Insect classification and biodiversity
ENT-304

Dr. Muhammad Arshad
Department of Entomology,
College of Agriculture, University of Sargodha
makuaf@gmail.com

Biodiversity

The air you breathe, the water you drink and the food you eat all rely on biodiversity, but right now it is in crisis – because of us. What does this mean for our future and can we stop it?

Define

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Terms

Population: A group of individuals belonging to one species living in an area.

Species: A group of populations of similar organisms that reproduce among themselves, but do not naturally reproduce with any other kinds of organisms

Species richness is the number of different species represented in an ecological community, landscape or region.

Species evenness refers to how close in numbers each species in an environment is.

Endemic species—species that are only found in one particular location

Niche, in ecology, all of the interactions of a species with the other members of its community, including competition, predation, parasitism, and mutualism.

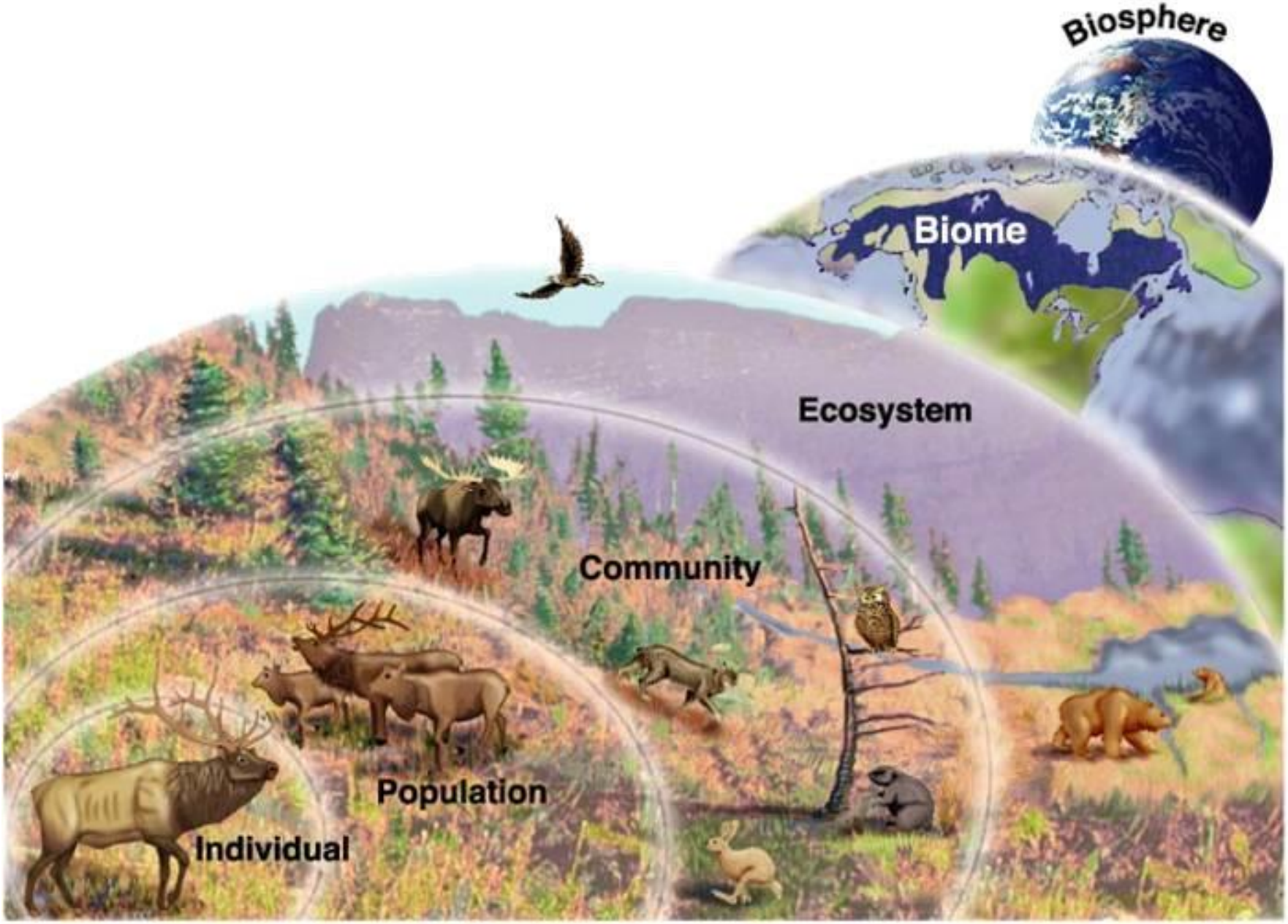
Ecosystem, the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space.

