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Contents

Insects and Human Life: A Delicate Balance worth Celebrating

Dr. R.K. Gupta

(Prof. & Head), Division of Entomology, SKUAST-Jammu

As we observe *Insect Appreciation Day*, it's time to shift our observation towards these small creatures that play big roles in sustaining life on Earth. Often dismissed as pests or nuisances, **insects** are, in truth, among the most important organisms in our ecosystem. From the honeybee to the humble ant, insects are not just vital for biodiversity, they are essential for human survival. Insects are the *unseen workforce* of the planet. They pollinate crops, break down waste, control other pest populations, and serve as a food source for countless animals. About 75% of the world's flowering plants and nearly 35% of global food crops depend on animal pollinators most of which are insects. Without bees, butterflies, beetles, and other pollinators, global food security would be under threat interestingly but **if insects disappeared from the Earth?** The consequences would be *catastrophic*. Crops that rely on pollination would fail, leading to severe food shortages and economic crises. Plants would die off, and with them, the animals including humans that depend on them. Waste and dead organic matter would pile up without decomposers like beetles and flies. The entire food chain would collapse, and biodiversity would plummet. In short, the absence of insects could lead to ecological disaster and even threaten human existence. Yet, despite their importance, insects are facing *massive population declines* due to habitat loss, pesticide use, climate change, and pollution. A world with fewer insects is a world that risks ecological collapse. Imagine a spring without bees buzzing or flowers blooming this is not just poetic loss, but a warning of environmental imbalance. Moreover, insects have long been a part of human culture and medicine. From silk production by silkworms to the use of beetle shells in dyes, their impact stretches beyond ecology into economics and industry. Even in modern science, insects are studied for insights into robotics, pharmaceuticals, and sustainable protein sources.

Insects offer sustainable life Inspirations for technological advancements, particularly in the field of biomimicry, where nature's designs are harnessed to solve human engineering challenges. The Namib Desert beetle, for instance, has inspired innovations in water-harvesting technologies, with its remarkable ability to collect moisture from the air, a property now being replicated in systems aimed at addressing water scarcity. Similarly, the structure of moth eyes, which are uniquely designed to minimize light reflection, has influenced the development of anti-reflective coatings for screens and solar panels, enhancing efficiency and visibility. In

addition, the compound eyes of insects, which allow them to perceive a wide field of vision with exceptional precision, have shaped the design of advanced optical sensors and wide-angle cameras used in various industries, including security and medical imaging. The tunnel-building techniques of fire ants have also been adapted to the creation of stable underground structures, providing insights into engineering resilient infrastructures, as well as inspiring the development of swarm robotics for search-and-rescue missions. These examples demonstrate how the study of insect physiology and behavior can lead to breakthroughs across a wide range of fields, from sustainable technologies to advanced robotics, proving that even the smallest creatures can spark some of the most innovative solutions in modern science and engineering. Nearly 77 percent of animal are insects. They evolved to serve us not to hurt us. Human or ecological interventions are responsible for making them pests on crops or our possessions but they are more than allies to us not enemies. We must conserve them as they are threatened. Let's explore and inspire from them for saving this planet. For those interested in exploring the fascinating world of insects, the *Division of Entomology at Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST), Jammu*, houses an Insect Museum. This facility serves as a repository for preserved insect specimens and offers insights into their ecological roles and significance. The museum is an educational resource for students, researchers, and the general public, fostering a deeper understanding of entomology and biodiversity. On this *World Insect Appreciation Day*, let us not merely acknowledge the role of insects but also renew our commitment to protecting them. Conservation begins with awareness. Planting pollinator-friendly gardens, reducing pesticide use, and supporting biodiversity initiatives are steps each of us can take. Insects are not just bugs in the background; they are engineers of life on Earth. In the intricate web of existence, humans and insects are more interconnected than we often realize. A world without insects is a world that cannot sustain human life. It's time we give them the respect and protection they truly deserve.

Insect Diversity in Jammu and Kashmir: A Keystone of Ecological Stability in the Northwestern Himalayas

Kamlesh Bali and Ranjana Bali

Division of Sericulture, SKUAST-Jammu

The northwestern Himalayan region of Jammu and Kashmir, characterized by its altitudinal gradients, climatic heterogeneity and rich vegetation zones, harbors a remarkable diversity of insect fauna, making it a vital repository of entomological biodiversity in the Indian subcontinent. Stretching from the lower Shiwalik foothills to the alpine meadows and glacial ecosystems, this fragile eco-region supports an array of micro-habitats that nurture both endemic and migratory insect species. From soil-dwelling collembolans in pine and oak forests to high-altitude bumble bees and butterflies in the alpine pastures, the ecological amplitude of insect diversity here is profound. Insects perform essential ecological functions *viz*., pollination, decomposition, nutrient cycling, biological pest regulation and acting as food resources for higher trophic levels. Pollinator insects, particularly bees, flies, butterflies, beetles and moths are indispensable in maintaining reproductive cycles of wild flora and cultivated crops like apple, walnut, saffron, buckwheat, maize and rajmash. In forest ecosystems, decomposer groups such as termites, saprophagous beetles and detritivore fly larvae contribute to the rapid turnover of organic matter, facilitating soil fertility and carbon sequestration. Moreover, parasitoids and predators such as ichneumonid wasps, coccinellids, and lacewings regulate the population of phytophagous pests, ensuring natural ecological balance. Several bio-indicator species recorded from alpine and temperate zones like certain species of hoverflies, dragonflies and aquatic insects that provide crucial insights into environmental quality, particularly in response to climate variability and anthropogenic pressures. However, despite its richness, systematic documentation of insect taxa in this region remains inadequate. Fragmented taxonomic studies, limited baseline data and lack of region-specific insect checklists have hindered our understanding of species distributions, endemism and conservation priorities. The need for comprehensive surveys using integrative taxonomy combining morphological, molecular and ecological approaches is more urgent than ever, especially as many native insect populations face habitat degradation, chemical contamination and climate-driven shifts in range and phenology.

Emerging research and ground-level observations over the past decade indicate that the insect diversity in Jammu and Kashmir is undergoing significant stress due to rapid land use changes, deforestation, agricultural intensification and unsustainable developmental practices. Native pollinators such as solitary bees, stingless bees and syrphid flies are showing signs of population decline in apple-growing belts of Kashmir Valley and dry temperate zones of the Chenab basin. Simultaneously, forest-dependent insects like longhorn beetles, saproxylic wasps and wood borers are losing ground due to the

diminishing availability of deadwood and natural cavities in overexploited forests. Alpine meadows, traditionally home to diverse butterfly assemblages, are now exhibiting a decrease in species richness and abundance, with several species being locally extinct due to rising temperatures and changes in alpine floral communities. The cascading effects of these losses are beginning to reflect in ecosystem productivity, plant regeneration and wildlife food chains, posing risks not just to biodiversity but also to livelihood security of communities dependent on forest-based resources. To address this growing concern, coordinated efforts involving entomologists, forest ecologists, agricultural scientists and policymakers are essential. Recent initiatives under biodiversity conservation and climate-resilient agriculture in the Union Territory have attempted to restore insect habitats by broadcasting native flowering seeds, creating micro-niches for nesting and restricting pesticide use in buffer zones. Academic institutions like SKUAST-Jammu and research stations in the Pir Panjal and Zanskar ranges are gradually building insect repositories and conducting baseline studies to develop insect conservation models that integrate with agro-forestry and forest management plans. However, the momentum must accelerate. It is imperative for the academic community to foster interdisciplinary collaborations, enhance insect taxonomic expertise, engage local communities through citizen science and embed insect conservation into environmental education. For students of biological sciences, entomology offers not just academic fulfillment but also a pragmatic pathway to contribute to ecosystem restoration, food security and climate change mitigation. Insects, despite their diminutive size, represent the foundation of ecological integrity. Their conservation in the northwestern Himalayas is not a standalone task but a critical necessity to sustain the natural heritage, cultural resilience and agricultural prosperity of Jammu and Kashmir.

Tiny Beetles, Big Wonders: A Taste of Insect Week

Kapil Attri

Research Scholar, Division of SAericulture

Every year, Insect Week reminds us of the incredible diversity, resilience, and usefulness of the smallest creatures that share our world. Among these tiny marvels is an often-overlooked insect with a fascinating story: the **Mexican water beetle**, locally known as the **Acocil**.

Native to the wetlands and seasonal floodplains of **Oaxaca, Mexico**, these tiny aquatic beetles have been part of human history for centuries—not just as a curiosity, but as a food. Harvested by hand from shallow waters, they are gently toasted over fire and sprinkled as a flavorful, protein-rich garnish in traditional dishes. These beetles have a crunchy texture and a nutty, smoky taste that delights locals and surprises visitors alike. But the Acocil is more than just a culinary ingredient—it represents a perfect fusion of sustainability, nutrition, and culture.

Nature's Sustainable Superfood

Water beetles like the Acocil are **rich in protein, healthy fats, and essential micronutrients**. Unlike conventional livestock, they require no farmland, minimal water, and leave a tiny environmental footprint. Their short life cycles and efficient reproduction make them an **eco-friendly source of nutrition** in regions where resources are scarce.

Eating insects, known as **entomophagy**, is not just a trend—it's a practice with deep roots in indigenous cultures. In Oaxaca, children grow up watching elders collect beetles and prepare them as part of everyday meals, connecting generations through a shared appreciation of the natural world.

Guardians of Wetland Ecosystems

Beyond their value as food, these beetles are vital players in their ecosystems. As scavengers and prey, they help **maintain a balanced aquatic environment**, contributing to the health of rice fields and wetlands. Their presence indicates clean, oxygen-rich water—a sign of ecological wellbeing. Protecting such insects means preserving the very ecosystems that sustain biodiversity and human livelihoods.

