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2011 Horseshoe Crab Spawning Survey results

The tenth annual horseshoe crab spawning survey continues the local assessment of population abundance and critical habitat availability in the Coastal Bays. Thanks to the generosity of volunteers who provided their time and effort, 58 surveys were collected from five beach sites, and reveal a sum total of **23,105** crabs. This is just slightly lower than the total number observed last year; 23,438 (Table 1).

The status of the horseshoe crab populations along the Atlantic Coast are poorly understood due to the limited amount of information collected regarding stock levels.

Horseshoe Crab spawning varies by latitude but generally occurs between May and July along the Atlantic coast. Spawning in the Maryland coastal bays typically peaks in June, and often continues through July.

This pattern was repeated in 2011, indicating the spawning period was protracted through June and July.

YEAR	May	June	July	Aug	Grand Total
2002	0	105			105
2003	2	521			523
2004	57	632			689
2005	48	261			309
2006	125	3,793			3,918
2007	711	6,636	270		7,617
2008	1	4,689	5,928		10,618
2009	10	18,627	3,190	19	21,846
2010	1,205	17,285	4,948		23,438
2011	5	15,166	7,934		23,105
Grand Total	2,164	67,715	22,270	19	92,168

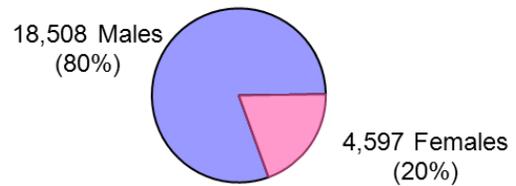
The Maryland Coastal Bays survey was initially set up to mirror the same time frame as the Delaware Bay horseshoe crab spawning surveys (May and June) to allow for comparisons. Since the noticeable temporal range of spawning seemed longer than this initial sampling period, the 2011 survey was again conducted throughout July as it has been since 2008. All surveys begin in late May and continue throughout July to better capture peak spawning activity.

The majority of crabs, 17,625 (76.3%), were observed to be spawning at or within one meter of the high tide line. It was noted that during the highest spawning activity along Skimmer Island that a substantial number of the crabs were spawning up to 2 meters out along the shoreline. These results only reflect those estimates for 1m² of the high tide line to be consistent in surveying methodology, and therefore the estimates of total crabs on the beach during high density spawning are lower than actually observed.

Table 2. Total number of Males and Females and sex ratio by year.

	Males	Females	M:F ratio
2002	67	38	1.8:1
2003	314	209	1.5:1
2004	438	251	1.8:1
2005	182	127	1.4:1
2006	2,939	979	3.0:1
2007	5,799	1,818	3.2:1
2008	8,289	2,329	3.6:1
2009	17,551	4,295	4.1:1
2010	18,642	4,796	3.9:1
2011	18,508	4,597	4.0:1

2011 Male to Female Ratio (4:1)



The survey counts over the last decade indicate a gradual increase in male to female ratios (Table 2). In 2011, we found that there are 4 males available to mate with every female crab. This is important for maintaining genetic diversity. Conservationists and ecologists know from experience in managing other economically important species that the higher the genetic diversity, the healthier the population. Harvest regulations in Delaware Bay, Maryland, and Virginia have capped the number of female horseshoe crabs that can be harvested. This data indicates that male biased harvest in recent years has not had an effect on the local spawning population's ratio.

While it is widely recognized that temperature, wind direction and wave energy influence where crabs will spawn, we can only speculate at how and why some areas experience heavy spawning while other equally available areas do not (Table 3). It is noteworthy that in 2009, 546 crabs were counted along the west side of Assateague Island, 49 crabs were observed in 2010, and 1,007 in 2011. Previous surveys have indicated that horseshoe crabs often move to new areas of spawning along beaches from year to year, which tends to complicate replicate site monitoring.

Table 3. Location of surveyed Horseshoe Crabs by year.

