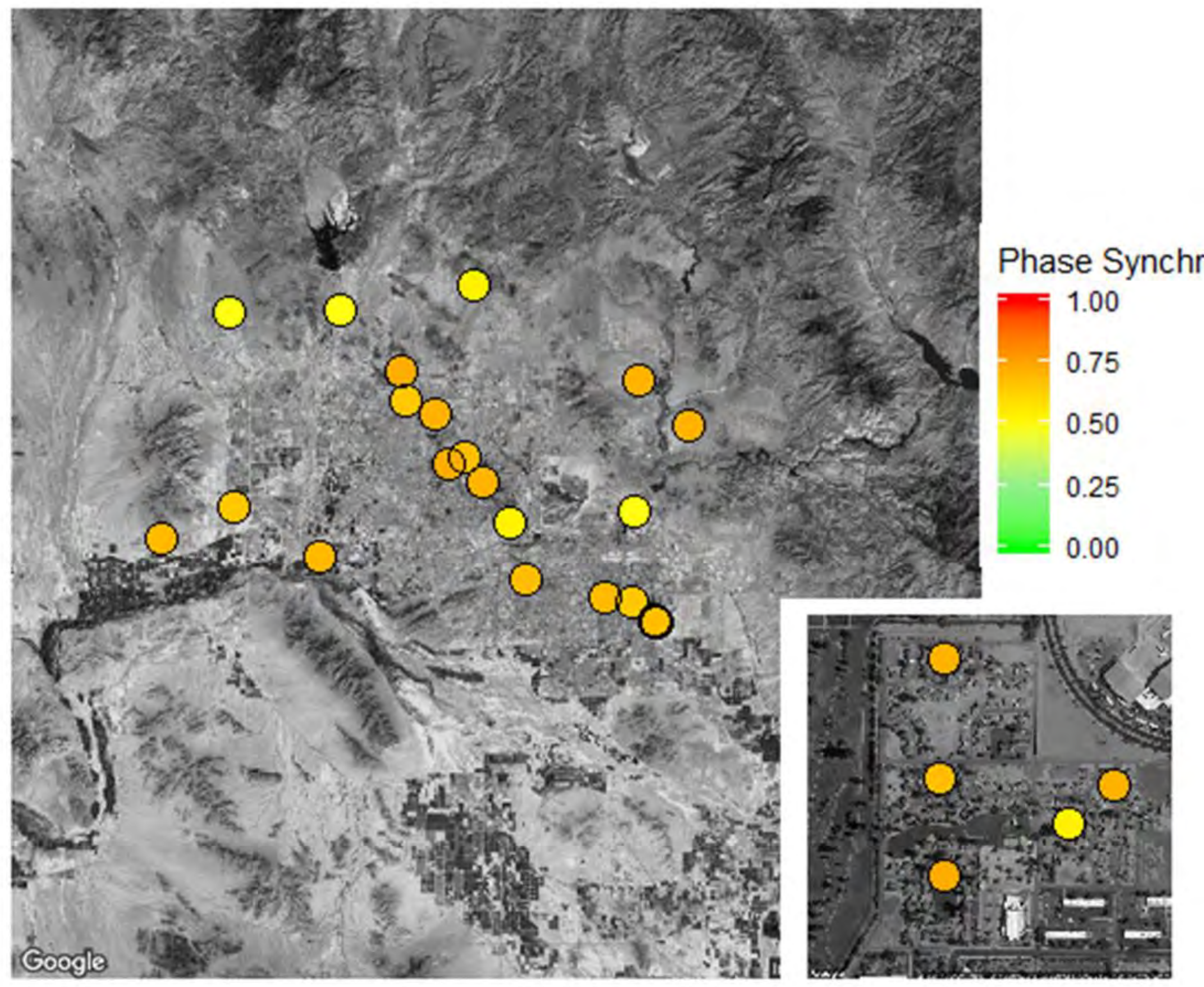
↑Fig. 5: Scatter plot of phase synchrony of beetle counts for pairs of sites vs. phase synchrony of mean annual maximum temperature for pairs of sites.



↑Fig. 6: Scatter plot of phase synchrony of beetle counts for pairs of sites vs. phase synchrony of mean annual precipitation for pairs of sites.



↑Fig. 7: Scatter plot of phase synchrony of beetle counts for pairs of sites vs. distance between sites in a pair.



↑Fig. 8: Average phase synchrony of beetle counts for each site in relation to all other sites. Values range from 0 (shown in green; no synchrony) to 1 (shown in red; perfect synchrony). Inset: A clearer view of a cluster of five sites.

Conclusions

- We found that pairs of sites with high percentages of impervious surface tend to have greater synchrony of beetle counts with one another.
- Other factors we investigated (distance, difference in impervious surface, synchrony of precipitation, synchrony of temperature) were not strongly related to synchrony of beetle counts.
- Most sites display some degree of beetle count synchrony with all other sites, even when widely separated in space. This may be due to the influence of widespread environmental forcing factors (i.e. Moran's effects).

Future Work

- Investigate other drivers of synchrony.
- Use existing taxonomic identification data to examine the synchrony of populations.