Cove Pont Horseshoe Crab Survey 2017

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Introduction

Our research group at Anne Arundel Community College has been examining *Limulus polyphemus* (horseshoe crab) spawning and abundance at Cove Point, MD since 2004. We have created a long-term data set that shows how Cove Point beach is used as a spawning area and how this usage has changed as the beach has physically changed. We continued this study in the 2017 spawning season. Our goals for the 2017 survey were to 1) quantify spawning using a new smartphone-based method, 2) involve volunteers in the survey of other beaches, 3) listen for signals from animals radio tagged the previous year and 4) construct a physical profile of Cove Point beach.

I. Spawning at Cove Point Beach

Our methods for the surveys were similar to those from previous years. Groups of 2-3 student workers visited Cove Point beach for four nights during each of four tide cycles in May and June. Students walked along the beach within one hour of high tide and recorded the presence of spawning females, any associated males, and their location. An innovation for 2017 was the use of a new method for recording data. When spawning groups were found, the information (#females, #males, any comments, GPS coordinates and a photo) was sent via a smartphone using Twitter. We then used a program (https://collection.apps.eigenmaps.com) that collected all tweets for a given survey and exported the data into an Excel spreadsheet. This spreadsheet was then imported into CARTO (https://carto.com), a mapping program that plots all data points on a map of the surveyed beach. The maps presented in this report were generated using CARTO.

This data collection method greatly improved the speed at which data could be analyzed and mapped. More importantly, it allows anyone with a smartphone to participate in the survey. We hope to greatly expand this program in subsequent years to involve larger numbers of volunteers in surveys of a greater numbers of spawning beaches.

Results of Cove Point Spawning Surveys

Our student workers began surveying Cove Point beach on May 11-14. This was a full moon cycle, and the earliest possible tide cycle for crab spawning. We visited the beach during the nighttime high tides, but observed no spawning activity or crabs on any night.

Spawning appears to have begun during the next tide cycle, in late May. Figure 1 shows the three tides cycles where spawning was observed. Spawning activity was increasing by the end of the late May cycle, reached its peak in early June, and by the end of June was in decline.

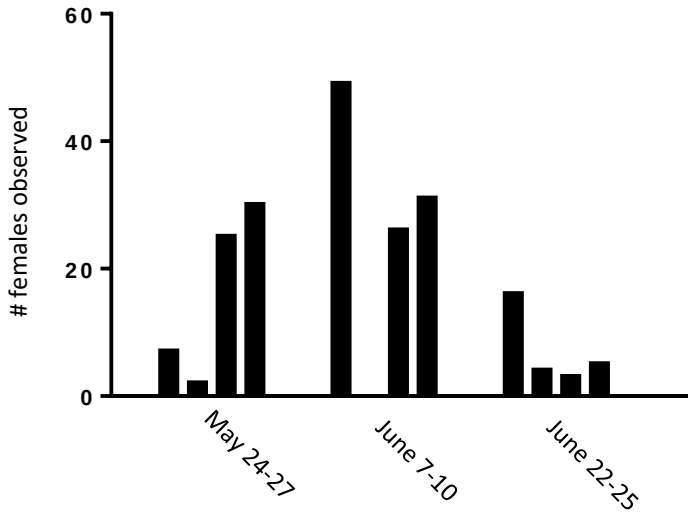


Figure 1. Number of spawning females observed for all survey night over the 2017 season. June 8 was stormy and no crabs were observed.

May 24-27, 2017

This was a new moon cycle. It was the apparent beginning to the spawning season, as we found spawning pairs on the beach for the first time.

May 24, 2017

Seven spawning females were observed, each with a single male. Some map points represent multiple spawning females.

May 25, 2017

Rain and cool weather. Two spawning pairs were observed.

May 26, 2017

Twenty-five females and twenty-eight males were observed on the beach.

May 27, 2017

Thirty spawning females were observed, each with a single male.

June 7-10, 2017

This was a full moon cycle. This cycle appeared to represent the peak of the spawning season.

June 7

Forty-nine females and eighty males were observed. This represents the highest level of spawning activity observed. Some points represent multiple spawning females clustered in the same area.

June 8

Storms and bad weather. No crabs were observed on the beach.

June 9

Twenty-six females and fifty-four males were observed.

June 10

Thirty-one females and forty-nine males were observed.