Rethinking the Small Things

This Insect Week, the humble Acocil challenges us to rethink our relationship with insects. Can a tiny beetle nourish a family? Yes. Can it sustain an ecosystem? Absolutely. Can it connect culture, conservation, and cuisine? Without a doubt.

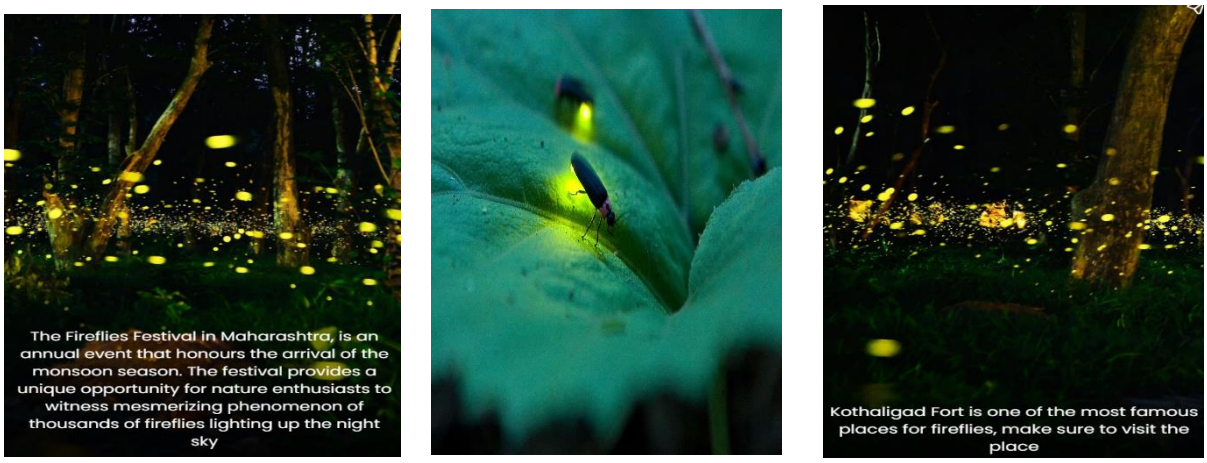
In celebrating insects, we also celebrate the **interconnectedness of life**. From the plate to the pond, from tradition to innovation, insects like the Acocil prove that even the smallest creatures can leave a powerful legacy. So, as we mark Insect Week, let us open our eyes—and perhaps our minds—to the idea that wonder often comes in tiny, unexpected forms. Let's stand tall for the small and honour the wings and wonders that make our planet thrive.

The Dimming Light: How We Lost Our Childhood Fireflies

Marvi Khajuria and R.S. Bandral

Division of Entomology, SKUAST-Jammu

Summer evenings once sparkled with nature's own light show. Children would race across lawns with mason jars, chasing the magical blink of fireflies dancing through warm twilight air. For generations, these luminous beetles were as much a part of childhood as scraped knees and ice cream trucks. Today, that enchanting glow is fading from our landscapes, taking with it a piece of wonder that defined countless summer memories. The decline of fireflies represents more than just the loss of an insect species,it signals the erosion of an entire childhood experience. Where backyards once twinkled with dozens of tiny lanterns, many children now see only darkness. The simple joy of cupping a gentle firefly in small hands, watching its cool green light pulse against tiny palms, has become increasingly rare .



Fireflies festival in Maharashtra (What is fireflies festival? Five places in Maharashtra to spot fireflies)

The Perfect Storm of Decline

Multiple factors have conspired against these beloved insects, creating a cascade of threats that has dramatically reduced firefly populations worldwide. Light pollution stands as perhaps the greatest threat, as fireflies communicate through their bioluminescent signals, with males flashing specific patterns to attract females of their species. Each species has its own unique flash pattern—some blink rapidly, others create long glowing trails, and some flash in synchronized waves. The artificial glow from streetlights, building illumination, electronic billboards, and even porch lights creates a chaotic backdrop that drowns out these vital courtship conversations. In areas saturated with human lighting, fireflies simply cannot find each other to mate, leading to reproductive failure and population collapse. Habitat destruction compounds the problem severely, as fireflies require specific environments to complete their complex life cycle—moist soil rich in organic matter for their larvae, which can spend

up to two years underground feeding on worms and slugs, and tall grasses, shrubs, or wooded areas for adults to hide during the day. As suburbs expand and wild spaces shrink, these critical habitats disappear. The manicured lawns that replaced natural meadows offer little refuge for creatures that evolved in diverse, layered ecosystems with fallen logs, leaf litter, and varied vegetation heights. Rapid urban development fragments firefly habitats, creating isolated patches too small to sustain viable populations, while roads and buildings create barriers that prevent fireflies from moving between suitable areas, leading to genetic isolation and reduced population resilience.

Pesticide and herbicide use adds another devastating layer of threat, as the chemicals designed to eliminate "pest" insects don't discriminate, affecting beneficial species like fireflies throughout their life cycle. Lawn treatments kill firefly larvae in the soil, while insecticides eliminate adult fireflies along with their prey species. Even organic pesticides can harm fireflies, and well-intentioned homeowners treating their lawns unknowingly contribute to the decline of these harmless creatures that once brought such delight to their own childhoods.

Climate Disruption and Environmental Stress

Climate change has altered the delicate timing that fireflies depend upon for survival. Their emergence patterns, synchronized with seasonal temperature and moisture cues for thousands of years, now face unpredictable weather patterns. Extended droughts affect the moist soil conditions their larvae require, while unseasonable temperature swings can disrupt their development cycles. Extreme weather events—from floods to heat waves—can devastate local populations before they have a chance to recover. Rising temperatures also affect firefly behavior directly, as many species are most active within specific temperature ranges, and climate change pushes some areas beyond their comfort zones. Additionally, changing precipitation patterns alter the availability of the small invertebrates that firefly larvae depend on for food.

Fireflies: Unsung Heroes of the Ecosystem

The loss extends far beyond childhood memories and nostalgic summer evenings, as fireflies serve crucial ecological roles that make them keystone species in many environments. Firefly larvae are voracious predators, consuming vast quantities of garden pests including slugs, snails, cutworms, and other soft-bodied insects that damage crops and garden plants. A single firefly larva can consume dozens of slugs during its development, providing natural pest control worth millions of dollars in agricultural savings, making them invaluable allies to farmers and gardeners seeking sustainable pest management solutions.

Adult fireflies serve as important food sources for numerous species, as spiders, birds, frogs, and other insects rely on fireflies as prey, while firefly larvae themselves consume other invertebrates. Their decline creates gaps in food webs that can cascade through entire ecosystems, affecting everything from bird populations to soil health. Some firefly species contribute to pollination, visiting flowers for nectar

and inadvertently transferring pollen between plants. While not as significant as bees, their role in pollinating certain native plants adds another layer to their ecological importance.

Perhaps most importantly, fireflies serve as "canaries in the coal mine" for ecosystem health. Their presence indicates clean water, healthy soil, and minimal chemical contamination, while their absence often signals broader environmental problems that affect many other species. Scientists use firefly population data to assess the overall health of ecosystems and track environmental changes over time, making their conservation crucial for understanding and protecting entire natural communities.

Rekindling the Light: A Comprehensive Conservation Strategy

Hope remains for restoring firefly populations, but it requires coordinated action at individual, community, and policy levels. Simple changes can make profound differences, starting with reducing outdoor lighting, especially during firefly season (typically May through September), to give these insects a chance to communicate. Switching to warm-colored LED lights, installing motion sensors, and shielding lights to direct them downward rather than into the sky can help, while turning off unnecessary lighting during peak firefly hours around dusk provides critical dark periods for mating displays. Creating firefly-friendly gardens involves planting native vegetation, avoiding pesticides completely, and leaving some areas of property wild with fallen logs, leaf litter, and unmowed grass where larvae can develop. Maintaining moist soil conditions through natural mulching rather than frequent watering helps support the two-year larval development cycle that these insects require. Communities are beginning to recognize fireflies as indicators of environmental health, with some cities implementing "dark sky" initiatives that reduce unnecessary lighting to help both fireflies and human stargazers. These programs involve retrofitting streetlights with shields, establishing lighting ordinances, and creating dark corridors that connect firefly habitats. Citizen science projects like Firefly Watch and iNaturalist now track firefly populations, engaging the public in conservation efforts while allowing ordinary people to contribute valuable scientific data. Protecting and restoring habitat requires policy intervention, including land conservation efforts, wetland protection, and requirements for developers to maintain wildlife corridors that all contribute to firefly conservation. Agricultural policies that incentivize reduced pesticide use and organic farming practices help protect firefly populations in rural areas, while education programs teach children about fireflies and their ecological importance, creating the next generation of conservationists through school programs, nature centers, and community education initiatives. The children who once chased fireflies are now adults with the power to ensure future generations experience the same wonder. By understanding the complex threats these creatures face “from light pollution and habitat loss to climate change and chemical contamination” and taking comprehensive action to address these challenges, we can work to restore the magical summer evenings that defined our youth. The fireflies' gentle glow reminds us that some of life's greatest joys come from the smallest, most fragile sources, and that protecting these remarkable insects means preserving entire ecosystems that support countless other species. Their conservation is not just about

nostalgia—it's about maintaining the intricate web of life that sustains our natural world and ensuring that future children can still experience the wonder of chasing tiny lights through summer darkness.

