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THE POWER OF CITIZEN SCIENCE IN SHAPING THE FUTURE OF ENTOMOLOGY

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Entomology, the scientific study of insects, is vital for understanding ecosystems, agriculture, medicine and environmental changes. As the most diverse group of organisms on Earth, insects influence pollination, nutrient cycling and serve as key components of food webs. Despite their importance, insect populations are facing significant threats, such as habitat loss, climate change and invasive species, which makes monitoring them a critical aspect of entomology. In the past, entomologists relied on traditional methods of research, such as field observations and conducting experiments in Controlled Conditions. However, with the advent of citizen science, the field has seen a profound shift in how data is collected, analysed and applied. Citizen science is where non-experts actively contribute to scientific research which has emerged as a transformative tool in entomology, expanding the reach of scientific investigations, improving data collection and engaging the public in environmental stewardship.

1) The Rise of Citizen Science in Entomology

Citizen science, in simple words, refers to public participation in scientific research. It ranges from observation and data collection to more sophisticated tasks such as data analysis and hypothesis generation. This democratization of science has made it possible for people with varying levels of expertise to contribute meaningfully to research efforts. The role of citizen science in entomology has grown significantly in recent years, driven by advancements in technology, such as smartphones, GPS tracking and online databases, as well as the increasing recognition of the need for large-scale data collection across vast and often inaccessible areas.

Citizen science initiatives in entomology often focus on specific insect groups, behaviors or ecological patterns. For instance, volunteers may be asked to monitor the abundance of certain insect species, report sightings or photograph insects to assist with species identification. This widespread participation helps overcome one of the biggest challenges in entomology: the vast number of insect species across varied ecosystems. Insects can be difficult to track because they are often small, hidden and short-lived, making comprehensive studies labour-intensive and resource-intensive. Citizen science, with its ability to engage thousands of participants over large areas, provides entomologists with the data they need to study insect populations, track biodiversity and understand the impact of environmental changes.

2) Expanding Geographic Reach and Data Collection

One of the primary advantages of citizen science is its ability to significantly expand the geographic scope of data collection. Insects are found in virtually every habitat, from dense forests and wetlands to urban environments and agricultural fields. Conducting comprehensive surveys in these diverse and often remote areas can be prohibitively expensive and time-consuming for professional entomologists. Citizen scientists, however they can collect data across a wider range of locations, providing a much more representative snapshot of insect populations and behaviors.

Programs such as *iNaturalist* and *BugGuide.net* allow individuals to submit insect observations, often including photographs that help identify species. These platforms rely on the expertise of both the public and professional entomologists to verify species identification and organize the data into a comprehensive database. For example, *iNaturalist* has accumulated millions of records from users around the world, providing researchers with a wealth of data on insect distribution, migration and even behavioural changes linked to seasonal shifts. This massive repository of data not only helps scientists track insect populations over time but also allows them to analyse trends on a global scale, shedding light on how insect communities are responding to global challenges such as climate change and habitat loss.

Citizen science can also play a key role in monitoring urban insect populations, a field that has gained increasing attention due to the impact of urbanization on biodiversity. Cities, with their unique combination of habitats and pollutants, provide an ideal setting to study how insects adapt and thrive in human-dominated environments. Volunteers participating in

citizen science programs focused on urban insects can help researchers track changes in species composition, abundance and distribution in cities. Programs like The Great Sunflower Project, which focuses on monitoring pollinator populations, enable participants to assess the health of pollinator species in urban and suburban gardens. This type of information is crucial for understanding the challenges faced by pollinators, many of which are in decline and it can inform strategies to create pollinator-friendly environments.

3) Biodiversity Monitoring and Conservation

Insects are essential for ecosystem functioning, serving as pollinators, decomposers and prey for other wildlife. However, many insect species are experiencing declines, particularly those that are dependent on specific habitats or environmental conditions. For example, studies have shown that the decline of pollinators, such as bees and butterflies, is linked to factors like pesticide use, habitat destruction, and climate change. Understanding these declines is critical for biodiversity conservation, but it requires extensive monitoring of insect populations across different regions and ecosystems.

Citizen science plays a pivotal role in monitoring insect biodiversity and detecting population trends. By leveraging the collective effort of volunteers, researchers can gather large amounts of data on insect species that might otherwise be overlooked.

