Same Time, Same Place, Different Year The 2002 Delaware Bay Spawning Survey

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Abstract

For the thirteenth consecutive year, the Delaware Bay spawning survey was implemented along 23 beaches in Delaware and New Jersey. Horseshoe crabs were counted on twelve dates surrounding the new and full moons in the months of May and June.

The May 28th date produced the highest estimate, 333,553 spawning individuals on the Delaware Bay shores. Consistent with previous years, Delaware spawning numbers (203,389) were estimated to more numerous than the New Jersey individuals (130,164).

This year's estimate of the visiting population proved to be higher than the previous two years of 2000 and 2001, an increase attributed to greater numbers observed spawning along the upper bay beaches of the New Jersey shoreline.

Introduction

The Delaware Bay Horseshoe Crab Survey, now in its thirteenth year, has had a tremendous impact on our understanding of horseshoe crab activity along the Delaware Bay spawning grounds. Data collected throughout the years demonstrated greater numbers of spawning individuals during the PM tide and days surrounding the new and full moon phases, a higher percentage of males than females along the beaches, varying levels of spawning activity at each beach and a decline in the overall spawning population. As the need for data swells, the survey has steadfastly remained the most useful study.

Methods

Horseshoe crabs were surveyed during the 2002 spawning season along the shores of the Delaware Bay. This massive undertaking was accomplished by trained volunteers recording the numbers of crabs on 13 beaches in Delaware and 1 0 beaches in New Jersey. The counts were performed during night hours enumerating male and female animals along the water's edge.

Surveyed beaches were North Cape May*, Townbank, Norburys Landing, South Cape Shore Lab*, Highs*, Pierces Point, Kimbles, Reeds*, Gandys* and Sea Breeze* in New Jersey and Cape Henlopen, Broadkill, Primehook*, Fowler*, Slaughter, Big Stone*, Bennetts Pier, South Bowers and North Bowers*, Ted Harvey Wildlife Management Area, Kitts Hummock*, Pickering and Woodland*. Beaches indicated by asterisks are "fixed" beaches meaning they are surveyed every year.

Dates for the survey were in sets of three surrounding the full or new moon days in May and June. Survey dates were May 10th, May 12th, May 14th, May 24th, May 26th, May 28th, June 8th, June 10th, June 12th, June 22nd, June 24th and June 26th.

Results

Spawning activity was greatest on May 28th, 2 days after the full moon with 333,553 spawning individuals estimated. Delaware spawners were calculated to be 203,389 and New Jersey animals were 130,164 for this date. Compared to the past two years, this estimate surpassed 2001's estimate of 216,929 individuals and 2000's estimate of 272,770.

New Jersey's peak estimate of 1 30,1 64 individuals on May 28th was higher than both the 2000 and 2001 estimates. As in previous years, South Cape Shore Lab was estimated to have the most spawners (87,472) during the twelve dates. Interestingly, both Gandys and Sea Breeze had abundant individuals along their shores, estimated to have a total of 78,852 and 62,486 spawners respectively during the twelve dates. A high density of 1 6.86 crabs per meter was achieved at Gandys Beach on May 26th and Sea Breeze had the next highest density of 14.58 on May 28th. (Table 1 A).

Consistent with previous years, the shoreline of Delaware supported more spawning activity than the New Jersey side. The May 28th estimate of 203, 389 individuals comprised of good numbers of spawners on Slaughter (42,630), Big Stone (24,050), Bennetts Pier (20,384) and South

Bowers (31,855) beaches. South Bowers, although not surveyed every year, had the season's greatest number of spawners at ,.1 58,792, almost double the estimate from the previous year of 76,866. South Bowers contributed 18% of the overall estimate for the Delaware Beaches. Kitts Hummock had the greatest density of spawners, 19.07, and Pickering's density was close behind with 18.65 crabs per meter, both on the May 28th date. Chronologically, these two beaches have had the greatest density of spawners since 1999. (Table 1 B).

Spawning numbers were most numerous during the May survey dates in both New Jersey and Delaware, almost three times the June spawning numbers. The number of spawners surrounding the full moon in May rose from 80,098 on May 24th to 251,311 on the full moon date to the peak estimate of 330,553 on May 28th, 2 days after the full moon. The latter survey dates in June surrounding the full moon had very little spawning activity with only 48,321 individuals estimated. (Figure 1).