The tiny giants: why insects deserve a week of celebration

Zinat-un-Nissa

Ph.D. Research Scholar, Division of Entomology, FoA, SKUAST-Jammu

Insects are often overlooked, yet they play indispensable roles in our ecosystems, agriculture, and daily lives. Dedicating a week to celebrate these tiny creatures not only acknowledges their contributions but also raises awareness about their conservation. Here's why insects deserve a week of celebration:

1. Pollinators of Our Food Supply

Insects like bees, butterflies, beetles, and flies are vital pollinators. They facilitate the reproduction of over 80% of flowering plants, including many crops that constitute a significant portion of the human diet. Without their pollination services, we would face a drastic reduction in fruits, vegetables, and nuts, impacting global food security

2. Nature's Decomposers

Insects such as dung beetles, ants, and certain fly species are nature's cleanup crew. They break down organic matter, recycling nutrients back into the soil, which promotes plant growth and maintains soil health. This decomposition process is essential for ecosystem sustainability.

3. Natural Pest Controllers

Predatory insects like ladybugs, lacewings, and parasitic wasps help control populations of agricultural pests. By keeping pest numbers in check, they reduce the need for chemical pesticides, promoting healthier crops and reducing environmental pollution.

4. Fundamental to Food Webs

Insects are a primary food source for many animals, including birds, amphibians, reptiles, and mammals. Their abundance and diversity make them a crucial link in food chains, supporting biodiversity and ecosystem stability

5. Indicators of Environmental Health

The presence and diversity of insect populations are indicators of environmental quality. Declines in insect numbers can signal habitat loss, pollution, or climate change impacts. Monitoring insect populations helps scientists assess ecosystem health and implement conservation strategies.

6. Inspiration for Culture and Innovation

Insects have inspired art, literature, and technological innovations. Their unique structures and behaviours have led to advancements in robotics, materials science, and more. Celebrating insects fosters appreciation for their influence beyond ecology.

7. Economic Contributors

Beyond pollination, insects contribute to economies through products like honey, silk, and dyes. Beekeeping, for instance, is a significant industry in many countries, providing livelihoods and supporting agriculture.

8. Facing Alarming Declines

Despite their importance, many insect species are declining due to habitat destruction, pesticide use, and climate change. A week dedicated to insects can highlight these issues, promoting conservation efforts to protect these vital creatures.

9. Engaging Educational Opportunities

Insect Week events, such as bug hunts, workshops, and citizen science projects, engage communities in learning about insects. These activities foster curiosity, scientific understanding, and a connection to nature, especially among children.

10. Empowering Conservation Actions

Celebrating insects encourages actions like planting pollinator-friendly gardens, reducing pesticide use, and supporting habitat restoration. Individual and collective efforts during Insect Week can lead to meaningful conservation outcomes.

Insects are integral to life on Earth. Dedicating a week to celebrate them not only honours their contributions but also promotes awareness and actions to ensure their survival. By understanding and appreciating insects, we take a step toward preserving the intricate web of life they support.

From Scare to Care: Changing the way we see insects

Goldy Fhonsa* and Uma Shankar

Division of Entomology, SKUAST-Jammu

*Email: goldyfhonsa@gmail.com

Insects evoke diverse reactions, often ranging from fascination to disgust, yet these reactions frequently overshadow their intricate complexity and ecological importance. They are crucial for pollination, decomposition, and nutrient cycling, underpinning ecosystem stability. Beyond their ecological roles, insects provide us with valuable resources like honey and silk, inspire medical advancements and technological innovations. Insect photography, videography and museums can exhibit their incredible colours, patterns, and behaviours and dispel the fears and misconceptions that many people have about them. Habitat loss, urbanization, and pesticide use are decimating insect populations. Raising awareness is essential for conserving these vital creatures and preserving their diverse forms for the critical services they provide.

Fear Rooted in Perception, Not Reality

Human disgust to insects frequently stems from psychological, rather than biological factors. Entomophobia, the fear of insects, is primarily triggered by their appearance and movement, even though only a small number of insects are dangerous. While most insects are harmless, and many are beneficial, children typically display an innate curiosity towards them, a tendency that is often suppressed by societal influences. This suggests that the fear of insects is a learned behaviour, and therefore, potentially reversible.

Insects: The Architects of Ecosystems

Long Geological History (250-500 MYA) of insects reflect that they are the founders in sustaining life on this earth planet. They pollinate more than 75% of the world's flowering plants Fig 1A, including essential food crops. They decompose organic matter, recycle nutrients (Fig 1B), control pest populations, and serve as food for birds, reptiles, mammals, and even other insects. If we learned to see insects not as invaders, but as invisible engineers of life, our treatment of them- and our environment would shift profoundly.

Fig 1: (A) Bees foraging on Sunflower (B) Termite mound

Beauty Beyond the Microscope

For centuries, insects have inspired art, innovation, and science. The iridescent wings of jewel beetles and the camouflage of stick insects have led to breakthroughs in material science and design. The compound eyes of flies have influenced camera technology. Honeybees have even shaped our understanding of communication through their intricate waggle dance. Their lives are works of evolutionary art - sharpened through hundreds of millions of years of adaptation. To fear them without trying to understand them is to miss out on a living library of natural intelligence. They are not merely creatures of function - they are artists, architects, and engineers in miniature form.

The Real Scare: Insect Decline

Ironically, the greatest threat to insects comes from humans, not the other way around. The alarming "Insect Apocalypse," characterized by a sharp global decline in insect populations, is driven by factors like pesticide use, light pollution, climate change, and habitat destruction. This decline pushes even common species toward extinction, resulting in a loss of biodiversity and a systemic unravelling of ecosystems. The disappearance of insects leads to reduced pollination, declining soil health, reduced bird populations, and potential food system collapse. The real cause for concern is not the presence of insects, but their potential absence.

From Fear to Care: Building a Kinder Relationship with Insects

Insects are crucial for healthy ecosystems, contributing to pollination, nutrient cycling, and natural pest management. Supporting insect populations through habitat restoration, reduced pesticide application, pollinator gardens and parks, and insect hotels can aid in the survival of these species and promote native plant diversity.

To foster a shift in how we perceive insects, education, and increased awareness are crucial. which involves teaching entomology to promote understanding, creating habitats that cater to insects, adopting safer technologies to minimize harm, and reshaping cultural narratives to move away from fear. By replicating the strategies used to improve attitudes toward other misunderstood animals, we can encourage coexistence with insects. By shifting our perspective from fear to appreciation, we can work towards a more harmonious coexistence. Insects play a vital role in maintaining the balance of

ecosystems, and their contributions are indeed "quiet miracles" that often go unnoticed. By recognizing their value and dignity, we can take steps towards preserving biodiversity and promoting sustainability for grand scheme of life on earth planet. The smallest creatures, often feared or ignored, hold the greatest lessons: about resilience, cooperation, and the quiet power of life in its most intricate web of life form.

Let us listen, learn, and care - before it's too late.

Tiger Beetle: Fastest and Furious Insects on Land

Shriya Sharma* and Uma Shankar

Division of Entomology, FoA, SKUAST-Jammu

*Email: shriyasharma1324@gmail.com

Tiger beetles, belonging to the family Cicindelidae, represent a captivating group of predatory insects renowned for their exceptional speed and striking patterns. These beetles are found in diverse habitats across the globe, exhibiting a remarkable adaptation to varied ecological *niches*. Over 2,900 species are known worldwide (Pearson *et al*., 2020). India has about 220 species, with 114 endemic species (Uniyal *et al*., 2007). There are 241 species of tiger beetles found in India which holds a record of the third highest number of any country in the world. Impressively, 118 of these species are found only within the borders of India (Pearson *et al*., 2020). Characterized by their elongated legs, large mandibles, and iridescent exoskeletons, tiger beetles possess exceptional hunting skills, preying on a wide range of insect pest. Their life cycle typically involves a larval stage spent in subterranean burrows, where they ambush passing prey. Adult tiger beetles are often observed running rapidly across open ground in pursuit of their next meal, exhibiting their impressive agility and predatory hunting valor. The combination of their vibrant coloration, remarkable speed, and crucial role in controlling insect pest populations that enables tiger beetles a subject of considerable interest to both entomologists and nature enthusiasts.

The following facts make them a fascinating, ideal and promising biocontrol agents in different ecosystems.

1. **Fastest Insects on Land:** Tiger beetles are renowned for their incredible speed, holding the record as some of the fastest-running insects on Earth. This remarkable velocity is not merely a fascinating biological trait but a critical adaptation for their predatory lifestyle. Reaching speeds of up to 5 miles per hour (8.5 km/h), these beetles use their swiftness to effectively chase

down and capture prey. Their exceptional eyesight, coupled with their rapid movement, allows them to locate and intercept other insects with remarkable accuracy. The speed of tiger beetles is a testament to the power of natural selection, displaying how specialized adaptations can evolve to enhance survival and predatory success in the insect world.

2. **Ferocious Predators:** Tiger beetles, though small in stature, exemplify ferocity in the insect world. They are renowned for their distinctive "run and chase" predatory behaviour. This strategy is characterized by rapid bursts of speed interspersed with brief pauses. However, their speed comes at a cost: during these high-speed sprints, tiger beetles are temporarily blind, necessitating frequent stops to reassess their surroundings and relocate their targets. This unique adaptation highlights the evolutionary trade-offs between speed and sensory perception in the natural world. Adult tiger beetles possess powerful mandibles that they use to seize and macerate their prey, which includes a variety of insects, ants, spiders, and other small invertebrates. Their larval stage is equally predatory; the larvae reside in subterranean burrows, ambushing unsuspecting prey that ventures too close.
3. **Excellent Vision:** Tiger beetles have large compound eyes which give them excellent vision—helping them detect movement and avoid threats.
4. **Iridescent or metallic coloured bodies:** The iridescent or metallic hues displayed on their exoskeletons are not merely ornamental but serve complex functions. These vibrant colours arise from the microscopic structure of the beetle's cuticle, which interacts with light to produce structural colouration. This phenomenon, unlike pigmentation, relies on the physical properties of the surface to generate colour. The resulting iridescence, where colours shift with the angle of observation, and metallic reflections contribute to camouflage, thermoregulation, and potentially, communication. The specific colours and patterns vary significantly among tiger beetle species, reflecting adaptations to their diverse habitats and lifestyles. The study of these intricate colour mechanisms offers valuable insights into the fields of biomimicry and materials science, inspiring the development of novel optical technologies.

