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Insect Apocalypse: A Modern Insect Crisis

*Priyanka S M[1] and Nilavazhagan L[2]
[1]PhD Scholar, Dept. of Entomology, Indira Gandhi Krishi Vishwa Vidhyalaya, Raipur
[2]PG Scholar (Entomology), Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani
*Corresponding Author's email: priyankapky2002@gmail.com

Insects dominate life on Earth, comprising over half of all documented animal species and forming a pillar of global biodiversity. This remarkable diversity arises from the wide range of genetic traits, physical forms and functional adaptations that insects have evolved to survive in complex and ever-changing environments. Some insects play crucial roles in the proper functioning of ecosystems, such as pollinating plants, recycling organic materials, contributing to sustainable nutrient flow and naturally controlling pests and diseases. Through these beneficial activities, insects also carry enormous economic value. A major decline in insect population and species would trigger chain reactions across food webs and disrupt entire global ecosystem.

From crop fields to orchards, insects quietly support agriculture around the globe while contributing enormous economic benefits worldwide agricultural productivity relies strongly on insect pollination which represents a highly valuable ecosystem service. The sweet potato hornworm (*Agrius convolvuli*), a widely distributed insect species, has been reported as one of the important pollinators of papaya in Kenya (Martins & Johnson, 2013). Insects that naturally control pests offer major economic and environmental advantages and many edible insect species also feed on agricultural pests.

The reasons behind the decline of wild bee population have been studied more than those affecting other insects. Most scientists agreed that this decline is caused by several human-related factors, including the loss of natural habitats, long-term exposure to multiple pesticides and the spread of diseases through commercially managed bee colonies. Neonicotinoids are powerful nerve-affecting insecticides and their presence in most honey samples worldwide suggests that bees and other insects are commonly exposed to them (Mitchell *et al.* 2017). It is very important to address the decline of insects because they provide vital services such as pollinating crops (which affects about 75% of food plants), controlling pests and recycling nutrients. Losing insects threatens global food supply, ecosystem health and human well-being. Their disappearance can disrupt food chains, affecting birds, amphibians and fish, and worsen environmental problems.

Diversity and Role of Insects in Ecology Health

Insects are the most diverse among all the species with approximately 5.5 million insect species around the world (Stork, 2018). There are nearly 63,760 species of insects particularly present in India belonging to 29 orders three classes and 658 families, representing 7% of global insect diversity. Among the 29 orders, eight orders viz. Coleoptera, Lepidoptera, Orthoptera, Diptera, Hemiptera, Odonata, Hymenoptera and Thysanoptera represents 94 percent of the insect fauna and remaining 6% were contributed by the remaining 21 orders (ZSI, 2012). The world has lost about 2,50,000 to 5,00,000 (5% to 10%) insect species in the past 150 years according to February 2020 study.

Insects are in a dangerous world. Insects are important ecosystem component and reducing rapidly of its diversity is reported globally. 10-20% insects are losing every decade.

International Union for Conservation of Nature reported that 18,180 (23.47%) out of 77,435 species of insects between 1996-2020 are reported to be threatened and higher number of threatened insect species was reported in order Odonata followed by Orthoptera, Coleoptera, Lepidoptera and Hymenoptera. 1843 species was listed as critically endangered, endangered, extinct, extinct in wild and vulnerable and of which 596 are predators, 40 are pollinators, 164 are saprophagous, 620 are herbivores, 272 are omnivores, 137 are parasites and 14 are unknown (Raghavendra, *et al*. 2022).

Insects play a critical role in terrestrial ecological function. They are present in all habitat in the globe and plays a major role in the function and stability of both terrestrial and aquatic ecosystems. They act as a biological foundation for the terrestrial ecosystem and for the biotic communities providing ecosystem services.

Insects serve as pollinators and without pollinators such as bees, butterflies, moths, flies, beetles and wasps many plants will struggle to reproduces, which in turn impacts food security and affects agricultural productivity. Insects occupy a central position in food web as they serve as food for birds, fishes, reptiles, amphibians and mammals and insect population decline leads to cascading effects as an early warning of ecosystem collapse. Insects help in control of harmful species as natural enemies, loss of beneficial insects results in the outbreak of pests, which enforces the farmers to accelerate the use of pesticides which further reduces insect population. Insects like dung rollers, ants, termites decomposes and breakdown organic matter, recycling nutrients back to the soil and ensures sustainable agriculture.

