BENTHIC AQUATIC MACROINVERTEBRATE INSECTS

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WHAT ARE BENTHIC AQUATIC MACROINVERTEBRATE INSECTS?

- **Let's look at the meaning of each term.**
- **Benthic** – Living at the bottom.
- **Aquatic** – Living in or near the water.
- **Macro** – Large enough to see with the naked eye.
- **Invertebrate** – A living creature without a backbone/vertebrae.
- **Insects** – Small animals that are arthropods, with six jointed legs and a body consisting of a head, thorax and abdomen.
- **Let's put the terms together.**

Benthic aquatic macroinvertebrate insects are small animals with no backbones that we can see and live at the bottom of freshwater streams, rivers, lakes and ponds.

AQUATIC INSECT BODY PARTS

- AQUATIC INSECTS, LIKE ALL INSECTS, HAVE 3 MAIN BODY PARTS.

1. HEAD – Made up of the eyes, mouth and antennae.

2. THORAX – Contains six legs and possibly wings. The thorax is made up of three segments:

a. Prothorax (Front section) **b.** Mesothorax (Mid-section) **c.** Metathorax (Back section)

3. ABDOMEN – The longest body part, consisting of segments.

Fig. # 1.

Fig. # 2.

THE LIFE CYCLES OF AN AQUATIC INSECT

- Aquatic insects all have one thing in common: They rely on water at one stage of their life.
- Aquatic insects live in water in their juvenile stage and go through several stages to live on land as adults.
- All insects go through metamorphoses or changes during their life cycles.
- There are two types of life cycles insects can go through:
    - **Incomplete Metamorphosis**
    - **Complete Metamorphosis**.

Fig. # 3.

Adult Dragonfly

INCOMPLETE METAMORPHOSIS

An **incomplete metamorphosis** includes three (3) life stages;

1. The **egg** stage.
2. The **larva/larval** stage.
3. The **imago** stage.

The incomplete metamorphosis life cycle does not include the pupal stage.

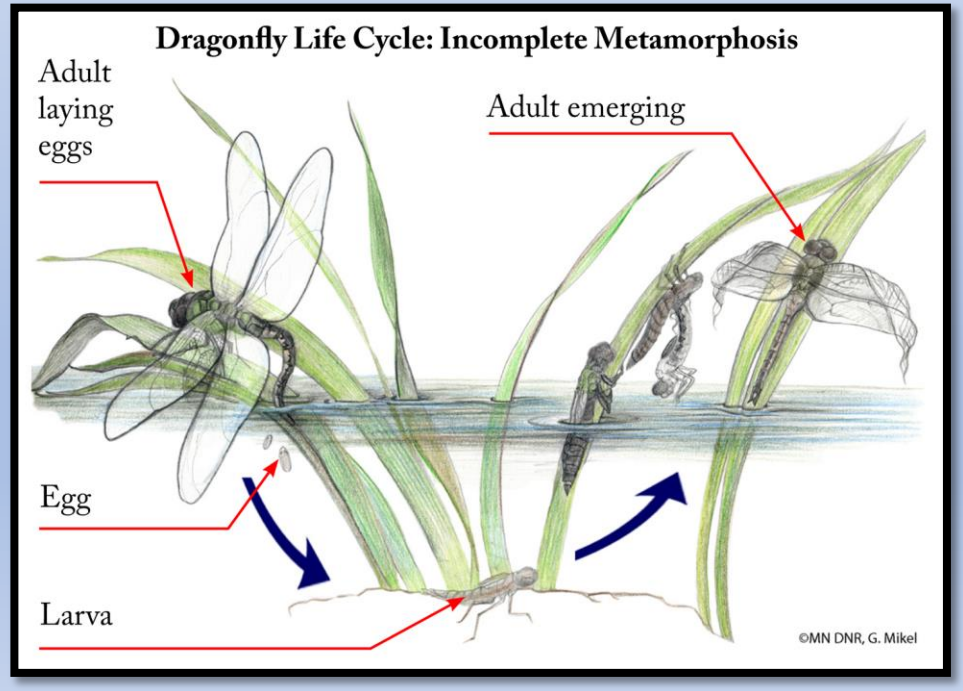

Fig. # 4.