Upon analyzing the data, the 2002 peak spawning estimate was a very welcome sight with approximately 30% more spawners than the 2001 estimate and 20% more than the 2000 figure (Table 2 and Figure 2). Also pleasing was the fact that the New Jersey spawners accounted for the increase since spawning numbers have been plummeting in New Jersey since the 1990 and 1991 peak PM estimates of 812,408 and 722,342. Extensive up bay spawning activity on Gandys and Sea Breeze beaches was an important contribution to the rise in New Jersey numbers.

Our reported increase does not appear to be influenced by the random selection of beaches that is a routine part of the survey procedures. In recent years, all the accessible beaches in Delaware have been surveyed. In New Jersey, four beaches were randomly selected to survey in addition to the "fixed" six beaches. New Jersey random beach selections for 2002 included Townbank, Norburys Landing, Pierces Point and Kimbles, all beaches that have historically displayed great spawning numbers. The increase in this year's survey estimate, however, cannot be explained by this random selection since Pierces Point was not surveyed on May 28th 2002 and our remaining three random beaches were surveyed in 2001.

The peak counts for New Jersey and Delaware during the years 2000- 2002 were graphed to further analyze the spawning activity (Figure 3. A and B). Peaks coincided with the overall peak with the exception of the 2001 data, where the greatest count in combination was on the June 5th date, even though the estimate for New Jersey was low (19,726 individuals). Therefore, the May 24th count in New Jersey (86,521), believed to be the more representative of the spawning activity, was used for the 2001 peak estimate. Only beaches that had counts performed during all three years were included. New Jersey estimates were greatest at Cape Shore Lab during all three years. T ownbank, Reeds and especially the up bay beaches, Gandys and Sea Breeze, had greater spawning activity during the 2002 season than the previous two years (Figure 3 A).

In Delaware, although the peak estimates for the three years, 2000 (202,477), 2001 (197,203) and 2002 (203,389) were relatively the same, the distribution of spawners during the 2002 survey was quite different than the years 2000 and 2001. The maximum number of crabs estimated during the three years was found at Slaughter Beach, however the 2002 estimate at Slaughter Beach did not reach the 2000 and 2001 levels. Nonetheless, the overall estimate was comparable to previous years due to the more even distribution of horseshoe crabs along the middle beaches (Slaughter, Big Stone, Bennetts Pier and South Bowers)(Figure 3 B). It is not known if the greater up bay spawning in New Jersey and the more even distribution in Delaware are linked and part of the same occurrence.

Spawning activity was further classified, similar to last year's analysis, by categorizing the densities into four levels: no spawning activity = 0 crabs, low activity = less than 5 crabs per meter, moderate = 5-1 0 crabs per meter and high activity = greater than 10 crabs per meter. Low densities (73 dates in NJ and 98 dates in DE) accounted for much of the spawning activity during the 2002 season. During 1 2 dates (4 in NJ and 8 in DE), no horseshoe crabs were observed. Periods of moderate spawning activity occurred on 12 dates in New Jersey and 20 dates in Delaware. Horseshoe crab densities greater than 10 crabs per meter accounted for 1 0 dates in New Jersey and 1 9 dates in Delaware. Compared to the 2001 survey densities, the 2002 year had fewer dates with no crab activity (12 compared to 22) and more dates with high densities (29 compared to 9).

The dedication of our volunteers was tremendous, nevertheless, some surveying was hampered by the weather or unforeseen circumstances. Counting on May 12th was prevented by a thunder/lightening storm on eight beaches in New Jersey and seven beaches in Delaware. Other than that date, there was no weather related
cancellations in Delaware. However, three dates on Cape Henlopen and one date on Fowler beach were missed accounting for 2.56% of the total dates. In New Jersey, five additional dates were canceled either due to weather or as in the case of Gandys Beach, too high a tide. Seven more dates were excluded in New Jersey, five at Sea Breeze and two at Pierces Point or 5.83%.

Discussion

Surveying the horseshoe crabs is an important task, more far reaching than most of the dedicated volunteers and others realize. The Atlantic States Marine Fisheries Commission (ASMFC) Interstate Management Plan for the horseshoe crab implemented requirements for each state, primarily regarding their reporting of harvests and identification of horseshoe crab .habitats. Although the Plan addresses the need for more scientific data 'on the dynamics of the horseshoe population, very little progress has been made. The Delaware Bay spawning survey remains the best tool in obtaining information on the status of the Delaware Bay horseshoe crab population.

