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The diversification of flower morphology: linking plant genes to the functioning of ecosystems

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Life on Earth exists in a tremendous amount of forms and shapes. Yet, identical biological structures have developed independently in distant species. Such recurrences during evolution imply that the morphology of organisms is not only the result of random processes but can also be influenced by deterministic factors such as environment and genetics. Identifying the parameters that drive modifications in morphology is an important challenge in biology as it will allow predicting future changes and understanding how specific alterations in DNA sequence may allow organisms to survive and adapt to new conditions.

For instance, most plants are not able to reproduce by themselves but depend on animal pollination to transfer pollen from one flower to another. As a result, some plant species have developed flowers that are attractive and, often, offer nutritive rewards to different pollinators. How plants have adapted the function and morphology of flowers to maximise the pollination service of different insects is, however, poorly understood. This is nevertheless an important question as many crops designated to human consumption rely on pollinators to reproduce. Furthermore, climate change and the modernisation of agricultural practices have been suggested to cause a decrease in pollinator abundance and are predicted to have negative consequences on crop productivity as well as on plant diversity. This has highlighted the need to promote plant-pollinator interactions to provide sustainability in agriculture and ecosystems.

My research focuses on understanding the molecular and evolutionary mechanisms causing changes in flower morphology. I aim to study recurrent patterns in plant evolutionary history to identify the genetic changes that have modified plant forms, to determine their origin and to understand why they have occurred. One of the most prominent examples of repeated evolution in plants corresponds to the changes in flower structure that followed the transition from a reproductive system based on animal pollination towards a system based on self-fertilisation. This transition has occurred many times independently and has been almost always followed by very similar changes in flower morphology, i.e. a reduction of flower size, scent and nectar production. The similarities between independent events are such that these changes have been termed the ‘selfing syndrome’. This, nevertheless, raises the question of why do we observe such convergence in the flower morphology after the transition to self-fertilisation? I will describe how our findings in the plant genus *Capsella* provide first insights into this question and highlighted general concepts on the mechanisms underlying morphological changes during plant evolution. I will then extend the discussion by demonstrating how this event can be exploited to identify genes important for pollinator attraction contributing to maximize plant reproduction and, thus, productivity.