Benha University
Faculty of Science
Entomology department
First semester 2016

Medical Entomology & Microbiology
Time: 2 hours
Date: 14/1/2016

Aquatic insects 343E; for 3rd year students

Answer the questions

AQ1- Write briefly on the following (<u>select three only</u>) (15 marks)

- **Lake Ecosystem.**
  Lake ecosystems are prime examples of lentic ecosystems. *Lentic* refers to standing or relatively still water, from the Latin *lentus*, which means sluggish. Lentic waters range from ponds to lakes to wetlands, and much of this article applies to lentic ecosystems in general. Lentic ecosystems can be compared with lotic ecosystems, which involve flowing terrestrial waters such as rivers and streams. Lake ecosystems can be divided into zones. One common system divides lakes into three zones. The first, the littoral zone, is the shallow zone near the shore. This is where rooted wetland plants occur. The offshore is divided into two further zones, an open water zone and a deep water zone (limnetic zone). In the open water zone (or photic zone) sunlight supports photosynthetic algae, and the species that feed upon them. In the deep water zone (profundal zone), sunlight is not available and the food web is based on detritus entering from the littoral and photic zones. The aphotic zone may be called the profundal zone.

- **Biotic characteristics of aquatic ecosystem**.
  The organisms (also called biota) found in aquatic ecosystems are either autotrophic or heterotrophic.
  1- Autotrophic organisms (self-feeding) or producer, is an organism that produces complex organic compounds (such as carbohydrates, fats and proteins) from simple inorganic molecules using a source of energy and can be divided into:
  ▪ Photosynthesis (phototrophs) such as plants on land or algae in water. The process in green plants and certain other organisms by which carbohydrates are synthesized from carbon dioxide and water using light as an energy source.
  ▪ Chemosynthesis (lithotrophs) such as chemosynthetic bacteria. They are the producers in a food chain in water. They do not use organic compounds as an energy source or a carbon source; they use other hydrogen compounds such as hydrogen sulfide, elemental sulfur, ammonium and ferrous iron. Chemosynthetic bacteria are found in benthic marine ecosystems. These organisms are able to feed on hydrogen sulfide in water that comes from volcanic vents. Great concentrations of animals that feed on these bacteria are found around volcanic vents.
  2- Heterotrophic organisms: Heterotrophic organisms consume autotrophic organisms and use the organic compounds in their bodies as energy sources and as raw materials to create their own biomass

- **Locomotion adaptation of aquatic insect surface dwellers**.
  Some aquatic insects adapted for "skating" on the surface where water striders (e.g., Heteroptera: Gerridae,) use the surface tension to their advantage through their highly adapted legs and distributed weight. The legs of a water strider are long and slender, providing the weight of the water strider body to be distributed over a much larger surface area. The legs are strong, but have flexibility that allows the water striders to keep their weight evenly distributed and flow with the water movement. There are several thousand hydrofuge hairs per square millimeter of the body, providing the water strider with a hydrofuge body that prevents wetting from waves, rain, or spray, which could inhibit their

ability to keep their entire body above the water surface if the water stuck and weighed down the body. This position of keeping the majority of the body above the water surface is called an epipleustonic position, which is a defining characteristic of water striders. If the body of the water strider were to accidentally become submerged, for instance by a large wave, the tiny hairs would trap air. Tiny air bubbles throughout the body act as buoyancy to bring the water strider to the surface again, while also providing air bubbles to breathe from underwater.

- **Ripple effect phenomena**
  Most aquatic insects are sensitive to water ripples to detect predators or prey. Some even create their own ripples on the water surface and process the returning "echoes" to detect prey. Many, such as the whirligig beetle, also create ripples to find mates and communicate with each other. The water strider uses its front legs as sensors for the vibrations produced by the ripples in the water

AQ2- Give the reasons for <u>three only</u> from the following (12 marks)

- **Energy relationships are more abundant in lotic than lentic habitats**
  The headwaters of a river are very important to the overall health of the entire river, because this is the source of food and nutrients carried downriver. In forested areas, leaves and wood from overhanging trees and shrubs provide food energy. Consequently, you will find many collectors and shredders in these types of areas. In areas not shaded by trees and shrubs, such as prairies, deserts, and mountains, algae and aquatic plants are the main source of energy. You will find that grazers dominate this type of environment. As the river widens and deepens, sunlight is a limiting factor. Rooted vascular plants may grow along the shoreline and algae may grow on rocks. Collector organisms will be found in this area, filtering out particles suspended in the water and gathering fine particles that have settled to the bottom.

- **Water strider or skaters prefer calm water habitats.**

- **Females of subfamily belostomatinae lay their eggs on the back of male.**
  Father water bug keeps his progeny safe from predators and free of fungal infections. He also oxygenates the eggs in several different ways. In the subfamily belostomatinae, the male and female mate, and then the female lay a few eggs on the back of the male. The female finishes laying whatever eggs she has available and leaves the area. All of the belostomatines carry their clutches to the surface periodically. This allows the embryos developing inside eggs to breathe more efficiently. Eggs that are abandoned or deposited anywhere other than on the backs of the male never hatch. In contrast, almost 100% of brooded eggs hatch.

- **The amount of dissolved oxygen was high in lotic than in lentic aquatic habitats**.
  The amount of dissolved oxygen in a water body is frequently the key substance in determining the extent and kinds of organic life in the water body. Fish need dissolved oxygen to survive, although their tolerance to low oxygen varies among species. Conversely, oxygen is fatal to many kinds of anaerobic bacteria. Dissolved oxygen was dependent on current where dissolved oxygen was high with running current water. The same flow carries nutrients and carbon dioxide to plants.

3- Mention the type of respiration in the following aquatic insects (8 Marks)

Rat-tail larvae	Telescopic siphon	Stone fly larvae	Cuticular, abd. gills
Anopheles larvae	Spiracles seg. 8	Chironomous larvae	Hemoglobin
Adult diving beetle	Plastron	Caddisflie larvae	Cuticular
Water strider	Long siphon	Dragon fly larvae	Rectal gills

4- Put the sign ✓ or X in front of each of the following statements (13 Marks)

	The Statements	
1	Diving beetle has a streamlined body reducing water friction and fringed jointed legs allowing it to move very fast through the water to hunt and catch its prey.	√
2	Burrowers, they live on the bottom like sprawlers but they dig holes into the sediment or debris on the bottom and leave only to capture prey	√
3	**Sprawlers** are organisms that live on the bottom or in crevices within the substrate	√
4	**Pleuston** are organisms associated with the surface film	√
5	Tracheal system in **phantom midge** is reduced to kidney-shaped air sacs	√
6	**Piercers**, who are suck out the liquefied insides of their victim like belostomatide bugs and predaceous diving beetles)	√
7	**Shore flies (Ephydridae)** can breed in pools of crude petroleum and waste oil	√
8	Collector-filterers are insects that feed by straining suspended matter and food particles from water like mosquito larvae and black fly larvae.	√
9	Swimmers are aquatic insects that adapted for “fishlike” swimming in lotic or lentic habitats like Back swimmer	√
10	Net-spinning caddisflies (Hydropsychidae) create silk nets to filter food from the stream	√
11	Water scorpions and rat-tailed maggots are two more examples of aquatic insects that have snorkel-like breathing tubes	√
12	Detritivores are dead plant materials with associated microbes	√
13	**Plastron** is a special array of rigid, closely-spaced hydrophobic hairs that create "airspace" next to the body with balanced in hydrostatic pressure.	√

With best wishes
Dr/ Mohamed M. Baz