June 22-25, 2017

This was a new moon cycle. The spawning season appeared to be nearing its end, as fewer crabs were observed during this period.

June 22

Sixteen female and twenty-one males were observed.

June 23

Four females and 15 males were observed.

June 24

Three female and four males were observed.

June 25

Five female and 11 males were observed.

Daytime Spawning at Cove Point

During our 2016 survey, we placed a radio receiver on the beach to record the presence of any tagged spawning animals on the beach when workers were not present. The receiver detected three tagged females during a daytime high tide. Previously, we had never observed spawning activity during the day. Our smartphone technique allowed us to recruit volunteers to conduct daytime surveys. Two volunteer groups were able to survey Cove Point beach during daytime high tides.

Matt Overton surveyed the beach on the afternoons of May 25 and June 8 near high tide. He observed one spawning pair on May 25 but none on June 8. His single observation is mapped below. Fran and Tim Cook surveyed the beach on June 9 and 10. They did not observe crabs on June 9 but saw three pairs on June 10. A picture of a June spawning pair is shown below. These observations suggest that daytime spawning does occur at Cove Point but as a minor component of the overall spawning effort. For comparison, the nighttime spawning numbers for May 25 and June 10 were two and 31, respectively.

Long-term Changes to Spawning Activity at Cove Point Beach

Over the course of the spawning season, we observed 198 spawning females and 309 associated males. These numbers are lower than observations from 2016 (263 and 764, respectively). Spawning activity was lower than observed over the previous three years. Our observations suggest a ten year decline in spawning activity, followed by an increase in spawning activity in 2014, followed by a second decline thereafter. These long term changes in spawning activity are shown in Figure 2.

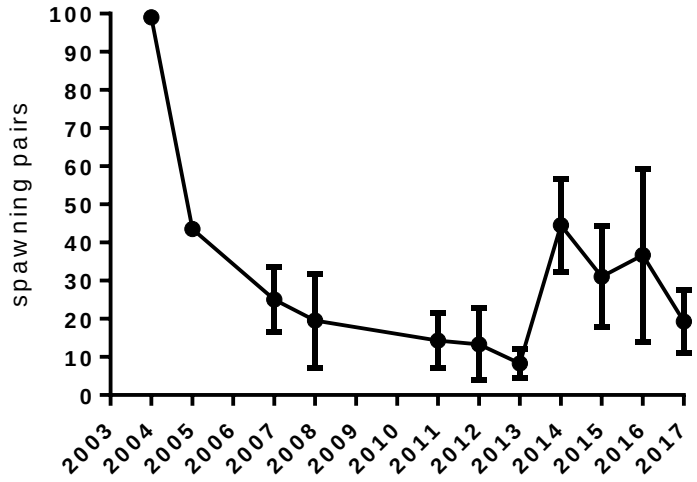
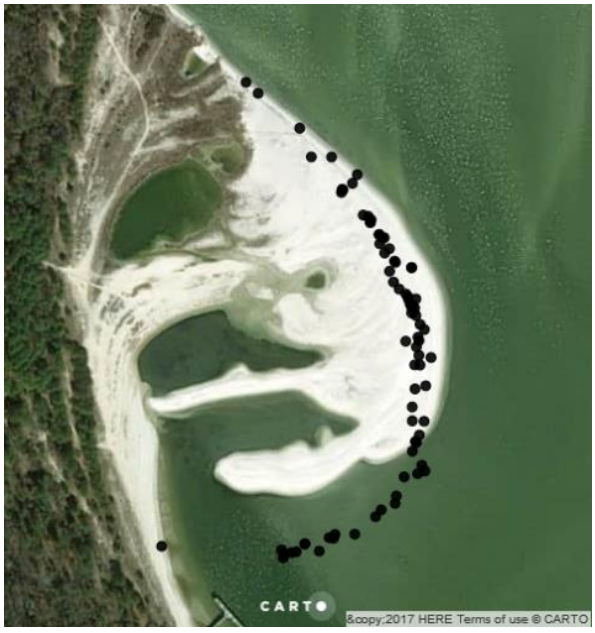


Figure2. Mean number of spawning females at Cove Point Beach. The mean was calculated from the highest spawning night from each tide cycle.

