



Importance of Insects and Their Arthropod Relatives

IMPORTANCE TO NATURAL ECOSYSTEMS

Approximately 80% of animal species on earth are insects, 99% are invertebrates. We share a large proportion of our genetic material with all life on earth down to the simplest worms. Insects provide natural services that we often take for granted. They are the pollinators, undertakers, leaf litter sweepers, garbage collectors, soil conditioners and natural fertilizer producers of nature.

1. POLLINATION

About 80% of the flowering plants on Earth are pollinated by insects. Flower color, shape and scent has evolved to attract their insect pollinators.

Examples: bumble bees, solitary bees, squash bees, beetles, butterflies, flies and ants.

2. DECOMPOSITION & NUTRIENT CYCLING

Insects and their arthropod relatives are responsible for much of the nutrient cycling, conditioning and aeration of the soil. The value of nutrient cycling in terrestrial ecosystems is estimated to be over \$3 trillion per year (Costanza et al. 1997). Insects and related arthropods make up half the animal biomass in some tropical forests (Fittkau and Linge 1973).

Examples of reducers and recyclers: dung beetles, flies, carrion beetles, millipedes, cockroaches, ants termites.

3. FOOD FOR WILDLIFE

Many different kinds of animals eat insects making them essential parts of the food chain.

Examples: amphibians, reptiles, birds, fish, arthropods and other invertebrates, mammals (primates including humans, insectivores focus almost exclusively on insect prey (hedgehogs, shrews, tenrecs, moles).

4. PREDATORS, PARASITES & PARASITOIDS

Some insects provide natural population control of other insects, arthropods and vertebrates.

Examples: ladybird beetles, lacewings, parasite wasps

5. DISEASE AGENTS OR VETORS

Diseases provide natural population control, helping to control overpopulation or overexploitation of natural resources.

IMPORTANCE TO HUMANS

1. ALL OF THE ABOVE

Humans depend on natural ecosystems of water, oxygen, sources of food and building materials.

2. MEDICINE

Insects have been invaluable as research models to discover key scientific principles.

Examples:

- *genetics: fruit flies, Madagascar hissing cockroaches*
- *bioprospecting sources of new pharmaceuticals*
- *first anesthesia; flies during WWII used to clean wounds*
- *insects pollinate the rosy periwinkle plant which was an important drug to treat childhood leukemia*
- *sources of bioluminescent chemicals used in medical diagnostics*

3. BASIC RESEARCH

How the world works; flight, miniaturization, neural networks, biomimetics, genetics, population biology.

4. FOOD AGRICULTURE

A. POLLINATION OF HUMAN CROPS

Approximately one third of the world's crop production depend directly or indirectly on pollination by insects. The value of pollination in the world, most of it by insects, has been estimated at about \$117 billion per year (Costanza et al. 1997).

Examples of crops: coffee, tea cacao (chocolate), vanilla citrus fruits, nuts (almonds), vegetables, other fruit (figs, cranberries, cherries, mangos), clover to name a few.

Examples of pollinators: The honey bee (Apis mellifera) is responsible for the production of approximately \$14 billion worth of agricultural products in the United States in 1998, however other pollinates are important pollinators as well including bumble bee which are used to pollinate tomatoes and cranberries; and carpenter bees which pollinate wild and domestic tree fruits.

B. BIOLOGICAL CONTROL

Natural biological control provided mostly by insects is valued at over \$400 billion per year, according to Constanza (1997). As pests and



Importance of Insects and Their Arthropod Relatives

human competitors insects can destroy or eat \$5 billion worth of domestic crops.

C. COMMERCIAL PRODUCTS

- Silk production, the silk worm (*Bombyx mori*) is the sole sources of commercial silk.
- Cotton (*Gossypium hirsutum*) can self pollinate but can cross pollinate with services of bees: bumble bee (*Bombus spp.*) Melissodes bees, and honey bees (*Apis mellifera* (MfGregor 1976)
- Red cochineal dye for textiles and cosmetics is produced by the scale insect *Dactylopius coccus* (Dactylopiidae) native to Mexico and *Kermes vermilio* (Kermidae) native to Europe.
- Honey is produced by bees and harvested
- Beeswax: candles, cosmetics, soap
- Shellac: the scale insect *Laccifer lacca* (Lacciferidae), native to India, is used to make phonograph records and varnish
- Salt production: Brine shrimp cleaned salt is better tasting than salt containing the organism that the brine shrimp eat. The price of the salt is affected.

4. ECOLOGICAL MONITORING

Insects are excellent indicators of ecosystem health. The numbers of species and kinds of species of insects can tell scientists if a particular ecosystem is healthy or disturbed

5. HUMAN AND LIVESTOCK HEALTH

Arthropods as vectors of disease insects weaken or kill 200 million people per year.

Examples:

- Mosquito borne diseases: malaria, yellow fever, dengue, West Nile virus, some forms of encephalitis
- Tick borne diseases: lyme disease, erlichiosis, tularemia, Q fever, Colorado tick fever, Rocky Mountain spotted fever, relapsing fever and more
- Flea borne diseases: plague, typhus

6. AESTHETICS

- What would a summer night be without the sound of crickets or the flash of fireflies?
- What would a spring meadow be like without the fluttering beauty of butterflies?
- What would a fly-fisherman do without the diversity of insects to feed the trout?

- What would writers, artists, poets do without the inspiration and imagery of insects?
- What would the world be like without flowers, their beautiful and diverse colors, shapes and scents?
- What would be the fun of travel if every place on earth were the same? The uniqueness (of the cloud forest in Costa Rica, the Pantanal wetlands of Brazil, the great grasslands of the Serengeti, the tall grass prairie of the midwest U.S. the great barrier reef of Australia, is what makes each place on Earth special.

References

- Costanza, R. and Folke, C. 1997. "Valuing ecosystem services with efficiency, fairness and sustainability as goals". pp: 49-70 in: G. Daily (ed) *Nature's services: Societal dependence on natural ecosystems*. Island Press, Washington, DC. 392 pp.
- Costanza, R., et al. 1997. "The value of the world's ecosystem services and natural capital". *Nature* 387:253-260.