

The Delaware Bay Horseshoe Crab Spawning Survey
2001 Season

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Abstract

The 12th annual horseshoe crab survey was conducted along the Delaware Bay shore during the 2001 spawning season. Along 10 New Jersey beaches and 13 Delaware beaches, horseshoe crabs were counted on twelve dates surrounding the new and full moon phases in May and June.

The greatest number of horseshoe crabs (216,929) were estimated on the full moon date of June 5th with the majority of the horseshoe crabs (197,203) found along the Delaware side of the bay. A slightly lower peak of 216,636 occurred 2 days after the new moon phase on May 24th. During this count, horseshoe crabs were somewhat more equally divided on both sides of the bay (86,521 individuals in New Jersey and 130,115 in Delaware). Delaware shores supported almost 3 times as many crabs as the shoreline of New Jersey during the 2001 spawning season.

The 2001 peak estimate of 216,929 individuals was the lowest estimate in the history of the survey, excluding the unfavorable weather dates in 1994 and 1995.

Introduction

The spawning survey has been instrumental in guiding the management of the Delaware Bay horseshoe crab population for many years. Improvements to the methodology of the survey, most importantly the increase in the number of days the survey is conducted, have added to the validity and usefulness of the survey in determining trends in the crab population.

Methods

Horseshoe crabs were enumerated during the high tide on 23 beaches. Twelve of these beaches are "fixed" beaches (listed from south to north); North Cape May, South Cape Shore Lab, Highs, Reeds, Gandys and Seabreeze in New Jersey and Primehook, Fowler, Big Stone, North Bowers, Kitts Hummock and Woodland in Delaware.

In addition to the New Jersey "fixed" beaches, Sunset Beach, Townbank, Norburys Landing and Kimbles Beach were surveyed. In Delaware, the number of volunteers this year enabled the survey to be conducted on all 13 accessible beaches, the "fixed" beaches as well as Cape Henlopen, Lewes, Broadkill, Slaughter, Bennetts Pier, South Bowers and Pickering.

Twelve dates were covered during the 2001 spawning season. During each high tide period, horseshoe crabs were counted by trained volunteers using a 1 meter quadrat. The quadrat was randomly placed 100 times along the water's edge in a 1 kilometer segment where possible. Delaware beaches have expansive lengths with the exception of Woodland beach (500 meters) allowing the 1 kilometer segment to be surveyed. Unfortunately, erosion along the New Jersey coastline has severely reduced the available area for surveying resulting in segments ranging from 200 meters to 1 kilometer.

Results

Table 1 -A, 1 -B and Figure 1 summarize the survey data collected. This table lists the beaches surveyed, the density and the estimated number of horseshoe crabs on each of the twelve dates. Crabs along the New Jersey side of the bay were found in greater numbers during the early part of the season, whereas crabs spawning on the Delaware shores were more numerous during the June dates.

The 2001 May estimate in New Jersey was similar to the 2000 May estimate. However, the June estimate from 2001 was almost half the June 2000 estimate. Low estimates may be due to windy conditions in New Jersey during mid May that prevented the horseshoe crabs from spawning on the beaches. At Highs Beach, no horseshoe crabs were observed from May 12th until May 22nd.

The 2001 May and June approximations from the Delaware side of the bay flip flopped from 2000 with greater numbers found in June rather than May. Low May counts in Delaware can be partially attributed to adverse weather conditions for both spawning crabs and surveying on May 2, 20th and May 22nd.

As in past years, South Cape Shore Lab supported the greatest spawning activity of all the New Jersey beaches. The overall estimate from South CSL comprised almost half of the total number of spawners estimated on all ten beaches during the twelve dates. Density estimates also were highest on this beach, 16.68 crabs per meter on May 24th and 6.54 crabs per meter on May 9th.

Delaware numbers peaked on June 5th with more spawning activity occurring during June than May. Slaughter and Big Stone beaches contributed the greatest number of individuals to the overall season count, 20% from each. Peak density was reached on June 5th at Kitts Hummock. The second highest peak density, 20.10 was also found on Kitts Hummock beach on May 24th.

