Phylogenetic Methods Final Project
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Invasion Stages Method

What types of biological problems can you address with this method?

1. Does a continuous species trait increase or decline over the course of an invasion?
   Specifically, this project asked: does plasticity increase or decline as the invasion ages.
   Approach: I examined whether new or old invaders had greater plasticity. If old invaders have greater plasticity, this suggests that the trait amplifies over the course of an invasion. On the other hand, if new invaders have greater plasticity, this suggest the trait declines over the course of an invasion.

2. Does an increased value of continuous species trait lead to a higher rate of invasion?
   Specifically, this project asked: does increased plasticity lead to a higher likelihood of invasion?
   Approach: I examined whether species likely to invade also had higher plasticity than species not likely to invade.

The method

1. Simulate a rate matrix based on what we know about the stages of invasion
   Four stages: native species not likely to invade, native species likely to invade, new invaders, old invaders
   Native species not likely to invade transition into native species likely to invade through the evolution of traits that increase their ability to invade. Both native species can transition into new invaders (although native species likely to invade transition at a much higher rate). New invaders can then transition to old invaders.
2. Use the rate matrix to simulate invasion stage data for tree tips.
3. Stochastically map invasion stage data unto the tree.
4. Use an Orstein-Uhlenbeck model to calculate the optimum plasticity value for each invasion stage. A OUM model was used as it allows for variation in theta (optimums) depending on discrete data.
5. Use the optimum plasticity values to answer the biological questions.

Method testing

I tested this method by generating data sets using my hypotheses: 1) individuals with higher plasticity have a higher likelihood of invasion; 2) old invaders will have decreased plasticity than new invaders. The degree of variation of plasticity of the different invasion stages ranged from low to high in order to investigate the sensitivity of my method.

I also generated plasticity data randomly using the tree, in order to compare random data with data generated to match the hypothesis.

I also tested the method using different sized taxonomic trees (n=25, n=50, n=100).

Results of testing

The results indicate that the method has greater power to detect patterns in plasticity based on invasion stage in larger trees. Power decreases as the difference in plasticity thetas decreases. Overall, there is a lot of spread in the results, which would be improved as more and more data sets are tested.