New England Botanical Club – Minutes of the 1029th Meeting

5 October 2007

Karen Searcy, Recording Secretary *pro tempore*

The 802nd meeting of the New England Botanical Club, being the 1029th since its original organization, was held on Friday, October 5, 2007, in the lecture hall of the Fairchild Biochemistry Building at Harvard University, Divinity Avenue, Cambridge, MA. There were 33 members and guests in attendance.

Dr. Elena Kramer from the Department of Organismic and Evolutionary Biology, Harvard University, presented some of the research from her lab, which is involved in understanding the evolution of floral morphology using molecular, morphological, and phylogenetic approaches. Her talk "Where Do New Floral Parts Come From?" focused on the origin of novel floral organs beyond the typical four. Specifically, her research has been on the evolution of staminodia, however, she also touched on the evolution of petal identity and addressed the question of how petaloid sepals and petals (second whorl petals) are genetically distinguished.

Kramer's research uses a model system that was developed in her lab using *Aquilegia* and other members of the Ranunculaceae. For questions of the sort Kramer is interested in, members of the Ranunculaceae are a good choice because the genera have a great deal of natural variation in floral parts, some members have been subject to recent adaptive radiation – particularly *Aquilegia* where many species are interfertile – and the family represents a phylogenetic midpoint between *Arabidopsis* and rice.

Floral organ identity is largely determined by the interaction of three classes of genes (termed the ABC Program). In this system, the A gene alone determines sepal identity, the A and B genes determine petal identity, the B and C genes determine stamen identity, and C determines carpel identity. Since the ABC Program is widely conserved in the angiosperms, Kramer was able ask if the ancestral ABC program has been modified in *Aquilegia* and the Ranunculaceae to produce staminodia and other variations in perianth morphology seen in the family. Her hypothesis is that a gene duplication event in the ABC Program facilitated the evolution of new floral organs, particularly the staminodia. In gene duplication, copies can assume a different function (neofunctionalization), or if the original gene had multiple functions, those functions can be parsed out among the copies (subfunctionalization).

By using gene function studies in which the genes in question were silenced in the developing floral primordia, Kramer's group was able to show that staminodia, the fifth floral organ in *Aquilegia*, arose through gene duplication in the ABC program, specifically in the petal and stamen identity gene (APETALA3), which has three distinct copies in the Ranunculales. One copy is primarily expressed in the petals, another in the stamens, and a third in the staminodia. Although gene duplication explained the origin of a fifth floral organ, data also indicated that these genes did not control the development of the brightly colored petaloid sepals in *Aquilegia.* Kramer suggested that *Aquilegia* has a distinct genetic mechanism for controlling petaloidy in the first and second whorls of the flower that might, in part, be related to differences in developmental kinetics.

Finally, Kramer shared some more broadly directed studies on whether petals in the Ranunculaceae have a different identity program, which she said would be expected if they were independently derived. Comparative gene expression techniques showed, unexpectedly, that the same genetic identity program functioned across the Ranunculaceae and in the sister family Berberidaceae. This suggested that petals of the Ranunculaceae are derived from a commonly inherited but differentially expressed genetic program.