Urbanization and agricultural intensification affect coextinctions by altering networks of plant-pollinator interactions

Insect pollinators visit flowers for nectar and pollen foods with species preferring different flowers, leading to a community network of plant-pollinator interactions (Figure 1). Human land use, such as urbanization or agricultural intensification, may disrupt the structure and stability of this network by eliminating species. The loss of a plant or pollinator species may cause a coextinction cascade: a series of knock-on species extinctions due to their dependence on eliminated species for food (pollinator) or pollination (plant). We investigated how agricultural and urban land cover affected plant-pollinator network structure and robustness to coextinctions compared to more natural landscapes.

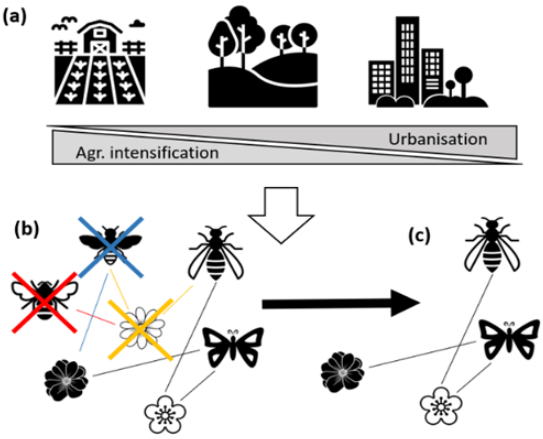

Figure 1. Landscape structure (a) modifies structure and composition of plant-pollinator networks (b). Loss of a species (red), can lead to initial (yellow) and further (blue) coextinctions that alter the community (c). The risk and severity of species losses depend on the level of pressure exerted by different land-uses on the plant-pollinator network. Icons: The Noun Project (Satawat Anukul, Muhajir Ila Robbi, Wan Ikhsan, Nick Kinling, Georgiana Ionescu, Aripatut Dasuki, Zie Art, Gede Pangrango, Pham Duy Phuong Hung).

KEY RESULTS:

- Urban landscapes supported more species and symmetrical networks with similar numbers of plant and pollinator species due to diversity of ornamental plants.
- Intensively managed agricultural landscapes had smaller, tightly connected networks where specialist plants and pollinators mainly interacted with generalist partners.
- Rural landscapes comprising a mix of agricultural, peri-urban and semi-natural habitat supported networks that were intermediate in diversity and structure.
- Networks in urban and agricultural landscapes had lower risks of a coextinction cascade than networks in rural habitats.
- A high diversity and density of interactions tended to lower coextinction risk, but if a coextinction cascade did occur, more species were lost. Generalist pollinators with many, strong links to multiple plant species (species strength) had the lowest extinction risk.

CONCLUSION: An interplay between land use and network structure affects the robustness of plant-pollinator communities to coextinctions after initial species losses. Such human-caused changes to species interactions have implications for ecosystem functions such as pollination.

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