Maintenance of outbred seraya seed production by selectively excluding inbred seeds in natural hill dipterocarp forests

Maintaining forest regeneration is essential for sustainable forest management when timber and other forest materials are extracted. Nearly all unprotected forests in the humid and sub-humid tropical regions should be regarded as disturbed rather than truly primary forests because timber has been selectively logged from them. It has been widely believed that forests have sufficient resilience to recover from selective logging, and selective logging regimes have been widely applied in management programs for tropical forests. However, selective logging may threaten the pollination and sexual reproduction systems of tropical tree species, and hence ultimately the regeneration of healthy cohorts of seeds, seedlings, and saplings of timber trees required for sustainable forest management. Consequently, outcrossing restrictions can markedly increase the proportions of unhealthy offspring through inbreeding depression. Generally, pollination and subsequent outcross mating are susceptible to reductions in population density for tropical tree species, which depend on weak flyer insects for pollination. In particular, tree species of the family Dipterocarpaceae are widely distributed and dominant in Southeast Asian tropical rain forests.

The pollination of tree species belonging to section *Mutica* of genus *Shorea* (Dipterocarpaceae), including our study species, *Shorea curtisii* (seraya in local language), depends mainly on weak flyer insects such as thrips. This in turn leads to lower mature seed production and decreased outcross mating, which have been reported to be associated with low population density. It has also been unveiled how tropical forest species maintain outcrossing at a high level. Outcross mating is maintained not only by the relative amount of self vs. outcross-pollen landing on the stigma but also by some biological processes, such as partial self-incompatibility and inbreeding depression, which can reduce the amount of self-mating. Therefore, we revised our modeling of pollen dispersal and male fecundity (See Tani et al. 2011 in JIRCAS Research Highlights) by incorporating a parameter expressing the biological processes to exclude self-mating, namely partial self-incompatibility and/or inbreeding depression until seed maturation, and simultaneously estimated the parameters of pollen dispersal, male fecundity, and the biological process by hierarchical Bayesian method. We compared parameters expressing the biological processes to exclude self-mating between natural and selectively logged forests. The estimated parameter showed that fertilization of the ovules of self-fertile mother trees was not restricted and that self-fertilized seeds grew into maturity in the selectively logged plot. In contrast, the estimated parameter showed that higher outcrossing in the natural forest was caused by the exclusion of large amounts of self-pollen due mainly to biological processes. Mother trees with higher amounts of total pollen indicated exclusion due to biological processes during seed maturation. These mother trees also showed large female fecundity, which implied that the higher fecund trees tend to exclude self-pollen and/or abort immature selfed seeds.

(N. Tani, Norwati. M., S. L. Lee, C. T. Lee, [Forest Research Institute Malaysia], Y. Tsumura [University of Tsukuba])

