BI 271 Lab: Intertidal Snail and Algae Distribution

Introduction

Maine's rocky intertidal habitats are challenging, stressful places to live. Organisms that live in the intertidal zones deal with tidal inundation, desiccation, heat stress, cold temperatures, saline ocean water, freshwater runoff and rain, crashing waves, limited space, and predation. Because of the roughly 12-hour tide cycles, conditions can change dramatically in a short period of time. Add to that Maine's seasonal fluctuations and occasional storms, and you can see why relatively few organisms can live in the rocky intertidal coastline.

Because snails are abundant and slow-moving, they are ideal organisms for studying distribution across a gradient. In this laboratory, you will look at snail species distribution along a gradient from the water's edge up to the bare rock in the upper intertidal zone. Because these snail species are dependent on limited resources (food, cool/damp hiding spaces), we expect competition to drive snail distribution along this gradient. You will also assess the dominant vegetation type (algae) found growing on the rocks that these snails inhabit.

Study organisms

Snails are relatively well-suited to this harsh environment. They have hard shells that serve as heat shields and protect their soft bodies from predators (Figure 1). Their opercula allow the snails to seal to rock surfaces, reducing jostling and desiccation. The algae (seaweed) in the intertidal zone serves as food, shelter, and/or a moist, cool haven for snails between tide cycles.

Snails use a rough "tongue" called a radula. Herbivorous species of snails use this radula to scrape algae off rocks or to rip through the tough rockweed tissue. Carnivorous snails use a specialized radula to bore holes in the shells of its prey (mainly blue mussel and barnacles).

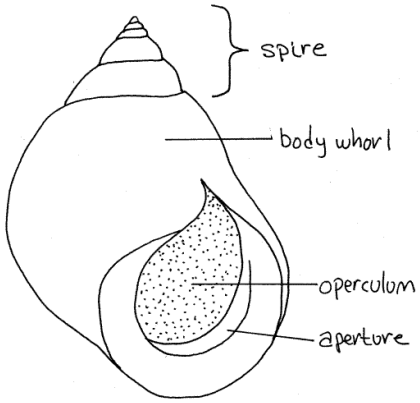

Figure 1. External anatomy of *Littorina littorea*.

Littorina littorea, or common periwinkle, is generally the most abundant snail in Maine's rocky intertidal habitats, although it is not native to North America. It can reach up to 2.5 cm across, but are often smaller. The common periwinkle is primarily herbivorous and prefers to eat *Ulva* (sea lettuce), but is a generalist and will scrape biofilms off algae and rocks, and will also consume mussels and barnacles. Common periwinkles can exhibit a wide range of colors, but are often greenish-gray.

Littorina saxatilis, or rough periwinkle, is a small periwinkle that is native to the coast of Maine. It generally feeds by scraping layers of algae off the surface of rocks, especially the cyanobacteria *Calothrix*. Rough periwinkle shells generally do not exceed 1.5 cm, and can exhibit a wide range of colors (brown, off-white, reddish, and sometimes have swirls of colors). The shell has a distinct, swirled appearance that is reminiscent of soft-serve ice cream.

Littorina obtusata, or smooth periwinkle, is a small periwinkle that is native to the coast of Maine. It almost exclusively feeds on brown algae - especially bladder wrack (*Fucus*). Smooth periwinkle is generally the smallest of the three periwinkle species, often no more than 1 cm. The shell can range from bright yellow, to deep green, to orange, brown, and red. It also may have distinct, colored stripes. The shell has a flattened appearance, with no sharp points.

Nucella lapillus, or dogwhelk, is only distantly related to periwinkles. It is native to the Maine coast. Dogwhelks are carnivorous, and mainly feed on blue mussels and barnacles. The shells can grow relatively large; they can reach over 3 cm. The apex of the shell's whorl is sharply pointed, as is the canal (groove) at the end of the shell aperture (opening). Dogwhelks can vary from white, pale yellow, and gray to deep brown or orange. They often have stripes that follow the swirled growth pattern of the shell. Dogwhelks are particularly susceptible to desiccation.