The number of horseshoe crabs spawning are dependent on many factors and may vary drastically throughout the spawning season. Spawning activity is at its peak during the new and full moon phases and during calm water. The levels of spawning activity were categorized into four groups in order to chart the activity during the 2001 season: no activity = 0 crabs, low spawning activity = less than 5 crabs per meter, moderate = 5 to less than 10 crabs per meter and high spawning activity = greater than 10 crabs per meter. The majority of the densities were categorized as low spawning activity with 76 survey dates containing less than 5 horseshoe crabs in New Jersey and 71 dates in Delaware. Other activity in New Jersey consisted of 12 survey dates with no horseshoe crabs observed, 6 dates with moderate activity and 6 dates with high activity. The highest densities were found at South Cape Shore Lab and Highs beach in May. In Delaware, 20 of the dates exhibited no crab activity, 27 dates had moderate activity and 9 dates had high spawning activity (3 were in May and 6 were in June). The high spawning densities occurred at Pickering and Kitts Hummock with one date at Slaughter and one date at North Bowers.

Table 2 summarizes the survey information during the spawning seasons 1996-2001. This table lists the estimated number of horseshoe crabs, the number of beaches surveyed in Delaware and New Jersey and the main spawning beaches in each state. Figure 2 graphs the peak estimates from the start of the survey in 1990 through 2001. This year the peak spawning estimate was the lowest estimate in all the years the survey has been conducted with the exception of the bad weather dates in 1994 and 1995.

Survey coverage was similar to previous years with 23 beaches covered. Nine percent or 25 dates from a total of 276 possible survey counts were missed due to inclement weather. The May 22nd count on both sides was canceled on many beaches due to lightening, 5 out of 10 beaches in New Jersey and 8 out of 13 beaches in Delaware were not surveyed on this night. In New Jersey, 9% or 11 out of 120 dates were missed for reasons other than weather. Most of these missed dates (6 of 11) were at the most northern beach, Sea Breeze. Flooding and an out of the way location make this beach a difficult beach to find volunteer help for. Fourteen dates (9% or 14 out of 156 possible dates) were missed in Delaware for reasons other than adverse weather conditions. The southern most beach in Delaware, Cape Henlopen was the greatest contributor to missing dates on the Delaware side, only one date was covered during the season.

Discussion

Horseshoe crabs are a valuable resource with far reaching benefits. Monitoring their numbers is essential to the management of the population. This survey has existed since 1990. At least two critical pieces of data have been gleaned from the current data: 1) The spawning population is in decline and 2) There is a clear population majority on the Delaware side. It is essential to continue it yearly in order to oversee this critical species.

While the survey has undergone some changes in methodology over the course of its tenure it remains the most accepted and only long-term source of data on the spawning population in Delaware Bay. This year's data indicates a continuing decline, albeit smaller than in past years, in the total spawning population. This relatively small population change from the previous year (2000) might be expected as the estimated total number is the smallest in the history of the survey. Recruitment of mature or spawning adults appears to be at a low, again to be expected because of the lag time from egg to sexual maturity, a process thought to average ten years for the females.

Historically, population declines indicate that the recovery time between population highs and lows takes from 25 to 30 years. Assuming the population high occurred in the early 1990's and history holds true, then the current population, assuming no fishery pressures, would not return to 1990 levels until at least 2015.

The effect of low numbers of horseshoe crabs on bay diversity is not known. What is known is that a number of shorebirds, marine fishes, and marine turtles feed on either horseshoe crabs eggs or juveniles or adult horseshoe crabs. In the case of shorebirds, their dependency on eggs is believed to be high and could negatively affect shorebird populations. Dependency of marine fishes and turtles is not so clear so that impacts of fewer horseshoe crabs or their eggs is unknown. However, it is clear that population monitoring of this species is a relevant and cost effective method which may offer management agencies insight into the overall health of diverse populations of the marine community.

