

Modeling Allopatric Speciation by Distance

How does distance between island populations impact the potential for speciation in Sykros lizards?

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Introduction

Isolation has been known to promote more rapid phenotypic evolution in island populations^[1]. Dr. Anna Runemark with Lund University has published several papers on the lizards of Skyros, Greece^[3,4,5]. This system of islands forms a mainland-island system and can be used to study the potential for allopatric speciation.

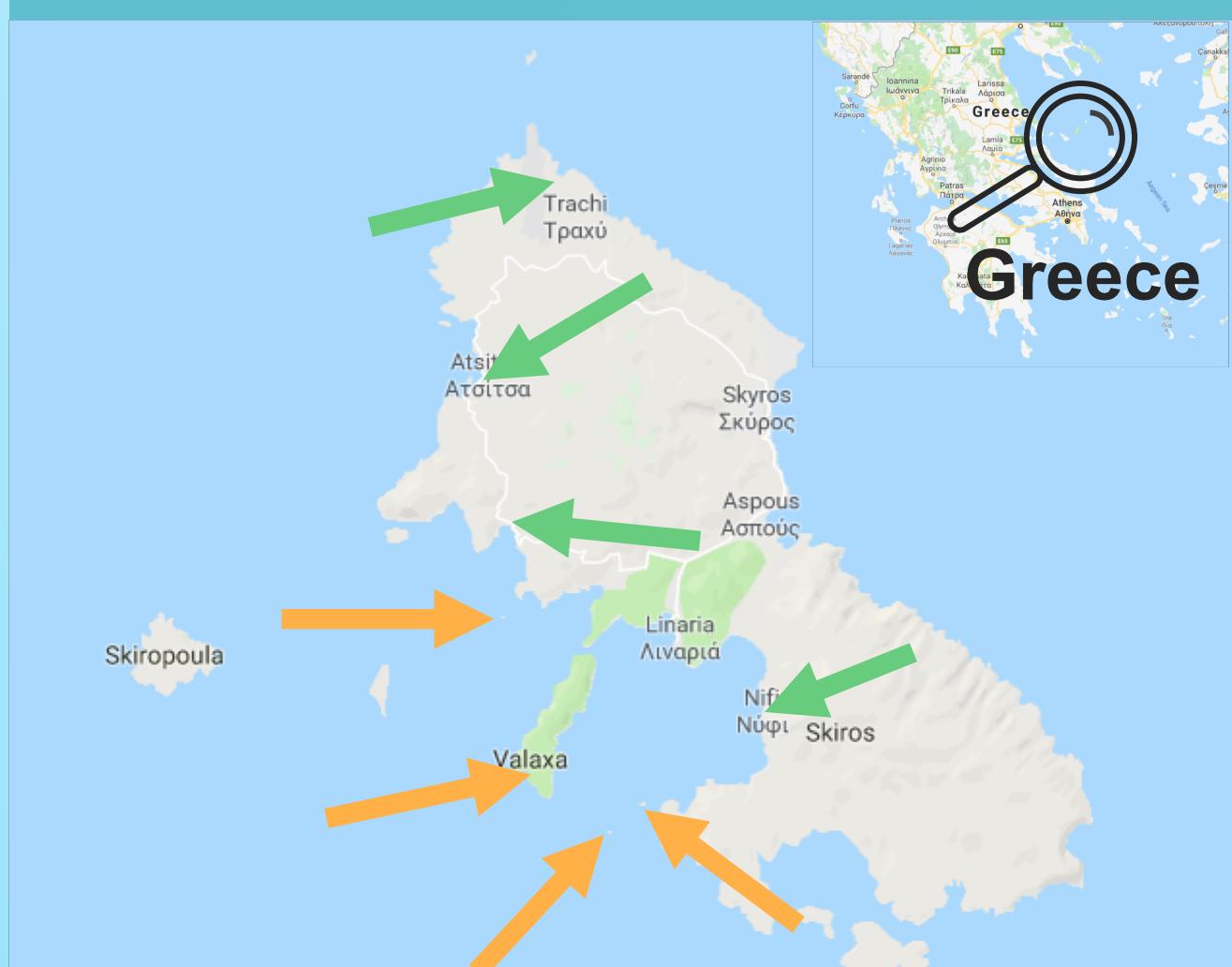


Figure 1: The island of Skyros with “mainland” and “island” sites.

