Theme Talk

Climate Change: Impacts on Plant-Pollinator Interactions

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Abstract

For plant reproduction, timing of phenological events is important. Flowering phenology is a key event in enabling the pollinators to visit and pollinate the flowers. In this process, most of the flowering plants and pollinators are co-evolved. Pollination is the key event for plants to set fruit and for the pollinators to get their food. Flowering phenology is affected by many environmental factors, among which temperature and photoperiod are reliable signals of seasons. Any shift in the timing of flowering phenology is bound to impact the foraging activities of pollinators. In effect, the mismatch between the flowering time and the flight time of insects would lead to disruption of the pollination process. Further, plants with insufficient material resources if flower too early will have a limited capacity for seed production while those that delay flowering might gain higher capacity, but might also run out of time to use it prior to the end of the season. Therefore, resources and conditions impose bottom-up selective forces on flowering phenology. Several workers outside India have shown that climate change due to global warming is affecting pollination by disrupting the synchronised timing of flowering and the timing at which pollinators pollinate. In effect, the plants bloom early or delay flowering due to rising temperatures; such shifts in flowering time would severely impact their sexual reproduction due to mismatch of their flowering timings with the timing of foraging activities of their pollinators. In case of fruit, vegetable, seed, nut and oil crops which are sources of vitamins and minerals, if the pollination rate is limited or ceased to happen, the world will witness increasing risk of malnutrition. The responses of individual species of pollinators to shifts in flowering timings vary but they are almost unknown. If there is no shift in timing by pollinators, there could be a severe decline in pollination and a lack of food sources for them. Plants also end up with pollination limitation or failure due to which sexual production gets severely impacted. Recent reports indicate that the climate change is interfering with plant-pollinator mutualism, an interaction facilitated largely by floral colour and scent. Floral scent production decreases with an increase in ambient temperature; in effect a significant decrease in the emission of scent compounds occurs. This drop in floral scent production is the result of arrested expression and activity of proteins that help in the biosynthesis of the compounds. Floral scent provides a sensory signal to pollinators and drop in floral scent production could make them less attractive to pollinators. Floral colours provide a visual signal to pollinators and shifts or change in their colour would affect the visitation by pollinators. Increase in ambient temperature could cause early fading or shift in floral colour and thus affecting the pollination rate by pollinators. Elevated temperatures affect the physiology of flowering plants due to which production rate of flowers, nectar and pollen is altered. Warming temperatures influence foraging activity, body size at maturity, as well as the individual life span of insect pollinators. Insect larvae mature into adults sooner, some bird species lay eggs earlier in the season, and many plants bloom earlier. In addition to advancing many phenological events, climate warming is altering the distributions of both plant and pollinator species. Climate change also brings about positive effects for certain plant and pollinator species. Increased ambient temperature enables some plant species to proliferate well and some other plant species to be invasive and occupy new habitats across latitudes, longitudes and altitudes. Similarly, some pollinator species such as stingless bees multiply and produce numerous colonies, especially in urban settings where warm conditions exist. Therefore, pollination biologists have a tremendous challenge to understand how climate change might affect plant-pollinator interactions, and reveal the importance of climate warming relative to other human modifications of natural habitats for the persistence and stability of these interactions. This insight could enable us to better understand how community properties and biodiversity in different ecosystems may change by climate-driven plant-pollinator mismatches.

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