5. **Heat Avoidance Behaviour:** In hot environments, they engage in stilting-lifting their bodies off the hot ground with extended legs to stay cool.

6. **Habitat Variety:** They exhibit a diverse array of habitat preferences, reflecting their adaptation to varied ecological *niches*. These predatory insects are found across the globe, occupying environments ranging from sandy beaches and riparian zones to woodlands and grasslands. A key factor influencing habitat selection is substrate composition; many species favour sandy or loamy soils that facilitate burrowing for larval development and provide suitable hunting grounds for adults. Moisture levels also play a crucial role, with some species thriving in arid conditions while others are restricted to moist or even aquatic habitats. Furthermore, vegetation cover influences tiger beetle distribution, as different species exhibit preferences for open, sparsely vegetated areas or more densely vegetated environments. Microclimatic conditions, such as temperature and sunlight exposure, are also important determinants of habitat suitability.
7. **Larval Hunters:** These ambush hunters construct vertical burrows in the soil, patiently awaiting unsuspecting prey. Their flattened heads and powerful mandibles are perfectly suited for seizing insects and other small invertebrates that venture too close to the burrow entrance. A unique adaptation is the presence of hooks on their abdomen, which anchor them firmly within their burrows, preventing struggling prey from pulling them out. This combination of stealth, specialized morphology, and secure anchoring makes tiger beetle larvae highly effective predators in their hidden world.
8. **Conservation:** Tiger beetles, a diverse group of predatory insects, face increasing threats that necessitate conservation efforts. Habitat loss, primarily due to deforestation and urbanization, deprives these beetles of their essential hunting grounds and breeding sites. Climate change further exacerbates the situation, altering their natural ranges and disrupting their life cycles. Pollution, particularly from pesticides, directly diminishes their prey populations.
    a) Effective conservation strategies are crucial for the survival of these ecologically important insects.

b) Habitat preservation and restoration are paramount, requiring the protection of existing natural areas and the creation of new habitats suitable for tiger beetles.

c) Reducing pesticide use and promoting sustainable agricultural practices can minimize the harmful effects of pollution

d) Public awareness campaigns can also play a vital role in fostering appreciation for these fascinating creatures and promoting responsible environmental stewardship.

e) Some species are **endangered or threatened** which needs a dire attention for their conservation as important indicators of ecosystem health.

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Pollinators in Peril: Securing Agricultural Future through Insect Biodiversity Conservation

Ranjana Bali

(SRF, DBT Project, PR-39667)

Pollinators are nature's silent allies, playing a critical role in maintaining the integrity of ecosystems and ensuring the productivity of agricultural systems. From the subtle flutter of butterflies to the industrious hum of native bees, insect pollinators mediate the reproductive success of nearly 75% of the world's food, fiber, oilseed and forage crops. In India, this includes vital produce such as mustard, litchi, guava, tomato, apple, mango, sunflower and cardamom. Beyond food, their services contribute to forest regeneration, soil stabilization and biodiversity conservation. Among the insect pollinators, bees both wild and domesticated remain the most efficient, but butterflies, moths, hoverflies, beetles and wasps also provide indispensable contributions. Pollinators not only increase the yield but also improve crop quality by enhancing fruit set, seed viability and nutrient content. Despite their foundational role, pollinators today face an existential crisis driven by multiple anthropogenic pressures. Rapid urbanization, unregulated monocultures and large-scale deforestation are eliminating their nesting and foraging grounds. The indiscriminate use of synthetic pesticides, especially neonicotinoids and fungicide mixtures directly impacts their neurobiology, reproduction and navigation. Climate change adds another layer of complexity, disrupting phenological synchrony between flowering times and pollinator activity, while new challenges such as emerging pathogens (Nosema, deformed wing virus) and invasive species (*Varroa destructor* mites, *Apis mellifera* competition) further aggravate their decline. In regions like Himachal Pradesh, farmers are already witnessing falling apple yields due to inadequate pollination services; in Rajasthan, mustard productivity is being undermined by the dwindling presence of native bee populations. Forest ecosystems in the northwestern Himalayas report a sharp decline in non-Apis pollinators like solitary bees and syrphid flies, with a consequent drop in fruiting of wild plants threatening food chains and livelihoods dependent on these landscapes.

Amid this crisis, hope emerges through strategic interventions and community-based conservation. Across India's Himalayan landscapes and forest-fringe villages, researchers and forest managers are working collaboratively to restore pollinator populations by sowing nectar-rich, native flowering plants and building artificial nesting structures for solitary bees. Notable improvements in insect activity and wild fruiting rates have been recorded within a single growing season. Conservation beekeeping focusing on indigenous species like *Apis cerana indica* and stingless bees (*Trigona* spp.) is being increasingly promoted for their adaptability to local ecosystems and lower competition with wild pollinators. These bees offer ecological and economic benefits, including sustainable honey, wax and propolis production, thereby enhancing rural incomes. Furthermore, ecological farming practices such

as intercropping, agroforestry, use of biopesticides, maintaining wildflower strips and rotating diverse crops can substantially enhance pollinator habitats. Programs like the National Beekeeping and Honey Mission (NBHM) should be expanded to include wild and non-Apis pollinators and linked with employment schemes like MGNREGA to integrate pollinator conservation into rural development and forest restoration. Education and awareness also play a pivotal role: incorporating pollination ecology into academic curricula and promoting citizen science initiatives like pollinator gardens, butterfly surveys, and insect monitoring can instill conservation values early on. On the scientific front, long-term, multi-location studies using tools like GIS, molecular barcoding and AI-based pollinator identification are essential to map pollinator populations, understand threats, and develop targeted action plans. Cross-disciplinary collaboration among entomologists, botanists, agronomists, and ecologists will be vital to ensure the sustainability of our pollinator-dependent systems. In conclusion, pollinators are the linchpins of food security, biodiversity, and ecological resilience. Their protection is not merely an environmental obligation but a strategic imperative for securing the future of agriculture, human health, and climate stability. As guardians of the biosphere, scientists and students alike must rise to the challenge of transforming research into action and awareness into advocacy. In the grand orchestra of nature, pollinators are silent players keeping ecosystems in harmony ensuring their survival is ensuring our own.

Threads of Change: Empowering Rural Women through Sericulture

Monika Attri

Ph.D. Research scholar, Division of Sericulture, SKUAST-Jammu.

email: monikaattri7786@gmail.com

In the quiet lanes of India's villages, where agriculture still anchors daily life, a silent revolution is unfolding woven not with banners or protests, but with silk threads and the determination of women. At the heart of this transformation is an unlikely hero: the silkworm. Once seen merely as a source of luxury fabric, this humble insect is now empowering women to spin their way to dignity, resilience and leadership. Sericulture, a time-honored practice rooted in tradition, is being reimagined as a force for economic independence and social change, with rural women leading the charge.

Sericulture, the cultivation of silkworms for silk production involves activities that can be performed at home, making it an ideal enterprise for women, especially in remote and underserved areas. What was once considered supplementary farm work has now become a pathway to entrepreneurship, innovation and community revival. For women burdened with unpaid domestic labour, sericulture provides not only flexibility and seasonal income, but also a renewed sense of purpose and power. No longer confined to feeding silkworms and spinning cocoons, today's women sericulturists are embracing scientific training, sustainable practices and business leadership with conviction.

Crucial to this transformation are forward-thinking policies and inclusive schemes like "Silk Samagra" and the National Rural Livelihood Mission (NRLM). These initiatives have democratized access to quality silkworm seeds, technical training, microfinance and market linkages. Across states like Karnataka, Assam, Tamil Nadu, and Jammu & Kashmir, women are now not just participating in silk farming. They are reviving a traditional industry and redefining its future. They are not just earning; they are leading and revolutionizing.

There are many inspiring stories comes from different parts of India, where rural women are breathing new life into Sericulture. As women organize into self-help groups (SHGs), they gain access to collective bargaining, shared infrastructure and enhanced social capital. Many have gone on to explore value-added products such as silk weaving, eco-dyeing, silk-waste jewellery and handcrafted fabrics; catering to both domestic and global markets.

This growing movement is not only rejuvenating a traditional industry, also it is reshaping gender norms and community dynamics. In many villages, they have become symbols of self-reliance and resilience, inspiring younger generations to dream beyond boundaries.

Sericulture, once a modest rural craft, is being revolutionized by the hands of determined women. It is not just producing silk but also producing leaders, innovators and changemakers. Their work revives not only the fabric of a forgotten economy but also the spirit of empowerment woven deep into our cultural heritage.

As we celebrate Insect Appreciation Week, let us pause to honor the tiny creature at the center of this quiet revolution.

"*The silkworm may not buzz or sting, but in the hands of rural women, it spins threads of strength, revival and unstoppable transformation.*"

Life Below Water: The Fascinating World of Aquatic Insects

Ellulla Praveena* and Magdeshwar Sharma

Division of Entomology, SKUAST-Jammu

*Email: praveenaellulla2398@gmail.com

Aquatic insects, though often overlooked, play a pivotal role in freshwater ecosystems across the globe. These insects, either spending part or all of their lives in water, are crucial components of the aquatic food web and act as bioindicators of ecosystem health. From the slow-moving waters of ponds to the rushing streams of mountainous regions, aquatic insects display an incredible diversity in form, function, and ecological significance.