Habitat: place where an organism or a community of organisms lives, including all living and nonliving factors or conditions of the surrounding environment.

Areas with extremely high levels of biodiversity are called **hotspots.**

Biome: also called major life zone, the largest geographic biotic unit, a major community of plants and animals with similar life forms and environmental conditions.

Community: Populations of organisms of different species that interact with one another


Biosphere
Biome
Ecosystem
Community
Population
Individual

To assess the conditions and trends of biodiversity

It is necessary to measure the abundance of all organisms over space and time, using

1- Taxonomy (such as the number of species),

2- Functional traits (for example, the ecological type such as nitrogen-fixing plants like legumes versus non-nitrogen-fixing plants),

3- The interactions among species (predation, parasitism, competition, and facilitation such as pollination, for instance, and how strongly such interactions affect ecosystems)

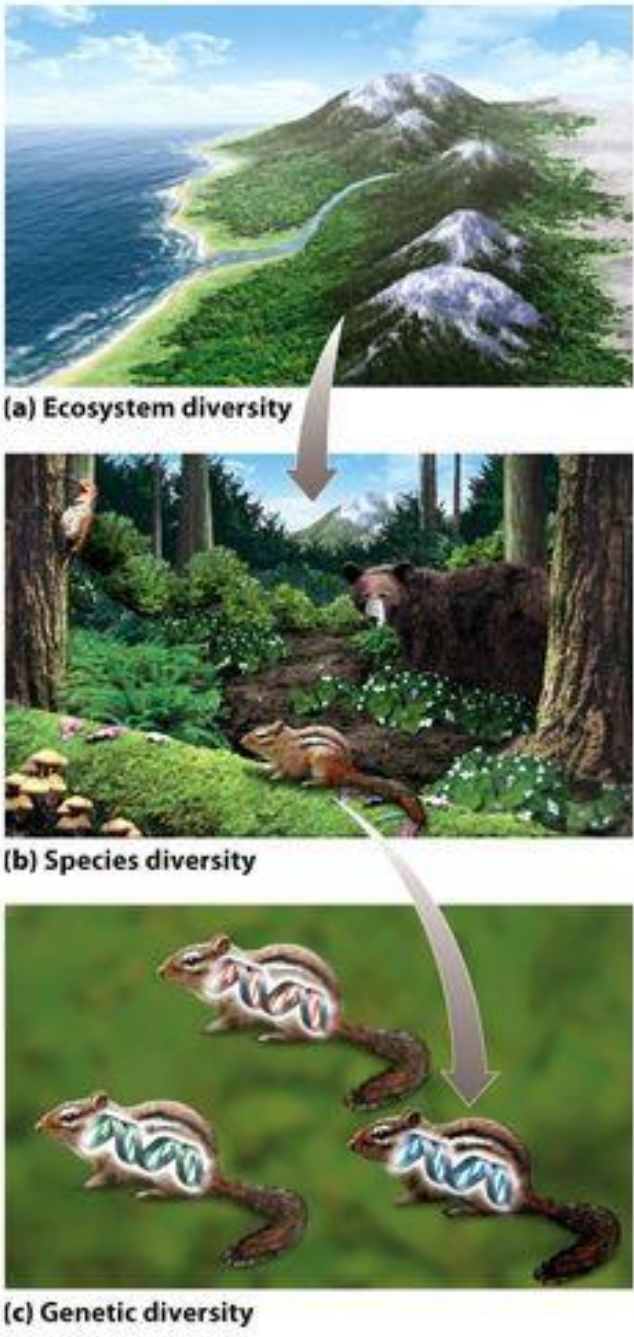
Types

Ecosystem diversity is the variety of ecosystems in a given place. An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem can cover a large area, such as a whole forest, or a small area, such as a pond.

