PLANT POLLINATION SYSTEMS: EVOLUTIONARY TRENDS IN GENERALIZATION AND SPECIALIZATION

Perhaps one of the most intriguing varieties of mutualism is the relationship between angiosperms and their pollinators. The evolutionary forces at work in these systems continue to both intrigue and perplex botanists and evolutionary biologists. In a relatively recent paper, Johnson & Steiner (2000) explore the common theories, misconceptions, and research methodologies that are used in the study of plant-pollinator relationships. They challenge some long held ideas about the nature of specialization and generalization of floral complexes, and suggest that the cause of these trends may be more complex than current thinking predicates. In addition, they explore the implications of ecosystem alterations and the threat of extinction on the more specialized mutualists.

Theoretically, specialization and generalization of plants to pollinators offers some mutually exclusive advantages. These advantages stem form the observation of Stebbin that specialization is best when the most effective pollinator's availability is reliable, whereas generalization should be favored when pollinator availability is irregular. From this theoretical framework many hypotheses have been forwarded and tested concerning these systems. In their review Johnson & Steiner reconsider some of the theories. For example, plants which cover a large range should favor specialization for particularly specific insects who are themselves specialized to the plants – because excess pollen for a variety of other plant species might "clog-up" their reproductive bits. In addition to this observation, Johnson & Steiner explore a host of other ideas about these systems, such as: the impact of plant life-histories, colonization practices, and breeding systems on the tendency to generalize or specialize.

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From this theoretical base the authors then explore and intriguing cause of convergence present in the plant world – which they refer to as pollination syndromes. These syndromes, it is argued, are driven by similar needs for similar pollinator types. For example, large pollinators – such as butterflies – may prefer larger flowers with specific colors, whereas smaller pollinators may favor smaller flowers with alternative colorings. One well studied instance of this type of favoring has been documented in the *Mumulus* (monkeyflower). It is thought that the preferential dispositions of these animals drives convergence in unrelated genera of plants. Therefore, the penchant of evening or night pollination by moths, would drive plants to have syndromes that make pollination more easy for these pollinators. The authors question, however, the simplistic causal relationship within theses systems. They argue that some theoretical evidence denies, for example, some common notions about these systems: such as, the importance of flower coloring as a mode of specialization. This is important from an evolutionary biologists standpoint because often these syndromes are seen as an isolating mechanism in sympatry. However, since the casual relationship is often unclear, the authors argue prudence when exploring speciation events based on these traits. Furthermore, they argue that geographic trends might also play a large role in the specialization or generalization of plants. Since ecosystems are notably different in northern and southern climates, they authors argue that other abiotic factors maybe driving the trends of specialization and generalization.

Finally, then, the authors explore the implications of the budding quantity of evidence on efforts for conservation. They observe that the lifespan of plants versus pollinators, may give false impressions about the intrinsic link between pollinators and their plants; since some plants may survive long after their specific pollinator is gone, we may witness a delayed extinction in these species. It seems that as the study of these amazing systems grows, so will are our understanding

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of evolutionary convergence and speciation, and our best means of species protection and management.

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Johnson, S.D. and K.E. Steiner (2000) "Generalization versus specialization in plant pollination systems" *Trends in Ecology and Evolutionary Biology* 15:140-143.

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