The natural contraction amplitudes and stretches of the heart muscles of the American lobster
Genesis Escalante, Class of 2018

Lobster hearts serve the same primary function as human hearts: they generate the pressure that moves blood throughout the body. While human hearts contract in response to specialized muscle cells that have the ability to generate electrical activity, lobster hearts contract in response to electrical signals from the cardiac ganglion (CG). The CG can be dissected from

heartbeat. My research focused on the function of the intrinsic muscles of the heart, those muscles whose rhythmic contractions are driven by the CG, by exploring the natural stretch and contractions of the heart of the American lobster, *Homarus americanus*.

The Johnson and Dickinson labs are interested in how stretch changes what the CG is doing to control the amplitude and frequency of the heartbeat. To study that, stretch is imposed on muscle groups that are thought to be associated with the stretch-sensitive dendrites of the CG, and the response of the CG to that stretch stimulus is measured. However, both to design and to interpret these experiments it is important to know what the natural stretches are in the lobster.

My research this summer focused on developing methods that would allow us to quantify the natural contraction and relaxation of individual muscles of the heart. For my experiments, the

within the pericardial cavity and all suspensory ligaments and arteries were intact. I took videos of these semi-intact preparations and analyzed heart contraction and relaxation from these videos using Tracker Physics software. From these data, fractional length change was calculated as:

$$\text{fractional length change} = \frac{\Delta}{\quad},$$

where Δ = change in length and = contracted length. I found that fractional length change was greatest on the anterior transverse measurements compared to posterior transverse and length-wise measurements.

My future priority is to translate these external deformations to the level of the muscles. For this purpose I have experimented with injecting India ink marks on and into the heart, which may allow us to interpret whole heart results relative to muscle contraction and relaxation. Then, I hope to work with neuropeptides, such as SGRNFLRFamide (SGRN), which are known to alter the frequency and amplitude of the heartbeat. The effect of SGRN has been studied in the Johnson and Dickinson labs on isolated CG as well as on semi-isolated CG/heart preparations, but not on the more intact preparations I worked on this summer. Thus, to investigate one aspect of neural control of the muscle contraction, I would perform my experiments bathing the heart first in lobster saline and subsequently in solutions of physiologically-relevant concentrations of SGRN.

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