# of crabs observed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
North Assateague Island bayside	*	*	*	*	158	653	528	546	49	1,007
Skimmer Island	*	*	*	*	764	5,914	9,935	20,467	23,035	21,265
Oceanic Motel at Inlet	67	307	297	#	822	389	32	723	344	824
Gudelsky Park in West O.C.	#	#	234	60	1,898	466	123	110	10	9

*areas not sampled due to lack of access #areas lacking volunteer presence

Additional spawning was observed at inlet cove #1 (closest to the ocean): approximately 200 crabs on June 29th 2011, and at Fager's Island at 56th Steet: 76 crabs

Another consideration is changes in frequency and volunteer coverage of monitoring beaches. Access to the bayside of northern Assateague Island and Skimmer Island was surmounted with the assistance of DNR Fisheries Service in 2006. An attempt to standardize these finding through count per unit effort via “total hours invested” and “number of surveys returned” was initiated (Table 4).

Table 4. Catch Per Unit Effort of Horseshoe Crabs by year.

Year	total # of crabs	total hours	CPUE- hours	# of surveys	CPUE- surveys
2002	105	7.52	13.96	19	5.53
2003	523	5.57	93.90	13	40.23
2004	689	35.22	19.56	53	13.00
2005	309	27.07	11.41	46	6.72
2006	3918	18.63	210.31	57	68.74
2007	7617	27.28	279.22	115	66.23
2008	10690	16.57	645.14	86	124.30
2009	21846	19.87	1099.63	63	346.76
2010	23438	11.08	2114.71	42	558.05
2011	23105	30.85	748.95	58	398.36

Once again, Skimmer Island, which is just north of the Rt. 50 Bridge, held the most surprises and number of crabs this year. This photograph on the lower right shows the heavier spawning occurring along the southeastern side of Skimmer Island. Waves and subsequent spawning causes egg masses to wash out of the nests and collect in the wrack line. The eggs feed many species of birds and fish and are an integral part of the food web.



Royal terns, *Thalasseus maximus*, guard their nests on Skimmer Island. Photo credit: Dick Arnold



Heavy horseshoe crab spawning was observed throughout June and July along southeast Skimmer Island. Photo credit: Dick Arnold

The tern photo above captures a glimpse of the growing colony of endangered royal terns that have been nesting on Skimmer Island. These birds lay their eggs in small depressions in bare sand, preferably on inaccessible islands in an effort to minimize mammalian predation.

Skimmer Island Beach Restoration

Noteworthy in 2011 was the sand nourishment project at Skimmer Island. This island formed on top of the Ocean City flood tidal shoal when the State Highway Administration placed scour protection underneath the Rt. 50 Bridge. This was intended to protect the bridge pilings and help naturally maintain the federal navigation channel at the east end of the bridge. Then in 1985 Hurricane Gloria struck, devastating the beaches of Ocean City and resulting in a project to repair and replenish the beach. That project added extra sand to the tidal flux through the inlet and resulted in the fairly rapid accretion of an island on top of the already existing flood tidal shoal.

By the mid-1990s, Skimmer Island had become an important breeding site in Maryland for several species of colonial nesting waterbirds, especially Black Skimmer, Common Tern, and Royal Tern. At its peak Skimmer Island was 7 acres in size and supported about 1,000 or more breeding pairs of terns and skimmers. Skimmer Island is the most important breeding site in Maryland for waterbirds species that require barren sand beaches, a very rapidly disappearing habitat. At peak use Skimmer Island supported over 600 breeding pairs of Royal Tern, 500 pairs of Common Tern and 175 pairs of Black Skimmer. At the turn of the 21st century, things began to change for the worse as the size of the island declined. Competition with nesting gulls made life hard for terns and skimmers breeding at this unique natural area. By 2006, Black Skimmers and Royal Terns abandoned Skimmer Island as a nesting site.

