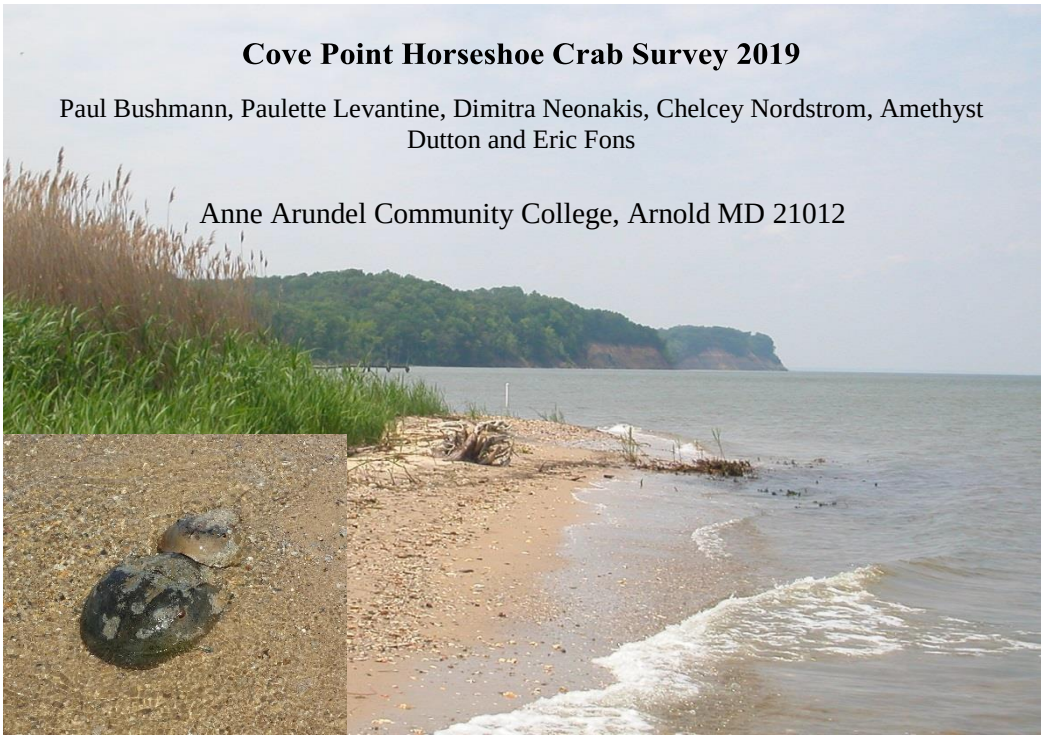


Acknowledgements

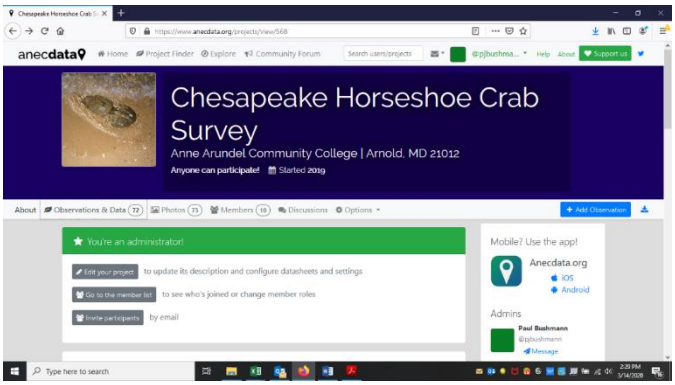
This work was funded through a grant by Cove Point Natural Heritage Trust. The authors of this report wish to thank CPNHT for their continued support over the course of this and previous studies.

Introduction

The *Limulus polyphemus* (horseshoe crab) spawning population at Cove Point, MD has been the focus of our research group since 2004. We added to our long-term data set of spawning activity in 2019. As in previous years, we enlisted student workers to conduct surveys of spawning activity.
A survey consisted of a single pass along a beach, within one hour of a nighttime high tide. This project employed eight students, three more experienced managers, and three faculty members. Workers recorded 1) the GPS location of all females, males and spawning groups and 2) the number of males associated with each spawning female. Surveys were conducted on four nights around four tide cycles in May, June and July. Flag Ponds beach was surveyed once in July, as a comparison with Cove Point.