Optimism abounds when viewing the 2002 peak spawning estimate, which is an indication of the current horseshoe crab plight. The restrictive measures introduced in the Delaware Bay region on harvesting, the implementation of the Carl N. Shuster Jr. Horseshoe Crab Reserve (CNSJrHSCR) and the utilization of bait bags seem to be benefiting the horseshoe crab. However, the increase is currently not substantial enough to warrant any less restrictive measures in the management of the species.

Acknowledgements

Table 1. 2002 Survey Results - Densities and Estimates
A. New Jersey Beaches (2 pages)

Moon Phase	New -2	New	New +2	Full -2	Full	Full +2
Date	10-May	12-May	14-May	24-May	26-May	28-May
North Cape May* (3 km)						
Density of HSC, Crabs/m	0.05	canceled	0	0.04	0.78	0.47
Estimated Number of HSC	150	canceled	0	120	2,340	1,410
Townbank (2.3 km)						
Density of HSC, Crabs/m	2.78	canceled	0.24	0.39	2.70	9.28
Estimated Number of HSC	6,394	canceled	552	897	6,210	21,344
Norburys Landing (2.43 km)						
Density of HSC, Crabs/m	4.99	canceled	canceled	0.15	4.35	3.27
Estimated Number of HSC	12,126	canceled	canceled	365	10,571	7,946
South CSL* (2.2 km)						
Density of HSC, Crabs/m	4.43	canceled	0.02	1.29	11.06	13.01
Estimated Number of HSC	9,746	canceled	44	2,838	24,332	28,622
Highs* (0.8 km)						
Density of HSC, Crabs/m	4.48	canceled	0.12	1.14	9.66	6.28
Estimated Number of HSC	3,584	canceled	96	912	7,728	5,024
Pierces Point (0.7 km)						
Density of HSC, Crabs/m	4.28	8.22	0.16	0.71	11.42	no survey
Estimated Number of HSC	2,996	5,754	112	497	7,994	no survey
Kimbles (1 km)						
Density of HSC, Crabs/m	2.32	canceled	0.06	5.05	8.44	8.31
Estimated Number of HSC	2,320	canceled	60	5,050	8,440	8,310
Reeds* (1.53 km)						
Density of HSC, Crabs/m	6.58	canceled	1.10	1.25	10.05	12.42
Estimated Number of HSC	10,067	canceled	1,683	1,913	15,377	19,003
Gandys* (1.2 km)						
Density of HSC, Crabs/m	4.36	canceled	canceled	9.00	16.86	12.04
Estimated Number of HSC	5,232	canceled	canceled	10,800	20,232	14,448
Sea Breeze* (1.65 km)						
Density of HSC, Crabs/m	0.08	no survey	0.00	5.62	no survey	14.58
Estimated Number of HSC	132	no survey	0	9,273	no survey	24,057
Totals	52,747	5,754	2,547	32,664	103,223	130,164
Moon Phase	New -2	New	New +2	Full -2	Full	Full +2

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A. New Jersey Beaches (2 pages)

Moon Phase	New -2	New	New +2	Full -2	Full	Full +2	Totals
Date	8-Jun	10-Jun	12-Jun	22-Jun	24-Jun	26-Jun	
North Cape May* (3 km)							
Density of HSC, Crabs/m	0.2	0.53	canceled	0.09	0.31	0.14	
Estimated Number of HSC	600	1,590	canceled	270	930	420	7,830
Townbank (2.3 km)							
Density of HSC, Crabs/m	0.22	1.84	canceled	0.11	0.51	0.49	
Estimated Number of HSC	506	4,232	canceled	253	1,173	1,127	42,688
Norburys Landing (2.43 km)							
Density of HSC, Crabs/m	0.47	0.90	1.10	0.09	0.10	0.26	
Estimated Number of HSC	1,142	2,187	2,673	219	243	632	38,102
South CSL* (2.2 km)							
Density of HSC, Crabs/m	0.95	4.09	3.84	0.33	0.58	0.16	
Estimated Number of HSC	2,090	8,998	8,448	726	1,276	352	87,472
Highs* (0.8 km)							
Density of HSC, Crabs/m	0.24	1.54	0.51	0.06	0.13	0.04	
Estimated Number of HSC	192	1,232	408	48	104	32	19,360
Pierces Point (0.7 km)							
Density of HSC, Crabs/m	0.51	0.95	0.30	no survey	0.28	0.09	
Estimated Number of HSC	357	665	210	no survey	196	63	18,844
Kimbles (1 km)							
Density of HSC, Crabs/m	0.90	0.7	0.36	0.00	0.03	0.01	
Estimated Number of HSC	900	700	360	0	30	10	26,180
Reeds* (1.53 km)							
Density of HSC, Crabs/m	0.87	3.16	4.21	0.04	canceled	0.04	
Estimated Number of HSC	1,331	4,835	6,441	61	canceled	61	60,772
Gandys* (1.2 km)							
Density of HSC, Crabs/m	1.32	14.47	7.35	0.00	0.29	0.02	
Estimated Number of HSC	1,584	17,364	8,820	0	348	24	78,852
Sea Breeze* (1.65 km)							
Density of HSC, Crabs/m	no survey	10.23	7.36	no survey	canceled	no survey	
Estimated Number of HSC	no survey	16,880	12,144	no survey	cancelled	no survey	62,486
Totals	8,702	58,682	39,504	1,577	4,300	2,721	442,586
Moon Phase	New -2	New	New +2	Full -2	Full	Full +2	Totals