Common Periwinkle

Rough Periwinkle

Smooth Periwinkle

Dogwhelk

Figure 2. Intertidal snails of the Maine coast. The shells can suffer from wear and tear over time and may have dulled edges or small holes

***Research Questions*:**

1. Do snail species distribute into distinct zones along a gradient from low tide to upland zones?
2. Do algae types distribute into distinct zones along the gradient from low tide to upland zones?
3. Do snail species distributions correlate with algae distributions?

Methods

Start your experiment in the lower intertidal zone at the edge of the water at low tide (Figure 2). Run a meter tape perpendicular to the water edge up the intertidal zone, at least 15 m. Start your survey by placing a quadrat at the 0 m mark. Count all the snails of each species in your quadrat and record the dominant (>50% cover, or record top two if split evenly) algae type (kelp, red, green, brown, cyanobacteria), as described in your ID handout. Continue placing quadrats every 2 m up the transect until you reach the cyanobacteria zone and have two consecutive quadrats with no snails present. Hand your datasheet to your lab instructor. We will combine these data with other lab sections for analysis in class next week.

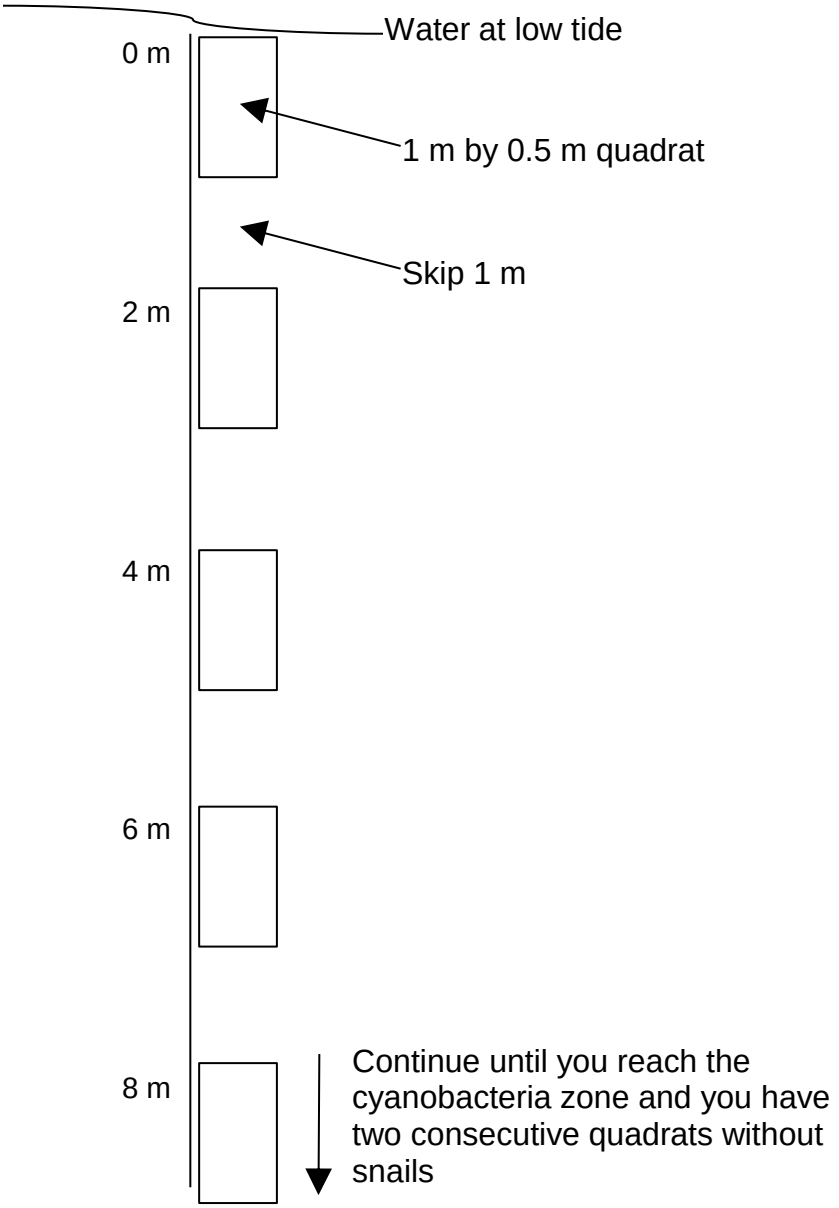

Figure 2. Experimental design for sampling snails along a transect, perpendicular to the shore.