# Adaptive dynamics of specialization in plant-herbivore systems

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Many species of phytophagous arthropods are specialized: they exploit only one or a few host plant species. Since having a more general feeding habit has obvious advantages, much work has been devoted to explaining why specialists are in such an overwhelming majority. The most-addressed hypothesis states that herbivores face a fitness trade-off in exploiting different host plants. In this view a specialist gains a higher fitness on one host plant at the cost of reduced fitness on other host plants, while a generalist is a "Jack of all trades but a master of none". The question we currently investigate is under which conditions a specialist strategy will pay off. Theoretical studies, taking the fitness trade-off into account, predict that host-plant specialization will evolve when herbivores express habitat preference. However, habitat preference has been modelled as either optimal foraging behavior or fixed preference behavior - extreme types of behavior, seldom expressed by plant-eating insects. Furthermore, none of these studies has integrated the relevant ecological, behavioral and physiological characteristics of plant-herbivore systems into one model. Moreover, the interplay of evolutionary and population dynamics is generally absent in these analyses. Therefore, we study the adaptive trait dynamics of the herbivore exploitation strategy, allowing for ecological feedback into the evolutionary process. We take into account realistic foraging assumptions for the herbivores, plant types in a gradient of quality, explicit plant population dynamics and a linear fitness trade-off, which is based on physiological considerations. The trait under investigation is a functional trait of two characters, together describing the exploitation strategy of a herbivore. In this way we allow for the simultaneous evolution of two aspects of exploitation: the level of specialization in digestion efficiency and the range of the plant quality gradient on which the herbivore is focused. We show that evolution leads to specialization, even under a non-selective foraging behavior. Selective foraging allows the herbivore population to split up in a number of different specialized types - a process called evolutionary branching. Adding a cost for selective foraging reduces the level of specialization, as well as the number of different types evolving. We discuss the conditions for host race formation and for coexistence of specialist and generalist strategies on an evolutionary time-scale.