Acknowledgement

Volunteers are crucial to the survey and very much appreciated. With each year the outpouring of assistance grows, demonstrating the public's concern for the horseshoe crab and its surrounding environment. We thank them.

We are also thankful to the State of Delaware, Division of Fish and Wildlife for funding the 2001 survey and the State of New Jersey for providing manpower for survey set up and data entry.

Table 1. 2001 Survey Results - Densities and Estimates
A. New Jersey Beaches (2 pages)

Moon Phase	Full -2	Full	Full +2	New -2	New	New +2
Date	5-May	7-May	9-May	20-May	22-May	24-May
Sunset Beach (2.02 km)						
Density of HSC, Crabs/m	0	0	0	0	0.27	0.12
Estimated Number of HSC	0	0	0	0	545	242
North Cape May* (3 km)						
Density of HSC, Crabs/m	0	0	0.02	canceled	0.5	0.06
Estimated Number of HSC	0	0	60	canceled	1,500	180
Townbank (2.3 km)						
Density of HSC, Crabs/m	0.30	0.16	0.27	0.69	no survey	0.65
Estimated Number of HSC	690	368	621	1,587	no survey	1,495
Norburys Landing (2.43 km)						
Density of HSC, Crabs/m	2.95	1.96	1.20	0.23	canceled	5.76
Estimated Number of HSC	7,169	4,763	2,916	559	canceled	13,997
South CSL* (2.2 km)						
Density of HSC, Crabs/m	13.20	13.67	16.54	0.38	3.58	16.68
Estimated Number of HSC	29,040	30,074	36,388	836	7,876	36,696
Highs* (0.8 km)						
Density of HSC, Crabs/m	13.22	9.63	5.67	0.12	canceled	12.86
Estimated Number of HSC	10,576	7,704	4,536	96	canceled	10,288
Kimbles (1 km)						
Density of HSC, Crabs/m	1.25	3.39	5.85	0.00	2.98	4.93
Estimated Number of HSC	1,250	3,390	5,850	0	2,980	4,930
Reeds* (1.53 km)						
Density of HSC, Crabs/m	2.68	1.28	0.89	0.05	canceled	5.04
Estimated Number of HSC	4,100	1,958	1,362	77	canceled	7,711
Gandys* (1.2 km)						
Density of HSC, Crabs/m	0.38	0.12	0.45	0.60	canceled	3.39
Estimated Number of HSC	456	144	540	720	canceled	4,068
Sea Breeze* (1.65 km)						
Density of HSC, Crabs/m	0.00	no survey	0.11	no survey	cancelled	4.19
Estimated Number of HSC	0	no survey	182	no survey	cancelled	6,914
Totals						
Moon Phase	Full -2	Full	Full +2	New -2	New	New +2
	53,281	48,401	52,454	3,874	12,901	86,521

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* Beaches Surveyed Every Year

Table 1. 2001 Survey Results - Densities and Estimates
A. New Jersey Beaches (2 pages)

