Insects in Ecosystem functioning

1. Herbivory – Leaf cutting ants

While many insects that feed on plants are considered as pests of agricultural importance, in natural ecosystems such as forests they play a key role in stabilising the community structure. The leaf-cutting ant, *Atta* influence the light availability and seed dispersal, impacting the overall forest composition of Amazonian forests. Leaf-cutter ants are important ecosystem engineers and conspicuous bioturbators in Neotropical regions

2. Pollination

Insects are major pollinators of flowering plants. Different groups of insects show specialized pollination behaviours, and based on the type of pollinator involved, insect pollination is classified into several categories. Some plants are generalists and attract many insect groups, while others are specialists, relying on only one type of pollinator. Flowers evolved is size colour and strips called honey guides to attract insects.

Category	Pollinating Insect	Plant Adaptations	Examples
Melittophily	Bees	Bright flowers, sweet scent, UV nectar guides	Sunflower, lavender, clover
Phalaenophily	Moths	Pale or white flowers, strong scent at night	Jasmine, tobacco, yucca
Psychophily	Butterflies	Bright, scented flowers with landing platforms	Milkweed, lantana, zinnia
Myophily	Flies	Dull-coloured flowers, sometimes bad odour	Wild ginger, skunk cabbage
Sapromyophily	Carrion/dung flies	Dark, foul-smelling flowers mimicking rotting matter	Stapelia, Rafflesia, Aristolochia
Cantharophily	Beetles	Large, bowl-shaped flowers, fruity or spicy smell	Magnolia, water lily, lotus
Thysanophily	Thrips	Tiny flowers, exposed anthers, often wind-assisted	Some grasses and small shrubs

Highly mutualistic pollination systems have evolved in plants such as the fig – fig wasp pollination, Yucca pollination by the Yucca moth. Similarly, the orchid flowers have developed bizarre means to attract insects. Some orchids mimic the female insect pheromone odour or even the shape. In this case greater benefit is to the flowers.

3. How Insects Help in Nutrient Recycling

Decomposers:

Beetles, ants, termites, fly larvae (maggots) break down dead plants, animals, and waste and help recycle nutrients, enrich soil, speed up decomposition. Dung beetles bury and consume faeces, enriching the soil with nutrients.

Soil Aeration and Mixing

Insects like earth-boring beetles, ants, termites. Their burrowing mixes organic matter into the soil, helping microbes and roots access nutrients.

Accelerating Decay

Maggots from flies rapidly consume and decompose carcasses. Their activity supports faster microbial breakdown.

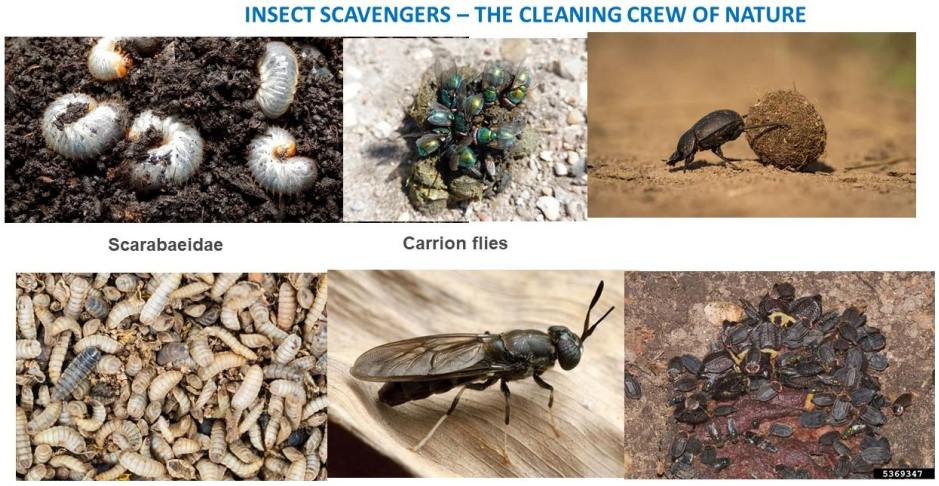
Fungal Farming Insects

Termites and certain ants cultivate fungi on organic material, aiding decomposition.

Detritivores

These are insects that feed on detritus (dead organic material). They shred material into smaller pieces, increasing the surface area for microbes to work on.