Diversity and Adaptations

Aquatic insects belong to several orders, including *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), *Trichoptera* (caddisflies), *Odonata* (dragonflies and damselflies), *Hemiptera* (water bugs), and *Coleoptera* (aquatic beetles). Their adaptations to aquatic life are as varied as their taxa. Gills, air bubbles, and plastrons (a type of physical gill) are among the fascinating respiratory structures that evolved to breathe underwater. Some larvae build protective cases from sand and debris, like *Trichoptera,* while others, such as *Dytiscidae* beetles, are efficient predators with hydrodynamic bodies.

Ecological Role

Aquatic insects occupy multiple trophic levels—herbivores, detritivores, predators, and prey. They contribute to nutrient cycling by breaking down organic matter and serving as a primary food source for fish, amphibians, and birds. Their presence and abundance often reflect the quality of freshwater systems. Sensitive taxa such as *Ephemeroptera, Plecoptera,* and *Trichoptera* (EPT) are commonly used in water quality assessments.

Indicators of Ecosystem Health

Due to their sensitivity to pollutants, temperature, oxygen levels, and habitat alterations, aquatic insects are widely employed in biomonitoring programs. A decline in their populations often signals deteriorating water conditions, making them valuable sentinels of freshwater biodiversity and environmental change.

Threats and Conservation

Despite their importance, aquatic insects face multiple threats including habitat destruction, pollution, climate change, and invasive species. Urbanization and agriculture often lead to sedimentation and contamination of water bodies. Conservation strategies must prioritize habitat protection, pollution control, and public awareness to safeguard these vital insects.

Aquatic insects are more than just inhabitants of the watery world—they are key ecological players that maintain the health and function of freshwater ecosystems. Their fascinating life cycles, diverse

adaptations, and roles as environmental indicators make them worthy of scientific attention and conservation efforts. Exploring and understanding their world beneath the water's surface is not just an academic pursuit, but a crucial step towards freshwater ecosystem sustainability.

"Small Creatures, Big Ecological Impact."

Wings of Wonder: Why the Bumblebee Deserves the Spotlight

Shallu Choudhary[1] and R.K. Gupta[2]

[1]Ph.D Scholar, [2]Professor, Division of Entomology, SKUAST-Jammu, J&K

email:Choudhary.shally1995@gmail.com

In a world full of vibrant flowers and lush crops, one humble insect often goes unnoticed despite its vital role in sustaining nature's beauty and our food supply — the bumblebee. Far from being just a buzzing background presence, bumblebees are ecological superheroes that deserve appreciation and protection.

"The bee is more honored than other animals, not because she labors, but because she labors for others**."**

— *St. John Chrysostom*

Bumblebees, with their fuzzy bodies and gentle buzz, are among the most efficient pollinators on Earth. Their unique ability to **"**buzz pollinate**"** vibrating flowers to release tightly held pollen - is something honeybees and many other insects can't do. This makes them indispensable to the reproduction of countless plants, including tomatoes, blueberries, and peppers. Without bumblebees, many of our favorite fruits and vegetables would see dramatic declines. Unlike their more famous relatives, honeybees, bumblebees are not aggressive. They are social but modest creatures, often working quietly in small colonies. Bumblebees are also unique in their behavior and temperament. Living in small colonies — often fewer than 200 individuals - they are social yet modest creatures. They do not make honey in large quantities like honeybees, but their contribution lies in their pollination power, not in honey production. Their docile nature means they rarely sting unless threatened, making them ideal companions in gardens, farms, and wildflower meadows. Their calm demeanor makes them less likely to sting unless provoked, which only adds to their charm. Without bumblebees, many of these fruits and vegetables would face significant yield reductions, directly impacting agriculture and food security. In fact, studies estimate that pollinators like bumblebees contribute to more than 75% of the world's flowering plants and over one-third of the food we eat.

"The hum of bees is the voice of the garden**."**

-Elizabeth Lawrence

Beyond their agricultural value, bumblebees also serve as indicators of environmental health. Their presence signals balanced ecosystems and clean habitats. Sadly, habitat loss, pesticide use and climate change have caused alarming declines in bumblebee populations worldwide. This crisis is a wake-up call to appreciate and protect these vital pollinators before it's too late. But we are not powerless. Individuals can take meaningful action to support bumblebees. Planting native, nectar-rich flowers, creating bee-friendly gardens, avoiding harmful pesticides and participating in citizen science projects are all small steps that can lead to big change. Schools, communities and even city planners are now beginning to include pollinator corridors in urban and rural landscapes. Simple acts - like planting native wildflowers, avoiding pesticides, and supporting conservation programs - can make a significant difference. By recognizing the bumblebee not just as a bug, but as a beloved ally, we honor the crucial role it plays in our daily lives. So, next time you see a bumblebee hovering near a bloom, pause and appreciate it. That little buzz is the sound of nature's unsung hero at work. Let's cherish the bumblebee - not just for what it does, but for what it represents: resilience, teamwork, and the quiet strength of nature's smallest guardians.

Soil Arthropods and Their Ecological Role

Suray Singh Rajpurohit*, Amit Kumar Singh, Vishrava, and Swati Sharma

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, Jammu- 180 009, India

* Email: suryasingh7861087@gmail.com

Abstract

Soil arthropods are crucial for the biological and physicochemical functioning of soils, especially in ecosystems reliant on natural and organic farming practices. These small invertebrates operate as regulators, recyclers, and engineers in the soil system, performing functions such as litter decomposition, nutrient cycling, soil aggregation, bioturbation, and biological control. This article delves deeper into the taxonomy, trophic roles, theoretical ecology, and ecosystem services provided by soil arthropods, particularly within Indian agricultural and forest systems. It highlights the need for their inclusion in soil health assessments and conservation strategies, aligning with India's sustainable development and climate adaptation goals for 2024–25.

Keywords: Agroecology, ecosystem engineers, India, nutrient cycling, soil arthropods, soil biodiversity, sustainable agriculture,

Introduction

The soil ecosystem is a living matrix composed of organic matter, minerals, air, water, and a vast diversity of living organisms. Among these, soil arthropods play a foundational role in maintaining soil quality and resilience. In India, where agriculture employs over half of the population and contributes significantly to GDP, soil health is critical. However, traditional soil quality indicators have largely ignored biological metrics, especially arthropod diversity.

Theoretical frameworks such as the Soil Food Web Theory (Hunt *et al*., 1987) and Ecosystem Services Concept (Daily, 1997; MEA, 2005) position soil arthropods as central agents in linking belowground biodiversity to aboveground productivity and climate regulation. Modern ecological theories now incorporate functional diversity and trait-based approaches, focusing on how specific arthropod traits influence ecosystem functions (Lavelle *et al*., 2006).

Taxonomic and Functional Diversity of Soil Arthropods in India

Soil arthropods include a diverse array of taxa under the phylum Arthropoda, such as- Mesofauna: Acari (mites), Collembola (springtails), Protura, Diplura—typically 0.1–2 mm in size.

Macrofauna: Termites (Isoptera), Ants (Formicidae), Beetles (Coleoptera), Spiders (Araneae), Centipedes (Chilopoda), Millipedes (Diplopoda) – > 2 mm.

Functional classifications based on feeding guilds and trophic levels include:

- Primary decomposers (e.g., millipedes, isopods) fragment plant litter.
- Secondary decomposers (e.g., oribatid mites, springtails) feed on microorganisms.
- Micro-predators (e.g., predatory mites, centipedes) regulate mesofaunal populations.
- Ecosystem engineers (e.g., termites, ants) restructure the soil matrix.

Regional studies (Ranganath *et al*., 2023; Kumar *et al*., 2023) confirm that tropical Indian soils host some of the highest soil arthropod richness globally, especially in organic farms and undisturbed forest ecosystems.

Ecological Functions and Theoretical Contributions: Litter Fragmentation and Microbial Interactions According to Detritus-Based Food Web Theory (Moore *et al*., 2004), soil arthropods initiate energy flow by breaking down complex plant materials into smaller fragments, facilitating microbial colonization and enzymatic degradation. Collembola and oribatid mites, in particular, influence microbial succession and competition (Kaneko *et al*., 1998)

Nutrient Cycling and Mineralization: Soil arthropods enhance nutrient turnover through feeding, digestion, and excretion. Their fecal pellets serve as microbial hotspots for nitrogen and phosphorus mineralization (Das and Mukhopadhyay, 2010). Termite gut symbionts can fix atmospheric nitrogen, particularly in arid Indian soils (Veeresh and Bhat, 2023).

Soil Formation and Structure: The Bioturbation Theory suggests that the physical reworking of soil by macrofauna alters its porosity, texture, and aggregation (Lavelle *et al.*, 2006). Ant and termite mounds

redistribute subsoil minerals, regulate pH, and improve water retention. This is particularly critical in rain-fed zones like the Deccan Plateau (Joshi and Ballal, 2010).

Natural Pest Control and Trophic Regulation: Arthropod predators such as carabid beetles and rove beetles consume soil-dwelling pests, thereby reducing pesticide dependency. Functional redundancy among predators ensures resilience even if one trophic group is lost (Thakur *et al*., 2014). This aligns with ecological theories on the relationships between biodiversity and stability.

Indicator Species and Bioassessment: Soil arthropods like collembolans are used as bioindicators to assess ecological stress due to pollutants, tillage, and land-use change. Their diversity, abundance, and functional traits are included in multimeric indices such as the QBS-ar Index (Parisi *et al.,* 2005), which has potential for adoption in India's Soil Health Card Scheme.

Current Relevance: 2024–25 Soil Health and Biodiversity Initiatives in India: The Indian government's focus on agroecological transitions (e.g., PM-PRANAM, National Mission on Natural Farming) recognizes soil biodiversity as a key component of resilience. In 2023, the Ministry of Agriculture began exploring biological indicators in collaboration with ICAR and NABARD.

