Animal behaviour

Reply

How to investigate a putative signal? Stick to the right method when assessing the response of a receiver

The evolution of autumn leaf coloration moved into the focus of ecologists after the seminal publication by Hamilton & Brown (2001). In that article, Hamilton & Brown proposed the coevolutionary hypothesis, suggesting that red and yellow leaves in autumn evolved as warning signals to repel herbivorous insects, particularly aphids. Despite strong interest in the topic, experimental studies supporting this hypothesis are lacking. In a recent article, we describe the first experiment reporting that autumnal leaf colours, because it allows us to distinguish the coevolutionary hypothesis from related hypotheses concerning post-landing decisions. For example, the defence indication hypothesis posits that leaf colour is linked to the production of defensive compounds via a common biosynthetic pathway (Schaefer & Rolshausen 2006). In this scenario, leaf colour did not evolve to repel aphids, but aphids react to pleiotropic effects of pigment production. Consequently, even though leaf colour does not function as a warning signal, fewer aphids might be observed on strongly coloured plants, because they vacate these plants after probing. It is thus necessary to measure the first contact with a plant in order to differentiate between alternative hypotheses on plant–herbivore interactions.

In their reply, Döring & Hardie (2007) imply that the detrimental effects of aphids are limited to reproductive individuals. However, aphids are the most common vectors of plant viruses and often transmit infections by probing tissue (Ng & Perry 2004). Indeed, aphids that do not reproduce and colonize a host are often primarily responsible for virus spread (Edwards 1963). Thus, warning signals should generally deter aphids from landing and are not necessarily limited to colonizing aphids. Moreover, if the selective pressures exerted by aphids are strong enough to generally translate into the evolution of autumnal leaf coloration in plants, aphids’ avoidance of strongly coloured plants is expected to be relatively invariant. Finally, reproductive plants are characterized by high levels of circulating nutrients. Therefore, our result that aphids land preferentially on plants with a high reproduction rate holds even if aphids feed on the plant without reproducing.

In our study site, mountain ash individuals were growing in a vegetation belt. We found no evidence for an edge effect explaining fruit set and aphid numbers independently. We therefore maintain that resource allocation conflicts explain why aphids attend to reproductive investment in plants.

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