Modelling pollination strategies and the robustness of pollination networks

A-2-Bee

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Dear Consultants,

Pollination is one of the most crucial biological processes with virtually all seed plants requiring pollination to reproduce. Furthermore, the fruit, vegetables, and crops that we, and many animals, eat do not grow with pollination. Whilst some plants rely on wind and water for pollen transfer, most flowering plants reproduce through animal pollination. Therefore, pollinator-plant relationships underpin the balance and biodiversity of all terrestrial ecosystems.

Of the 1,400 crop plants grown globally, over three-quarters require animal pollination. In the United States, the pollination of crops is valued at 10 billion dollars annually and globally valued at more than 3 trillion dollars.

Pollinator populations are in decline due to external stressors such as disease, extreme weather, competition from invasive species, habitat loss and climate change. There is a need to devise new, more effective solutions for the long-term resilience of food systems.

We need to increase our understanding of pollinator-plant relationships and pollination strategies in general ecosystems and agriculture. In doing so, we can create solutions and design agricultural landscapes that support diverse flora and fauna (e.g., technological/man-made solutions that augment with and do not disrupt natural systems). Can network/optimisation models be applied to local floral networks/ecosystems? We seek to measure network robustness and optimisation.

Data: https://figshare.com/articles/dataset/BeeWalk_dataset_2008-19/12280547

Optimisation: the most effective network structure or pollination strategy according to a chosen metric, given the pollinator-plant mix. The optimisation of a network can be measured within species (e.g., all bees forage) or across species (e.g., specialists and generalists all fulfil their role).

Robustness: broadly, how system metrics change when the network is altered due to external stressors as modelled by changes in pollinator-plant mix, loss of specialists, change in network structure, etc. Seek network designs that minimise these effects for as many scenarios as possible. [Seek a definition and measure of resilience. What metrics? Can they be applied in practice?]

Thank you for your help and interest - we look forward to receiving your analysis.

References

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4) Bosch, J., Martín González, A. M., Rodrigo, A., & Navarro, D. (2009). Plant–pollinator networks: adding the pollinator's perspective. Ecology letters, 12(5), 409-419.