

The proximate basis of evolutionary divergence in paternal care in sticklebacks

Alison M. Bell

Department of Evolution, Ecology and Behavior
University of Illinois Urbana

There is tremendous diversity in family life among animals, but little is known about how differences in family life arise over the course of evolution, and which mechanisms are most labile and hence likely to change during the early stages of divergence. Presumably, behavioral divergence requires coordinated changes at multiple levels of biological organization including at the genetic, molecular, neural, and endocrine levels, but how and when those changes arise and are integrated together is an outstanding question. In this talk I will present insights that my lab is starting to get into the proximate basis of evolutionary divergence in family life in three-spine stickleback fish. Typically, male sticklebacks exhibit sole paternal care which is necessary for offspring survival. However, an unusual stickleback ecotype has recently evolutionarily lost paternal care and exhibits a suite of traits associated with this divergent reproductive strategy. Quantitative trait locus mapping revealed that the white strategy evolved through at least nine different genetic changes distributed across the entire genome, each affecting distinct behavior modules. At the neural level, there were differences in the activity – but not the number – of oxytocin neurons in the preoptic area of the hypothalamus. Specifically, in the ancestral caregiving ecotype, oxytocin neurons were activated at the initiation of care behavior, suggesting that these neurons promote the transition into fatherhood. In the white ecotype, activation of these neurons did not change across stages. This suggests that a loss of activation of oxytocin neurons may have contributed to the loss of care. Finally, we observed higher hypothalamic-pituitary-gonadal activity (HPG) in the white ecotype, with evolutionary changes at multiple points along the HPG axis. Altogether these results provide insights into how mechanisms evolve to support distinct behavioral strategies.