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The drivers of insect decline

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Biologists and ecologists have been concerned about the worldwide reduction in biodiversity of many terrestrial and aquatic vertebrates. However, recently scientists have voiced similar concerns about invertebrate taxa, mainly insects. The rapid rate of insect decline may lead to the extinction of 40 per cent of the world's insect species over the next few decades (Sánchez-Bayo and Wyckhuys, 2019). Indian entomologists too agree that the country is witnessing a slump in insect numbers (Iyer, 2019).

The major factors responsible for the decline in insect fauna include habitat change, pollution, invasive species and climate change (Ceballos *et al.*, 2017). Habitat change is an immediate consequence of urbanisation, industrialisation, intensive farming and deforestation. The tremendous human population growth and urban development in the city of Liberia, Costa Rica (9⁰47'34"N, 83⁰51'29"W) caused a decline in the diversity and abundance of bees on the flowering tree, *Andira inermis* (W. Wright) (Frankie *et al.*, 2009). Due to industrialisation, the diversity of insect fauna reduced in Midnapur

(22⁰24'49"N, 87⁰20'51"E) district of West Bengal by 23.33 per cent (Jana *et al.*, 2006).

Intensive farming practices, monocultures, recurrent use of synthetic fertilisers, herbicides and pesticides are the major drivers of insect declines in both terrestrial and aquatic ecosystems. Neonicotinoid insecticides, the most widely used molecules for agricultural pest management have crucial negative side effects, especially on pollinators and other beneficial insects feeding on floral nectar and pollen (Calvo-Agudo *et al.*, 2019).

Water pollution reduces the quality of freshwater habitat, leading to a decline in aquatic insects. Light pollution interferes with insects that use natural light from the moon or stars as orientation cues for navigation (moths) and with communication of insects that use bioluminescent signals (fireflies). Noise pollution interferes with acoustic communication in insects like grasshoppers and cicadas. Electromagnetic radiation of mobile telecommunication antennas have a detrimental effect on the abundance and composition of pollinators like wild bees,

hover flies, bee flies, beetles and wasps (Lazaro *et al.*, 2016).

Introduction of invasive species may lead to local loss of native insects, particularly those exhibiting narrow geographic distributions. A long-term field study to assess the composition of ladybird beetles in the orchards of East Anglia, England revealed a decline in the native ladybird beetles caused by the invasive harlequin ladybird, *Harmonia axyridis* (Brown and Roy, 2017). Climate change causes threats to insects and the ecosystems they depend on. Climate warming in central Spain resulted in a decline in species richness of butterflies in 90 per cent of the region, due to the shift in the geographical range of many species from plains to higher elevations (Wilson *et al.*, 2007).

The decline of insects is a serious threat that the society must urgently address. Conservation strategies to counter the insect decline include reducing greenhouse gas emissions, replacing intensive agriculture with agro-ecological methods, curbing local light and noise pollution and protecting and creating microhabitat features for insects (Harvey *et al.*, 2020). If we do not stop the decline of our insects, there will be profound consequences on humans and all life on earth.

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