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Table 1. 2002 Survey Results - Densities and Estimates
B. Delaware Beaches (2 pages)

Moon Phase	New -2	New	New +2	Full -2	Full	Full +2
Date	10-May	12-May	14-May	24-May	26-May	28-May
Cape Henlopen (1.5 km)						
Density of HSC, Crabs/m	0.19	0.20	0.03	0.28	0.84	1.72
Estimated Number of HSC	285	300	45	420	1,260	2,580
Broadkill (1.5 km)						
Density of HSC, Crabs/m	0.09	canceled	0.21	0.02	0.84	2.56
Estimated Number of HSC	135	canceled	315	30	1,260	3,840
Primehook* (2.0 km)						
Density of HSC, Crabs/m	1.61	0.06	0.57	0.48	3.73	5.86
Estimated Number of HSC	3,220	120	1,140	960	7,460	11,720
Fowler* (3 km)						
Density of HSC, Crabs/m	0.42	cancelled	0.72	0.49	3.92	no survey
Estimated Number of HSC	1,260	cancelled	2,160	1,470	11,760	no survey
Slaughter (3 km)						
Density of HSC, Crabs/m	6.41	cancelled	2.53	0.50	6.75	14.21
Estimated Number of HSC	19,230	cancelled	7,590	1,500	20,250	42,630
Big Stone* (5.0 km)						
Density of HSC, Crabs/m	7.36	cancelled	0.65	0.30	2.94	4.81
Estimated Number of HSC	36,800	cancelled	3,250	1,500	14,700	24,050
Bennetts Pier (2.6 km)						
Density of HSC, Crabs/m	0.02	cancelled	0.17	1.67	5.93	7.84
Estimated Number of HSC	52	cancelled	442	4342	15418	20,384
South Bowers (2.3 km)						
Density of HSC, Crabs/m	6.02	10.10	10.46	5.03	10.82	13.85
Estimated Number of HSC	13,846	23,230	24,058	11,569	24,886	31,855
North Bowers* (1.3 km)						
Density of HSC, Crabs/m	14.60	16.19	11.73	3.71	5.58	11.45
Estimated Number of HSC	18,980	21,047	15,249	4,823	7,254	14,885
Kitts Hummock* (1.0 km)						
Density of HSC, Crabs/m	2.44	6.86	1.84	5.78	15.36	19.07
Estimated Number of HSC	2,440	6,860	1,840	5,780	15,360	19,070
Pickering (1 km)						
Density of HSC, Crabs/m	5.18	canceled	12.98	9.81	13.76	18.65
Estimated Number of HSC	5,180	canceled	12,980	9,810	13,760	18,650
Woodland* (0.5 km)						
Density of HSC, Crabs/m	0.04	0.01	0.00	0.00	0.74	0.79
Estimated Number of HSC	20	5	0	0	370	395
Ted Harvey WMA (1.0 km)						
Density of HSC, Crabs/m	2.52	canceled	6.58	5.23	14.35	13.33
Estimated Number of HSC	2,520	canceled	6,580	5,230	14,350	13,330
Totals	103,968	51,562	75,649	47,434	148,088	203,389
Moon Phase	New -2	New	New +2	Full -2	Full	Full +2

* Beaches Surveyed Every Year

Table 1. 2002 Survey Results - Densities and Estimates
B. Delaware Beaches (2 pages)

