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2015 Horseshoe Crab Spawning Survey results

The fourteenth annual horseshoe crab (*Limulus polyphemus*) spawning survey continues the local assessment of population abundance and critical habitat availability in the Maryland Coastal Bays. Horseshoe crabs and their eggs are a critical food source for many marine species including sharks, turtles and especially shore birds. Additionally, these crabs are harvested by waterman for bait and for biomedical uses. The status of horseshoe crab populations along the Atlantic Coast are slowly evolving through surveys, research, and harvest records. The most recent stock assessment indicated that the population is stable in the Delaware Bay area that also includes the Maryland Coastal Bays (Sweeka et al 2014). Thanks to the generosity of volunteers who provided their time and effort, 30 surveys were collected from five beach sites, and reveal a sum total of 14,207 crabs in 2015 (Table 1).

Residents at the Sunset Island community, 67th bayside in Ocean City, MD recorded 343 total spawning crabs in 2015. Photo credit: Carol Sottili

Count per Unit Effort

Sampling was condensed from 12 evenings to 6 evenings this year. Analysis of the data indicated that the most important information we were able to get from the survey data was the timing of the spawn and the relationship to temperature. We determined that we could get that information as well as an indicator of relative abundance from less sampling days. Another consideration is changes in the frequency of volunteer coverage of monitoring beaches. Sampling can sometimes be uneven from year to year due to volunteer availability and weather. An attempt to standardize these finding through count per unit effort via "total hours invested" and "number of surveys returned" is calculated from the survey data to give an idea of relative abundance from year to year.

CPUE (count per unit effort) from number of surveys is the best indicator of horseshoe crab relative abundance from year to year in this survey. Total hours are subject to variation by surveyor, while count per survey is not. The CPUE from the surveys in 2015 (474.6) was similar to CPUE since 2010, with some variation from year to year.

*Access to the bayside of northern Assateague Island and Skimmer Island was surmounted with the assistance of DNR Fisheries Service in 2006. This explains some of the increase in the total number of crabs from the first couple of years of the survey.

Table 1. 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	3,918	18.63	210.31		57	68.74
2007	7,617	27.28	279.22		115	66.23
2008	10,690	16.57	645.14		86	124.30
2009	21,846	19.87	1,099.63		63	346.76
2010	23,438	11.08	2,114.71		42	558.05
2011	23,105	30.85	748.95		58	398.36
2012	21,127	14.01	1,509.07		60	352.12
2013	31,873	20.45	1,558.58		83	384.01
2014	35,278	12.52	2,817.73		66	534.52
2015	14,238	6.93	2,053.57		30	474.60

Timing of the horseshoe crab spawning

Horseshoe crab spawning varies by latitude but generally occurs between May and July along the Atlantic coast. The peak of spawning the Delaware Bay is in May and June (Michels et al 2010). Spawning in the Maryland coastal bays typically peaks in June, and often continues through July. In 2015 the spawning period was protracted through late spring and early summer and almost equal numbers of horseshoe crabs were counted in June and July (Table 2).

Table 2.	Total # of Horseshoe Crabs counted by month and year				
YEAR	May	June	July	August	Grand Total
2002	0	105			105
2003	2	521			523
2004	57	632			689
2005	48	261			309
2006	125	3,793			3918
2007	711	6,636	270		7617
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
2012	2,032	13,330	5,748	17	21,127
2013	261	22,875	8,737		31,873
2014	560	28,790	5,928		35,278
2015	38	7,262	6,938		*14,238
Grand Total	5,055	139,972	49,621	36	194,684

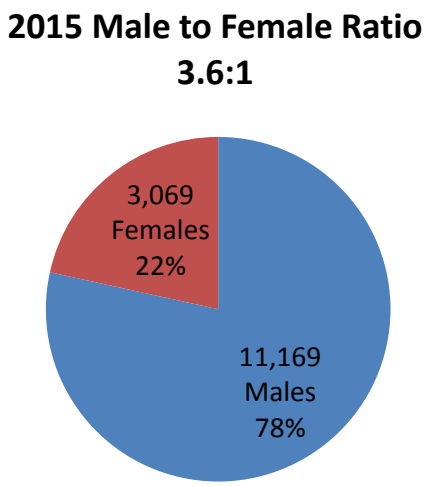
*The drop in total crabs in 2015 was due to a decrease in survey dates from 12 to 6 days.

Horseshoe Crab Spawning Beaches Sex Ratio

The survey counts over the last decade indicate male to female sex ratios have remained relatively stable (Table 3). In 2015, we found 3.6 males to 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.