COMPLETE METAMORPHOSIS

A **complete metamorphosis** includes four (4) life stages;

1. The **egg** stage.
2. The **larva/larval** stage.
3. The **pupa** stage.
4. The **imago (adult)** stage.

The **pupal** stage is found only in insects that undergo a complete metamorphosis.

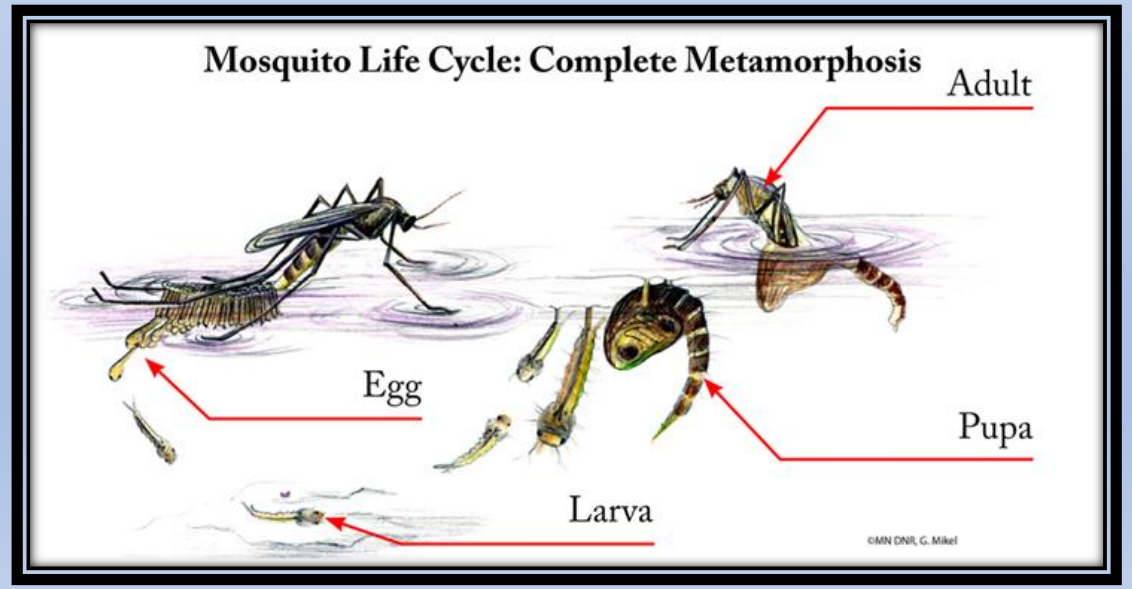

Fig. # 5.

WHY ARE AQUATIC MACROINVERTEBRATE INSECTS IMPORTANT?

Aquatic insects have several important functions:

1. Aquatic insects are a valuable food source for fish and other aquatic animals.
2. Aquatic insects eat dead/decaying bacteria, plants and animals and keep the water clean.
3. Aquatic insects are the foundation that supports the entire aquatic food chain.

Fig. # 6.

WHY ARE AQUATIC MACROINVERTEBRATE INSECTS IMPORTANT? (CONTINUED)

4. Aquatic insects are important key bioindicators of water quality.

5. Inspecting aquatic insect life to determine water quality is easy, reliable and inexpensive.

Fig. # 7.

HOW DO AQUATIC INSECTS BREATHE IN WATER?

- Some insects breathe through tiny **gills**.
- Other insects absorb air through **spiracles**, tiny holes on both sides of their bodies.
- Some insects use **breathing tubes**.
- Other insects use **air bubbles** to get oxygen.

Mayfly Nymph,
(Gills)

Fig. # 8.

Crane Fly,
(Spiracles)

Fig. # 9.

Mosquito Larva,
(Breathing Tubes)

Fig. # 10.

Diving Beetle,
(Air bubble)

Fig. # 11

Common Macroinvertebrates Found In Streams

The following chart shows common aquatic insects found in cold, oxygenated freshwater streams and rivers.