Species diversity is the variety of species within a habitat or a region. Some habitats, such as rainforests have many species. Others, such as polluted stream, have fewer.

In Australia, more than 80% of plant and animal species are endemic, which means that they only occur naturally in Australia.

Genetic diversity variety of genes within a species. Each species is made up of individuals that have their own particular genetic composition. This means a species may have different populations, each having different genetic compositions.



Insect Biodiversity

- In the world today – 1.5 million species of insect are present
- But Scientist believe, there are more
- Terry Erwin – Entomologist in Latin America reported that there might be 30 million species
- Insects are the largest biomass of all animals
- It is estimated that there are 10 quintillion (10,000,000,000,000,000,000) insect alive on our earth
- Another way – 200 million insects for every human
- The New York Times claimed – World holds 300 pounds of insects for every pound of human

- Insect may found everywhere
- Insect are successful
- Unfortunately insect fauna always claimed as pest fauna
- There are two aspects
  - Harmful
  - Beneficial

Loss of biodiversity

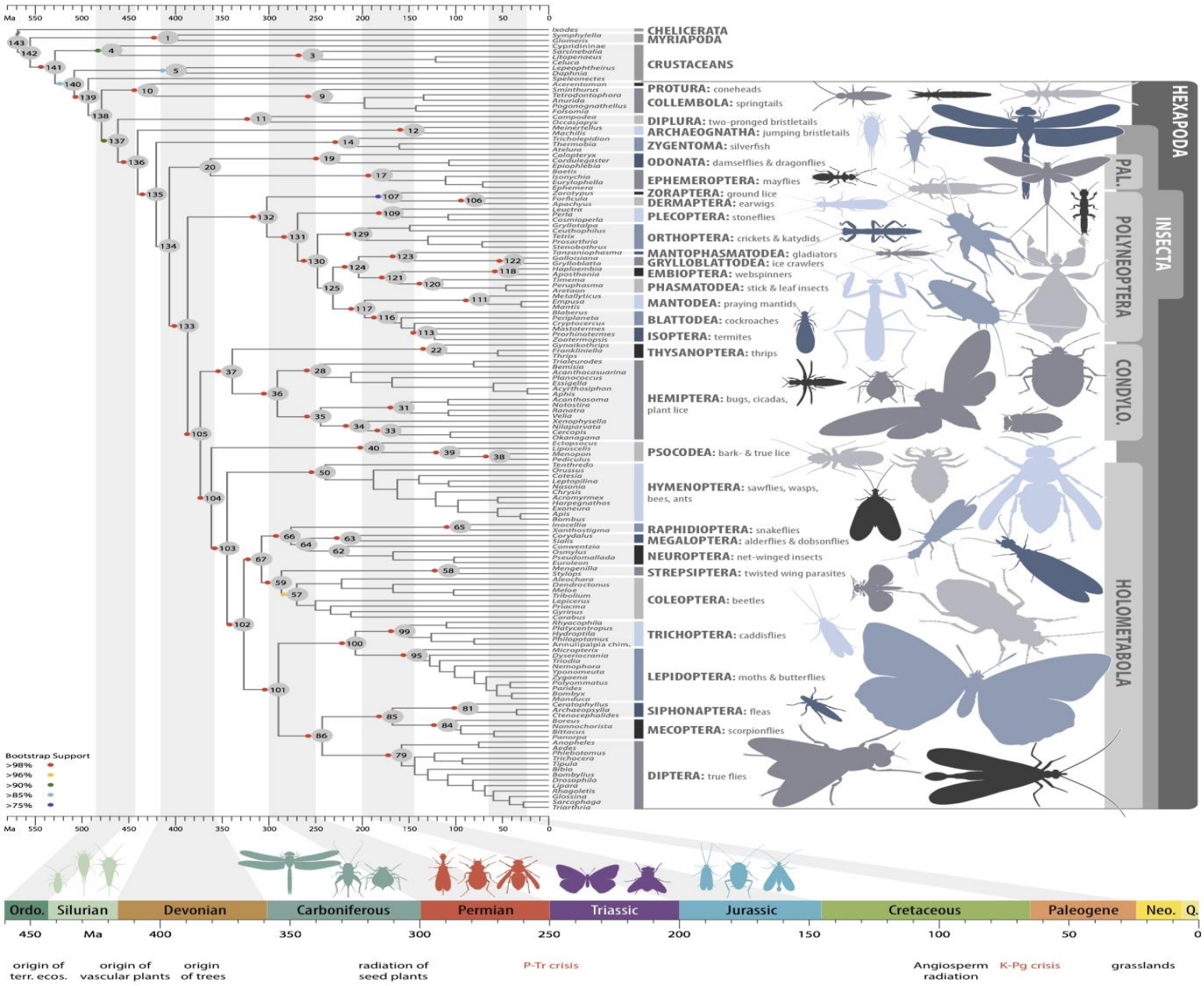
- Estimated 140 plants and animals are lost everyday in the world