For analysis, Cove Point beach was divided into three sections. From the lighthouse to the community access path was considered the southern beach. From the access path to the breakwaters was considered the middle beach, while the area inside the breakwaters was termed the northern beach. Beach conditions are quite different in these three sections, which could affect horseshoe crab utilization of Cove Point beach for spawning.

A New Survey Tool for Horseshoe Crab Citizen Science

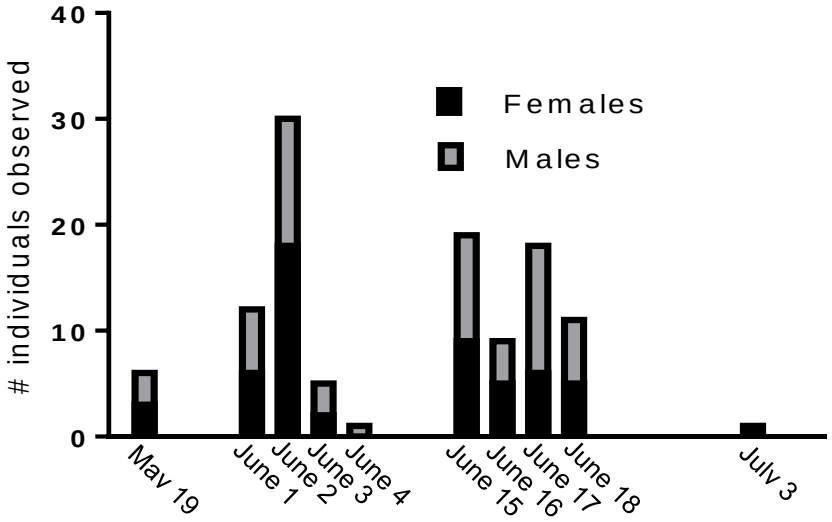


We began the 2019 surveys using the Twitter tool developed previously, but it was quickly apparent that a better system was needed. Instead, we used the website Anecdata.org to create a project – *Chesapeake Horseshoe Crab Survey*. Anecdata.org was developed by Mount Desert Island Biological Laboratories specifically for citizen science reporting. We developed and currently administer the project, while anyone with a smartphone can access the project and submit data. To submit data, a volunteer downloads the associated free app and finds the desired project. In our study, a worker walks the beach and, if animals are found, follows the prompts to enter #females, #males and a picture. The program automatically submits date, time, and GPS coordinates. All submitted data appears on the Anecdata.org website, so we can observe and monitor data submission. At the end of a survey, the data can be easily downloaded into a spreadsheet and imported into a mapping program. This website provides all the features of our Twitter program, but is less cumbersome and produces a more permanent record.

Results of Cove Point Spawning Surveys

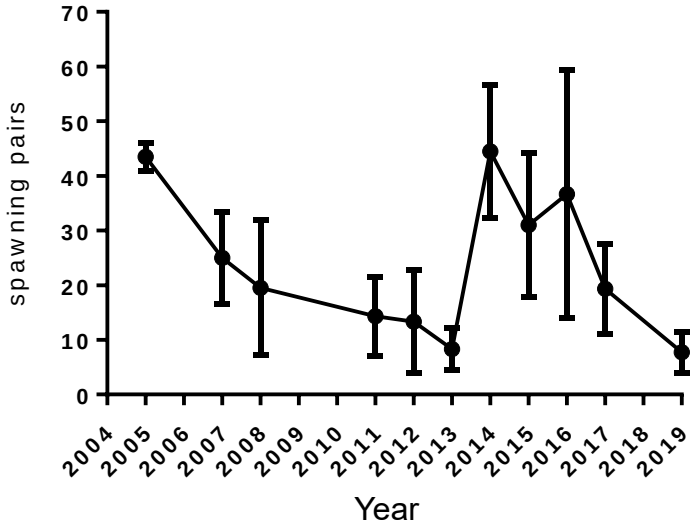
We began the 2019 season with a full moon survey on May 19. This single survey was done to determine if spawning had begun. In previous years, spawning seldom started until early June. The second set of surveys were done during a new moon cycle on June 1, 2, 3 and 4. The third set was around a full moon cycle on June 15, 16, 17 and 18, and the last surveys were conducted around a new moon cycle on July 1, 2, 3 and 4.

