Evaluating Changes in Size of Juvenile Horseshoe Crabs to Understand Environmental Effects on a Declining Species

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ABSTRACT

The American horseshoe crab (*Limulus polyphemus*) is a species that holds importance to both ecological communities and the medical industry. The species is known to have a declining population. To help guide conservation and management practices of this species, we still need to better understand how different aspects of the horseshoe crab's biology are changing as various environmental factors are changing. What we want to know is if horseshoe crabs size frequency distribution is consistent from year to year. Also if horseshoe crab molts from adjacent beaches are usable as actual size frequency distribution within nursery habitats. Horseshoe crab molts were measured and the frequency was taken based on size of the molts to find out consistencies between juveniles. Findings include horseshoe crabs leaving Sandy Point Marsh and moving to Long Wharf Harbor. Also, inconsistent size patterns between months were observed. Considering this, environmental influences may have impacted the results, such as currents, which may have moved the horseshoe crabs molts up to the harbor. Also, variation of temperature may have affected spawning time. The findings of this research have lead to a number of other questions concerning changes in environmental factors and how this may be affecting horseshoe crab biology.

INTRODUCTION

Horseshoe crabs are important species; they are harvested as fishing bait as well as for their blood, which is used in the biomedical industry. Horseshoe crabs also hold an ecologically important role in the food web. Given the important aspects of this species and the declining density of the populations, conservation efforts must be made to maintain healthy population sizes that allow for sustainable harvesting. To inform conservation efforts, aspects of the juvenile population must be understood. The information we know about juvenile horseshoe crabs before this study includes: 1) the general spawning times and location of the juveniles and 2) that they can be resistant to a large amount of changing environmental factors. The objectives that were focused on include: 1) determining if the size frequency distribution of juvenile cohorts of *Limulus polyphemus* are consistent from year to year and 2) evaluate if we can use molts from adjacent beaches as an indicator of actual size frequency distributions within nursery habitats.

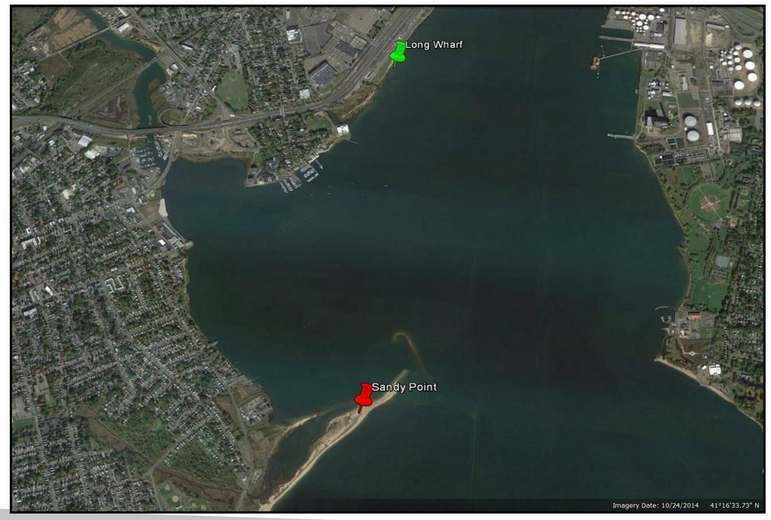
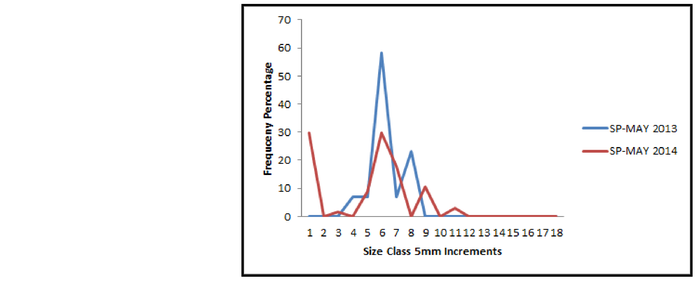
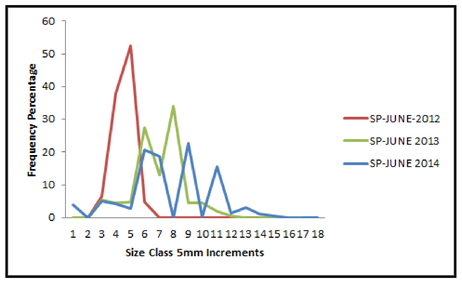


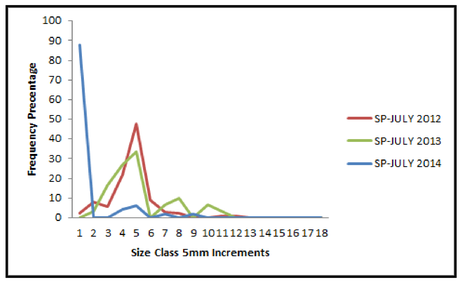
Fig 1. This map shows the locations of Sandy Point and Long Wharf where the data for this study were collected.