During March of 2011 sand from the approach channel to Sunset Marina was placed on Skimmer Island to nourish and improve nesting habitat conditions for Black Skimmers, Common and Royal Terns. This nourishment and restoration project is a great example of win-win wildlife habitat enhancement through beneficial use of dredged material. The MD Natural Heritage Program would be hard pressed to find the funds to restore Skimmer Island on its own and Sunset Marina needed to find a place for the sand dredged from its approach channel. The State of Maryland had a need for sand to nourish Skimmer Island and Sunset Marina covered the cost of dredging and placing the sand on Skimmer Island. The winners were Black Skimmers, Common and Royal Terns. The permits are now in place so that this "design with nature" adaptive management approach can place sand on Skimmer Island for several more years to improve habitat conditions for two endangered bird species. As sea level rise continues, the ability to nourish Skimmer Island with clean sand dredged from nearby channels will allow managers to maintain the critical barren sand habitats that are present on Skimmer Island. Skimmers, terns, horseshoe crabs and a myriad list of other species can take advantage of the benefits that the flood tidal sand flats and Skimmer Island provide to them.

Tagging effort and results

In 2010 and 2011, Dick Arnold (Fish and Wildlife Service Volunteer) tagged approximately 2,000 Horseshoe Crabs on Maryland and Delaware beaches. Recapture and reporting of 135 tag numbers for those two years reveal 115 individuals which were tagged on Maryland spawning beaches. Of the returns of horseshoe crabs that were tagged in Maryland, 53 returns were from the Atlantic Ocean or Atlantic Ocean beaches, 45 returns were from the Maryland Coastal Bays, eight returns were from Delaware Bay, and six returns were from Chincoteague VA, and five returns were from Indian River DE.

Of the locally tagged Horseshoe Crabs found in 2011, seven of those were tagged in 2010 (one year at liberty). There were animals recovered in the Indian River DE, Bethany Beach DE, Mispillion Harbor DE, Wallops Island, Ocean City Maryland beach, and Maryland Coastal Bays. This shows that while there is some site fidelity between years, there is also a good bit of mixing of regional populations between years. It also shows that this data is useful in giving us an idea as to the geographical range of locally spawning animals as well as annual movements.

As far as tag recoveries found during the spawning surveys, there were 16 tags found in 2011. Ten of those animals were tagged by Dick Arnold (Fish and Wildlife Service Volunteer) in the Maryland Coastal Bays. One was tagged in 2010 and the rest were tagged in 2011. Of the six recovered animals that were not tagged locally, three were tagged in Tom's Cove VA in 2008, one was tagged in Townsend, VA in 2007, one was tagged in Kimbles Beach, NJ in 2010, and one in lower Delaware Bay in 2004. All were tagged on spawning beaches in May, June, or July except for the Townsend, VA individual which was tagged in January on a trawl survey.

Temperature and Lunar Period analysis

Temperature and lunar period data in 2011 indicates spawning peaked in lunar phase three (mid-June) and at a temperature of 19 degrees centigrade (Figure 1). This is typical with what we have found in recent years. Temperature is taken in the water by handheld thermometer. Similar analysis done in the Delaware Bay spawning survey has found that the critical water temperature for spawning initiation is 15 degrees centigrade. That survey uses the sea buoy at the mouth of Delaware Bay for their temperature measurement which may explain the difference. The water temperature is cooler at an open deep water site such as the sea buoy at the mouth of Delaware Bay, than in the shallow water where spawning is actually occurring, as is measured in our survey.