II. Spawning at Other Beaches

Flag Ponds beach is a spawning beach about 9 km north of Cove Point. We have surveyed this beach since 2012 as a comparison with Cove Point. In 2017, we surveyed Flag Ponds once on June 8 and observed 80 spawning pairs. As a comparison, Cove Point had no observed animals that night, and 49 spawning pairs the previous night. This is consistent with our observation spawning activity is generally higher at Flag Ponds in comparison with Cove Point. A CARTO map of this survey is shown below. The map points in the water show how the sand spit has shifted recently.



We also began our efforts to expand spawning surveys beyond Cove Point and Flag Ponds. Helen Cummings, a volunteer, performed daytime surveys at Scientists Cliffs beach, about 15 km north of Cove Point. No crabs were observed on June 7, June 8 or June 25 but four spawning pairs were observed on June 24. Our group performed nighttime surveys of beaches in the Bay Ridge and Annapolis Roads community beaches in Anne Arundel County on June 24. Although we did not observe spawning that night, there are consistent reports of crabs on those beaches. These preliminary data, as well as anecdotal reports of spawning on other beaches such as Chesapeake Beach, North Beach and Sandy Point, suggest that an expansion of this program, using local volunteers, could provide a more complete picture of spawning along the western shore of the Chesapeake Bay.

III. Effectiveness of the Smartphone Survey Method

The new survey method worked reasonably well. When the surveys were conducted by the PIs, the latitude and longitude data were accurate and were used to create the maps presented in this report. There were times when student data contained inaccurate GPS information. This accounts for the missing maps in some surveys. It is likely that this was a human error rather than a technical problem and we will work to improve training for future surveys. This method allowed us to expand the surveys and to better involve interested volunteers as citizen scientists. We hope to expand this program to include increasing numbers of volunteers and survey sites.

IV. Radio Telemetry

In 2016, we attached 10 radio transmitter/archival tags to spawning females and males. The radio transmitter alerted us that the animal was on the beach, while the archival tag recorded depth and temperature while the animal was in the water. Using these tags, we produced new and important information concerning movements of tagged animals between spawning nights and between spawning cycles. We also discovered that some spawning occurs during daytime high tides. These data are fully discussed in our 2016 report.

The battery life on the tags was more than a year, so it was possible that a tagged animal would be found in 2017. This would produce detailed information concerning the movement of animals between spawning seasons, which has not been described in the Chesapeake. We listened and watched for the return of a tagged animal each night throughout the 2017 spawning season. Unfortunately, we did not re-sight a tagged animal. With only 10 tagged crabs, the likelihood of re-sighting was very low, but the potential value of data from a tagged animal was such that it was worth a serious effort.

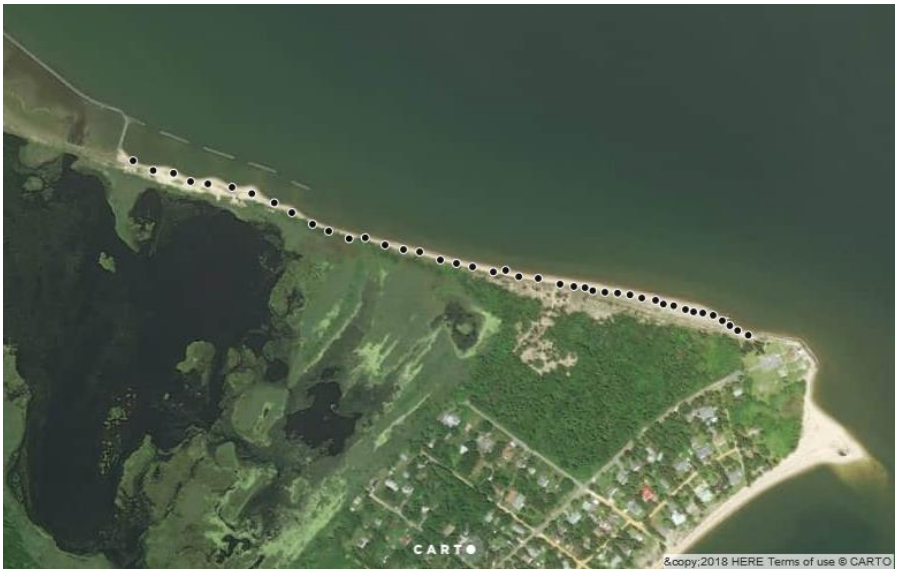
V. 2017 Beach Profile

In October 2017, we conducted a series beach profiles. As in previous profiles, we used Emery rods (Emery, K.O., *Limnology and Oceanography* v. 6, p. 90-93, 1961) to carry out the profiles at 42 stations ranging from the southern lighthouse (station 1) to the riprap at the northern end of the beach (station 42). To perform a profile, rod 1 was placed at the high tide mark at a given station, and rod 2 was stretched 1 meter toward the water. By observing differences between the 1 cm marks on each rod, the elevation change for that meter was determined (Fig. 3). Elevation

change for each meter from the benchmark to the water's edge was measured in a similar fashion. These measurements were used to construct a profile at each benchmark station, showing vertical elevation change and beach slope.