Recent developments include: The integration of soil arthropod monitoring in Himachal Pradesh's Natural Farming Program.

Guidelines from the National Biodiversity Authority encourage the inclusion of edaphic fauna in Biodiversity Management Committees.

Pilot studies in Telangana and Gujarat evaluating springtails as early indicators of soil health degradation under monocropping.

Threats to Soil Arthropods in India: Pesticide overuse (especially systemic insecticides like imidacloprid) alters arthropod food webs.

Climate extremes (drought, erratic rainfall) affect moisture-sensitive groups like collembolans and mites.

Land-use change, tillage, and habitat fragmentation reduce habitat heterogeneity.

Invasive species and pollution disrupt native arthropod assemblages.

Conservation and Research Needs: Establish long-term monitoring plots under ICAR-NBSS&LUP and Forest Research Institutes.

Expand participatory soil biodiversity documentation through citizen science and school programs.

Promote arthropod-inclusive curriculum in agricultural universities.

Fund molecular taxonomy and barcoding for understudied groups like diplurans and micro-arthropods.

Incorporate soil fauna indicators in government soil testing protocols (e.g., Soil Health Card 3.0).

Conclusion

As India navigates a path toward climate-smart and regenerative agriculture in 2024–25, soil arthropods must be acknowledged as biological sentinels of sustainability. Their role in ecosystem service provision, soil structure regulation, and pest suppression is essential for achieving both ecological resilience and

food security. Integrating arthropod data into national policy, farming practice, and scientific research will ensure that these vital but often invisible organisms receive their due recognition.

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Disappearing Wings: Investigating the Insect Apocalypse

Swati Sharma, Amit Kumar Singh, Vishrava and Suray Singh Rajpurohit

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology- Jammu, Jammu- 180 009, India

* Email: swatisharma17p@gmail.com

Insects, despite their small size, play indispensable roles in maintaining the ecological balance and supporting human life. They are vital pollinators, decomposers, and a key component of food webs, yet these essential creatures are facing unprecedented declines in population and diversity. This article delves into the critical issue of disappearing insect in the context of what some scientists are calling an "insect apocalypse." It examines the causes, potential consequences, and urgent need for conservation efforts to avert this ecological crisis.

The term "**insect apocalypse**" refers to the alarming rates at which insect populations are declining across the globe. Studies have documented significant reductions in insect biomass, species diversity, and geographic distribution. For instance, long-term research in Germany has shown a more than 75% decrease in flying insect biomass over a 27-year period. Similar trends have been observed in other parts of the world, indicating a global phenomenon. The primary drivers of these declines include habitat loss, agricultural intensification, pesticide use, climate change, pollution, and invasive species.

Habitat loss due to urbanization, deforestation, and agricultural expansion is one of the most significant threats to insect populations. The conversion of natural landscapes into human-dominated environments destroys the habitats that insects depend on for survival. Agricultural practices, particularly monoculture farming and the widespread use of pesticides, further exacerbate the problem by eliminating the plants that insects feed on and by directly killing them through chemical exposure. Climate change poses another profound threat to insects. Changes in temperature, precipitation patterns, and extreme weather events disrupt the delicate balance of ecosystems. Many insects have narrow climatic tolerances and are unable to adapt quickly to rapid environmental changes. This leads to mismatches in ecological interactions, such as the timing of flowering plants and the activity periods of pollinators, which can have cascading effects throughout ecosystems.

Pollution, including light and chemical pollution, also adversely affects insect populations. Artificial lighting disrupts the natural behaviors of nocturnal insects, leading to declines in species such as moths and fireflies. Chemical pollutants, including heavy metals and endocrine-disrupting chemicals,

accumulate in the environment and have sub-lethal effects on insects, impairing their reproduction and development. The decline of insects has profound implications for ecosystems and human well-being. As pollinators, insects are crucial for the reproduction of many flowering plants, including crops that humans rely on for food. The loss of pollinators threatens global food security and agricultural economies. Insects also play key roles in nutrient cycling, decomposition, and soil formation. Their decline can lead to the disruption of these processes, affecting plant growth and ecosystem health.

The potential consequences of an insect apocalypse extend beyond ecological impacts. Biodiversity loss diminishes the resilience of ecosystems to environmental changes and reduces their capacity to provide essential services. This can lead to increased vulnerability to climate change and other stressors, creating a feedback loop that further accelerates ecological degradation.

To address the impending insect apocalypse, urgent conservation efforts are needed. Strategies should include the preservation and restoration of natural habitats, the promotion of sustainable agricultural practices, and the reduction of pesticide use. Creating insect-friendly landscapes in urban and rural areas, such as planting native vegetation and reducing artificial lighting, can also support insect populations. Additionally, public awareness and engagement are crucial in driving policy changes and conservation actions.

Common Monsoon Insects and Why They Matter?

Vishrava*, Amit Kumar Singh, Suray Singh Rajpurohit and Swati Sharma

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology- Jammu, Jammu- 180 009, India

* Email: vishravarajput@gmail.com

When the monsoon arrives, nature comes alive with a buzz of insect activity. From dashing dragonflies to glowing fireflies, these tiny creatures play a vital role in our ecosystem. Some pollinate plants, others control pests, and many serve as food for birds and animals. While certain monsoon insects may seem like nuisances, they are essential for maintaining nature's balance. Let's explore some common rainy-season insects and discover why they matter more than we realize—both for the environment and for us.

Why Do We See More Insects During the Monsoon?

The rainy season creates ideal conditions for insect activity and reproduction. The increased humidity prevents delicate insects from drying out, while temporary pools of water provide perfect breeding grounds for mosquitoes, dragonflies, and other aquatic species. Additionally, the abundance of fresh vegetation supports herbivorous insects, which in turn attract predators like spiders and mantises. Many

insects, such as fireflies and beetles, also time their mating seasons with the rains, using the moist environment to their advantage.

Unique Adaptations for Wet Conditions

Monsoon insects have evolved incredible survival strategies to cope with heavy rains and flooded habitats.

1. Waterproof Exoskeletons and Wings

Many insects, like beetles and dragonflies, have waxy coatings on their exoskeletons that repel water. Dragonfly wings are covered in microscopic ridges that prevent water droplets from sticking, allowing them to fly effortlessly even during downpours (Watson et al., 2010).

2. Breathing Underwater

Diving beetles and mosquito larvae have developed ingenious ways to survive submerged. Diving beetles trap air bubbles under their wing cases, acting like portable oxygen tanks (Seymour & Matthews, 2013). Mosquito larvae, on the other hand, use snorkel-like tubes to breathe while hanging upside down at the water's surface.

3. Walking on Water

Water striders defy gravity with their super-hydrophobic legs, which are covered in thousands of tiny hairs that trap air. This allows them to glide across water surfaces without sinking (Hu et al., 2003).

4. Raindrop Survival

Mosquitoes are so lightweight that they can survive direct hits from raindrops. Instead of being crushed, they briefly merge with the droplet before pulling free and continuing their flight (Dickerson et al., 2012).

Ecological Importance of Monsoon Insects

These tiny creatures play vital roles in maintaining healthy ecosystems:

- **Pollination:** Many monsoon-blooming plants rely on insects for pollination. Bees, butterflies, beetles, and even some flies transfer pollen between flowers, ensuring the reproduction of numerous plant species.
- **Pest Control:** The predatory behavior of monsoon insects provides invaluable pest control services. Dragonflies and damselflies consume hundreds of mosquitoes daily, while their aquatic nymphs regulate mosquito larvae populations in water bodies (Corbet, 1999). This natural form of pest management reduces the need for chemical interventions in both wild ecosystems and agricultural landscapes. Similarly, spiders and ants contribute to keeping herbivorous insect populations in check, protecting vegetation from excessive damage (Nyffeler & Birkhofer, 2017).
- **Nutrient Cycling:** Decomposer insects perform the critical task of nutrient cycling during monsoon months. Termites and beetles break down decaying plant matter, enriching the soil. Dung beetles efficiently process animal waste, while termites break down woody material,

returning essential nutrients to the soil (Jouquet et al., 2011). These processes enhance soil fertility and structure, benefiting plant growth throughout the rainy season and beyond. The rapid decomposition facilitated by carrion beetles also helps prevent disease spread by efficiently recycling animal remains (Ratcliffe, 1996).

- **Food Source:** Monsoon insects form a vital link in food webs, serving as primary food sources for numerous vertebrate species. Insectivorous birds time their breeding seasons to coincide with peak insect abundance, ensuring adequate nutrition for their young (Naik & Parasharya, 2018). Bats, frogs, and reptiles similarly depend on seasonal insect explosions for their survival and reproduction. The abundance of monsoon insects supports biodiversity at higher trophic levels, maintaining the delicate balance of ecosystems.
- **Bioindicators:** Certain insect species serve as sensitive bioindicators of environmental health. The presence or absence of mayflies in water bodies provides valuable information about water quality (Brittain, 1982), while firefly populations reflect the integrity of terrestrial habitats (Lewis et al., 2020). Monitoring these insects helps scientists assess ecosystem conditions and implement timely conservation measures.

Tips to Keep Insects Away from Homes

While monsoon insects are ecologically important, some can become household nuisances. Here are some effective, eco-friendly ways to manage them:

1. **Eliminate Standing Water** – Regularly empty containers, unclog drains, and cover water storage to prevent mosquito breeding.
2. **Use Natural Repellents** – Neem oil, citronella, and camphor can deter insects without harmful chemicals.
3. **Install Screens** – Fit windows and doors with fine mesh to keep mosquitoes and flies out.
4. **Seal Entry Points** – Caulk cracks and gaps in walls to block ants and cockroaches.
5. **Encourage Predators** – Attract dragonflies and birds by maintaining a small garden pond or bird feeder.

