

BIOLOGICAL ECOSYSTEM SERVICES

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ABSTRACT: An ecosystem is a community of animals and plants interacting with one another and with their physical environment. Ecosystems include physical and chemical components, such as soils, water, and nutrients that support the organisms living within them.

Key words: *Ecosystem, Ecosystem Services, Biological control, parasite, parasitoid, microbial diversity, Biological diversity*

INTRODUCTION: Human kind benefits from a multitude of resources and processes that are supplied by natural ecosystems. Collectively, these benefits are known as ecosystem service. Ecosystem Services are the processes by which the environment produces resources that we often take for granted such as clean water, timber, and habitat for fisheries, and pollination of native and agricultural plants.

AN ECOSYSTEM

An ecosystem is a community of animals and plants interacting with one another and with their physical environment. Ecosystems include physical and chemical components, such as soils, water, and nutrients that support the organisms living within them. These organisms may range from large animals and plants to microscopic bacteria. Ecosystems include the interactions among all organisms in a given habitat. People are part of ecosystems. The health and wellbeing of human populations depends upon the services provided by ecosystems and their components - organisms, soil, water, and nutrients.

ECOSYSTEM SERVICES

Ecosystems provide “services” that:

- Moderate weather extremes and their impacts
- Disperse seeds
- Mitigate drought and floods
- Protect people from the sun’s harmful ultraviolet rays
- Cycle and move nutrients
- Protect stream and river channels and coastal shores from erosion

- Detoxify and decompose wastes
- Control agricultural pests
- Maintain biodiversity
- Generate and preserve soils and renew their fertility
- Contribute to climate stability
- Purify the air and water
- Regulate disease carrying organisms (pest regulation)
- Pollinate crops and natural vegetation

Biological control: A service to the ecosystem

Biological control is defined as the reduction of pest populations by natural enemies and typically involves an active human role. Natural enemies of insect pests, also known as biological control agents; and include predators, parasitoids, and pathogens. Biological control agents of plant diseases are most often referred to as antagonists. Biological control agents of weeds include herbivores and plant pathogens.

1. **Predators** such as birds, lady bird beetles, lacewings, spiders, reptiles, monkeys, frogs, ground beetles, bugs etc are mainly free-living species that consume a large number of preys during their whole lifetime.
2. **Parasitoids** are species that's immature develops on or within a single insect host, ultimately killing or fatally infecting the host. Most have a very narrow host range. Many species of wasps and some flies are parasitoids.
3. **Pathogens** are disease-causing organisms including bacteria, fungi, and viruses. They kill or debilitate their own host and are relatively specific. There are three basic types of biological control strategies; conservation, classical biological control, and augmentation.

Biological diversity of biological control

Microbial- In these group of organism they usually predate the harmful insect-pest eg arthropods, mites, vertebrates , etc

Predator diversity-

Non-insect predators: Invertebrates

Vertebrates

27 mite families prey on or parasitize invertebrates, only 8 important to biological control

Fishes effective against mosquito larvae

Gambusia affinis

Poecilia reticulata

Insect predators:

Mainly 8 orders

More than 30 families

Eg- ladybird beetle, spiders, colloid, snakes, birds, frog etc.

Parasitoid diversity-Most insect parasitoids are wasps or flies. Parasitoids comprise a diverse range of insects that lay their egg on or in the body of an insect host, which is then used as a food for developing larvae. Parasitic wasps take much longer than predators to consume their victims, for if the larvae were to eat too fast they would run out of food before they became adults. Such parasites are very useful in the organic garden, for they are very efficient hunters, always at work searching for pest invaders. As adults they require high energy fuel as they fly from place to place, and feed upon nectar, pollen and sap, thereby pollinating plenty of flowering plants, particularly buckwheat, umbel lifers, and composites will encourage their presence.

Four of the most important groups are:

- Ichneumonid wasps: (5–10 mm). Prey mainly on caterpillars of butterflies and moths.
- Braconid wasps: Tiny wasps (up to 5 mm) attack caterpillars and a wide range of other insects including greenfly. A common parasite of the cabbage white caterpillar- seen as clusters of sulphur yellow cocoons bursting from collapsed caterpillar skin.
- Chalcid wasps: Among the smallest of insects (<3 mm). Parasitize eggs/larvae of greenfly, whitefly, cabbage caterpillars, scale insects and Strawberry Tortrix Moth (*Acleris comariana*).
- Tachinid flies: Parasitize a wide range of insects including caterpillars, adult and larval beetles, true bugs, and others.

Examples of parasitoids: wasp

Most parasitoids fall under

Diptera Hymenoptera

Diptera contains 13 families parasitic on arthropods and snails

Most important are

Tachinidae

Phoridae

Parasitoids occur in at least 36 families of Hymenoptera

Microbial diversity

Biological control with micro-organisms

Various microbial insect diseases occur naturally, but may also be used as biological pesticides. When naturally occurring, these outbreaks are density-dependent in that they generally only occur as insect populations become denser.