The figure at right shows the four tide cycles where spawning was observed. Three spawning females were observed on May 19. Peak spawning occurred in the early June cycle and declined in late June. By July, only one living female was observed over the four days of the survey.

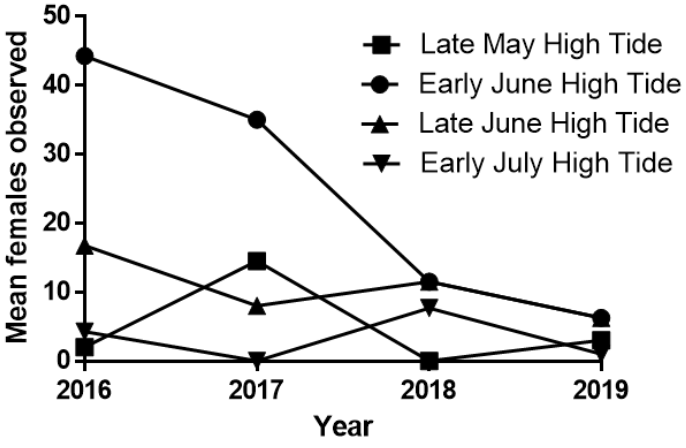


We observed a total of 55 females and 67 males over the course of the

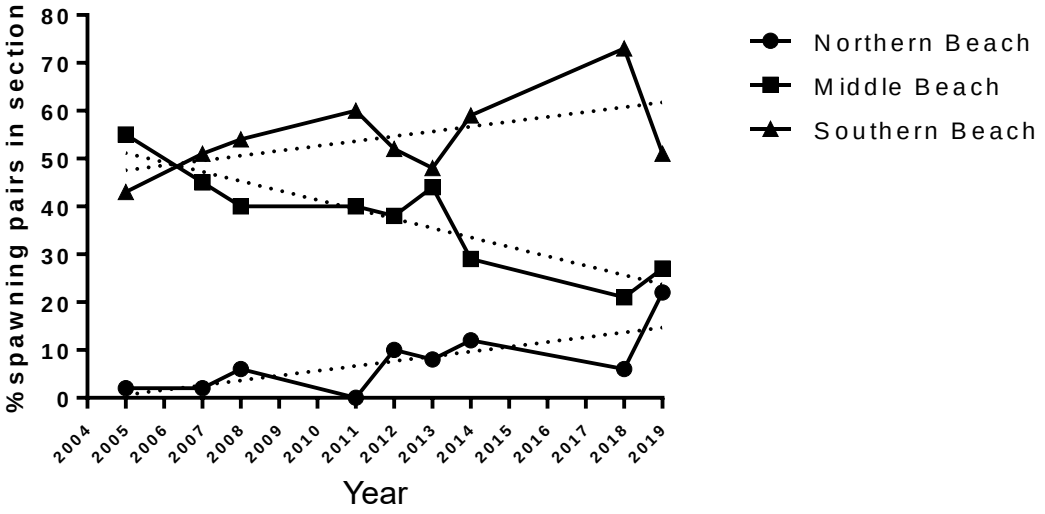
surveys. This is a severe decline in observed spawning activity. For comparison, in 2017 and 2018 we observed 198 and 174 spawning females, respectively. In 2019, no survey resulted in more than 18 females, and most were below ten. The figure opposite shows a comparison of 2019 results with all previous years. We observed a decline from 2005 to 2013, which was attributed to a decline in beach quality. Spawning numbers increased sharply in 2014. This may have been due to a beach restoration project a few year prior, which stabilized and widened the northern beach. However, spawning again began to fall, and has now reached a low point similar to that observed in 2013. Areas of Cove beach outside the breakwaters are eroding. The middle section of Cove Point beach is particularly eroded. This section has no open beach at high tide and our workers had to walk off the beach in order to access the northern area. If beach quality is contributing to these fluctuations in spawning numbers, it is possible that that further decline in beach quality, particularly along the middle section, may be involved in this latest drop in spawning activity. It is also interesting that on July 3 we observed ten spawning females at Cove Point, while only a single, unpaired female was observed at Cove Point. Apparently, spawning was occurring in July on beaches outside of Cove Point.