Research Plan

- Expand on Runemark’s categorical data to infer a model using continuous distance.
- Estimate how sexual compatibility chances with population separation distance.
- Model the potential for speciation over time due to pre mating isolation.
- Compare to real system.



Figure 4: A Skyros lizard projectnoah.org

Results

Breeding success likelihood and female interest in male pheromones decrease as distance between populations increases.

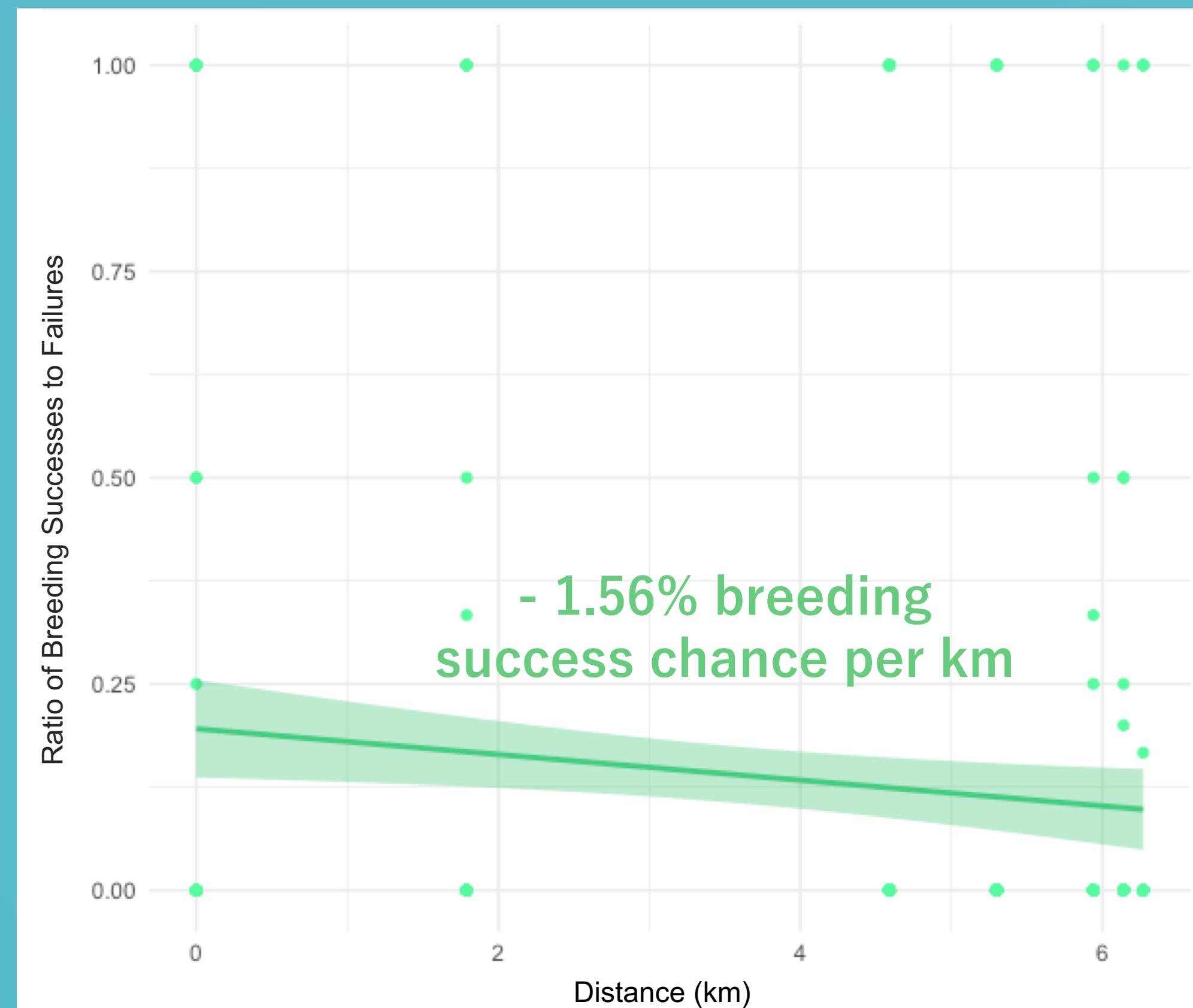


Figure 2: Breeding success likelihood of a pair decreases with distance between their origin sites ($p = 0.02151$). Shaded region represents 95% confidence intervals in linear model.