- Loss of 1 plant mean extinction of 30 insects including other animal

Example

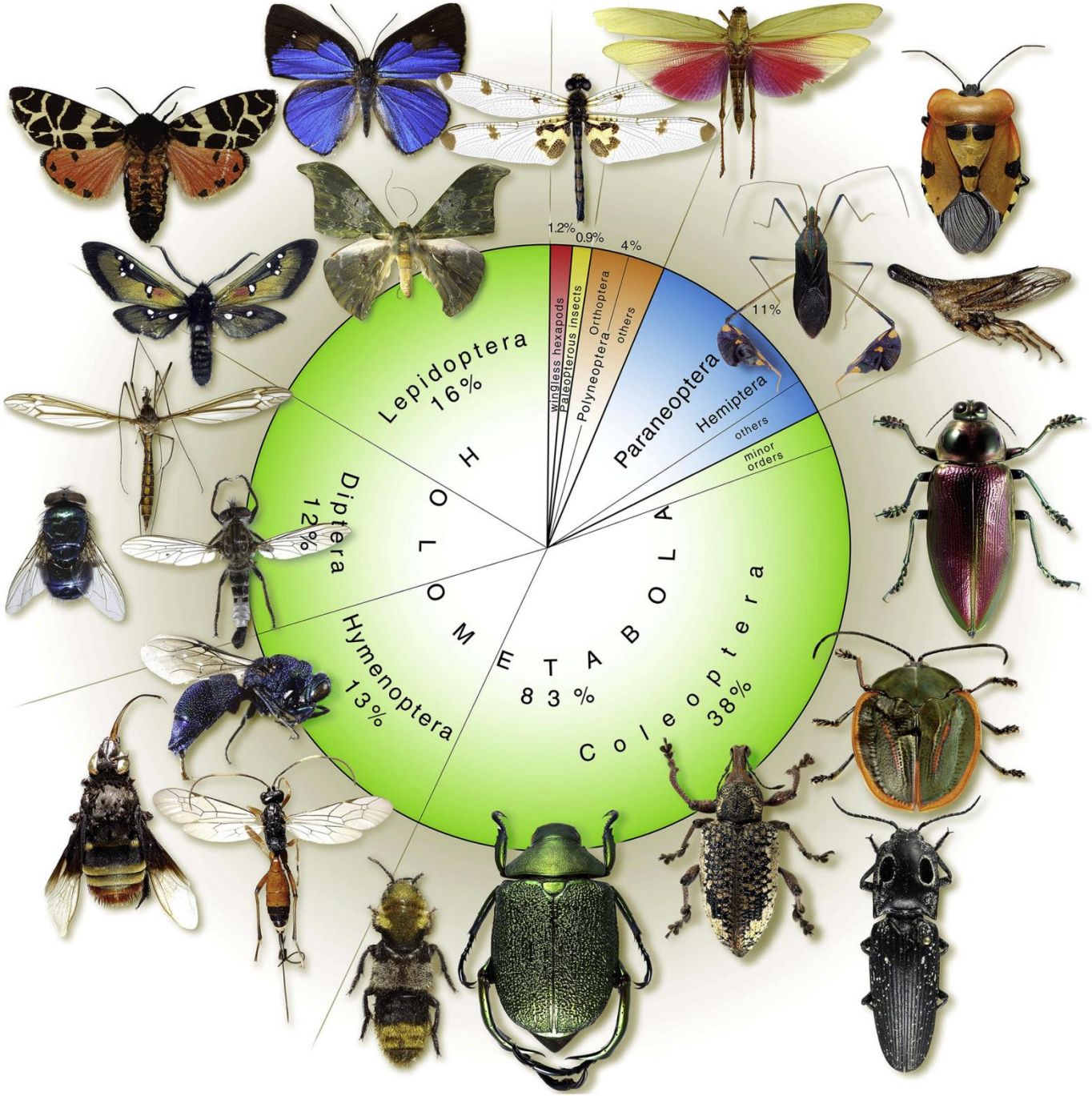
- Due to Insecticidal use
  - Harmful for beneficial also
  - Pollinators have been disturbed
- Due to Urbanization
- Due to Environmental changes

History of Insects


Ma 550 500 450 400 350 300 250 200 150 100 50 0
CHELICERATA
MYRIAPODA
CRUSTACEANS
PROTURA: coneheads
COLLEMBOLA: springtails
DIPLURA: two-pronged bristletails
ARCHAEOGNATHA: jumping bristletails
ZYGENTOMA: silverfish
ODONATA: damselflies & dragonflies
EPHEMEROPTERA: mayflies
ZORAPTERA: ground lice
DERMAPTERA: earwigs
PLECOPTERA: stoneflies
ORTHOPTERA: crickets & katydids
MANTOPHASMATODEA: gladiators
GRYLLOBLATTODEA: ice crawlers
EMBIOPTERA: webspinners
PHASMATODEA: stick & leaf insects
MANTODEA: praying mantids
BLATTODEA: cockroaches
ISOPTERA: termites
THYSANOPTERA: thrips
HEMIPTERA: bugs, cicadas, plant lice
PSOCODEA: bark- & true lice
HYMENOPTERA: sawflies, wasps, bees, ants
RAPHIDIOPTERA: snakeflies
MEGALOPTERA: alderflies & dobsonflies
NEUROPTERA: net-winged insects
STREPSIPTERA: twisted wing parasites
COLEOPTERA: beetles
TRICHOPTERA: caddisflies
LEPIDOPTERA: moths & butterflies
SIPHONAPTERA: fleas
MECOPTERA: scorpionflies
DIPTERA: true flies
HEXAPODA
PAL.
INSECTA
POLYNEOPTERA
CONDYLO.
HOLOMETABOLA
Bootstrap Support
>98%
>96%
>90%
>85%
>75%
Ordo.
Silurian
Devonian
Carboniferous
Permian
Triassic
Jurassic
Cretaceous
Paleogene
Neo.
Q.
450 Ma 400 350 300 250 200 150 100 50 0
origin of terr. ecos.
origin of vascular plants
origin of trees
radiation of seed plants
P-Tr crisis
Angiosperm radiation
K-Pg crisis
grasslands