We explored this spawning decline in more detail by comparing spawning numbers over the last four years by tide cycle. The figure opposite shows our results for the years 2016 through 2019. Although overall numbers have declined, the biggest drop has been in the early June tide cycle. The other survey cycles have fluctuated at a lower number, with less severe declines. It is interesting that our 2019 survey on May 19 found spawning females. This date is typically early for spawning, and similar surveys in previous years did not find spawning females. In 2017 we found spawning females in May, but the high tide cycle that year was very late – May 26 and 27. It is possible that females have shifted their spawning to an earlier cycle. If so, this may account for some of the decline observed in 2019.

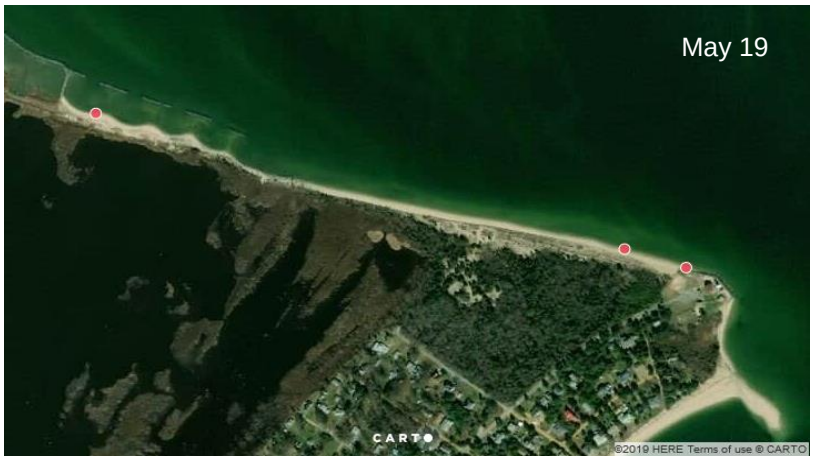


In previous surveys, we have reported an increase in spawning activity on the northern beach. This area is inside the breakwaters, and has benefited from the beach restoration project. We have also reported a decline in spawning in the middle beach, which has suffered from erosion for several years. The figure below shows these trends, with our 2019 data included.



Utilization of Cove Point beach is not uniform. In the past, the majority of spawning females have used the southern beach, and this was true in 2019. However, in 2019 the southern beach saw proportionally less spawning than in previous years. The proportion of females spawning in the other two sections rose, with the greatest increase in the northern beach. This section (inside the breakwaters) is still the least utilized, but there has been a trend toward greater spawning in this area. There was slightly more spawning activity in the middle beach than in previous years, but the long-term trend is for reduced activity. The middle beach has been subjected to the greatest erosion, with a short, steep beach and woody debris. The left picture below shows a portion of the middle beach. In places there is no beach at high tide. The right picture below shows the broader beach that has become established behind the breakwaters at the northern beach.

