

Lab Exercise 2- Arthropod diversity

Introduction

Arthropods are abundant in terrestrial, marine, and freshwater aquatic habitats. Their success is probably related to their body plan. There are four main groups of arthropods. The Crustacea (crabs, shrimp and lobsters) usually inhabit marine or aquatic habitats. The Chelicerata (spiders, scorpions, mites, and horseshoe crabs) are marine, aquatic or terrestrial. They have piercing mouthparts called chelicerae for feeding and respire with book gills or book lungs. The Myriapoda (centipedes and millipedes) are terrestrial and have many segments with undifferentiated legs. The Hexapoda are terrestrial or aquatic. Insects are the most diverse group of arthropods. Several million species have been described, but millions more remain unnamed.

Arthropods have colonized terrestrial habitats several times. Indeed, colonization of land has even occurred more than once among Crustaceans. The chelicerates, insects, and myriopods colonized land over 300 million years ago. Today we will compare the overall form of representative arthropods and examine the morphology of a shrimp closely.

Classification and characteristics

PHYLUM ARTHROPODA

External morphology: external skeleton consisting mostly of chitin; segmented body where individual segments are often fused together (tagmatization); appendages are also segmented (jointed appendages); Appendages vary in structure and function, i.e. they are specialized to perform different functions (sensory, feeding, locomotion); compound eye present (secondarily lost in some).

Internal structure and physiology: Ventral nerve cord present; dorsal cerebral ganglion; open circulatory system; dorsal heart; excretion through a gland (Crustacea) or malpighian tubules (Hexapoda and Myriapoda); respiration through diverse mechanisms (Crustacea- gills and body surface, Hexapoda and Myriapoda- tracheal system, chelicerates- book gills or book lungs and tracheal system)

SUPERCLASS CRUSTACEA- Mandibles used for feeding. Biramous appendages. Two pairs of antennae. Mostly marine or aquatic. Great variety in habitat use, feeding behaviors (predatory, herbivorous, filter-feeding or parasitic), and size (microscopic to at least 1m in length). Crustaceans are classified based on appendage morphology and body plan.

SUPERCLASS CHELICERATA- Body consists of a cephalothorax (resulting from the fusion of the head and thorax) and an abdomen. No antennae. The first pair of appendages are chelicerae, which they use to catch and pierce their prey. The second pair of appendages are pedipalps, which vary greatly among groups. Marine forms have book gills for respiration, while terrestrial ones use the homologous structure called book lungs. Horseshoe crabs have compound eyes but terrestrial chelicerates such as spiders have simple eyes. Spiders have excellent vision.

SUPERCLASS MYRIAPODA- Body divided into a head and a long trunk with many segments with legs on them. Relative lack of tagmatization (fusion of segments). In contrast to crustaceans, these organisms all have uniramous appendages. They are terrestrial.

Class Chilopoda- The centipedes. Flattened body with one pair of walking legs per segment. Appendages on first trunk segment modified from legs into poisonous fangs.

Class Diplopoda- The millipedes. Two pair of walking legs per diplosegment (pairs of segments that appear to have fused), body often cylindrical.

SUPERCLASS HEXAPODA - Body divided into three regions with at least some fused segments: head, thorax, and abdomen. Six legs, one pair of antennae. Compound eyes and mandibles for feeding. Terrestrial or aquatic (freshwater); adults often with wings; uniramous appendages.

Laboratory Exercise:

Part A. Diversity of the Crustacea

Activity 1- Shrimp morphology

Place a shrimp specimen into a dish and just barely cover it with fresh water. You should examine it carefully under the dissecting scope. We will compare the morphology and the function of the appendages in different parts of its body.

1a. Overall morphology- The shrimp body includes three regions: head, thorax, and abdomen. Each body region possesses appendages specialized for different functions. The head and thorax are fused into a cephalothorax, which is covered by a carapace on the dorsal side. Note that you can see segmentation much more clearly on the ventral side of the animal, particularly in the thorax. Walking appendages are also attached to the thorax. The abdomen is clearly segmented on the dorsal and ventral side. The pleopods along the abdomen are modified swimming or burrowing appendages. Draw the overall body of the shrimp from the side and label the major body regions and appendages.

1b. Closer examination of shrimp appendages- Most appendages in the shrimp are biramous. They are united at base by several segments, but two rami extend distally. Examine anterior head appendages. The first appendages are sensory structures. Turn your shrimp over and carefully examine appendages surrounding the mouth. Note that several delicate segmented appendages cover the mandibles. These appendages are used to feed. Remove these appendages carefully, examine them, and identify them, using figures provided.

1c. Structure of the compound eye- The compound eye is supported by a stalk. It consists of many separate repeated subunits, called ommatidia, which contain parts needed for image reception. Each ommatidium contains an external cornea, which works as a lens. Examine the microscope slide of the shrimp Mysis sp. at low magnification under your compound microscope. Examine the compound eye closely and **draw** the structures mentioned above.

Activity 2- Display of crustacean diversity

Representatives of several groups of crustaceans are on the back table. Familiarize yourself with these, examine differences in body plan among them, and note their common names.

Part B. Diversity and form of Myriapoda

Activity 3: Comparison of millipedes and centipedes

3a. Examination of Chilopoda- Centipedes are active, predatory, terrestrial arthropods. They live beneath stones and logs and in crevices. They often move very rapidly, have one pair of antennae and a pair of poison claws on the first segment of the trunk (segments posterior to the head). Most species have no compound eyes but they often have antennae. Examine centipedes on display (class Chilopoda). Describe their body form and appendages below.

3b. Examination of Diplopoda- Millipedes feed on decaying vegetation and they spend much of their time in burrows or in the leaf litter. Some inhabit the burrows of other organisms or even ant nests. Compare the millipede specimens with the centipedes, noting differences in body form, the number of legs per segment, and the morphology of the mouthparts.

Part C. Diversity and form of Chelicerata

Activity 4: Comparison of marine and terrestrial chelicerates

4a. Examination of Merostomata-Examine the horseshoe crab specimen closely. Note the compound eyes and carapace. **Draw** the ventral side, indicating the pedipalps, number of legs, and book gills. These were originally legs that became modified into respiratory structures.

4b. Examination of terrestrial chelicerates- Some features of terrestrial arachnids clearly represent homologies with those of their marine chelicerate relatives. One example is their book lungs. The appendages are also clearly homologous, although they vary in size and shape. The same thing is true for the overall body form. All arachnids have a cephalothorax and abdomen, but the size and shape of these parts varies. Examine the spiders and scorpions and describe the difference in body form below.