Insect Apocalypse

The "insect apocalypse" refers to the alarming global decline in insect populations, with over 40% of species at risk of extinction. This decline, driven by habitat loss, pesticide use, climate change and pollution, poses significant threats to biodiversity and human well-being (Chinmayi *et al*. 2024).

Insects are essential for pollinating plants, breaking down organic matter, and serving as food for other animals. Losing them can upset ecosystems, impacting plants, wildlife, and key processes like nutrient cycling. To tackle this problem, it is important to cut down on pesticide use, restore natural habitats and practice sustainable farming. Safeguarding insects is vital for keeping ecosystems healthy and ensuring food security and biodiversity for the future.

Studies from Europe, North America and parts of Asia show steep declines in insect numbers. A global review in 2019 found that more than 40% of insect species could face extinction. In some regions, populations of flying insects have dropped by as much as 75% within just a few decades. Multiple factors contribute to this decline, including habitat loss, pesticide exposure, climate change, pollution and the introduction of invasive species (Jactel, *et al*. 2020).

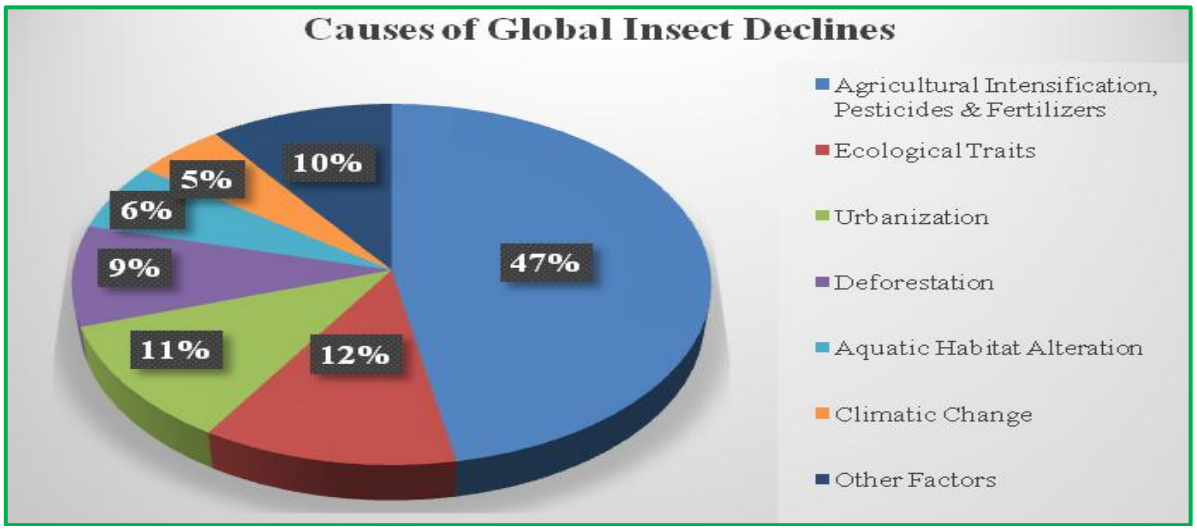

Figure 1. Causes of global insect decline (Source: Chinmayi *et al.*, 2024).

Natural population fluctuation is the normal breathing rhythm of insect life. Insects respond quickly to seasons, rainfall, temperature, food availability and predator pressure. A grasshopper population may explode after a good monsoon and crash the following dry year. Mosquito numbers rise after floods and fall when breeding sites dry up. They are short-term, reversible, and usually followed by recovery once conditions improve. Fluctuation is nature experimenting, adjusting, and self-correcting.

Long-term decline is something else entirely. Here, insect populations don't just dip they fail to bounce back. Year after year, the baseline keeps sinking. Even when weather conditions are favorable, numbers remain low. Species that were once common become rare, and rare species quietly disappear. This pattern signals a structural problem in the ecosystem rather than a temporary disturbance.

Major Causes of Insect Crisis

There are many well known established factors which is causing insect decline globally (Bruhl & Zaller, 2019). The most serious reasons behind insect decline include the destruction of natural habitats, widespread use of pesticides, climate change and global warming add to these problems by altering temperature and rainfall patterns. Other factors such as eutrophication, general environmental pollution, genetically engineered crops, increased ultraviolet radiation due to ozone layer damage and artificial night lighting place additional stress on insect populations (Diamond, 1989).