History of Insects

- First terrestrial animal – relation with plants
- First insect – Devonian period – 360-400 m year
  - Collembola, Protura, Diplura
- Age of Cockroaches – Pennsylanian period – 285-310 m years
- Adaptation to flight
- 1500 species of fossil insect known in 2 groups
  - 1) flying insect or Paleoptera
  - 2) folding wing insect or Neoptera
- Great diversity insect – Permian period – 245-285 m years
- Many new insect order appeared
- Recently Hymenoptera appear as fossil – Jurassic period – 145-210 m years ago’
- Mantodea fossil – Eocene period – 35-60 m years ago


1.2%
0.9%
4%
11%
Wingless hexapods
Paleopterous insects
Polyneoptera
Orthoptera
others
Paraneoptera
Hemiptera
others
minor orders
Lepidoptera
16%
Diptera
12%
Hymenoptera
13%
HOLOMETABOLA
83%
Coleoptera
38%

Insect adaptation

- Adaptation is the process whereby a group of organisms becomes better suited to its environment over the course of many generations
- Adaptations may refer to an organism's ability to change in order to cope with changing environmental circumstances.
- It may be a special feature or behaviour that makes an organism particularly suited to its habitat.
- The following categories of adaptations are recognized:
  - (1) Behavioral
  - (2) Morphological
  - (3) Physiological.

BEHAVIOURAL ADAPTATIONS

A-Migration

- All insects move to some extent.

- The range of movement can vary from within a few centimetres for some sucking insects and wingless aphids to thousands of kilometres in the case of other insects such as locusts, butterflies and dragonflies.

Lepidoptera

- Migration of butterflies and moths is particularly well known. In southern India, mass migrations of many species occur before monsoons. As many as 250 species of butterflies in India are migratory.

Orthoptera

- Short-horned grasshoppers sometime form swarms that will make long flights.

Odonata

- Dragonflies are among the longest distance insect migrants.

Coleoptera

- Ladybird beetles such as *Hippodamia convergens*, *Adalia bipunctata* and *Coccinella undecimpunctata* have been noted in large numbers in some places.

B-Hibernation

- Insects are known to pass winter through different stages viz. egg, nymph, larvae, pupae, and adults
- Ladybird beetles hibernate in big colonies under the loose bark of trees, in tree cavities, and in buildings

C-Sounding scary

- Many insects, such as some shield bugs, dung beetles, longhorn beetles, ants and tiger moths produce buzzing or hissing sounds when disturbed or handled,
- In most cases by rubbing or vibrating one part of the body against another part (a mechanism called stridulation)

D-Shooting spray

- A foul smell or a bad taste is often enough to discourage a potential predator.
- Shield bugs have specialized glands located in the thorax or abdomen that produce foul-smelling hydrocarbons. These chemicals accumulate in a small reservoir adjacent to the gland and are released onto the body surface only as needed.
- Some blister beetles produce cantharidin, a strong irritant and blistering agent that circulates in their haemolymph. Droplets of this blood ooze from the beetle's leg joints when it is disturbed or threatened - an adaptation known as **reflex bleeding**.
- Many more - Irritant chemical sprays - some termites – cockroaches – earwigs - stick insects - some beetles

E-Death feigning

- As a defensive response is very widespread in insects.
- Fire ants, *Solenopsis invicta*, when colonies are at war, youngest feign death, after danger has apparently passed, they look around before fully reviving
- Red flour beetles feign death upon encountering a predator such as a jumping spider
- Pselaphid beetle (*Claviger testaceus*) - entering an ant nest
- Males of the praying mantis (*Mantis religiosa*) freeze immediately after mating