ANNELIDS	CRUSTACEANS	TRUE INSECTS	MOLLUSKS
*Aquatic Worms	* Aquatic Sowbugs	* Beetles	* Clams
*Leeches	* Crayfish	* Caddisflies	* Mussels
*Planaria	* Scuds	* Damselflies	* Snails
		* Dobsonflies	
		* Dragonflies	
		* Mayflies	
		* Stoneflies	
		* True Flies	

ANNELIDS

- Burrowing annelids, like the **earthworm**, play an important role in helping organic matter decompose. Earthworms are omnivores.
- Earthworms also help loosen the soil so air can circulate, which helps plants grow.
- **Leeches** are found in most freshwater ponds and lakes. Leeches are carnivores, eating worms, snails and insect larva.
- **Planaria** are flatworm Annelids that are opportunistic omnivores.

Aquatic Earthworm

(Haplotaxids)

Fig. # 12.

Leach

(Hirudinea)

Fig. # 13.

Planaria

(Tricladida)

Fig. # 14.

CRUSTACEANS

Crustaceans are important members of aquatic freshwater ecosystems.

Crustaceans and arachnids (spiders) are from the same group, arthropods.

All arthropods have distinctive physical characteristics:

1. No backbone.
2. A hard exoskeleton.
3. Jointed legs.
4. Segmented bodies.

Crustaceans breathe through gills.

Crustaceans play a vital role in aquatic ecosystems as a food source.

Crustaceans also recycle important nutrients back into the water.

CRUSTACEANS – SCUDS & SOWBUGS

- **Scuds:** (order Amphipoda)
- Also called freshwater shrimp, scuds range in size from less than an eighth of an inch to over one inch.
- Scuds can be free-swimmers but are mainly bottom-dwellers.
- Scuds are omnivores, eating decaying plants, animals and detritus (poop).
- **Aquatic Sowbugs**: (order Isopoda)
- Aquatic Sowbugs are common in water rich with organic materials.
- Sowbugs are omnivores, feeding on dying, dead and decaying plants and animals.
- Sowbugs are an important food source for many aquatic predators.

SCUD

Fig. # 15

AQUATIC SOWBUG

Fig. # 16.

CRUSTACEANS – CRAYFISH

(order – Decapoda, phylum Arthropada)

- **Crayfish** – Are small freshwater crustaceans that look like a small lobster.
- Average life span is 3 – 8 years and can grow up to 6 – 9 inches in size.
- Crayfish are found in brooks, streams, swamps and ditches.
- Crayfish live under rocks and logs and breathe through gills.
- Most species cannot tolerate polluted water and are good indicators of water quality.
- Crayfish are omnivores and will eat whatever they can find, living or dead.

CRAYFISH

Fig. # 17

AQUATIC INSECTS - WATER BEETLES

Water Beetle - is the basic name for beetle species that live in freshwater.

- Some beetles are herbivores and eat only aquatic vegetation.
- Some beetles are carnivores and eat mainly other aquatic insects.
- Many beetles are omnivores, feeding on decomposing plants and other insects.
- Beetles breathe through air bubbles.

_____Herbivore_____ ___Carnivore___ _____Omnivores_____

Riffle Beetle Larva | Riffle Beetle | Predacious Diving Beetle | Scavenger Beetle | Crawling Beetle

Fig. # 18

Fig. # 19.

Fig. # 20.

Fig. # 21

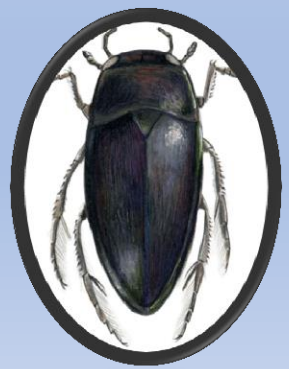

Fig. # 22.

AQUATIC INSECTS: “FLIES”

- The following aquatic insects have wings in the adult stage and are referred to as “flies.”
- Because they are not in the order Diptera, they are not considered true flies.
- These insects belong to 4 orders of insects with aquatic larvae and winged terrestrial adults.

1. Caddisflies (Trichoptera)

Fig. # 23.