Bacteria and biological control

Bacteria used for biological control infect insects via their digestive tracts, so insects with sucking mouth parts like aphids and scale insects are difficult to control with bacterial biological control. *Bacillus thuringiensis* is the most widely applied species of bacteria used for biological control, with at least four sub-species used to control Lepidopteran (moth, butterfly), Coleopteran (beetle) and Dipteran (true flies) insect pests.

Bacteria most successful

Most emphasis placed on *Bacillus thuringiensis*, known subspecies and many thousands of isolate

Fungi and biological control

Fungi that cause disease in insects are known as entomopathogenic fungi, including at least fourteen species of entomophthoraceous fungi attack aphids. Species in the genus *Trichoderma* are used to manage some soilborne plant pathogens. *Beauveria bassiana* is used to manage different types of pest such whiteflies, thrips, aphids and weevils.

Examples of entomopathogenic fungi:

- *Beauveria bassiana* (against white flies, thrips, aphids and weevils)
- *Paecilomyces fumosoroseus* (against white flies, thrips and aphids)
- *Metarhizium* spp. (against beetles, locusts, Hemiptera, spider mites^[6] and other pests)
- *Lecanicillium lecanii* (against white flies, thrips and aphids)
- *Cordyceps* species (sometimes teleomorphs of the above: that infect a wide spectrum of arthropods)

At least in 15 cases, baculoviruses

Introduced and established successfully

Use of pathogens in classical biocontrol

Rhinoceros beetle (*Oryctes rhinoceros*) in Pacific islands by an *Oryctes* virus

Though still uncommon, of pathogen in classical biological control may increase in the future

Plants as agents of biological control

A diverse range of plants for the garden can help to regulate pests in a variety of ways, including;

- Masking the crop plants from pests, depending on the proximity of the companion or intercrop.
- Producing olfactory inhibitors, odors that confuse and deter pests.
- Acting as trap plants by providing an alluring food that entices pests away from crops.
- Serving as nursery plants, providing breeding grounds for beneficial insects.
- Providing an alternative habitat, usually in a form of a shelterbelt, hedgerow, or beetle bank where beneficial insects can live and reproduce. Nectar-rich plants that bloom for long periods are especially good, as many beneficial are nectivorous during the adult stage, but parasitic or predatory as larvae. A good example of this is the soldier beetle which is frequently found on flowers as an adult, but whose larvae eat aphids, caterpillars, grasshopper eggs, and other beetles.
- Some plants have chemical defenses in order to regulate pests. The geranium has developed such a defense against Japanese beetles, one of the most damaging and expensive pests to control when it comes to ornamental and turf plants. The geranium's petals contain a chemical compound that paralyzes the beetle within 30 minutes of ingestion. The beetle will remain paralyzed for several hours and will typically regain movement within 24 hours. However, while paralyzed the beetle is very vulnerable to its predators and is usually hunted before the paralysis subsides,

The following are plants often used in vegetable gardens to deter insects:

Plant	Pests
<u>Basil</u>	Repels flies and <u>mosquitoes</u> .
<u>Catnip</u>	Deters flea beetle.
<u>Dill</u>	Deters black bean beetles.
<u>Garlic</u>	Deters <u>Japanese beetle</u> .
<u>Horseradish</u>	Deters potato bugs and <u>phytophthora</u>
<u>Marigold</u>	The workhorse of pest deterrents. Discourages Mexican bean beetles, nematodes and others.
<u>Mint</u>	Deters white <u>cabbage moth</u> , ants.
<u>Nasturtium</u>	Deters <u>aphids</u> , squash bugs, cabbage moth, Whitefly and striped pumpkin beetles.
<u>Pot Marigold</u>	Deters <u>asparagus beetle</u> , <u>Manduca quinquemaculata</u> (tomato horn worm), and general garden pests.
<u>Peppermint</u>	Repels the white cabbage butterfly.
<u>Rosemary</u>	Deters cabbage moth, bean beetles and carrot fly.
<u>Sage</u>	Deters cabbage moth and carrot fly.

<u>Southernwood</u>	Deters cabbage moth.
<u>Summer Savory</u>	Deters bean beetles.
<u>Tansy</u>	Deters flying insects, Japanese beetles, striped <u>cucumber beetle</u> , squash bugs and ants.
<u>Thyme</u>	Deters <u>cabbage worm</u> .
<u>Wormwood</u>	Deters animals from garden.

CONCLUSION:

1. Ecosystem functions as natural biological control
2. Till date the potential of biological control has not been sufficiently investigated for their capacity of insect pest control.
3. Biological pest control is one of the most important ecosystem services which is directly linked with our food security
4. Valuation of Biological pest control as a ecosystem service through standard methodologies is essential

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