Temperature alters growth of species whose body temperature is the same as environmental temperatures, in part because the metabolic cost of living changes with temperature. Growth depends not only on temperature, however, but also on size. Considerations of how growth depends on size and temperature are a major question in biology (West et al. 1997, 1999, 2003). Scaling of growth, size and metabolic rate has been measured in the green sea urchin, Strongylocentrotus droebachiensis, in Professor Johnson’s lab at Bowdoin College, where they have measured and modeled growth for a size range of urchins growing at two temperatures. The next step in this work, however, is to fill in a more complete understanding of the relationships between these variables. This summer, and throughout the fall semester, I will grow urchins over a range of temperatures to fill in this piece of the puzzle.

Sea urchins are excellent model animals for this study because they are marine ectotherms. They also maintain their shape over a wide range of sizes and are easy to grow and measure. In addition, they are an important fishery species. Originally considered a pest of the Maine coastline because of their destruction of kelp beds and lobster traps, this urchin has been overfished due to a demand for sea urchin roe (gonads) that began in the 1980s. The green sea urchin has also been decimated by disease in recent years. Insight into the biology of their growth will provide basic data for informing fishery and aquaculture models, as well as allowing predictions of some of the consequences of seawater temperatures to models of growth.

Facilitating the recolonization of urchin beds has proven to be an intractable problem. Once an urchin bed has been overfished, kelp and other seaweeds (which the sea urchin grazes on) can establish themselves. The seaweed provides a refuge for crabs and other animals that prey on young sea urchins. Therefore, even in areas where harvesting of sea urchins has been banned, populations have not been able to recover (NOAA, 2009). Thus, a better understanding of how sea urchins grow and the optimal conditions for growth could allow for the restoration of sea urchin populations in the Gulf of Maine. In addition, it may also be possible to create a sustainable sea urchin aquaculture industry to replace commercial fishing of wild populations.

To test the effects of temperature on growth rates of a size range of in sea urchins, we are using tanks in the marine lab at the Coastal Studies Center. We set up six tanks at three different temperatures (7, 14, and 17 °C) to narrow down the optimal temperature for growth. In each tank, 78 urchins ranging in weight from 0.02 to 295 grams are being kept in individual hanging mesh baskets in recirculating seawater aquaria which receives a drip of fresh seawater to improve water quality. The urchins were either collected by us from the surrounding coastline (Giant Steps, Basin Point, Rockland Breakwater, etc.), were collected for us by the Department of Marine Resources, or were raised from fertilization at the Peacock Hatchery in Lubec, ME. The urchins will be fed experimental chow from Stephen Watts, University of Alabama, twice per week to provide a controlled diet. In addition a control group of urchins will be used to assess initial gonad size. At the start of the experiment, all urchins were weighed and randomly sorted into treatments. Urchins will be weighed once per month hereafter for at least six months. In addition, at the end of the experiment, and for the control group at the start of the experiment, we will dissect out and weigh the gonads to determine gonad size.

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References:


