A new force in the evolution of floral form

Floral form is a prime example of evolutionary or adaptive compromise. Many parts of a flower can be involved in more than one function. Showy petals, for example, might attract pollinators during the day, but might protect other floral organs from rain or herbivores at night. If selection pressures on organs with multiple functions are in conflict, floral form will evolve as an adaptive compromise to reflect the net effect of different selection pressures. The adaptive analysis of floral form is an active area of evolutionary research and much progress has been made in understanding and quantifying different forces that affect the evolution of floral form; one might think then that the forces involved in the evolution of floral form have already been identified. However, in a new paper, Vaknin and co-workers [1] provide the first empirical evidence for a new force that might play a role in the evolution of floral form. They show that the shape and size of a flower influences its electrostatic properties and, therefore affects where electrostatically charged pollen is deposited.

Using metal replicas of almond *Amygdalus communis* flowers experimentally dusted with either electrostatically charged or uncharged pollen, Vaknin *et al.* found that pollen deposition was higher when pollen was electrostatically charged and, unlike uncharged pollen, which was evenly distributed over the entire flower, charged pollen was deposited preferentially on corolla extremities and on the stigma. This deposition was influenced by the size and form of the experimental flowers. More pollen was deposited on the stigma when stigma exertion above the petal extremities was increased. However, in flat flowers with constant corolla diameter, increasing stigma length led to higher pollen deposition on the corolla, rather than on the stigma.

These results suggest that electrostatic forces might play a role in the evolution of floral form, but leave ample opportunity for the study of conflicting selection pressures on floral form. Stigmas that are more exerted might increase electrostatic pollen deposition, but might reduce the fit of flowers with pollinators. Also, selection for wider, more-open flowers generated by electrostatic enhancement of pollination could be in conflict with selection generated by other flower visitors, such as nectar thieves.

1 Vaknin, Y. *et al.* (2001) Are flowers morphologically adapted to take advantage of electrostatic forces in pollination? *New Phytol.* 152, 301–306

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The community ecology of live long and prosper

Life-history theory has long predicted that the development time of organisms should be positively associated with body size and, ultimately, fitness. This admittedly oversimplified view assumes that resource quality remains constant through time. Of course, this is not true; the relationship must also be affected by changes in resource quality, especially in seasonally varying environments. In a community context, one could predict that, during periods of rapid environmental change, organisms might not benefit from extended development times. Alternatively, when resource quality remains relatively static, the original life-history predictions should hold. Understanding the seasonal changes in resource quality and determining experimentally the genetic relationships between life-history traits in a community of organisms is a tall order. This is just what Kause *et al.* [1] deliver in a new paper. This, along with two other new papers by the birch–herbivore group in Turku, Finland, demonstrates local adaptation of herbivores to the timing of seasonal physiochemical decline in leaf quality and the predicted genetic relationships between development time and body size.

Mountain birch leaves are fed on by at least 30 species of sawfly; each of which has a distinct seasonal window during which they develop. Altering the phenology of these herbivorous wasps both alters the quality of the diet and has a dramatic negative effect on fitness (local adaptation in phenology). Kause *et al.*'s key result is that two early season (bud break) feeders and two late season (senescing foliage) feeders show no benefit (some detriment) to extended larval development periods. Rapid changes in the profiles of several groups of phenolics, toughness and water content early in the season and rapid declines in the nutritive value of yellowing leaves late in the season make them resources that cannot be continuously exploited. Conversely, three species of mid-season feeders experience a more constant diet and show strongly significant positive genetic correlations between development time and final mass. These same species also show high levels of genetic variation, especially when compared with the early and late feeders. Kause *et al.* argue that predictability in resource quality might just as easily alter life-history correlations for other specialists of declining habitat quality, such as amphibians in temporary ponds.

Recently, some community ecologists (primarily G. Bell and S. Hubbell) have proposed that the abundance and distribution of organisms is not a result of their adaptations to the environment, but is rather a neutral process relating to dispersal. Although this implicit merging of community and evolutionary ecology is welcome, few detailed studies of community-wide patterns in adaptation exist. Kause *et al.*'s analysis of the quantitative genetics of adaptation in sawflies is evidence against the strongest interpretations of the neutral theories of community ecology, and provides some of the first evidence that the underlying genetic architecture of species might be predicted by the regular seasonal fluctuations in resource quality.

1 Kause, A. *et al.* (2001) Seasonally varying diet quality and the quantitative genetics of development time and body size in birch feeding insects. *Evolution* 55, 1992–2001
2 Kause, A.and Morin, J.P. (2001) Seasonality and genetic architecture of development time and body size of the birch feeding sawfly *Priophorus pallipes. Genet. Res.* 78, 31–40
3 Martel, J. *et al.* (2001) Diversity of birch sawfly responses to seasonally atypical diets. *Entomol. Exp. Appl.* 100, 301–309

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 0169-5347/02/$ – see front matter