Moon Phase	Full -2	Full	Full +2	New -2	New	New +2	Totals
Date	3-Jun	5-Jun	7-Jun	19-Jun	21-Jun	23-Jun	
Sunset Beach (2.02 km)							
Density of HSC, Crabs/m	0.12	0.35	no survey	0.66	1.44	1.92	
Estimated Number of HSC	242	707	no survey	1333	2909	3878	9,858
North Cape May* (3 km)							
Density of HSC, Crabs/m	0	0.9	1.02	0.13	no survey	0.17	
Estimated Number of HSC	0	2,700	3,060	390	no survey	510	8,400
Townbank (2.3 km)							
Density of HSC, Crabs/m	no survey	1.1	3.89	no survey	2.42	1.01	
Estimated Number of HSC	no survey	2,530	8,947	no survey	5,566	2,323	24,127
Norburys Landing (2.43 km)							
Density of HSC, Crabs/m	0.02	1.02	2.94	0.57	0.51	canceled	
Estimated Number of HSC	49	2,479	7,144	1,385	1,239	canceled	41,699
South CSL* (2.2 km)							
Density of HSC, Crabs/m	0.00	2.34	5.27	0.55	1.13	0.92	
Estimated Number of HSC	0	5,148	11,594	1,210	2,486	2,024	163,372
Highs* (0.8 km)							
Density of HSC, Crabs/m	0.00	0.54	0.27	0.19	0.23	0.06	
Estimated Number of HSC	0	432	216	152	184	48	34,232
Kimbles (1 km)							
Density of HSC, Crabs/m	0.02	1.73	0.43	0.29	0.09	canceled	
Estimated Number of HSC	20	1,730	430	290	90	canceled	20,960
Reeds* (1.53 km)							
Density of HSC, Crabs/m	0.02	0.63	1.32	0.08	0.06	0.12	
Estimated Number of HSC	31	964	2,020	122	92	184	18,620
Gandys* (1.2 km)							
Density of HSC, Crabs/m	0.53	2.53	3.60	0.00	0.03	0.64	
Estimated Number of HSC	636	3,036	4,320	0	36	768	14,724
Sea Breeze* (1.65 km)							
Density of HSC, Crabs/m	no survey	no survey	no survey	0.16	canceled	no survey	
Estimated Number of HSC	no survey	no survey	no survey	264	canceled	no survey	7,359
Totals	978	19,726	37,731	5,147	12,602	9,735	343,351
Moon Phase	Full -2	Full	Full +2	New -2	New	New +2	

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* Beaches Surveyed Every Year

Table 1. 2001 Survey Results - Densities and Estimates
B. Delaware Beaches (2 pages)

Moon Phase	Full -2	Full	Full +2	New -2	New	New +2
Date	5-May	7-May	9-May	20-May	22-May	24-May
Cape Henlopen (1.5 km)						
Density of HSC, Crabs/m	no survey	no survey	no survey	no survey	no survey	2.47
Estimated Number of HSC	no survey	no survey	no survey	no survey	no survey	3,705
Lewes (1.0 km)						
Density of HSC, Crabs/m	0.14	0	canceled	canceled	canceled	0.85
Estimated Number of HSC	140	0	canceled	canceled	canceled	850
Broadkill (1.5 km)						
Density of HSC, Crabs/m	0.00	0.00	0.00	0.00	canceled	0.04
Estimated Number of HSC	0	0	0	0	canceled	60
Primehook* (2.0 km)						
Density of HSC, Crabs/m	1.79	0.02	1.06	0.00	canceled	3.01
Estimated Number of HSC	3,580	40	2,120	0	canceled	6,020
Fowler* (3 km)						
Density of HSC, Crabs/m	0.10	0.00	1.09	canceled	canceled	2.21
Estimated Number of HSC	300	0	3,270	canceled	canceled	6,630
Slaughter (3 km)						
Density of HSC, Crabs/m	7.96	0.05	1.28	0.00	canceled	6.97
Estimated Number of HSC	23,880	150	3,840	0	canceled	20,910
Big Stone* (5.0 km)						
Density of HSC, Crabs/m	1.09	0.01	5.88	0.00	7.14	3.45
Estimated Number of HSC	5,450	50	29,400	0	35,700	17,250
Bennetts Pier (2.6 km)						
Density of HSC, Crabs/m	0.04	0.00	0.11	0.00	canceled	6.48
Estimated Number of HSC	104	0	286	0	canceled	16,848
South Bowers (2.3 km)						
Density of HSC, Crabs/m	0.50	0.62	4.58	canceled	canceled	6.98
Estimated Number of HSC	1,150	1,426	10,534	canceled	canceled	16,054
North Bowers* (1.3 km)						
Density of HSC, Crabs/m	0.63	2.38	6.62	no survey	4.00	6.11
Estimated Number of HSC	819	3,094	8,606	no survey	5,200	7,943
Kitts Hummock* (1.0 km)						
Density of HSC, Crabs/m	no survey	0.01	9.94	0.02	canceled	20.10
Estimated Number of HSC	no survey	10	9,940	20	canceled	20,100
Pickering (1 km)						
Density of HSC, Crabs/m	4.30	0.05	12.40	no survey	6.35	13.54
Estimated Number of HSC	4,300	50	12,400	no survey	6,350	13,540
Woodland* (0.5 km)						
Density of HSC, Crabs/m	0.00	0.00	0.00	0.00	0.06	0.41
Estimated Number of HSC	0	0	0	0	30	205
Totals	39,723	4,820	80,396	20	47,280	130,115
Moon Phase	Full -2	Full	Full +2	New -2	New	New +2