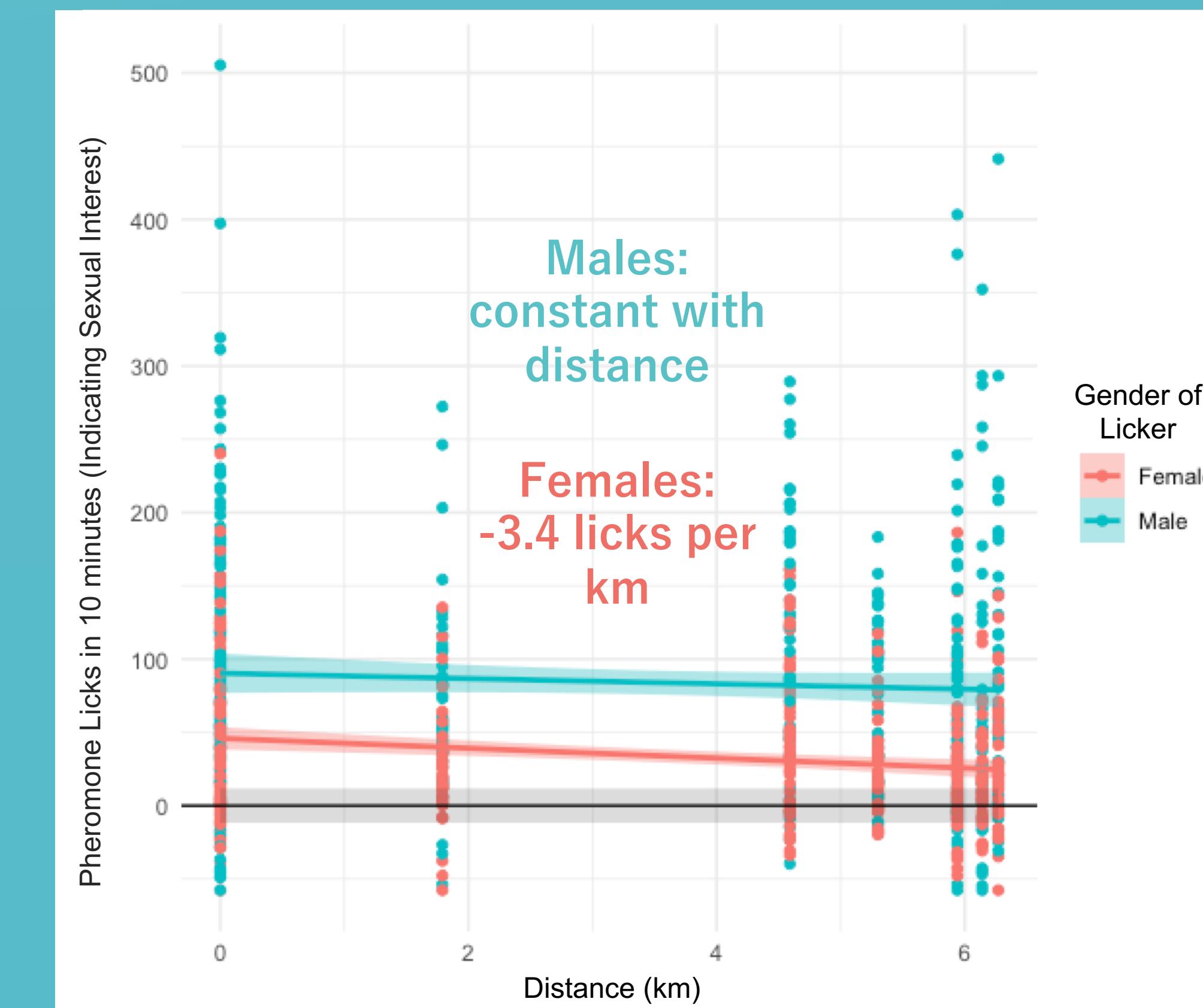


Figure 3: Sexual interest indicated by how often a pheromone sample was licked by a member of the opposite sex (Females: $p = 0.00011$). Values are corrected against an ungendered control (black line). Shaded regions represents 95% confidence intervals in linear model and in value ungendered control mean.