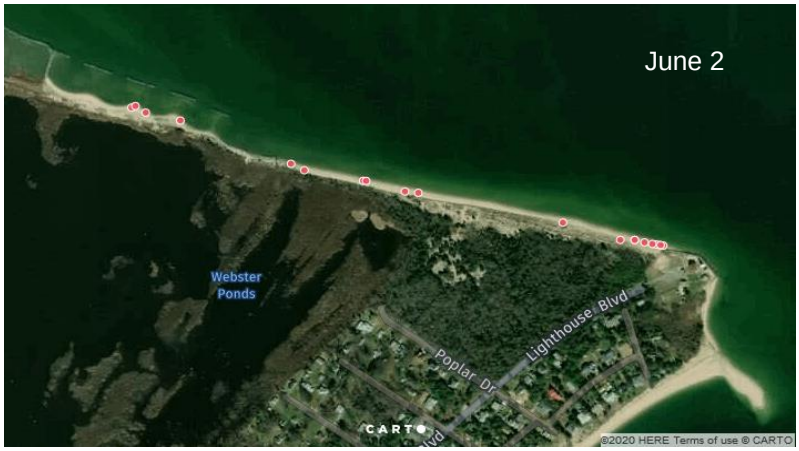
Cove Point Survey Maps



May 19, 2019
The first successful survey was made on May 19, part of a full moon cycle. Three females, each with a single male, were recorded.

June 1-4, 2019
This was a new moon cycle.

June 1, 2019
Six females, each with a single male, were observed during the survey. GPS coordinates were not taken, so this survey was not mapped.



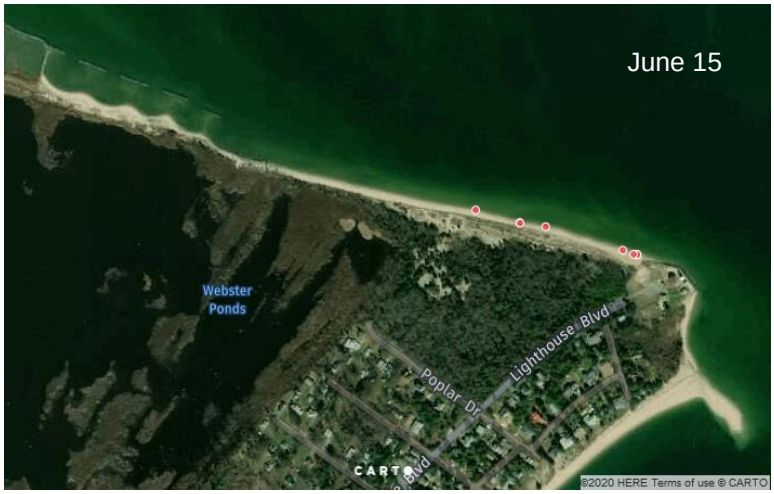
June 2, 2019
This night showed the greatest activity of the season. Eighteen females and 22 males were observed during this survey.

June 3, 2019
Three females and three males were observed during this survey.

June 4, 2019
There were no females observed during this survey. There was a single male.

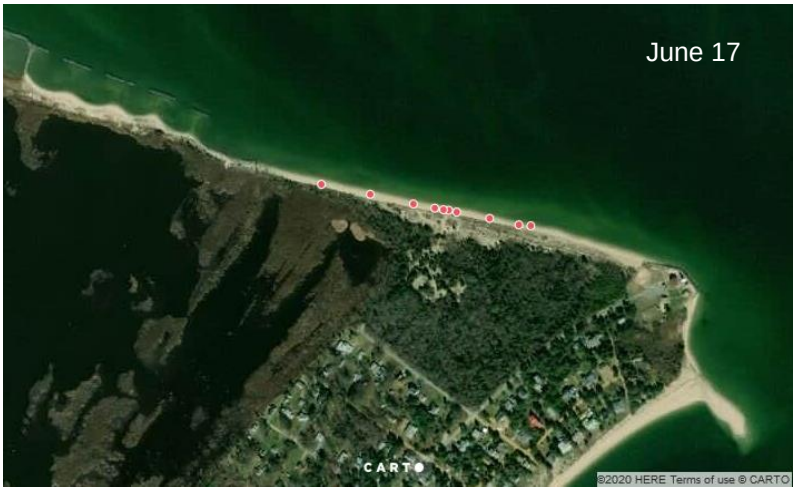
June 15-18, 2019
This was a full moon cycle.

June 15, 2019
Nine females and ten males were observed during this survey.