Table 3. Total # of Males and Females & 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	2939	979	3.0:1
2007	5799	1818	3.2:1
2008	8289	2329	3.6:1
2009	17551	4295	4.1:1
2010	18642	4796	3.9:1
2011	18508	4597	4.0:1
2012	16872	4255	4.0:1
2013	24876	6997	3.6:1
2014	29613	5665	5.2:1
2015	11169	3069	3.6:1



Horseshoe Crab Spawning Locations

It is widely recognized that temperature, wind direction and wave energy influence where crabs will spawn. 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. All sites saw decreases from last year due to sampling being condensed from 12 to 6 dates. Sunset Island nevertheless had about the same number of crabs reported.

Table 4. Number of Horseshoe Crabs observed at survey locations over time.

Numbers of crabs observed	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
North Assateague Island bayside	546	49	1,007	413	489	477	187
Skimmer Island (two sites)	20,467	23,035	21,265	20,138	25,338	29,367	13,474
Oceanic Motel at Inlet	723	344	824	563	2,652	4,216	226**
Gudelsky Park in West O.C.	110	10	9	13	2,432	865	8
Sunset Island (67th St.)*	-	-	-	-	962	353	343

*n*ew site- not sampled until 2013*

**The Oceanic Motel was only monitored on one date this year.

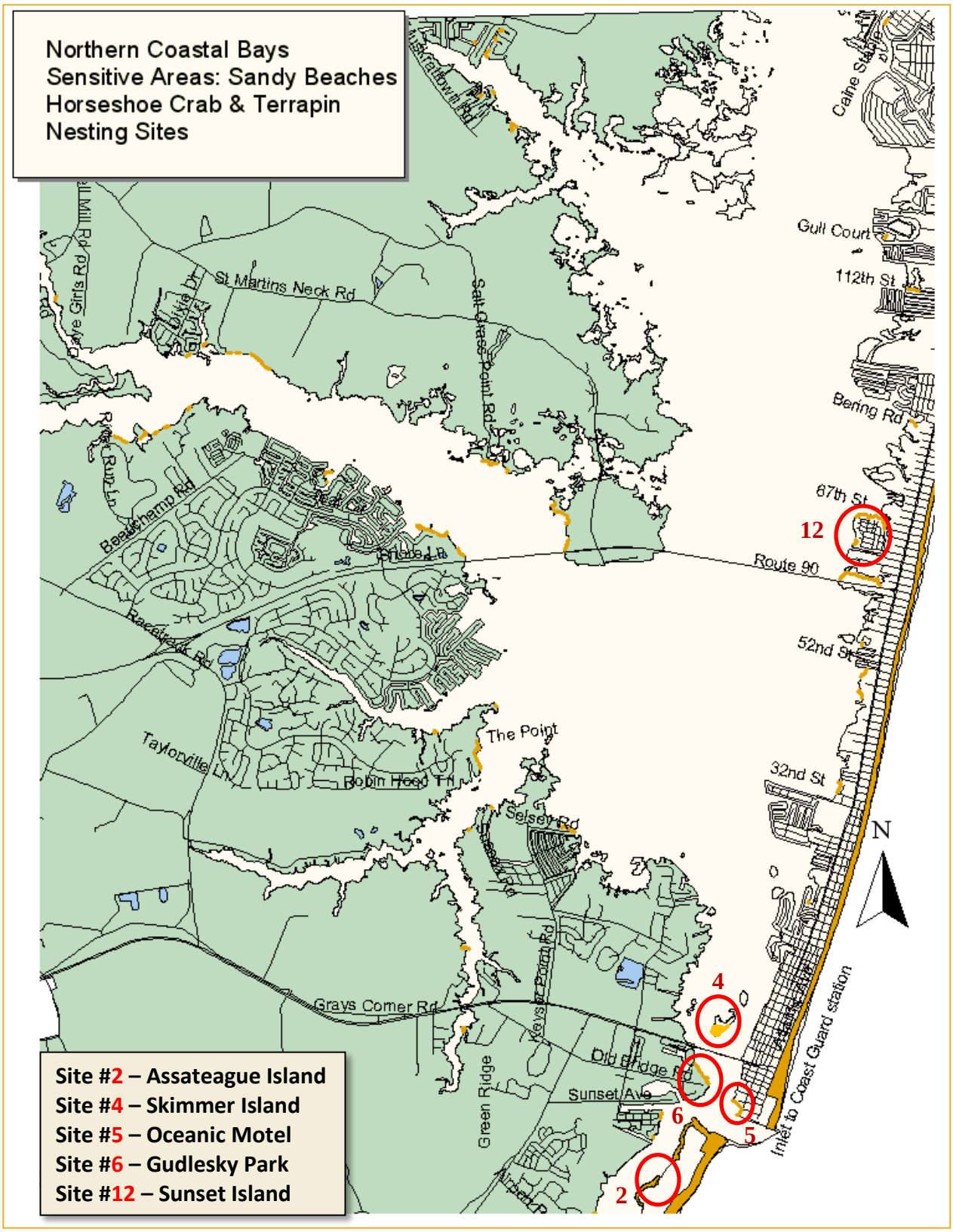
Skimmer Island Beach Replenishment Provides Spawning Habitat