F-Web spinning

- They use this silk to create tunnels where numerous females and their young are protected from desiccation and predators

- Embioptera and Psocoptera

MORPHOLOGICAL ADAPTATIONS

- Adaptations via various physical features which enable an insect to live a stress free life in adverse conditions.
  - (1) Mimicry
  - (2) Camouflage

A-Mimicry

- Is the adaptive resemblance
- About not being eaten
- Insect is mimicking or trying to look like something else.
- Just like our criminals pretended to be other people at the party,

1-Batesian Mimicry

- Two or more species similar – but 1 is dangerous
- Insects pretend to be other animals to escape from potential predators.
- When a non-bee insect (like the robber fly) looks like an actual bee. Bees sting! So predators know to stay away from them.

2-Mullerian Mimicry

- Their color pattern confuse the predator
- Viceroy/Monarch butterflies
- Monarch feed entirely on milkweed that makes them toxic to predators.

3-Self mimicry

- One body part mimics another to increase survival
- Fooling predators into grabbing the wrong part of the butterfly.
- Eyespots may serve the same function - misdirecting a predator that's aiming at its head - they may also scare - think they've tangled with a much larger beast.

B-Camouflage

- Insects that look like their environment won’t be seen by predators such as birds and lizards
- Looper moth caterpillars and walking sticks are other examples of extreme insect mimics. When searching for these creatures, one has to look closely because they can easily be mistaken for just another extension of a tree branch.

PHYSIOLOGICAL ADAPTATION

- Physiological adaptation refers to internal mechanisms of insects to avoid unfavourable circumstances.
- To escape or alleviate low temperatures, insects have evolved a battery of physiological strategies

A-Adpatation to low temperature

1-Freeze avoidance - selection of a dry hibernation site in which no ice nucleation from an external source can occur.

2-Freeze tolerance - Freeze tolerance in insects refers to the ability of some insect species to survive ice formation within their tissues

B-Adaptation to high temperature

- Transpiration through the cuticle is the main route of water loss from insects, The primary passive barrier to evaporative water loss is a thin layer of lipids on the surface of the cuticle

INSECT CLASSIFICATION

- Dividing things into smaller, similar groups is called classification.
- The science of dividing, or classifying, living things is called taxonomy.
- Brauer (1885), Sharp (1899) earlier attempts for classification
- Handlirsch (1908) and Wilson and Doner (1937) have reviewed the classification and define many orders
- Kingdom - Animalia
- Phylum - Arthropoda
- Class - Insecta
- Order - Hymenoptera
- Family - Apidae
- Genus - Apis
- Species - mellifera

Classification of Class Insecta

Naeem Javid M. Hassani
of Mastung, Balochistan

Class Insecta

Sub-Class

Pterygota (Winged insects)

Endopterygota:

1. Lepidoptera - Butterflies, moths
2. Coleoptera - Beetles
3. Hymenoptera - Bees, ants, wasps
4. Diptera - Ture flies, mosquitoes
5. Siphonoptera - Fleas
6. Neuroptera - Lace wings, ant lions
7. Mecoptera - Scorpion flies
8. Tricoptera - Caddis flies

Exopterygota

1. Orthoptera - Grass hopper, cricket
2. Dictyoptera - Cockroaches, Mantids
3. Hemiptera - Bugs
4. Homoptera - Aphids, Plant hoppers
5. Odonata - Dragon flies
6. Isaptera - Termites
7. Thysanoptera - Thrips
8. Anaplura - Sucking lice
9. Plecoptera - Stone flies
10. Dermoptera - Earwigs
11. Phasmida - Stick and leaf insects
12. Ephimeroptera - May flies
13. Malophaga - Chewing lice

Sub-Class

Aptrygota (Wingless insects)

Orders:

1. Thysanura - Silver Fish
2. Collembola - Spring tails
3. Diplura - Campoda silver fish
4. Protura - Proturon