Human activities are the main cause of changes in natural habitats, and these changes have increased over the past few centuries. Large areas of land are now used for houses, roads, transport, and tourism, replacing forests, grasslands, and other natural areas. Because of this, many insects are being affected. Coleoptera, Lepidoptera and Hymenoptera are among the insect orders that suffer the most from habitat loss and fragmentation (Whittaker, 2001).

Another serious problem is the heavy use of pesticides. Research from different countries shows that pesticides have strongly reduced insect populations. In rural areas of UK and Italy, pesticide use has been linked to decline in moths and pollinating insects (Brittain *et al.*2010). Broad-spectrum insecticides are harmful because they kill many soil-dwelling insects along with pests. Systemic insecticides reduce beneficial insects such as ladybird beetles and butterflies (Krischik *et al*. 2015). Fipronil and Neonicotinoids cause serious damage to aquatic insects (Beketov & Liess, 2008). In Japan, neonicotinoids are considered a major reason for the decline of dragonflies. Chemicals such as neonicotinoids do not only kill harmful pests but also damage helpful insects like bees and butterflies.

Deforestation plays a major role in the decline of insect populations. When trees are cut down, insects that live and depend on them lose their shelter and food, leading to their destruction. Since forests are stable ecosystems that support rich biodiversity, their loss threatens insects and many other living organisms. In tropical regions of West Africa, rapid urban growth has led to a sharp decrease in beetle and wasp populations, as natural habitats are replaced by built-up areas (Cardoso *et al.* 2020).

Artificial lighting at night has became an another growing threat to insect populations and is expanding rapidly across the world. In many biologically rich regions, nighttime light levels have increased dramatically, placing extra stress on insects. Fireflies are especially affected, as artificial light interferes with their natural mating signals and seriously disrupts their reproduction.

Consequences of Insect Decline

- Loss of pollination
- Reduced crop yield and food insecurity
- Disruption of food chains
- Decline of insect dependent birds and animals
- Increased pest outbreaks and reduced natural control agents
- Greater use of chemical pesticides

- Soil fertility reduction and degradation
- Slower decomposition and nutrient cycling
- Loss of biodiversity
- Ecosystem instability
- Economic losses and threats to humna health

Anthropogenic Activities in Insect Crisis

Anthropogenic pressures have profoundly altered natural ecosystems pushing insects populations toward rapid decline. Humans thorugh deforestation, urbanization, road construction, mining, agricultural expansion reduces the breeding site, feeding and overwintering sites of insects. Intensive agriculture practices such as monocropping, deep tillage, removal of hedgerows and loss of floral diversity leads to poor habitat quality. Farmers are using excessive pesticides that directly kills insects as well as natural enemies. Other industrial pollutions like effluents, heavy metals, plastics contaminating soil and water adversely affects insects survival and insect development. Artifical light disrupts insect behavior, mating and increases particularly in noctural insects. Human activities causes changes in climate which affects insects and also over exploitation of natural resources and biomass leads to insect crisis.

Strategies to Reduce Insect Decline

Restoring natural habitats plays an important role in protecting insect populations, especially in landscapes. Such efforts can lower the risk of local insect extinctions and help maintain overall biodiversity, even though planning restoration with insects in mind may require additional investment. Research shows that measures like planting flowering hedgerows in farmlands support the survival and spread of pollinators, resulting in healthier and more diverse insect communities.Monitoring insect populations is essential for effective conservation of individual species. Simple tools such as malaise traps, light traps, and pheromone traps help scientists observe changes in insect numbers, distribution, and overall diversity.

Sustainable agriculture offers a hopeful way forward by reducing dependence on harmful pesticides and supporting biodiversity, including insects, which helps create stronger and more productive farming systems. This approach includes practices such as integrated pest management, use of biopesticides, crop diversification, creating habitats for beneficial insects, and precision farming techniques. However, achieving truly sustainable agriculture requires the combined efforts of farmers, researchers, policymakers, and industry to ensure these practices are applied responsibly and effectively.