Fun Facts About Monsoon Insects!!!

- A single dragonfly can eat hundreds of mosquitoes in one day.
- Firefly light is nearly 100% energy-efficient, producing almost no heat.
- Water striders can move at speeds of 1.5 meters per second—faster than a walking human!

Monsoon insects are not just survivors—they are master engineers of adaptation. Their incredible strategies for thriving in wet conditions highlight nature's ingenuity. While some species may be pests, their ecological roles make them indispensable. By understanding and appreciating these tiny marvels, we can find better ways to coexist with them during the rainy season.

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Small Creatures, Big Impact: Why Insects Matter?

Kritika Sharma and Kamlesh Bali

Division of Sericulture, Faculty of Agriculture SKUAST-J, Chatha-180009

Email: ks4722892@gmail.com

Introduction

Insect Week is observed every year all across the world to raise awareness of the value of insects in our lives. The ecological web, pollinators, recyclers, and engineers of nature depend on these microscopic organisms, which are often overlooked. The "Small Creatures, Big Impact" theme reminds us that despite their small size, insects have a big impact on our environment, economy, agriculture, and health. From bees coordinating pollination to butterflies soaring over wildflowers, insects ensure the health of ecosystems. The contributions of these little powerhouses are highlighted in this article, with a focus on beneficial insects like the silkworm, whose role goes beyond fabric to livelihoods and culture.

Pollination: The Silent Workforce

Insect pollination is essential for more than 85 per cent of major food crops and 75 per cent of flowering plants. In addition to being essential for fruits, vegetables, nuts, beetles, and oilseeds, bees, butterflies, moths, and flies also contribute $235 to $577 billion to global agriculture each year (FAO, 2023). Particularly in crops like apples, berries, and almonds, they improve quality and yield. Plants and pollinators have evolved harmoniously together; some even produce caffeinated nectar to help pollinators remember things better. However, this equilibrium is in danger. Butterfly populations have halved in the last 20 years, according to a 2024 UK report, which indicates a larger ecosystem decline with major ramifications for global food security.

Pest Control and Soil Builders

Natural pest suppression by beneficial insects such as ladybirds, lacewings, and *Trichogramma* wasps lowers the need for pesticides. *Trichogramma* are released as part of IPM programs to parasitise pest eggs in crops such as maize and cotton. Termites and dung beetles, on the other hand, enhance soil health by breaking down waste and enhancing nutrients. Their subterranean activity improves soil fertility, aeration, and water retention; all of which are crucial for agriculture.

Silkworm: Tiny Weaver, Big Impact

Domesticated over 5,000 years ago, the silkworm (*Bombyx mori*) is the basis of sericulture, which is essential to rural livelihoods. More than 9.18 lakh people in India alone rely on it, and women make up 60 per cent of the workforce (CSB, 2024). Especially in states like Karnataka, Assam, and Jammu & Kashmir, silk is more than just a fabric; it's a symbol of tradition, craftsmanship, and economic empowerment. Silk is also sustainable because, unlike synthetic fibres, it is biodegradable, renewable, and promotes sustainability.

More Insect Heroes

- **Honeybees:** Besides honey, they are top pollinators for crops like sunflower, coffee, and apples.
- **Butterflies & Moths:** Key pollinators and bioindicators. Moths like muga and eri produce wild silk and support forest-based livelihoods.
- **Dragonflies & Mayflies:** Indicate clean water and healthy wetlands.
- **Black Soldier Flies:** Convert organic waste into protein-rich feed, making them key players in circular economies.

Insects as Food of the Future

As the world's population is predicted to reach 9.7 billion people by 2050, edible insects such as mealworms, grasshoppers, and crickets are being marketed as nutrient-dense, sustainable protein substitutes. They are already consumed in more than 113 countries and require significantly less feed, water, and land than livestock (FAO, 2013).

Why Insect Conservation Matters?

Despite their significance, a third of insect species are endangered, and 40% of them are declining. Main threats:

Monoculture farming; • Pesticides; • Loss of habitat; • Climate change.

Ecosystems collapse when insects are lost. For the sake of food, health, and environmental stability, they must be protected. Loss of insects = collapse of ecosystems. Protecting them is crucial for food, health, and environmental stability.

What Can We Do?

Grow native, blooming plants; stay away from dangerous pesticides; encourage beekeeping and sericulture; and establish habitats that are conducive to insects. Teach children the value of insects. Encourage the use of organic farming

Conclusion: Our Future Depends on Them

Insects are more than just microscopic organisms; they are vital designers of our economies, agriculture, and ecosystems. Their influence is extensive, ranging from pollinating crops and improving soil to creating silk and sustaining livelihoods. It is essential for biodiversity as well as for a resilient, sustainable, and food-secure future to preserve and support beneficial insects like silkworms, bees, and butterflies. By protecting insects, we are protecting life in general.

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Cicadas: The Summer's Call

Abhishek TS*, Uma Shankar and Ellulla Praveena

Ph.D. Research Scholar and Member RES, Division of Entomology, FoA, SKUAST-Jammu

Email: drmegachile@gmail.com

As temperatures rise and the trees begin to shimmer with sound, you know summer has truly arrived and that unmistakable buzz filling the air belongs to **cicadas**. With their fascinating life cycles, global presence, and iconic songs, cicadas are far more than just seasonal noisemakers. These insects are nature's chorus, steeped in mystery, culture, and biology.

What Exactly Are Cicadas?

Cicadas are part of the insect group **Hemiptera**, or "true bugs," and belong to the superfamily **Cicadoidea.** With **over 3,000 species** found across the globe, they thrive in **tropical and temperate regions,** from dry deserts and grassy fields to dense forests. Although often confused with **locusts**, cicadas are a completely different type of insect. Locusts are actually grasshoppers and swarm for very different reasons. The confusion mostly stems from their sudden, large-scale appearances.

Beyond biology, cicadas have captured human imagination for centuries. They've appeared in **ancient myths,** been used in **folk medicine,** served as **symbols in religion and currency**, and in some cultures especially parts of Asia their musical calls have been appreciated enough to keep them as pets.

Annual vs. Periodical: The Two Lives of Cicadas

Most cicadas are known as **"annual cicadas",** which doesn't mean they live only for a year. Instead, it refers to the fact that some individuals of the species appear every year. However, each one might still spend **multiple years underground** before emerging. More unique are the **periodical cicadas**, found exclusively in **North America,** especially within the genus *Magicicada*. These species emerge in perfect synchrony after either **13 or 17 years,** depending on the species, a phenomenon almost unheard of in the animal kingdom. Once they appear, they swarm forests and fields for a few short weeks before vanishing underground once more.

The Hidden Years: Life Cycle of a Cicada

Every cicada goes through a **three-stage life cycle:**

Egg, Nymph, Adult.

Female cicadas lay their eggs in slits cut into the twigs of trees and shrubs. Once hatched, the tiny nymphs drop to the ground and burrow into the soil, where they spend years sometimes over a decade feeding on sap from plant roots. When the time is right (likely triggered by soil temperature), they emerge and climb nearby plants and undergo a dramatic transformation. Their old skin splits open along the back, and out comes a soft, winged adult that will harden within hours. These cast-off shells, or **exuviae,** are a common sight on tree trunks during emergence season.

Adult cicadas **live for just a few weeks**, during which they mate and start the cycle all over again. While generally harmless, large numbers of egg-laying females can occasionally damage **young trees and saplings.**

Singing for Survival: The Sound of Cicadas

That singing hum you hear in midsummer. That's the work of **male cicadas,** broadcasting their presence in hopes of attracting a mate. Their sound-producing organs, called **tymbals,** are located on the sides of their abdomen. These tymbals contract and expand rapidly, creating clicks that are amplified by the hollow body cavity. The result? One of the **loudest natural sounds** in the insect world produced by some cicadas which can reach up to **100 decibels**, about as loud as a motorcycle!

Each species has its own unique song, which helps females find the right mate. Interestingly, some cicadas like **Putnam's cicada** don't have tymbals at all. Instead, they use their **wings to make soft rustling noises,** and in those cases, **females may also respond with their own sounds**, creating a gentle acoustic duet.

More Than Just Insects: Cicadas in Culture

Cicadas have buzzed their way into human culture for centuries. In many **Native American stories,** they symbolize resurrection or transformation. In **ancient China**, cicadas were carved into jade amulets to represent immortality. Even in **modern Japan,** their presence is deeply tied to the fleeting beauty of summer and youth.

A Marvel of Nature

Whether you find their songs soothing or startling, there's no denying the cicada is a marvel of the insect world. With one of the most mysterious life cycles in nature, an unmistakable voice, and a long history shared with humans, cicadas truly are summer's unsung or rather, sung heroes.

Potential Health Benefits of Royal Jelly

Bhumika Rathour, Devinder Sharma, Manoj Thakur, Yashasvini Goswamy and Virandar Yadav

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu, Main Campus Chatha, Jammu and Kashmir, India, 180009

A milky secretion from worker bees, used to feed larvae and queen bees, rich in water, proteins (especially major royal jelly proteins, MRJPs), fats (notably 10-HDA), sugars, vitamins (B-complex, small amounts of C, A, E, D), minerals, and bioactive compounds. Royal jelly (RJ), which has attracted a lot of attention due to its potential as a functional dietary additive and medicinal intervention.

1. Antioxidant & Anti-Inflammatory Properties- Laboratory and animal studies suggest it reduces oxidative stress and inflammation via pathways like NF-κB, MAPK, and AMPK. MRJPs support collagen production and wound healing.

2. Immune Boost & Antimicrobial Effects- Displays antibacterial and antiviral activity (e.g., HSV-1). Enhances immune responses and wound repair.