4. **Insect scavengers**



The insects that decompose dead matter and help in nutrient cycling also play the vital role of Insect scavengers in our ecosystems, cleaning and recycling dead plants, animals, dung, or decaying organic matter.

The story of dung beetles- ecosystem engineers project of Australia

Native Australian species of beetle had co-evolved alongside marsupials such as the kangaroo and wombat, which produce small, hard, dry and fibrous pellets of dung. Cattle were introduced to Australia by European settlers and now most farmers are rearing cattle. The large, soft, moist dung pads of cattle are not utilised by the native beetles, except a few. **Dr George Bornemissza** of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), noticed this and an increase in pestilential flies. He started dung beetle introductions from other countries in four phases and some 15 species could establish.

1. 1965-1985 - More than 50 species were introduced by CSIRO with the primary aim to reduce the bush-fly population. Twenty three out of forty-three released species became established.

2. 1990 - 1992 – CSIRO imported four species of dung beetle from Spain for bush-fly control. Few beetles were released and none of the field releases were successful.

3. 2012-2016 - Two spring-active dung beetles' species (*Onthophagus vacca* and *Bubas bubalus*) were imported leading to establishment of commercial breeding operations.

4. 2018 –2022 'Dung Beetle Ecosystem Engineers' project commenced

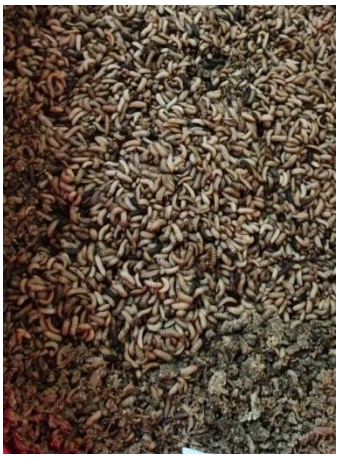
Source: https://www.dungbeetles.com.au/

Release of dung beetles on farm in New South Wales

Black soldier flies – the new superhero of waste decomposition

Black soldier flies (*Hermetia illucens*) belonging to the family Stratiomyidae are amazing insects used in biowaste decomposition and organic recycling. Their larvae are voracious eaters that can turn organic waste into valuable biomass, making them champions of sustainable waste management. They are native to the Americas but now found globally. Adults do not bite or spread disease. Larvae are used in composting, animal feed, and even biofuel production.

Larval stage is key for waste decomposition.



- Kitchen waste such as vegetable peels and food scraps, animal manure, food industry waste from breweries, dairies, and slaughterhouse waste such as bones and meat scraps are decomposed by black soldier flies.
- It provides low-cost recycling with minimal space and resources.
- The larvae are also food source for poultry. The nutritional value of dried Black soldier fly Larvae contains 35–45% Protein, 25–35% fat and high on calcium and amino acids.
- Waste management firms and farms are using BSFL to process organic refuse.

Carrion Beetles – Nature's Undertakers

Carrion beetles belonging to the family: Silphidae feed on and help decompose dead animals. They play a vital role in ecosystems by recycling nutrients and preventing the spread of disease. Some species bury the corpses while other do not.

The adults locate dead animals/carrion using sensitive smell receptors and lay eggs on or near carcasses

Larvae feed on decomposing flesh. Adults and larvae help break down and recycle dead tissue into the soil. Some species exhibit parental care.

The burying beetle, *Nicrophorus* spp. bury small vertebrate carcasses such as birds and mice underground. First, the body is prepared by stripping fur/feathers and forming a "carcass ball". Then eggs are laid nearby; larvae feed on the buried carcass. Both male and female care for the young a rare occurrence in insects.

The carrion beetles, function as decomposers and prevent disease by remove decaying bodies lading to soil enrichment

Some species are used in forensics to help estimate time of death in crime scenes and provide clues based on species, life stage, and time of arrival on a corpse.

5. Seed Dispersal by Insects (Myrmecochory)

Ants are the main seed dispersers while some beetles and termites may move seeds accidentally. Some wasp species are also responsible for seed dispersal, a form of biotic seed dispersal where ants carry seeds to their nests.

Insect-dispersed seeds have a nutrient-rich part called an elaiosome that attracts ants. Ants eat the elaiosome and discard the seed in or near their nest, where it can germinate in a nutrient-rich environment.