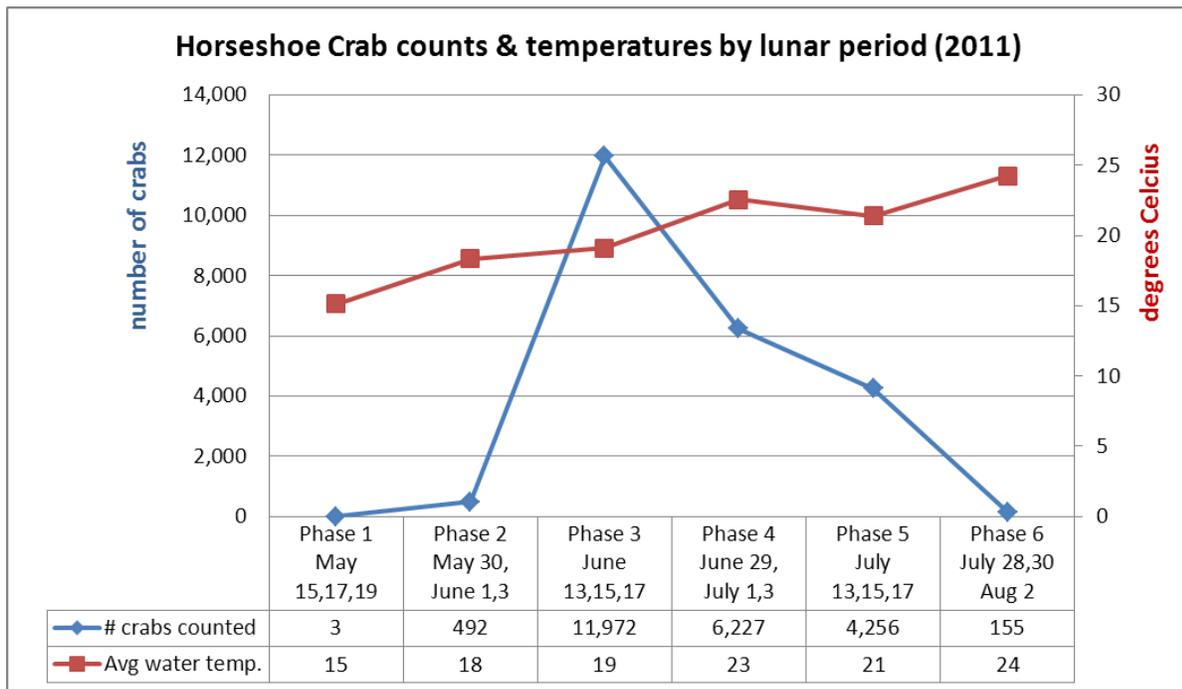


Figure 1. Horseshoe crabs counts and spawning temperatures by lunar period.

The peak lunar period for spawning has varied between lunar period three, four, and five from 2007 to 2011 (Figure 2). Lunar period three and four are both in June and they were the most frequent period of peak spawning in four of the past five years. June has also been the peak spawning period from 2002 to 2011 in nine of the past ten years (Table 1). This is in contrast to Delaware Bay where May is usually the peak spawning period. Delaware Bay spawning probably occurs at the same ambient temperature but spawning occurs earlier than in the Maryland Coastal Bays because the Delaware Bay sites warm up in the spring faster than the Maryland Coastal Bay sites where spawning occurs. Maryland Coastal Bay sites are closer to the inlet with the colder ocean water keeping ambient water temperatures colder longer in the spring than the Delaware Bay spawning sites which is warmed by inland runoff into the Delaware Bay.