Figure 3. Eric Fons and Dimitra Neonakis showing the use of Emery rods on a downward sloping beach.

Beach slope was calculated from the waterline 2 m landward, an area considered to be most relevant for impacts on horseshoe crab spawning. Slopes from each 2017 profile were compared with previous profiles from 2011, 2013 and 2015. Beach slope influences the energy of breaking waves and therefore could influence spawning behavior in females. Steep slopes are generally indicative of sand erosion, while a shallow slope suggests accretion. Stations where profiles were performed are shown on the map below.



In 2017, beach slopes were fairly consistent between stations. This is in contrast to earlier years. In 2011, 2013 and 2015, slopes showed greater variation. Some areas had shallow slopes and some areas were much steeper. This suggests that in those years conditions were different for different areas of the beach, with erosion occurring in some areas and accretion (or less erosion) in others. Figure 4 shows a comparison of beach slopes between 2013 and 2017. Earlier profiles were based on 22 stations and the 2017 data was converted to this format to allow comparison.

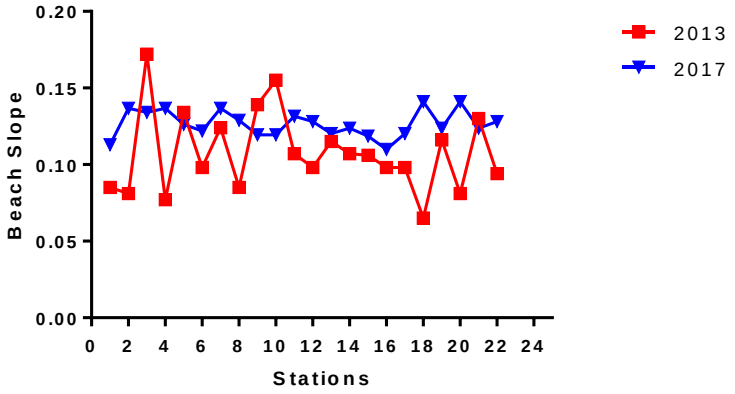


Figure 4. Beach slope from the waterline 2m landward from station 1 (Cove Point lighthouse) to station 22 (riprap at the northern end of the beach).

In 2011, when we first conducted beach profiles, there was a trend toward steeper slopes moving from the lighthouse north. We divided the beach into three areas: 1) lower beach, from the lighthouse to the access trail, 2) middle beach, form the access trail to the breakwaters, and 3) upper beach, from the breakwaters to the riprap. Mean slopes from these three areas show this trend toward steeper slopes in 2011 (Fig. 5). By 2013, this trend was not apparent and was not observed in 2015 or 2017. If a steeper slope is indicative of beach erosion, it is possible that the elimination of this trend since 2011 represents beach stabilization as a result of the installed breakwaters. If a shallower, less eroding beach is better spawning habitat, this might explain the increase in spawning activity along the northern beach that we have observed and documented in earlier reports.

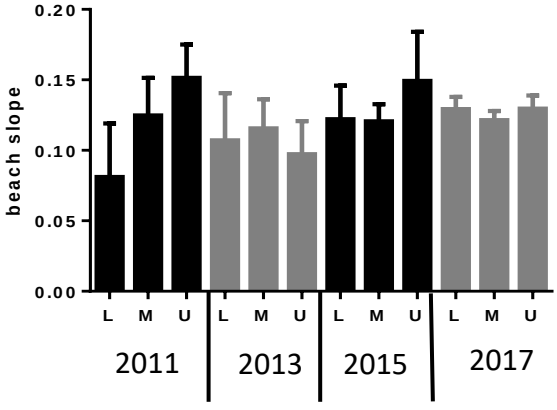


Figure 5. Mean beach slopes for lower (L), middle (M) and upper (U) beach areas in 2011, 2013, 2015 and 2017.