Methods

Lizards were collected from Skyros and surrounding islands and then subjected to breeding and pheromone recognition experiments^[3,4]: breeding successes and escapes were measured over an hour and pheromone licks over 10 minutes.

Runemark published their understanding of how island versus mainland status effected the potential for premating isolation. I instead used GPS collection site locations to calculate island distances and plotted a linear regression to determine how sexual isolation was effected by distance between islands. I also calculated the compatibility index by comparing the ratio of successful mating events to failed attempts.

Future Modeling

I will use the compatibility and pheromone regression information with a Monte Carlo simulation to model the potential for speciation.

I used NOAA Bathymetric Data Viewer to calculate current sea depth between islands I will use to calculate the divergence time between populations^[5]. This will be used to create a Gaussian probability distribution for migration between populations through time. The model will then be compared with χ^2 to the data from Runemark’s study.

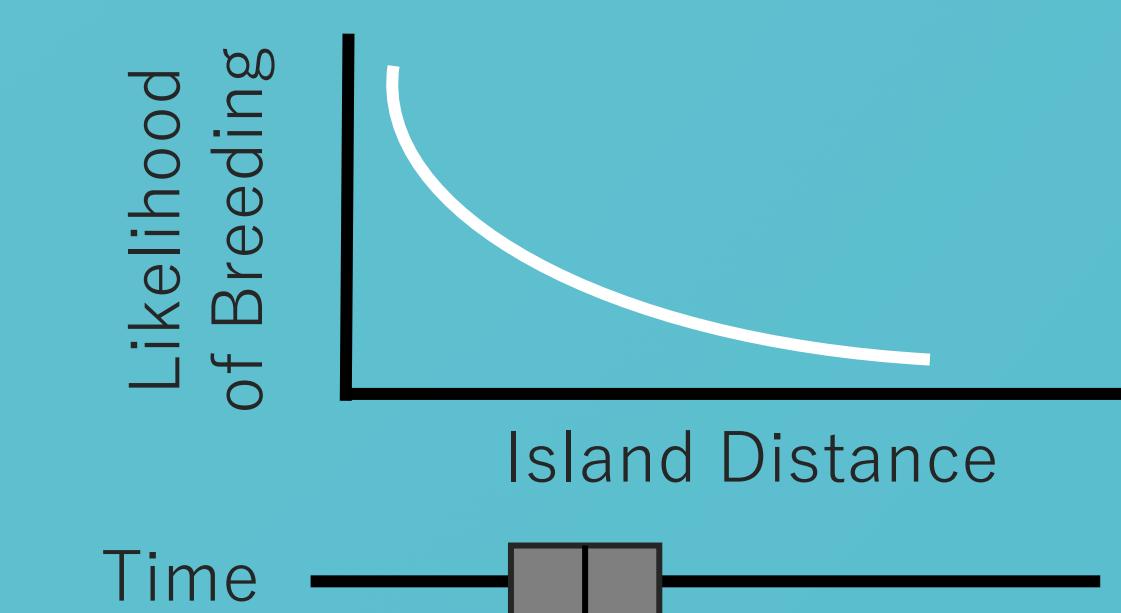


Figure 5: Example model.

References

- [1] Case TJ. A general explanation for insular body size trends in terrestrial vertebrates. *Ecology*. 1978;59:1–18.
- [2] Lambeck K. Sea-level change and shore-line evolution in Aegean Greece since Upper Palaeolithic time. *Antiquity*. 1996;70:588–611.
- [3] Runemark A, Gabirov M, Svensson EI. Population divergence in chemical signals and the potential for premating isolation between islet- and mainland populations of the Skyros wall lizard (*Podarcis gaigeae*). *J of Evo Bio*. 2011;24(4):795–809.
- [4] Runemark A, Hey J, Hansson B, Svensson EI. Vicariance divergence and gene flow along islet populations of an endemic lizard. *Molecular Ecology*. 2011;21(1): 117–129.
- [5] Runemark A, Svensson EI. Sexual selection as a promoter of population divergence in male phenotypic characters? A study on mainland and islet lizard populations. *Bio J of the Linnean Society*. 2012;106(2):374–389.