* Beaches Surveyed Every Year

**Table 1. 2001 Survey Results - Densities and Estimates
B. Delaware Beaches (2 pages)**

Moon Phase Date	Full -2 3-Jun	Full 5-Jun	Full +2 7-Jun	New -2 19-Jun	New 21-Jun	New +2 23-Jun	Totals
Cape Henlopen (1.5 km)							
Density of HSC, Crabs/m		no survey	no survey	no survey	no survey	no survey	
Estimated Number of HSC	no survey	no survey	no survey	no survey	no survey	no survey	3,705
Lewes (1.0 km)							
Density of HSC, Crabs/m	0.00	0.00	0.12	0.09	0.03	canceled	
Estimated Number of HSC	0	0	120	90	30	canceled	1,230
Broadkill (1.5 km)							
Density of HSC, Crabs/m	0.00	1.22	0.68	0.57	0.61	0.64	
Estimated Number of HSC	0	1,830	1,020	855	915	960	5,640
Primehook* (2.0 km)							
Density of HSC, Crabs/m	0.36	2.09	1.87	0.65	0.94	1.26	
Estimated Number of HSC	720	4,180	3,740	1,300	1,880	2,520	26,100
Fowler* (3 km)							
Density of HSC, Crabs/m	1.30	7.73	7.01	0.55	1.58	0.95	
Estimated Number of HSC	3,900	23,190	21,030	1,650	4,740	2,850	67,560
Slaughter (3 km)							
Density of HSC, Crabs/m	9.20	17.61	6.27	1.84	1.24	5.69	
Estimated Number of HSC	27,600	52,830	18,810	5,520	3,720	17,070	174,330
Big Stone* (5.0 km)							
Density of HSC, Crabs/m	1.19	8.38	5.15	0.56	1.77	cancelled	
Estimated Number of HSC	5,950	41,900	25,750	2,800	8,850	cancelled	173,100
Bennetts Pier (2.6 km)							
Density of HSC, Crabs/m	0.06	2.03	3.99	4.11	6.36	8.66	
Estimated Number of HSC	156	5,278	10,374	10,686	16,536	22,516	82,784
South Bowers (2.3 km)							
Density of HSC, Crabs/m	5.10	6.61	6.45	0.99	1.59	cancelled	
Estimated Number of HSC	11,730	15,203	14,835	2,277	3,657	cancelled	76,866
North Bowers* (1.3 km)							
Density of HSC, Crabs/m	4.15	10.74	8.30	3.45	4.37	3.80	
Estimated Number of HSC	5,395	13,962	10,790	4,485	5,681	4,940	70,915
Kitts Hummock* (1.0 km)							
Density of HSC, Crabs/m	15.83	22.84	19.23	2.87	9.07	8.23	
Estimated Number of HSC	15,830	22,840	19,230	2,870	9,070	8,230	108,140
Pickering (1 km)							
Density of HSC, Crabs/m	2.79	15.93	9.74	9.70	1.21	4.62	
Estimated Number of HSC	2,790	15,930	9,740	9,700	1,210	4,620	80,630
Woodland* (0.5 km)							
Density of HSC, Crabs/m	0.00	0.12	0.12	0.02	0.02	0.00	
Estimated Number of HSC	0	60	60	10	10	0	375
Totals	74,071	197,203	135,499	42,243	56,299	63,706	871,375
Moon Phase	Full -2	Full	Full +2	New -2	New	New +2	Totals