2. Dobsonflies (*Odonata*)

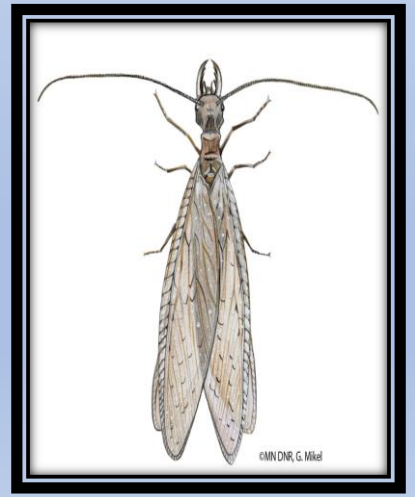

Fig. # 24.

3. Dragonflies (*Odonata*)

Fig. # 25.

4. Mayflies (E*phemeroptera*)

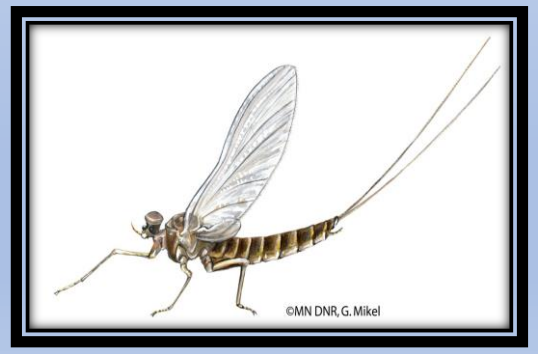

Fig. # 26.

5. Stoneflies (*Plecoptera)*

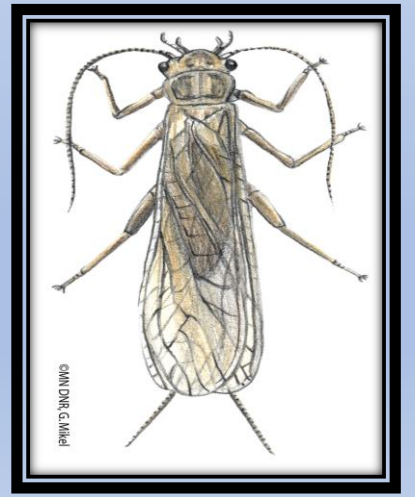

Fig. # 27.

LARVAL STAGE: CADDISFLIES & DOBSONFLIES

- **CADDISFLIES -** (Trichoptera)
- Mostly omnivores, some species are carnivores and herbivores.
- They make protective cases out of organic leaves/sticks or inorganic sand.
- Larvae reduce plant growth and eat animal/plant debris.
- Nymph stage 1 – 3 years, size 1 ½ inches.

Fig. # 28.

- **DOBSONFLIES –** (*Odonata*)
- Called Hellgrammites, carnivores that crawl between rocks & plants in search of prey.
- Nymphs are key indicators of a stream's health, found in clean water.
- Nymphs breathe through gills.
- Nymph stage 1 to 3 years, most of their feeding is done in this stage.

Fig. # 29.

ADULT STAGE: CADDISFLY & DOBSONFLY

CADDISFLY (Trichoptera)

EGGS LAID - 800 per cluster

LIFESPAN - 1 month

DIET - Liquid plant fluids, nectar

SIZE - Up to 1 ½ inch.

WINGSPAN- 2/8 to 3/4 of an inch

WINGS - Two pairs

PREDATORS- Birds, reptiles

Fig. # 30.

DOBSONFLY (*Odonata*)

- 1,000 per cluster.
- Males 3 days, Females 8 – 10 days
- Adults do not eat.
- 3 ½ inches
- 5 inch wingspan
- Two pairs
- Fish, birds and large invertebrates

Fig. # 31.

LARVAL STAGE: DRAGONFLIES & DAMSELFLIES

- **DAMSELFLY NYMPHS:** (Odonata)
- Nymphs are slender, with 6 legs, large eyes and small wing buds on the thorax.
- Nymphs are carnivores, eating small fish, crustaceans, tadpoles and aquatic insects.
- Nymphs are known to climb out of the water on plants looking for terrestrial insects to eat.