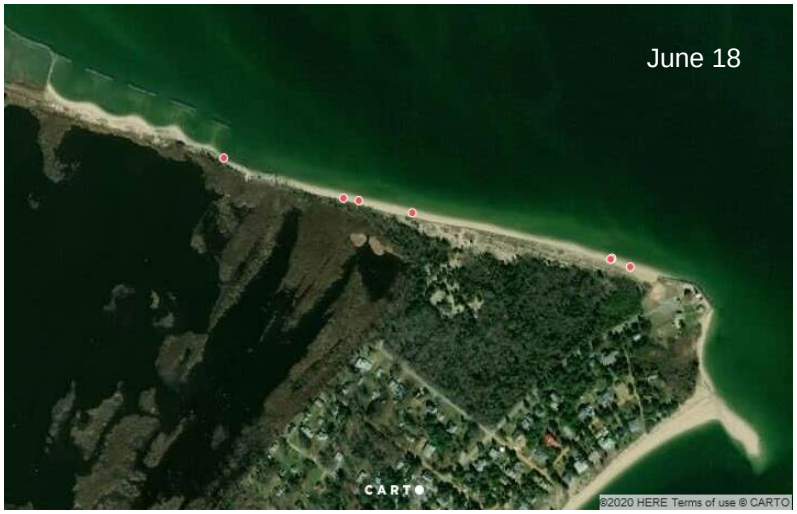


June 16, 2019
Two females, each with a single male, were observed on Cove Point beach. The workers also surveyed the community beach to the south, and observed three females, each with a single male, during that survey.

June 17, 2019
Six females and 12 males were observed during this survey. Three males were on the beach without partners and are included in the map.



June 18, 2019
Five females and six males were observed during this survey.

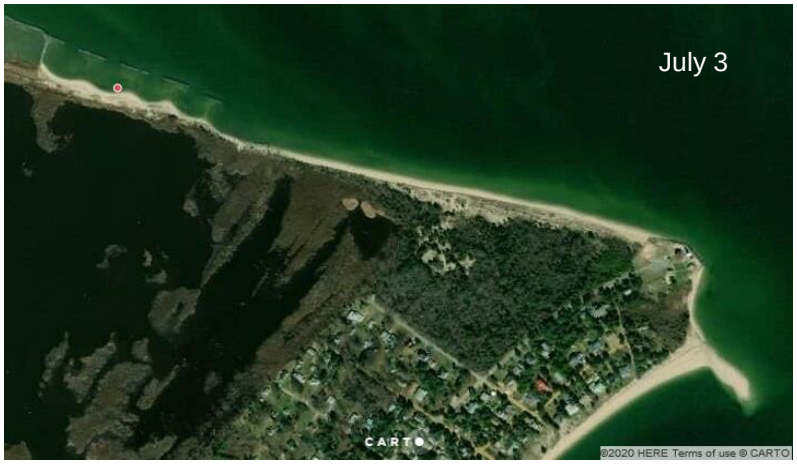


July 1-4, 2019

This was a new moon cycle.

July 1, July 2 and July 4, 2019
No females were observed during these surveys.

July 3, 2019
One female, without a male, was observed during this survey.



Conclusions

The website Anecdata.org proved to be an easy and successful way to record our spawning data. We have tried for several years to expand these surveys to include other beaches and other interested volunteers. We feel that this technique should allow people to more easily contribute. It involves only downloading a free app, then following directions provided on the project page. We hope to use this app to further expand our surveys efforts throughout the mid-Chesapeake area.

Cove Point data from 2019 suggests a severe decline in spawning activity. This is the second such decline we have observed since 2005. The first decline was attributed to beach degradation and erosion along the northern beach. Spawning numbers rose a few years after a restoration project stabilized the beach in this section. The current decline may also be linked to beach erosion, this time in the middle beach area south of the breakwaters. Our single survey of Flag Ponds in July showed spawning activity at that site, while there was none at Cove Point. This suggests that a spawning decline specific to Cove Point, rather than a general decline throughout the area. Future surveys should include Flag Ponds to compare spawning activity at both beaches.

It is also possible that spawning activity has shifted to some degree toward earlier high tide cycles. If so, this may account for some of the spawning decline observed during the early June cycle. This is expected as springtime water temperatures rise. Future surveys should include earlier May tide cycles.