For example, programs like The Butterfly Monitoring Scheme and The Monarch Watch rely on citizen scientists to track butterfly populations across wide geographic areas. Volunteers record sightings of specific butterfly species, including information about their abundance, life stages and migration patterns. This data is essential for understanding the factors that influence butterfly populations, such as climate conditions, habitat availability and the effects of agricultural practices. By engaging the public in long-term monitoring efforts, these programs have helped identify troubling trends, such as the decline of the monarch butterfly, which has spurred conservation efforts.

Additionally, citizen science initiatives can assist in detecting rare or endangered species that may not be well-documented. Programs such as The UK Ladybird Survey allow volunteers to report sightings of ladybirds, some of which are under threat due to climate change and competition with invasive species. In cases where professional entomologists may not be able to access every habitat, citizen science can provide crucial early warnings about the status of these species, allowing for targeted conservation actions.

4) Early Detection of Invasive Species

Invasive species pose significant threats to biodiversity, agriculture and forestry. Insects are often at the forefront of invasive species introductions, with species like the emerald ash borer, *Agrilus planipennis* and the Asian longhorned beetle, *Anoplophora glabripennis* causing extensive damage to ecosystems and infrastructure. Early detection of invasive insect species is crucial to prevent their spread and mitigate potential ecological damage.

Citizen science programs play a critical role in the early detection of invasive insect species. Volunteers are trained to identify and report sightings of species that are not native to their area, particularly those that may pose a threat to local ecosystems. By engaging a large number of citizens in the monitoring process, researchers can obtain real-time data on the spread of invasive species and respond more swiftly to emerging threats.

For example, the Asian Longhorned Beetle Survey in the United States trains citizens to identify the invasive Asian longhorned beetle and report any sightings, contributing to early eradication efforts. Similarly, in Europe, citizen science projects like The European Alien Species Information Network rely on volunteers to help track the spread of invasive insects and assess their potential impact on local biodiversity.

5) Public Engagement and Education

Beyond data collection, citizen science also serves as a tool for public engagement and education. By participating in entomological research, members of the public gain a greater understanding of the role insects play in ecosystems and the challenges they face. This involvement helps raise awareness about the importance of insects, particularly pollinators, and the threats posed by habitat loss, pesticide use, and climate change.

Many citizen science programs are designed to be educational, providing participants with the tools and knowledge to identify species, understand ecological concepts and interpret research findings. These initiatives foster a sense of ownership and stewardship over local environments, encouraging people to take action in their own communities to protect insect populations. For instance, programs like The Great Sunflower Project not only track pollinator populations but also encourage participants to plant pollinator-friendly plants in their gardens, thus promoting conservation at a local level.

Citizen science also helps bridge the gap between the scientific community and the public. Through collaboration, both professional entomologists and volunteers can contribute to solving complex environmental issues. As the number of individuals involved in citizen science grows, so too does the overall impact of these initiatives on public policy and conservation efforts. Researchers can use the data gathered by citizen scientists to inform policy decisions, advocate for stronger environmental protections, and engage in meaningful dialogues with stakeholders about the importance of biodiversity conservation.

6. Overcoming Research Limitations

Traditional research in entomology is often limited by factors such as funding, time and access to remote locations. Citizen science helps overcome these challenges by providing additional resources to volunteers who are eager to participate in research efforts. The involvement of volunteers can dramatically increase the amount of data collected without adding substantial costs, making it possible to conduct large-scale studies that would otherwise be unfeasible.

Furthermore, citizen science allows researchers to focus on specific questions or areas of interest. For instance, a researcher might study the effects of climate change on insect migration patterns and by tapping into the vast network of citizen scientists, they can collect data from regions that would otherwise be difficult to reach. This can lead to new discoveries or innovative approaches to understanding complex ecological processes.

Conclusion

Citizen science has become an essential tool in modern entomology, providing entomologists with the resources they need to monitor insect populations, track biodiversity, detect invasive species and engage the public in scientific research. Through the collective efforts of thousands of volunteers, significant strides have been made in understanding the complex dynamics of insect communities and the challenges they face in a rapidly changing world. As technology continues to evolve and more people engage with citizen science projects, the role of the public in entomology will continue to grow, fostering a deeper understanding of the importance of insects and the need to protect them for future generations.

References

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