Fig. # 32

- **DRAGONFLY NYMPHS:** (Odonata)
- Nymphs have 6 legs, large eyes, a thick abdomen and small wing buds on the thorax.
- Nymphs are carnivores, eating tadpoles, mosquitoes, small fish and insect larvae.
- Nymphs range from 1/4 inch – 2 ½ inches in length.

Fig. # 33.

ADULT STAGE: DRAGONFLIES & DAMSELFLIES

DAMSELFLY (Odonata)

EYES - Smaller eyes with a space in between.

BODY - Longer, much thinner body.

WINGS -Both sets of wings the same size.

RESTING -Wings fold together on its back.

SIZE - Can grow between 1 ½ - 2 inches.

DIET - Flies, mosquitos, moths and beetles.

Fig. # 34.

DRAGONFLY (Odonata)

- Huge eyes cover the head.
- Shorter, thicker body.
- Hind wings larger than front wings.
- Wings held perpendicular.
- Can grow between 2 – 4 inches.
- Mosquitos, flies, bees and butterflies.

Fig. # 35.

LARVAL STAGE: MAYFLIES & STONEFLIES

MAYFLIES (E*phemeroptera*)

- Nymphs live 1 -2 years in the water.
- Nymphs are herbivores, but a few species are carnivores.
- Nymphs breathe through paired gills on each segment of the abdomen.
- Nymphs are a food source for fish and aquatic insects.
- Nymph bodies vary in 3 shapes depending on the habitat they prefer.

Fig. # 36.

STONEFLIES (Plecoptera)

- Nymphs live 1 - 2 years in the water.
- Nymphs are carnivores, but a few species are herbivores.
- Nymphs breathe through gills under the arms and the cerci (tail).
- Nymphs are a food source for fish and aquatic insects.
- A nymph's body length is between 1/2 to 1 ½ inches.

Fig. # 37.

ADULT STAGE MAYFLIES & STONEFLIES

	MAYFLY - (E*phemeroptera*)	**STONEFLY -** (Plecoptera)
Lifespan -	Few days – few weeks.	• Two – three weeks.
Metamorphosis -	Incomplete.	• Incomplete.
Diet -	Do not feed.	• Pollen & nectar/do not feed.
Size -	1/2 inch - 2 inches.	• 1/4 inch – 2 ½ inches.
Wings -	2 pairs, hind wings smaller.	• 2 pairs, hind wings broader.
Predators -	Fish, birds and dragonflies.	• Surfacing fish.

Fig. # 38.

Fig. # 39.

TRUE FLIES (DIPTERA)

- True flies are characterized by:

1. One pair of forewings.
2. Very large compound eyes.
3. A large mesothorax (middle)
4. A large movable head.
5. Sucking or piercing mouth parts.
6. Small prothorax (front) & small metathorax (back).

Fig. # 40.

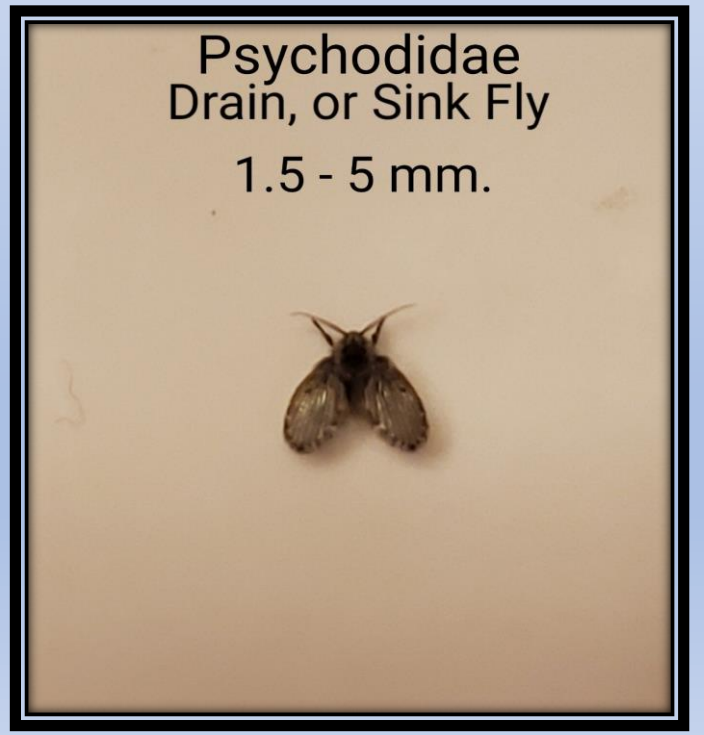

Fig. # 41.