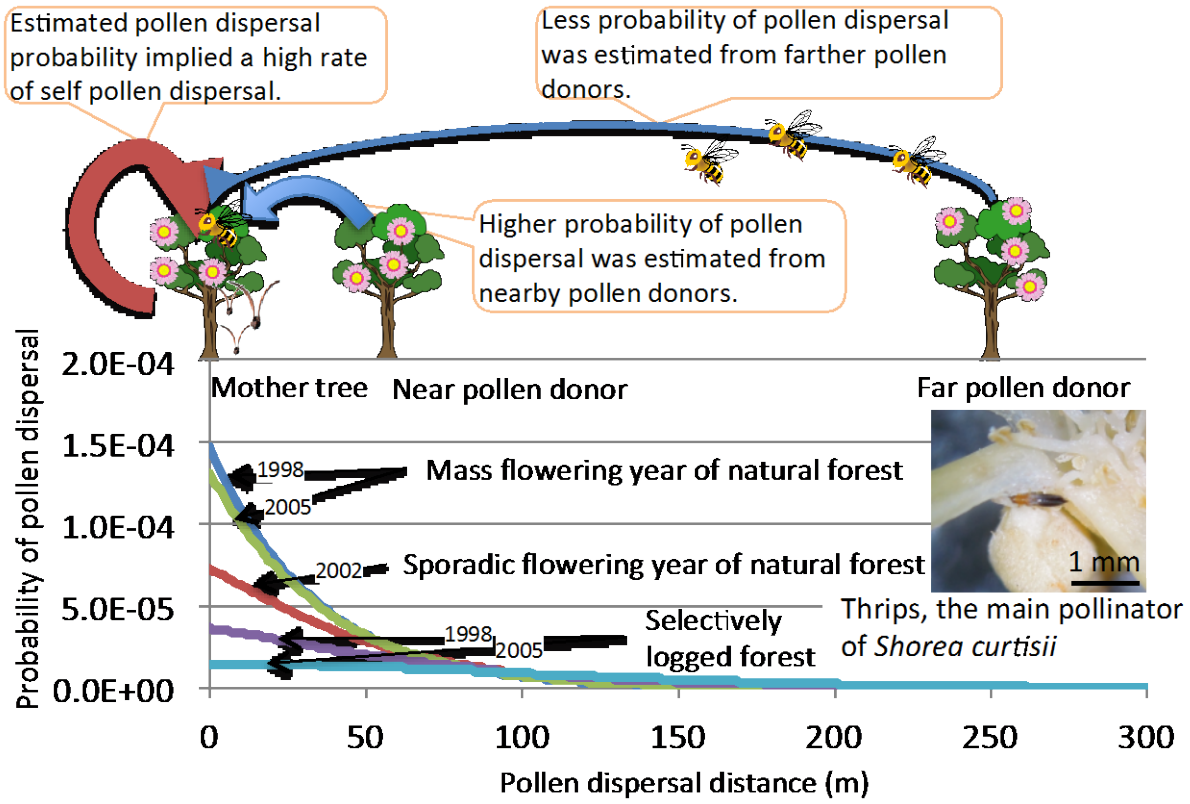

Fig. 1. Probability of pollen dispersal with distance between mother tree and pollen donors.
Pollen dispersal probability was estimated using paternity of 1,492 seeds collected in three synchronized flowering years at a natural forest and paternity of 728 seeds collected in two synchronized flowering years at a selectively logged forest. Self-pollen should be dispersed to each mother tree with higher probability even in the natural forest.

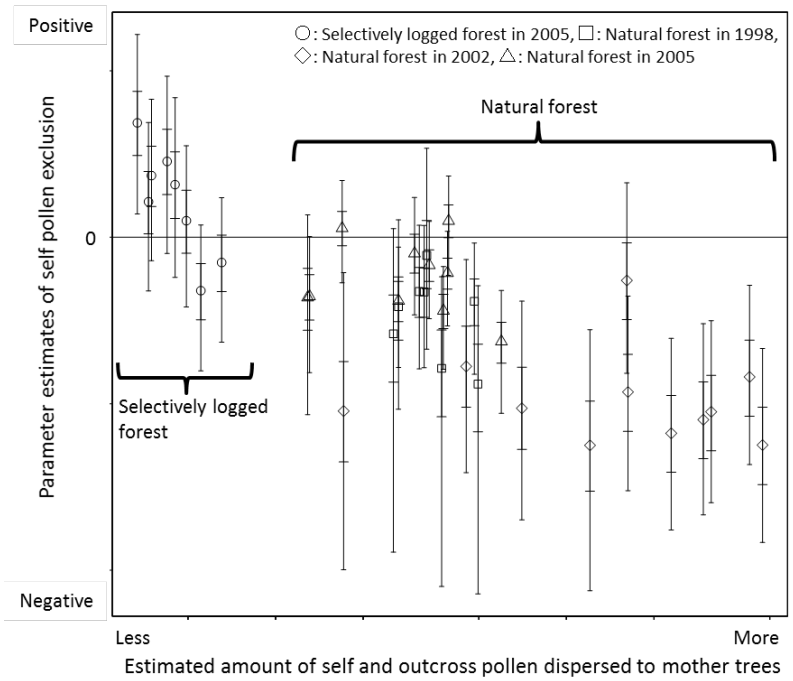

Fig. 2. Relationship between parameter estimates of self-pollen exclusion to total pollen amount dispersed to each mother tree.
The short and long ranges of vertical bar indicate 50% and 95% Bayesian credibility intervals, respectively. When the bar does not cross over zero and is in a negative area, self-pollen and/or selfed seeds were excluded by the biological processes.