

Plant Biology

Scented colors, colored scents

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ABSTRACT

Roses smell like red, and violets smell like blue: Can flower colors be linked to their scents? In a Mediterranean scrubland, specific combinations of floral color (as perceived by bees or butterflies) and scent compounds in insect-pollinated plants have been described. What pollinators see and smell is a major selective force shaping plant diversity in natural habitats.

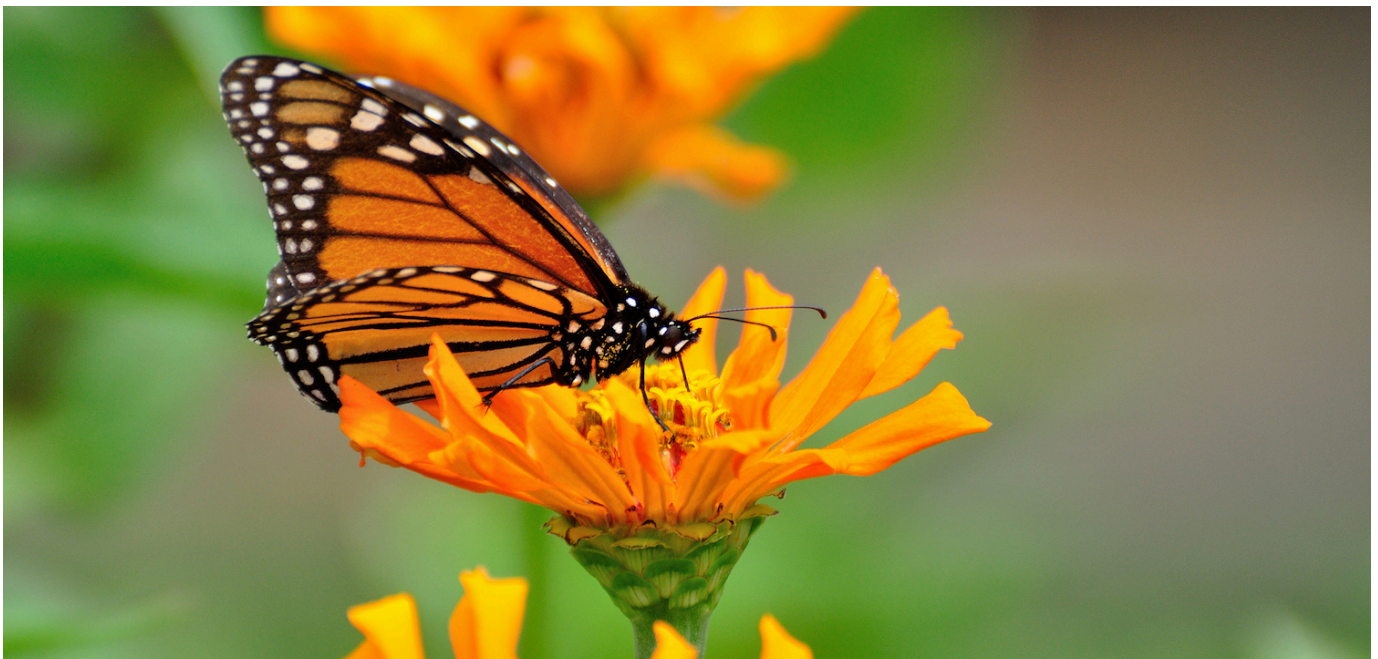


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Plants hold extraordinary communication devices enabling them to interact with other species: the flowers. The dazzling palettes and the tantalizing floral scents function as complex signals that mediate plants' interactions with other organisms, primarily with their animal pollinators. The language that plants use to communicate with other species consists of volatile chemical compounds released from the flowers (scents), and the striking colors of their petals, stimulating the olfactory and the visual systems of pollinators, respectively.

Plant–pollinator (“p–p” for simplicity) mutualistic relationships are fundamental for the primary production and for the maintenance of biodiversity in terrestrial ecosystems, as well as for a large part of the agricultural production (and economy) worldwide. However, major global threats to biodiversity disrupted these relationships in many parts of the world. Therefore, scientists are trying to understand how natural p–p communities are structured, and how these two trophic levels manage to successfully communicate so that the mutualistic relationship is fully functional for the ecosystem.

Given the importance of flowers as sensory data transmitters, and the necessity to preserve natural communities, we decided to study floral scent and color of all spring-flowering insect-pollinated plants in a natural Mediterranean scrubland on [Lesvos Island](#) in Greece. In this research, it was critical to describe these two floral traits in a human-unbiased way. This means that we were not interested in what we, humans, see in these flowers, but in what pollinators can sense. In the case of the Mediterranean Basin, pollinators are insects, mainly [bees](#); therefore, we tried to decipher floral language according to the visual system of the bees, and to that of the [swallowtail butterflies](#). Regarding aromas, we collected the real-time floral emissions and analyzed them to find out which compounds were contained in each species' scent bouquet.

We were astonished to discover that, in the entire community, floral color can predict the composition of floral scent. The integration of the two communication channels was evident in more than one groups of distant species. For example, we found that the “red” flowers, which offer no nectar to visitors, emit [aliphatic compounds](#). The facts that (a) bees cannot see the red color, and that (b) these compounds are known attractant to bees, suggest that these species perhaps try to compensate for their visual inconspicuousness to bees by emitting an alluring scent, in order to successfully attract these most effective pollinators in the area.

Furthermore, we found that the flowers that secrete nectar had a significantly different scent and color than the ones offering only pollen or only shelter to pollinators. Nectar-producing species even had more vividly colored flowers as perceived by bees and showed different color hues as perceived by butterflies. This demonstrates that the entire

community is oriented towards an honest signaling of the presence or absence of this floral reward, which is invaluable to the insects during the hot and dry spring-summer time in the Mediterranean.

What's so exciting about the correlation of floral color and scent in a community-context? It shows that the plant species composition in a community is not randomly assembled, but that it is directly linked to the native pollinating fauna. Specifically, it appears what pollinators see and smell represents a major selective force shaping the colors and fragrances of the amazing floral landscapes encountered in the wild.

What could plants gain from the floral color–scent integration? First, they could save energy and resources, by linking or merging the metabolic pathways that lead to the production of specific volatile compounds and pigments. Second, they could secure the delivery of their messages to pollinators by using both (instead of one) channels of communication. The latter is vital in habitats where the environmental conditions challenge the efficacy of floral signals. Given the exposure of flowers in low Mediterranean scrublands to prevailing winds that rapidly blend floral scents with the (differently scented) air, color can indeed act as a backup signal to volatile emissions.

What comes next is testing if the diversity of floral sensory stimuli in natural communities is indeed related with the actual visitation patterns by the pollinating insects. Exploring these relationships will provide further useful information about the structure of p–p communities, help select species of conservation priority, and help design effective prevention or restoration schemes.