SUBORDERS OF TRUE FLIES

True flies undergo a complete metamorphosis and are divided into two suborders.

SUBORDER, NEMATOCERA

Slender bodies, long legs & antennae.

Crane Flies

Gnats

Moth Flies

Midges----------

Mosquitos

Sand Flies

Fig. # 42.

SUBORDER, BRACHYCERA

Thick bodies, short legs & antennae.

- Deer Flies
- Fruit Flies
- Big Headed Flies ----------
- Horse Flies
- House Flies
- Soldier Flies
- Stable Flies

Fig. # 43.

MOLLUSKS (MOLLUSKA)

Invertebrates including snails, clams and mussels. They have soft unsegmented bodies with an external shell. They are a major food source for fish, turtles and other wildlife.

- <u>CLAMS/MUSSELS</u>
- CLAMS: clean/filter water by removing uneaten food and detritus.
  - Clams help maintain water quality and lower nitrate levels.
- MUSSELS: Help improve water quality by filtering bacteria, algae and pollutants in the water.
  - Like all mollusks, they are excellent water quality indicators.

- <u>SNAILS</u>
- SNAILS: scavengers that eat algae, dead plant material, dead fish and detritus.
  - Snails are excellent water quality indicators.
  - Calcium is stored in the shells and passed on to predators who eat them.

EXTENSION ACTIVITIES

Copy and paste the following links to view extension activities.

- Aquatic Aliens – Too Close For Comfort. http://www.wildlife.state.nm.us/discover-new-mexico-home/aquatic-wildlife/aquatic-aliens-too-close-for-comfort/
- Identify Aquatic Macroinvertebrate Insects, New Mexico Department of Game and Fish. http://www.wildlife.state.nm.us/download/education/conservation/non-correlated-curriculum/activities-and-how-to/Identify-Aquatic-Macroinvertebrate-Insects.pdf
- Water Habitat Site Study, Minnesota Department of Natural Resources, MinnAqua Program. https://files.dnr.state.mn.us/education_safety/education/minnaqua/leadersguide/chapter_1/1_4_water_habitat_site_study.pdf

SOURCES

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- Smithsonian Institute, True Flies (Diptera) - https://www.si.edu/spotlight/buginfo/true-flies-diptera
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- University of Florida Entomology & Nematology. Featured Creatures, Insecta: Odonata. Dragonflies and Damselflies. http://entnemdept.ufl.edu/creatures/misc/odonata/odonata.htm
- Minnesota Department of Natural Resources, MinnAqua Program. https://www.dnr.state.mn.us/
- New Mexico Department of Game and Fish, Wildlife Curriculum For New Mexico. http://www.wildlife.state.nm.us/education/conservation-education/discover-new-mexico/

PHOTOGRAPH & ILLUSTRATION SOURCES

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- Figures 9, 11, 12, 13, 14, 15, 16, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39 – Missouri Department of Conservation. “Aquatic Macroinvertebrates.” https://nature.mdc.mo.gov/discover-nature/field-guide/search?f%5B0%5D=field_fg_types%3A5583
- Figures 3, 4, 7, 8, 9, 10, 34, 44, 45, 46 – Source: New Mexico Department of Game and Fish. http://www.wildlife.state.nm.us/education/conservation-education/discover-new-mexico/
- Figure 6 – Source: Paggen, Ryder, New Mexico Department of Game and Fish. http://www.wildlife.state.nm.us/education/conservation-education/discover-new-mexico/
- Figures 1, 2, 40, 41, 43 – Source: Segura, Dennis, New Mexico Department of Game and Fish. http://www.wildlife.state.nm.us/education/conservation-education/discover-new-mexico/