Integrated pest management (IPM) is a balanced approach to pest control that focuses on prevention and natural methods rather than heavy use of chemical pesticides. By limiting unnecessary spraying, IPM helps protect beneficial insects that are often harmed by conventional chemicals. It supports natural enemies of pests, such as predators and parasites, and improves insect habitats through practices like cover cropping, flowering field borders, and reduced soil disturbance. These methods increase biodiversity and make farm ecosystems more stable and resilient. Biopesticides, which come from natural sources like bacteria, fungi, or plant extracts, are another important tool. They break down more quickly than synthetic chemicals and usually target specific pests, helping to protect beneficial insects and overall ecosystem health. When used as part of IPM, biopesticides offer a sustainable alternative to traditional pesticides by maintaining ecological balance, supporting key insect populations, and promoting environmentally friendly farming practices that help slow insect decline and protect essential ecosystem services.

Conclusion

Compared to other living organisms like plants and animals, insects are not protected or given more attention. Further increase in environmental degradation, urbanization and other anthropogenic activities more taxa of insect species will be endangered fast if there are no

proper management strategies. The insect apocalypse is no longer a distant ecological concern but a present and escalating crisis with profound consequences for ecosystems and human well-being. Conserving and protecting insects is a necessity for food security, ecosystem stability and sustainable development. The future of insects and ultimately human survival and other surrounding creatures depends on the choices we make today.

References

1. Beketov, M.A. and Liess, M. (2008). Potential of 11 pesticides to initiate downstream drift of stream macroinvertebrates. *Archives of environmental contamination and toxicology*.55(2), 247-253.
2. Brittain, C.A., Vighi, M., Bommarco, R., Settele, J. and Potts, S.G. (2010). Impacts of a pesticide on pollinator species richness at different spatial scales. *Basic and Applied Ecology*. 11(2), 106-115.
3. Bruhl, C.A. and Zaller, J.G. (2019). Biodiversity decline as a consequence of an inappropriate environmental risk assessment of pesticides. *Frontiers in Environmental Science*. 31 (7), 177.
4. Cardoso, P., Barton, P.S., Birkhofer, K., Chichorro, F., Deacon, C., Fartmann, T., Fukushima, C.S., Gaigher, R., Habel, J.C., Hallmann, C.A. and Hill, M.J. (2020). Scientists' warning to humanity on insect extinctions. *Biological Conservation*. 242, 108426.
5. Chinmayi, S., Sandeep, V. and Chiranth, M. P. (2024). The Insect Apocalypse: Why Losing Insects Means Losing Biodiversity. *Vigyan Varta*. 5(11), 14-16.
6. Diamond, J.M. (1989) The present, past and future of human-caused extinctions. Philosophical transactions of the Royal Society of London. *Biological Sciences*. 325(1228), 469-477.
7. Jactel, H., Imler, J.L., Lambrechts, L., Failloux, A.B., Lebreton, J.D., Le Maho, Y., Duplessy, J.C., Cossart, P. and Grandcolas, P. (2020). Insect decline: immediate action is needed. *Comptes Rendus. Biologies*, 343(3), 267-293.
8. Krischik, V., Rogers, M., Gupta, G. and Varshney, A. (2015). Soil-applied imidacloprid translocates to ornamental flowers and reduces survival of adult *Coleomegilla maculata, Harmonia axyridis,* and *Hippodamia convergens* lady beetles, and larval *Danaus plexippus* and *Vanessa cardui* butterflies. *PloS one*. 10(3), e0119133
9. Martins, D.J. and Johnson, S.D. (2013). Interactions between hawkmoths and flowering plants in East Africa: Polyphagy and evolutionary specialization in an ecological context. *Biological Journal of the Linnean Society*. 10, 199–213.
10. Mitchell, E.A.D., Mulhauser, B., Mulot, M., Mutabazi, A., Glauser, G., and Aebi, A. (2017). A worldwide survey of neonicotinoids in honey. *Science.* 358, 109–111.
11. Raghavendra, K. V., Boopathi, T., Gowthami, R. and Keerthi, M.C. (2022). Insects: biodiversity, threat status and conservation approaches. *Current Science.* 122(12), 1374-1384.
12. Whittaker, J.B. (2001). Presidential address: Insects and plants in a changing atmosphere. *Journal of Ecology*. 89(4), 507-518.
13. Sankarganesh, E. (2017). Insect Biodiversity: The Teeming Millions- A review. *Bulletin of Environment, Pharmacology and Life Sciences*. 6(3), 101-105.
14. ZSI, (2012). COP XI publications. www.zsi.gov.in/Cop-11/cop-11.html/.
15. Stork, N.E. (2018). How Many Species of Insects and Other Terrestrial Arthropods Are There on Earth? *Annual Review of Entomology*. 63(1), 31–45.