Moon Phase	New -2	New	New +2	Full -2	Full	Full +2	Totals
Date	8-Jun	10-Jun	12-Jun	22-Jun	24-Jun	26-Jun	
Cape Henlopen (1.5 km)							
Density of HSC, Crabs/m	no survey	0.63	0.52	no survey	0.73	no survey	
Estimated Number of HSC	no survey	945	780	no survey	1,095	no survey	7,710
Broadkill (1.5 km)							
Density of HSC, Crabs/m	0.00	0.04	0.49	0.05	0.17	0.40	
Estimated Number of HSC	0	60	735	75	255	600	7,305
Primehook* (2.0 km)							
Density of HSC, Crabs/m	0.00	1.48	1.30	0.16	0.20	0.32	
Estimated Number of HSC	0	2,960	2,600	320	400	640	31,540
Fowler* (3 km)							
Density of HSC, Crabs/m	0.00	0.86	0.11	0.06	0.06	0.08	
Estimated Number of HSC	0	2,580	330	180	180	240	20,160
Slaughter (3 km)							
Density of HSC, Crabs/m	0.06	2.86	1.11	0.36	0.33	0.17	
Estimated Number of HSC	180	8,580	3,330	1,080	990	510	105,870
Big Stone* (5.0 km)							
Density of HSC, Crabs/m	0.09	0.83	2.77	0.19	0.40	0.25	
Estimated Number of HSC	450	4,150	13,850	950	2,000	1,250	102,950
Bennetts Pier (2.6 km)							
Density of HSC, Crabs/m	0.26	3.23	6.08	0.46	0.96	0.94	
Estimated Number of HSC	676	8,398	15,808	1,196	2,496	2,444	71,656
South Bowers (2.3 km)							
Density of HSC, Crabs/m	1.54	3.42	4.30	0.26	1.76	1.48	
Estimated Number of HSC	3,542	7,866	9,890	598	4,048	3,404	158,792
North Bowers* (1.3 km)							
Density of HSC, Crabs/m	2.02	4.72	2.09	1.06	0.69	1.19	
Estimated Number of HSC	2,626	6,136	2,717	1,378	897	1,547	97,539
Kitts Hummock* (1.0 km)							
Density of HSC, Crabs/m	0.13	10.28	7.56	1.95	3.95	4.80	
Estimated Number of HSC	130	10,280	7,560	1,950	3,950	4,800	80,020
Pickering (1 km)							
Density of HSC, Crabs/m	5.44	13.77	13.38	3.09	2.34	4.18	
Estimated Number of HSC	5,440	13,770	13,380	3,090	2,340	4,180	102,580
Woodland* (0.5 km)							
Density of HSC, Crabs/m	0.19	0.10	0.15	0.00	0.00	0.00	
Estimated Number of HSC	95	50	75	0	0	0	1,010
Ted Harvey WMA (1.0 km)							
Density of HSC, Crabs/m	1.11	9.06	7.52	2.39	3.46	4.68	
Estimated Number of HSC	1,110	9,060	7,520	2,390	3,460	4,680	70,230
Totals	14,249	74,835	78,575	13,207	22,111	24,295	857,362
Moon Phase	New -2	New	New +2	Full -2	Full	Full +2	Totals

* Beaches Surveyed Every Year

Table 2. Comparison of Data on Horseshoe Crabs Spawning on Delaware Bay Shores
Years 1996-2002

	28-May-02	5-Jun-01	18-May-00	30-May-99	23-May-98	24-May-97	1-Jun-96
Estimated Number of HSC During PM Tide	333,553	216,929	272,770	422,775	464,934	475,810	398,290
Estimated Number of HSC (PM) - NJ Beaches	130,164	19,726	70,293	141,720	148,444	98,487	65,846
Estimated Number of HSC (PM) - DE Beaches	203,389	197,203	202,477	281,055	316,490	377,323	332,444
Beaches Surveyed in Delaware	13	13	11	9	7	7	7
Beaches Surveyed in New Jersey	10	10	11	13	12	12	10
Main Spawning Beaches in Delaware	South Bowers	Slaughter	Slaughter	Slaughter	Slaughter	Slaughter	Slaughter
	Slaughter	Big Stone	Big Stone	Big Stone	Big Stone	Big Stone	Big Stone
	Big Stone						South Bowers
	Pickering						
Main Spawning Beaches in New Jersey	South CSL	South CSL	South CSL	Townbank	South CSL	Norburys	Norburys
	Gandys			Norburys	Reeds	South CSL	South CSL
	Sea Breeze			South CSL	Cooks		Highs
							East Point