Skimmer Island, the best spawning site we have in the Maryland Coastal Bays, was the target of beach nourishment efforts from 2012 to 2014. More than 2,500 cubic yards of sand that was collected in the approach channel to the Ocean City Fishing Center has been dredged and deposited on Skimmer Island. As a result, this has expanded the available area for spawning. Note that the expanded areas were not surveyed this year and are not reflected in the final results for 2015. Wave energy subsequent to 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.

Substantial numbers of crabs and wading birds were observed at the sand deposit areas on western Skimmer Island. Photo credit: C. Cain

Islands that are isolated from heavily populated areas, such as Ocean City, Maryland, provide excellent habitat for horseshoe crabs and nesting birds. Skimmer Island (above) provides a safe habitat for many species that rely on sandy beaches for nesting. Skimmer is protected from the boating public by posted signs. This protection is backed by the Natural Resources Police. The Maryland Coastal Bays Program provides outreach to the local community to supplement these protective efforts.

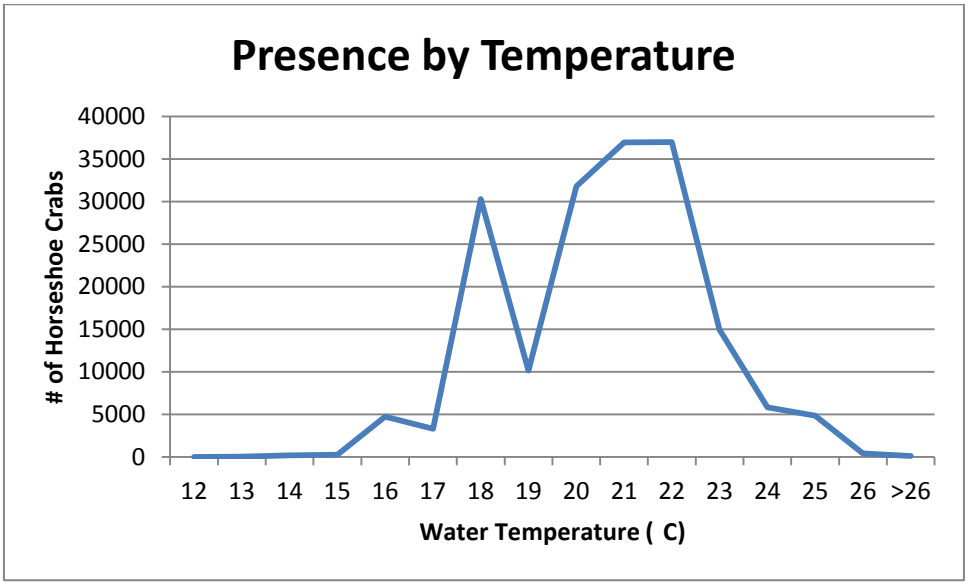
Figure 1. Maryland Coastal Bays 2015 Horseshoe Crab Spawning Survey



Temperature Effects of the Timing of Spawning

Long-term results from 2002 to 2015 reveal spawning activity begins around 18°C in Maryland, and then peaks at 21°C (Figure 2). Temperature and total number of crabs were compared from all surveys and then graphed. Temperature is taken in the water by handheld thermometer. The majority of horseshoe crab spawning in Maryland's coastal bays occurs between 17°C and 23°C. Similar analysis done in the Delaware Bay spawning survey has found that the critical water temperature for spawning initiation is 15°C. That survey uses the sea buoy at the mouth of Delaware Bay for their temperature measurement which may explain the difference (Michels et al 2010).

Figure 2. Temperature influences when Horseshoe Crabs will spawn.



References

Michels, S., D. Smith, and S. Bennett. 2010. Horseshoe crab spawning activity in Delaware Bay: 1999-2009. Report to the Atlantic States Marine Fisheries Commission's Horseshoe Crab Technical Committee (March 26, 2010).

Sweka, J.A, et. al. 2014. Horseshoe Crab Stock Assessment Update. Report by the Atlantic States Marine Fisheries Commission's Horseshoe Crab Technical Committee. (August 2014)

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