



Compiled by M. Iles, Dougan Ecology – contact miles@dougan.ca for support with Mini Forest BioMonitoring and setting up your iNaturalist project

Why Focus on Insects in Biodiversity Monitoring?

High Sensitivity and Rapid Response:

- Insects react quickly to **environmental changes** – including pollution, climate change, or habitat loss.
- Some of the first organisms to utilize a Mini Forest, as it establishes.

Abundance and Diversity:

- Represent over 70% of forest species.
- Massive, diverse sample population - changes to which can be tracked over time.

Critical Ecosystem Services:

- Include **pollinating** plants, breaking-down dead organic matter, providing ecosystem balance through control of ‘pests’, and as prey for many other animals.

Finer-Scale Assessment:

- Insects are well suited for analyzing **localized** impacts.

Technological Feasibility:

- Modern methods and tools, including photography and iNaturalist.



What is an insect?

(Taxonomically, Insecta is a 'Class' of animals)

3x Body Segments: Head, thorax and abdomen.

6x Legs: Six jointed legs.

Antennae: One pair.

Wings: Typically two pairs, if present.

Metamorphosis: Complete (egg, larva, pupa, adult) or Incomplete (egg, nymph, adult).

Abundant and Diverse, but under threat

- ~80% of all know animals are insects.
- **Exoskeleton, size, adaptability, flight and metamorphosis** - contribute toward success
- However, **declining globally** at an alarming rate.
- Studies suggest a potential 75% drop in flying insects over three decades.

Some key Insect Orders:

Lepidoptera – Butterflies and Moths

- *Lepidoptera* identified by two pairs of scale-covered wings and a coiled proboscis;

Butterflies generally diurnal, clubbed antennae.

- Common butterfly families include: Swallowtails; Whites and Sulphurs; Blues, Coppers and Hairstreaks; Brushfoots; Skippers.



Monarch and Black Swallowtail, M. Iles

Moths generally nocturnal, feathered antennae.

- Mothing can require more specialist survey approaches and equipment: e.g. UV-light, white sheet.



LDD or 'Spongy' Moth, and evening 'mothing', Karl Konze

Coleoptera – Beetles

- Most diverse Order of organisms on the planet... 25% of all known animals!
- 40% of all described insects.
- Minute to large in size.
- Identified by hardened wing case or 'elytra', and mandibles – chewing mouthparts.
- Important to recognise due to role as forestry/tree pests.



Northern Pine Sawyer, *M. Iles*



Bronzed Tiger Beetle, *K. Konze*

Hymenoptera – Bees, Wasps, Ants and Sawflies

- Second only to beetles for number of species.
- Petiole = narrow waist.
- Minute to large in size.
- Bees are particularly important in pollination due to their *relentless* flower visitation.
- Significant global decline... wild bees in particular.
- Some Social – only truly social insects (along with termites).
- Most species are solitary.
- Many are parasites of other insects.



< Great Golden Digger Wasp, *K. Konze*

Tri-coloured Bumblebee, *M. Iles*

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Diptera – ‘True’ Flies

- Just one pair of wings present.
- Large compound eyes and mouthparts designed for piercing and sucking.
- Includes hover flies, robber flies, midges, crane flies, fruit flies, mosquitos, deer and horse flies, and many other.
- Many are mimics of bees and wasps.



Hemiptera - 'True' Bugs

- Includes aphids, cicadas, shield and stink bugs, planthoppers, leafhoppers, water bugs, bedbugs(!) and many others.
- Piercing mouthparts – for feeding on plants or other animals.
- Highly variable physically.
- Sometimes agricultural and forest 'pests'.



Odontata – Dragonflies and Damselflies

- 6000 species worldwide.
- Long, slender bodied.
- Large compound eyes.
- Two pairs of wings.
- Amazing flight capabilities – impressive predators.
- Dragonflies – larger, wings rest outspread.
- Damselflies – generally smaller, resting wings held vertical.

Familiar Bluet, *M. Iles*



Twelve-spotted Skimmer, *M. Iles*

Orthoptera - Grasshoppers, Crickets and Katydid

- Medium to large in size - stout body and blunt head.
- Hing legs enlarged and modified for jumping and communication.
- Herbivores; Dwindling habitat (grasslands).
- Crickets tend to flattened 'top-to-bottom'.
- Grasshoppers usually flattened 'side-by-side'.
- Katydid have antenna longer than their body and sword-like ovipositors (females).



Immature Insects: These are often wingless and may look completely different from adults. E.g. caterpillars or beetle larvae/grubs

Other Orders:

Many others including Stoneflies, Stick Insects, Earwigs, Cockroaches, Termites, Lacewings, Caddisflies, Fleas and more...!

Other key Invertebrate groups:

Spiders: Eight legs, no antennae, and two body segments (cephalothorax and abdomen).

Mites: Very small (often ~1 mm), sometimes with distinct feeding damage, such as stippling on leaves.

Ticks: Eight legs – spreading with climate changes – disease concerns.

Other **Arthropods**, with many legs, including Centipedes, Wood-Lice or Isopods, segmented worms, and many, many more...

Photo resources

Unless indicated, photos are sourced from:

- Bugwood.org

A Primer for Insect Ecology:

Class Insecta, or insects, is the largest and most diverse group of animals, characterized by a three-part body, six legs, and often wings, with over a million described species worldwide.

General Characteristics

Insects are hexapod invertebrates belonging to the phylum Arthropoda, distinguished by a chitinous exoskeleton, a three-part body (head, thorax, abdomen), three pairs of jointed legs, compound eyes, and a pair of antennae. Most insects also have wings at some stage of their life cycle. Their nervous system includes a brain and a ventral nerve cord, and they breathe through a tracheal system with spiracles that deliver oxygen directly to tissues. Insects reproduce primarily by laying eggs, and their development often involves molting due to the inelastic exoskeleton.

Anatomy and Physiology

The head bears sensory organs and mouthparts, including mandibles, maxillae, labium, and a hypopharynx. The thorax supports legs and wings, while the abdomen contains digestive, excretory, and reproductive organs. Insects have a complete digestive system, excrete nitrogenous waste via Malpighian tubules, and exhibit diverse feeding habits adapted to their ecological niches. Vision is primarily through compound eyes, with additional ocelli, and many insects can detect sound and smell using specialized organs.

Diversity and Classification

Insects are the most diverse group of animals, with about 1 million described species and estimates of up to 5–10 million species globally. They occupy nearly all terrestrial and freshwater habitats, with a few species even in marine environments. Insects are classified hierarchically:

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Orders: Examples include Diptera (flies), Lepidoptera (butterflies and moths), Coleoptera (beetles), Hymenoptera (bees, wasps, ants)

Families, Genera, Species follow binomial nomenclature for precise identification.

Insects are further grouped into superorders such as Apterygota (wingless), Palaeoptera, Polyneoptera, Paraneoptera, and Endopterygota (holometabolous insects with complete metamorphosis),.

Ecological and Human Importance

Insects play critical roles in ecosystems: they pollinate plants, control pest populations, act as scavengers, and serve as food for other animals. They are also valuable in scientific research, contributing to studies in genetics, physiology, ecology, and environmental monitoring. Some insects are pests or disease vectors, while many are beneficial for agriculture and biodiversity.

Summary

Class Insecta represents a highly successful and adaptable group of animals, with remarkable diversity in form, function, and habitat. Their unique anatomy, life cycles, and ecological roles make them essential to both natural ecosystems and human society.