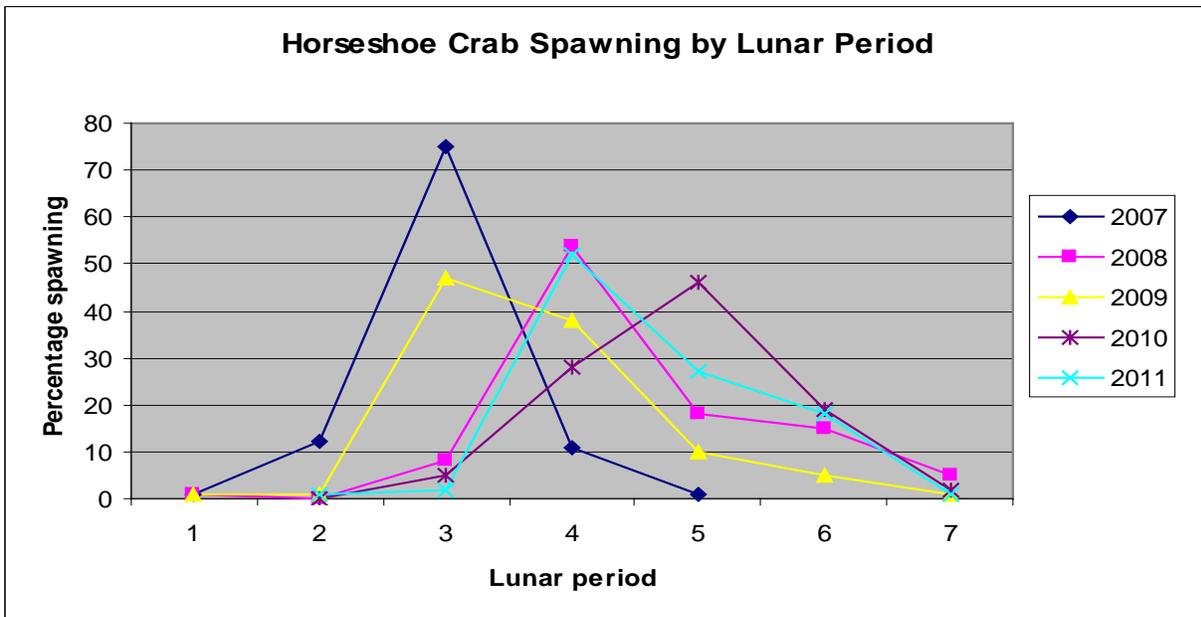


Figure 2. Horseshoe Crab Spawning by Lunar Period for 2007 through 2011.

The chart below shows a clear initiation of spawning when the ambient water temperature reaches 18 degree centigrade and a peak at 20 degree centigrade. More years of data should help further delineate the ambient spawning water temperature range (Figure 3).

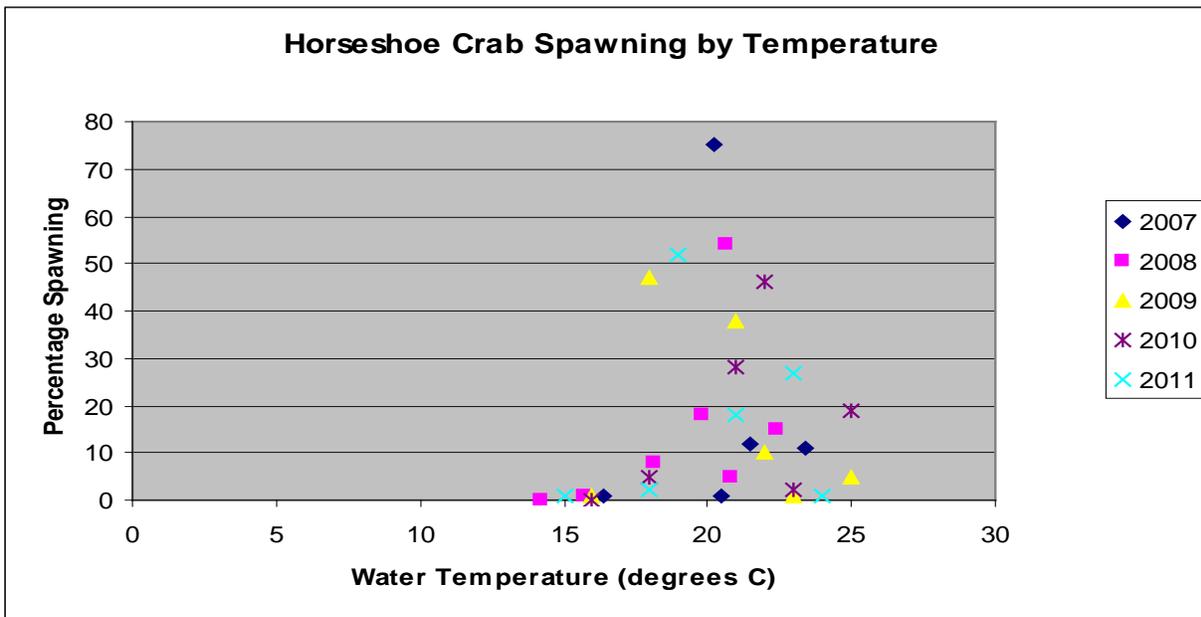


Figure 3. Horseshoe Crab Spawning by Temperature for 2007 through 2011.

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