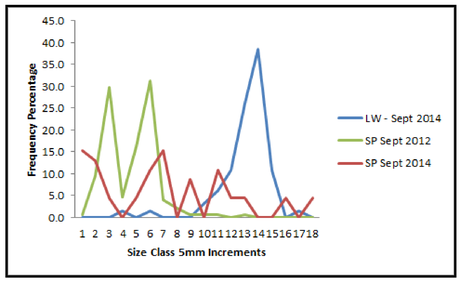
MATERIAL AND METHODS

- **Data for this study were collected at Sandy Point in West Haven, CT and Long Wharf in New Haven, CT (Figure 1).**
- **Juvenile horseshoe crab (*Limulus polyphemus*) molts were collected as encountered on the sand flats at Long Wharf in September and October 2014.**
- **At Sandy Point, live juveniles inhabiting the intertidal saltmarsh were collected in buckets and measured in the field between June 2012 and October 2014.**
- **Molts and live juveniles were measured to the nearest millimeter with calipers.**
- **Size frequency histograms were plotted for both sites by month.**









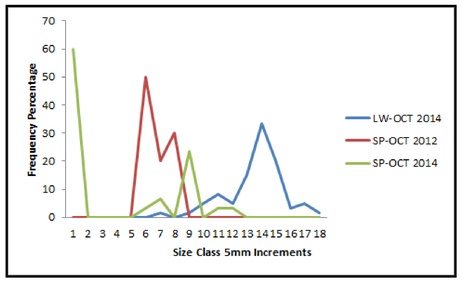


Fig 2. (Top) Frequency percentage in Sandy Point (SP) during May. (Middle Left) Frequency percentage in Sandy Point (SP) during June. (Middle Right) Frequency percentage in Sandy Point (SP) during July. (Bottom Left) Frequency percentage in Long Wharf (LW) and Sandy Point (SP) in September. (Bottom Right) Frequency percentage in Long Wharf (LW) and Sandy Point (SP) in October.

RESULTS

- **Based on the data, there appeared to be variation of size frequencies year to year from the location of Sandy Point. Those variations appear to be inconsistent from month to month (Figure 2, top panels).**
- **In May 2013-2014, similar frequency percentage was observed year to year (Figure 2, top panel).**
- **The molts measured in Long Wharf are larger than those that were measured at the same time in Sandy Point (Figure 2, bottom panels).**

Fig 3. On the bottom are juvenile horseshoe crab molts, which were measured with calipers, also on the bottom. The top is a molt of an older horseshoe crab for comparison.

CONCLUSIONS

Having an inconsistent pattern in size frequencies by month in the location of Sandy Point suggests that spawning time may have been influenced by temperature. Crabs spawning earlier in the year would show an increased frequency for larger sizes because they have had more time to grow. Whereas spawning later in the year will result in a great frequency of small sizes. When looking at size frequencies in June and September of 2014 and 2012 (Figure 2), an increase in size is visible over the years. Meaning that 2014 may have been a warmer year; therefore, increased growth could have taken place.

Addressing the data in May brings up many questions and possibilities for the increase in frequency in 2014. The reason could be again temperature or even other environmental factors that changed from that year.

Being that the molts from Long Wharf were larger than those of Sandy Point at around the same time, this suggests that juveniles of larger sizes from Sandy Point tend to disappear during this time. All things considered, you can possibly form a conclusion that the size that is missing from Sandy Point during this time are migrating to Long Wharf where juveniles of larger size may stay before heading out into deeper water.

The new findings of this study have brought up many questions. Future studies will attempt to address these questions that were inspired from this project, which will eventually lead towards a greater understanding of the American horseshoe crab (*Limulus polyphemus*) which can be used towards increasing and conserving its population.

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REFERENCES

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