<u>The evolution of Fitness Associated Outcrossing</u>

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The evolution of outcrossing is an intriguing question, since the short term cost of outcrossing has an intrinsic two-fold cost compared to self fertilization (selfing) - i.e., an allele for selfing contributes to the reproduction of alleles identical by descent, specifically itself. There are also the costs of finding a compatible mate, or investing in dispersing the gametes. The short term cost of selfing is mainly due to inbreeding depression – the reduction in fitness due to homozygotization of deleterious alleles. Selfing also has a long term cost, compared to outcrossing, of reducing the variance of the population in the long-term, thus making it less able to adapt to changing environments. Many organisms (yeasts, some worms, most plants) have a mixed mating system allowing for both outcrossing and selfing. This indicates the possibility for individual regulation of outcrossing according to the conditions experienced by the individual. This research explores the possibility that facultative outcrossing that is more likely to occur in less fit individuals, or Fitness Associated Outcrossing (FAO), can evolve and be maintained as a mixed mating system.

The intuitive idea is that costs and benefits of outcrossing depend on the state of the individual. High fitness suggests that the individual carries a low number of deleterious mutations. Such individual has little to earn from outcrossing (as inbreeding depression would be low) and much to lose (by mixing its DNA with a different individual that might have more deleterious mutations, together with the inherent cost). In contrast, an individual with low fitness, or one carrying many deleterious mutations, has more to earn from outcrossing – its outcrossed progeny are likely to be much fitter than selfed ones.

Using a deterministic multi-locus model, we show that FAO can evolve and be maintained: First, an allele for FAO can invade a uniformly distributed outcrossing population. Second, an allele for FAO can be fixed in a selfing population, even when an allele for uniformly distributed outcrossing cannot. FAO can thus help explain the evolution of outcrossing. Last, FAO has benefits at the long term. We show that the mean fitness of a FAO population can be higher than in either a uniformly outcrossing population or a selfing population. We also show that mean hetrozygosity tends to increase under FAO, suggesting an improved ability to adapt to changing environments.