Modeling Neural Circuitry to Understand Incipient Speciation in Chorus Frogs

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Introduction

- Species interactions propel biodiversity and can shape evolutionary trajectories among populations
- Species interactions can promote speciation when unfit hybridization results in the selection of traits that promote divergence of mating behavior to prevent hybridization
- Divergence of mating behaviors leads to reproductive isolation among populations of the same species
- The current study probes at the genetic drivers of reproductive isolation in the upland chorus frog (Pseudacris feriarum) through analyzing the variation in female preference for male mating calls
- The variation in male acoustic signaling is primarily observed in P. feriarum sympatric populations, which have diverged due to interactions with other species (e.g. P. nigrita). The male acoustic signal varies little in allopatry, although the upland chorus frog (P. feriarum) through analyzing the variation in female preference for male mating calls

Neural Circuit

- Previous work in neurophysiology (Naud et al. 2015; Aluri et al. 2016) has identified a neural mechanism by which female frogs can distinguish among male calls differing in the number and rate of pulses within the calls
- The neural computational model describing this mechanism incorporates the activities of neurotransmitter receptors, which determine the magnitude and duration of effect that each neuron has on the downstream
- Neurotransmitter receptor activities are controlled by the expression level and structure of proteins that make up the neurotransmitter receptor
- By comparing (among populations) the neural model parameters that best fit the behavioral data, we hope to identify the genes that have evolved as the female preferences have diversified across populations

Behavioral Data

- In a previous study (Lemmon 2009), male calls were recorded across the geographic range of the species. In addition, the preferences of females for different call types were assessed using binary choice experiments

Results

- The neural circuitry model was fit to the behavioral data, allowing us to identify whether pairs of populations have significantly different preference functions. For each population parameter estimates were optimized such that the likelihood of the preference data was maximized. Here we show the relative preference of females for male calls assuming the optimized model. The color represents the number of times the ICN neuron fires in a given call stimulus with a certain pulse rate and pulse number combination