Camp Evolution 2016 – February 21-25
Summaries of Lectures & Readings
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7) Gender strategies, sex ratios and sex chromosome evolution

Despite a strong theoretical basis, there is currently little known about the mechanisms governing sex-ratio variation in plants. In this lecture I consider the relationships between sex ratios and gender strategies in flowering plants and some of the mechanisms governing sex ratio bias. I begin by presenting the results of a large-scale comparative analysis of the ecological and genetic correlates of sex-ratio variation in dioecious angiosperms. Using comparative analyses of 243 species, representing 123 genera and 61 families, it was found that male-biased sex ratios were twice as common as female-biased ratios, and were associated with long-lived growth forms, biotic seed dispersal and fleshy fruits. Female bias was associated with abiotic pollen dispersal and sex chromosomes. I then discuss studies on the mechanisms governing female-biased sex ratios in *Rumex*, a genus of wind-pollinated herbs with XX (female) and XY and XYY (male) sex determination systems. Females located in close proximity to males produced more strongly female biased sex ratios compared to more isolated females. These results suggest that male proximity may influence progeny sex ratios by affecting pollen loads and the strength of gametophytic competition through differential pollen-tube growth of female- vs male-determining pollen tubes. It has been suggested that female biased sex ratios in *Rumex* may be a consequence of Y-chromosome degeneration. To examine evidence for Y-chromosome degeneration in *Rumex* we used recently established methods to identify sex-linked genes using segregation analysis and transcriptome sequencing, and found that both ancestral and neo-Y chromosomes in *R. hastatulus* show evidence of degeneration with ~28% and ~8% hemizygosity of ancestral and derived X chromosomes, respectively. Genes remaining on the Y chromosomes accumulated more amino acid replacements, contained more un-preferred changes in codon use, and exhibited significantly reduced gene expression compared with their X-linked alleles. Evidence for genetic degeneration is consistent with theoretical predictions of reduced Y-linked selection efficacy caused by recombination suppression. Our results indicate that the magnitude of genetic degeneration depends on the time since X-Y recombination became suppressed. We also found that Y-chromosome diversity was 40-fold lower than on the X chromosome, and nearly 50-fold lower than on autosomes, indicating that selective interference caused by the lack of recombination has likely played a significant role in reducing nucleotide polymorphism during the early stages of X-Y divergence. A future challenge will be to link the findings on Y-chromosome degeneration in *Rumex* to the proposed mechanism governing sex ratio bias by differential pollen tube growth. This proposed mechanism may not be specific to *Rumex* as our comparative survey of sex ratios in flowering plants revealed that female-biased sex ratio are associated with heteromorphic (XX/XY systems) sex chromosomes.

Field, D.L., Pickup, M. & Barrett S.C.H. (2013) Comparative analysis of sex-ratio variation in dioecious flowering plants. *Evolution* 67: 661-672.

Hough, J., Hollister J.D., Wang, W., Barrett, S.C.H., Wright, S.I. (2014). Genetic degeneration of old and young Y chromosomes in the flowering plant *Rumex hastatulus*. *Proceeding of the National Academy of Sciences, USA* 111: 7713-7718.

Stehlik, I., Friedman, J., & Barrett S.C.H. (2008). Environmental influence on primary sex ratio in a dioecious plant. *Proceedings of the National Academy of Sciences USA* 105: 10852-10857.