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Annotated Bibliography for Plant-Animal interactions class:  
Geitonogamy and Pollen Carryover

Barrett, S.C.H. and L.D. Harder. 1996. Ecology and evolution of plant mating. *Trends in Ecology and Evolution* 11: 73-79.

- Broad, non-experimental paper dealing with many aspects of plant mating including: evolution of self fertilization (Fisher's argument), # species that self vs. outcross, inbreeding depression related to breeding system and life style, field measurements of inbreeding depression, modes of self-pollination, pollen carryover, geitonogamy and outcrossed siring success.

Craig, J. L. (1989). Seed set in *Phormium*: Interactive effects of pollinator behavior, pollen carryover and pollen source. *Oecologia* 81(1): 1-5.

- Tui (honeyeater) preferentially visited male flowers and moved pollen within inflorescences in the same plants which exhibit moderate levels of abortion of selfed seeds. Knowledge of low pollen carryover (assessed using florescent dyes) along with observed bird movements allowed accurate predictions of fruit set and seed size.

Eckert CG. 1998. Contributions of autogamy & geitonogamy to self-fertilization in a mass-flowering clonal plant, *Decodon verticillatus* (Lythraceae). *Ecology*, 81(2), pp 532-542.

- Estimated components of self-fertilization using marker-gene analysis on emasculated flowers of this self-compatible, tristylous plant. Concluded geitonogamy responsible for 82 ( $\pm 17\%$ ) of selfing, distributed almost equally between: within branches, between branches, and between ramets.

Galen, C. and R. C. Plowright (1985). The effects of nectar level and flower development on pollen carryover in inflorescences of fireweed (*Epilobium angustifolium*) (Onagraceae). *Canadian Journal Of Botany* 63(3): 488-491.

- Experimentally manipulated nectar volume to young and old flowers visited by bumblebee pollinators. Bees visited more flowers, stayed

longer, and flew shorter distances when nectar contents were higher. Older flowers with enriched nectar contents received greatest amounts of pollen, which is likely to increase self-matings.

Harder, L.D. and S.C.H. Barrett. 1995. Mating cost of large floral displays in hermaphrodite plants. *Nature* 373: 512-515.

- Found increased levels of selfing (assumed to be from geitonogamy) with increased floral display size and increased position on an infl.

Jong, T.J. de, N.M. Waser & Klinkhamer, P.G.L. (1993). Geitonogamy: the neglected side of selfing. *Trends in Ecology and Evolution* 8(9): 321-325.

- Review article looking at various studies of geitonogamy. Discuss how to calculate based on different methods: estimates from pollen dispersal, genetic markers, and models of pollen transfer. Discuss evo-eco implications and examine direct consequences of geitonogamy on fitness.

Johnson S. D. & Nilsson L. A. 1999. Pollen carryover, geitonogamy, and the evolution of deceptive pollination systems in orchids. *Ecology* 80: 2607-2619.

- Hypothesis: absence of floral rewards in many orchids reduces geitonogamy. By experimentally adding nectar to non-nectar producing individuals they increased levels of visitation, but geitonogamy as well. Expected levels of geitonogamy were less than expected due to pollinaria bending and substantial pollen carryover.

KARRON, J. D., R. Tucker, N. N. Thumser and J. A. Reinartz. 1995. Comparison of pollinator flight movements and gene dispersal patterns in *Mimulus ringens*. *Heredity* 75: 612-617.

- 16 plants, each with a unique multiloci homozygous genotype, were planted in replicate arrays and pollinator flight distances were recorded and compared to the dispersal of genes. Mean gene dispersal distance was ~1.5 x as far as the mean pollinator flight distance which was thought to be due to pollen carryover. Neighborhood sizes were still comparatively low: 1.6-5.5, implicating high levels of random genetic differentiation.

Morris, W. F., M. V. Price, N. M. Waser, J. D. Thomson, B. Thomson, and D. A. Stratton. 1994. Systematic increase in pollen carryover and its consequences for geitonogamy in plant populations. *Oikos* 71:431-440.

- Review article that looks at 12 diff. data sets (6 plant species) pollinated by hummingbirds and bees, and uses maximum likelihood to test between constant and the newly introduced “changing carryover” models. Changing carryover model fit 75% of data sets examined better than constant model. Evidence pointed to burial of donor pollen underneath new pollen.

Nilsson L. A., Rabakonandrianina E. & Pettersson B. 1992. Exact tracking of pollen transfer and mating in plants. *Nature* 360: 666-667.

- New technique for mapping pollen flow introduced: “microtags” -cut from Kodak microfilm containing unique number/letter combinations. Pollen transfer between Orchids (*Aerangis*) was found to be infrequent, involve single pollen parents, and to occur within 5m.

Price, M.V. and N.M. Waser. 1982. Experimental studies of pollen carryover: hummingbirds and *Ipomopsis aggregata*. *Oecologia* 54:353-358.

- Using florescent dyes, measured effects of different aspects of floral structure on pollen carryover. Decline of carryover along the visitation sequence of plants was linear, and directly affected by the presence of pollen bearing anthers, but not by degree of stigma clogging.

Reusch 2000. Fitness-consequences of geitonogamous selfing in a clonal marine angiosperm (*Zostera marina*). *Journal of Evolutionary Biology*, 14, 129-138.

- Presents data on effects of patch isolation and clonal diversity on outcrossing rates of eelgrass from two locations in the Western Baltic Sea. Found positive correlation between genet diversity and proportion of outcrossed offspring yet relative fitness of selfed progeny was low, indicating that selfing rates may not be in evolutionary equilibrium because of spatial and temporal heterogeneity of clonal size and diversity.

Robertson, A.W. (1992). The relationship between floral display size, pollen carryover and geitonogamy in *Myosotis colensoi* (Kirk) Macbride (Boraginaceae). *Biological Journal of the Linnean Society* 46: 333-349.

- Uses experiments and literature review to assess extent of pollen carryover (deemed extensive in many systems) which reduces effects of geitonogamous pollinator movements. Selection for traits conferring added pollen carryover is discussed.

Thomson, J. D., and R. C. Plowright. 1980. Pollen carryover, nectar rewards, and pollinator behavior with special reference to *Diervilla lonicera*. *Oecologia* 46:68-74.

- Measured pollen carryover using three species of bumblebee pollinated plants with experimentally manipulated nectar volumes. In untreated flowers, pollen carryover was most extensive within the first few flowers visited after a target plant, but some pollen was observed on stigmas up to 54 flowers later in a sequence! Also bees deposited significantly more pollen in flowers with large volumes of nectar than in flowers with depleted nectar, implications of which include increased levels of geitonogamy.

Waddington K. D. 1981. Factors influencing pollen flow in bumble-bee pollinated *Delphinium virescens*. *Oikos* 37: 153-159.

- Pollen flow by bumblebees was assessed for *Delphinium* by observing pollinator movements on experimentally altered flowers. Pollen carryover was assessed using dead *Bombus* bees. Strategies for reducing geitonogamy such as lower quantities of nectar in flowers farther up an inflorescence are discussed.