3. Cardiovascular & Metabolic Health- May help improve lipid profiles: increases HDL, lowers LDL and total cholesterol. Could help blood sugar regulation in type 2 diabetes, though findings are mixed**.**

4. Menopause & Hormonal Support- Appears to alleviate menopausal symptoms (hot flashes, mood, lubrication) using doses of ~800–1,000 mg/day for 8–12 weeks. Exhibits estrogenic and testosterone-modulating effects.

5. Skin & Aging- Promotes collagen synthesis, fights photo-aging, enhances skin elasticity and hydration**.** Potential longevity-promoting effects via antioxidant and metabolic pathways.

6. Other Areas- Reduces PMS symptoms (e.g., bloating, mood) in small studies. May alleviate oral mucositis during chemotherapy. Early lab findings suggest benefits in neuroprotection and anticancer activity via autophagy (not yet validated in humans).

Safety & Dosage- Typical supplemental doses: 1,000 mg/day, up to 3,000–4,800 mg/day safely used short-term (≤1 year)

Allergic reactions: Skin rash, asthma, anaphylaxis) possible, especially in those with bee/hive product sensitivities. Not recommended during pregnancy, breastfeeding, or for children unless supervised. Possible interactions: blood thinners (e.g., warfarin), chemotherapy, hormone therapy, diabetes meds

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Insects and Us: Small Creatures, Big Importance

Harshita Thakur

(PhD Research Scholar) Division of Entomology, SKUAST –Jammu

Insects are everywhere. Most of the time, we don't pay much attention to them, but these small creatures actually play an important role in keeping our planet healthy. Without insects, life for us would be a lot harder and a lot less colourful. Insects have been living on Earth for more than 400 million years. Insects are tiny workers of nature.

Bees, butterflies and other insects help in pollinating the plants. The food we eat depends on the insects that pollinate plants. Without these insects we might not have food. Insects like ants, dung beetles help in decomposing of dead animals, plants. And it gives nutrients back to the soil. Insects can actually help people heal and stay healthy. Honey made by bees has natural germs-fighting power. Bee venom is also used for treating arthritis. Honeybees give us honey and wax. Silkworms make silk. Lac insects make shellac. These things help businesses and give jobs, especially in villages. These products show how insects are closely connected to our money and culture, even if we don't always notice it. In many cultures, people eat insects. They are high in protein, vitamins, and minerals. Insect farming needs less land and water than raising animals. The acceptance and integration of edible insects into diets can revolutionize food systems, reduce environmental impact, and combat hunger in many vulnerable communities. Insects inspire new ideas. Engineers learn from dragonfly wings to make better drones. Ants teach us about teamwork. Even computer programs are based on how bees and termites act. Insects like ladybugs and wasps help by eating bugs that harm crops. This means farmers don't need to use as many chemical sprays. It keeps farming more natural and better for the environment. These helpful insects support healthy and sustainable farming. The connection between insects and people is not just about nature but also about culture and money.

"From the shimmering silk of silkworms to the pollination of vast fields, insects are nature's master craftsmen and caretakers. Celebrate Insect Week by uncovering the remarkable stories of these tiny architects and champions of life."

Insect Week 2025, celebrated from 23rd to 29th June. Insect Week is celebrated to show how insects help us and the planet. Many people think insects are just pests, but they do important jobs. They help grow food, clean the environment, and support nature. This week helps us learn why we should protect them. Insect Week is celebrated every year to help people learn about insects and why they are important. It creates awareness that insects are not just pests but they are helpers that keep our world healthy and balanced.

Celebrating Insect Week is important because many insects are in danger due to losing their habitat, pollution, and changes in the weather. During Insect Week, people learn how to protect insects and where they live. This helps keep many different plants and animals safe. It also makes sure nature keeps working well. Creating awareness involves sharing stories of how insects influence food, medicine,

technology, and ecosystems, highlighting the connections between human life and insect health. Encouraging people to reduce pesticide use can make a big difference for insects. Schools and communities can plan fun activities about insects, like planting flowers that help bees and butterflies or making little homes for bugs. Sharing information about insects on social media or at local events can help more people learn about them. Scientists and teachers can also work together to make learning about insects fun and interesting. Insects may be small, but their role is huge from pollinating plants to cleaning nature. This Insect Week, let's celebrate and protect these tiny heroes that keep our world alive.

From Hive to Mound: How Insects Help Themselves Beat the Heat

Bhumika Kapoor

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu, Main Campus Chatha, Jammu and Kashmir, India, 180009

Insects such as termites, ants, and bees have evolved remarkable mechanisms to maintain thermal comfort in their habitats, showcasing sophisticated strategies for passive climate control. These natural innovations have not only fascinated entomologists but have also inspired architects and engineers globally to design environmentally responsive buildings that mimic insect architecture—an emerging field known as biomimicry.

Among the most studied are termites, specifically *Macrotermes spp.*, which construct complex mounds with an intricate network of air vents and tunnels. These structures function like lungs, facilitating continuous air exchange and stabilizing internal temperatures at approximately 30°C, even when external temperatures exceed 40°C (Turner, 2001). The Eastgate Centre in Harare, Zimbabwe, designed by architect Mick Pearce, is a prominent example that mimics termite mounds. The building uses stack ventilation and thermal mass, reducing energy consumption for climate control by nearly 90% (Turner & Soar, 2008).

Honeybees (*Apis mellifera*) exhibit behavioral thermoregulation. Worker bees fan their wings or cluster together to maintain brood temperatures around 34–35°C. Fahrenholz *et al.* (1989) demonstrated that honeybee colonies can regulate their internal hive temperature with exceptional precision. Inspired by such natural systems, The Hive at Kew Gardens in London mimics a real bee hive's structure and behavior using sensors and light to simulate vibrations and heat patterns from live bee colonies (Dunne, 2016). Leafcutter ants (*Atta spp.*) dig extensive underground nests with deep chambers that rely on the soil's thermal mass and a network of ventilation shafts to maintain temperature and humidity (Moreira

et al., 2004). Similarly, the Beijing National Aquatics Center (Water Cube) uses biomimetic modular designs based on the cellular geometry of bee combs to optimize insulation and temperature control.

In India, several projects have drawn directly from insect-inspired principles. The Pearl Academy of Fashion in Jaipur, designed by Morphogenesis, incorporates a double-skin facade, traditional *jaali* screens, and thermal buffering courtyards to reduce solar gain—mimicking termite mound ventilation (Morphogenesis, 2010). Another example is the Indian Institute of Management (IIM) Udaipur, where the campus utilizes high thermal mass materials, earth berms, and shaded courtyards similar to subterranean insect chambers. In Ahmedabad, CEPT University's Faculty of Architecture building features wind towers and courtyard planning, inspired by termite ventilation shafts to cool interiors naturally.

Additionally, Termitary House in Vietnam, designed by VTN Architects, uses brick lattice walls and passive ventilation directly influenced by termite mound structure, showing how these ancient systems inform modern sustainable housing (VTN Architects, 2015).

By emulating the thermoregulatory systems of insects, architects are achieving substantial reductions in building energy use. These examples illustrate how biological systems can guide innovative, climate-responsive architecture, particularly relevant as urban areas face increasing thermal stress due to climate change.

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Invisible Allies: How Insect Endosymbionts are cleaning up our pesticide mess

Tannu Sain

Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, Jammu- 180 009, India, Email: saintannu97@gmail.com

In the hidden world within insects, a silent revolution is taking place one that may help us combat one of modern agriculture's biggest challenges: pesticide pollution. While we as entomologists are trained to fight harmful insect pests, we're now discovering that the very insects we study could hold the key to cleaning up the damage we cause with insecticides. Over the past few decades, synthetic insecticides have become an essential tool for protecting crops and ensuring high yields. But this chemical shield comes at a steep price. Insecticide overuse has resulted in environmental contamination, toxicity to non-target organisms, reduced soil health, and the development of resistance in pest populations.

Interestingly, recent studies have shown that insect endosymbionts beneficial microorganisms residing inside insect bodies can degrade these insecticides naturally, a process called bioremediation. These microbes have co-evolved with their hosts, often helping them survive in chemically stressful environments. Some of these symbionts, especially in insects regularly exposed to pesticides, produce enzymes like esterases, hydrolases, and monooxygenases that can break down harmful insecticide molecules into simpler, non-toxic compounds.

Bacterial genera such as *Serratia*, *Bacillus*, *Enterobacter*, and *Pseudomonas* have shown promise in this area. For instance, in pesticide-resistant insects, endosymbionts may even play a direct role in degrading toxins before they harm the insect giving the host an evolutionary advantage. As entomologists, this insight opens up exciting research directions.

Imagine isolating these beneficial microbes and applying them to pesticide-contaminated soils, or even using them to develop bioformulations that can detoxify residues on crops. Their use could be a game-changer in developing environmentally sustainable pest management strategies, reducing dependence on chemical control.

Furthermore, by using molecular tools like 16S rRNA sequencing and metagenomics, we can explore the diversity and functional roles of these endosymbionts across different insect species. This knowledge could be integrated into Integrated Pest and Residue Management (IPRM) systems for cleaner and greener agriculture.

This new frontier reminds us that insects are not just pests, but complex ecosystems themselves, often harbouring solutions to problems caused by human intervention. As students and future researchers in agricultural entomology, it is our responsibility to explore these solutions, think beyond conventional methods, and contribute to sustainable food systems.

After all, sometimes the most powerful allies are the ones we can't see working quietly from within.

Peeping through the Nikon DSLR Camera

Uma Shankar

Professor, Division of Entomology, FoA, SKUAST-Jammu

Email: umashankar.ento@gmail.com

Above: Citrus Butterfly, *Papilio demoleus*

Below: Yellow Spotted Tiger beetle, *Calochroa flavomaculata*

Photo courtesy by Dr. Uma Shankar @2025

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