Indian J. Plant Genet. Resour. 35(3): 383–385 (2022)
DOI 10.5958/0976-1926.2022.00104.8

Role of Invertebrate Diversity with Special Reference to Insects in Agro-biodiversity and Ecological Services –Indian Efforts

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Invertebrates occupy larger proportion in the animal species diversity in almost all habitats and are important components of all ecosystems. The importance of the ecological role played by these invertebrates are not given due consideration and the diversity is under-sampled and understudied. Insects belonging to phylum Arthropoda form a major component that renders several ecological functions and ecosystem services. In this chapter, the importance of the insect services are highlighted and the role of ICAR-National Bureau of Agricultural Insect Resources, Bengaluru in documentation of the insect diversity, its utilization and conservation is emphasized, which are in line with the mandate of the Bureau and Delhi declaration on Agrobiodiversity management.

Introduction

Invertebrates are the most prolific animals in terms of numbers of species and numbers of individuals; abundant in every ecological niche and successful animals on the earth for over 400 million years. Invertebrates belong to the Phylum Arthropoda with segmented bodies, jointed appendages and chitinous exoskeletons. In addition to insects, arthropods include spiders, centipedes, millipedes, scorpions, mites, lobsters, and crabs. Insects are the largest group of arthropods. To date, 1.7 million invertebrate species have been documented out of estimated numbers ranging from 5-30 million. Unfortunately, species numbers are declining faster than we could record their existence. Invertebrates occur at all levels of highly complex food webs, and comprise an enormous biomass that is an important food source for birds and mammals. The diversity of invertebrate faunae in agroecosystems and their relationships to soil processes suggests that they are potential bioindicators.

Insects are the largest and most diverse group of organisms on Earth, comprising of 30 orders with nearly 1 million described species and estimated number exceeding 20 million. Ecological roles of insects are wide and far, contributing to every ecological niche and function. Many are herbivores while others function as predators and parasitoids feeding on other insects and, other arthropods and vertebrates; others as decomposers, feeding on dead wood and leaf litter, carcasses of larger animals, or as soil builders. Importantly insects/ invertebrates sustain pollination and recycle soil nutrients to plants. This illustrates the contribution that insects and other invertebrates make to the composition and functioning of all terrestrial ecosystems, including those in urban greenspaces. The breadth of ecosystem services provided by insects corresponds to an estimated annual economic value of US$57 billion. Insect pollinators (e.g. bees, flower-flies, and butterflies) pollinate over 85% of wild flowering plants and over 75% of agricultural crop species.

The evidence for decline of global insect diversity is irrefutable. A long-term study found declines of more than 75% of insects in protected areas in Germany. Multiple factors are driving insect declines, including loss and fragmentation of habitat; pollution from light, microplastics, and use of synthetic pesticide and climate change. A world without insects, the loss of partial or whole insect communities can have disastrous effects for food web and reduce an area's ability to recover and be productive.

ICAR-NBAIR and Delhi Declaration on Agrobiodiversity Management

ICAR-NBAIR is the youngest Bureau of ICAR which came in to existence in 2014. ICAR-NBAIR has three Divisions with specific mandate drawn in line with the Agrobiodiversity (ABD) conservation and sustainable use towards achieving the SDGs and the Aichi Targets of CBD, as mentioned below.

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- Biodiversity inventory: biosystematics, molecular diagnostics, genomics
- Biosecurity, ecological services, benefit sharing:
- Invasives, biological control, pollinators, soil builders, organic waste, as feed and food
- Capacity building, social awareness, community participation
- *In situ* biodiversity conservation technologies in cropping systems

Other Activities of ICAR-NBAIR include:

- Identification of traditional agrobiodiversity knowledge: ITKs related to entomophagy (insects as food & supplement) and biodiversity – Erisilk worm, white grubs; Surveys conducted in Pasighat, Arunachal Pradesh and Jorhat, Meghalaya to document insects used as food.
- Waste-to-Wealth (Ecological service): Utilizing Black soldier fly for conversion of organic waste from farm and urban sources to environmentally-safe compost and its by-products.
- Agrobiodiversity conservation: Insect repository and identification services where in cumulative preserved insect specimens in specimens in National Insect Museum at ICAR-NBAIR are 1,92,883 with an average annual additions at 15,000-18,000 specimens and addition of new species 300-310 annually; while *Ex situ* conservation of 136 live-insect cultures maintained in ICAR-NBAIR Insectary and Mass Production Unit; Documentation of potential *Apis* and non-*Apis* pollinator species in different crop ecosystems.
- Coordinated & harmonized management of INVASIVES with SMDs, NARES, SAUs, State line Depts including FAW in maize; Rugose white fly in coconut and palms in southern states, east, west coast etc., movement of planting material; broad mite in mulberry; black thrips in chilli in south and west India, and cassava mealybug in cassava in TN and Kerala; Continuous monitoring and surveillance through AICRP BC centres, SAUs and CIBXRC etc.
- Exchange of natural enemies (both multi- and bi-lateral) for global biological control : Importation of natural enemies on case-to-case basis including *Smicronyx lutulentus* – seed predator on parthenium weed from Queensland, Australia and *Anagyrus lopezi* – parasitoid on cassava mealybug from IITA, Benin, West Africa.
- Strategies adopted for mitigation of alien invasive species and biocontrol systems at ICAR-NBAIR include identification of indigenous natural enemies against introduced insect pests and suppression of invasives through conservation of indigenous natural enemies.

Priorities in Insect Biodiversity in Agro-ecological Systems for Ecological Services

With the intense anthropogenic activities and rapid climate change patterns, global agriculture in particular and eroding biodiversity there is an urgent need to meet the challenges of global food and nutritional security some of the priorities are

- Distributional information, delimitation of biogeo-graphical areas and their biological importance: Focus on (1) inventory and estimation of faunal richness; (2) monitoring for conservation management and the selection and use of bioindicators; and (3) assessment of conservation status and recovery of threatened species. We then explore the capacity of biosystematics to complement and enhance these programmes.
- INVENTORIZATION and database of agro-ecological zones; MONITORING temporal changes in species abundances, species richness or species assemblages; Bioindication in terms of three different categories of biological indicators: environmental, ecological and biodiversity.
- ENLIST THREATENED SPECIES and ecological communities at international, national and regional levels.
- Evolve strategies for *in situ* conservation of beneficials in soil and crop ecosystems.

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