* Beaches Surveyed Every Year

Figure 1. Spawning Estimates During the 2001 Survey

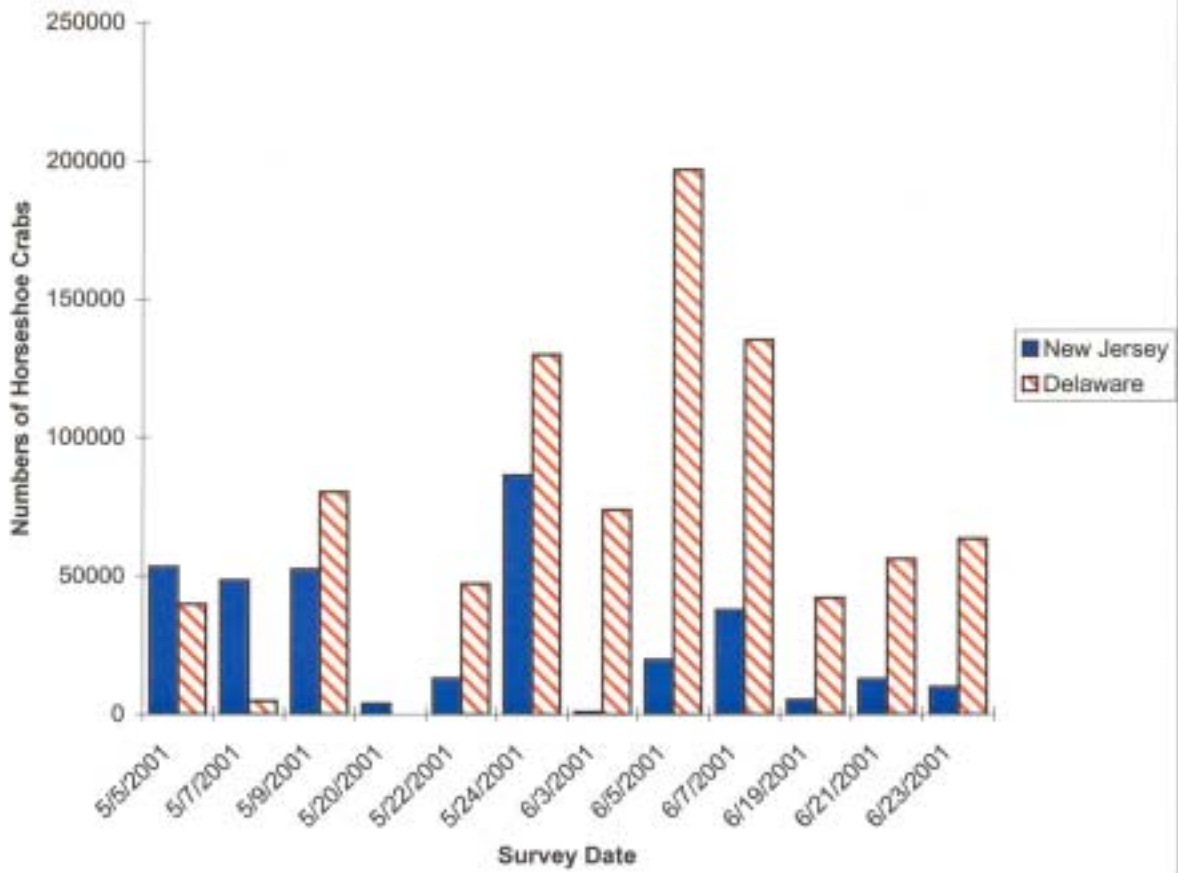


Figure 2. Horseshoe Crab Estimates 1996-2001

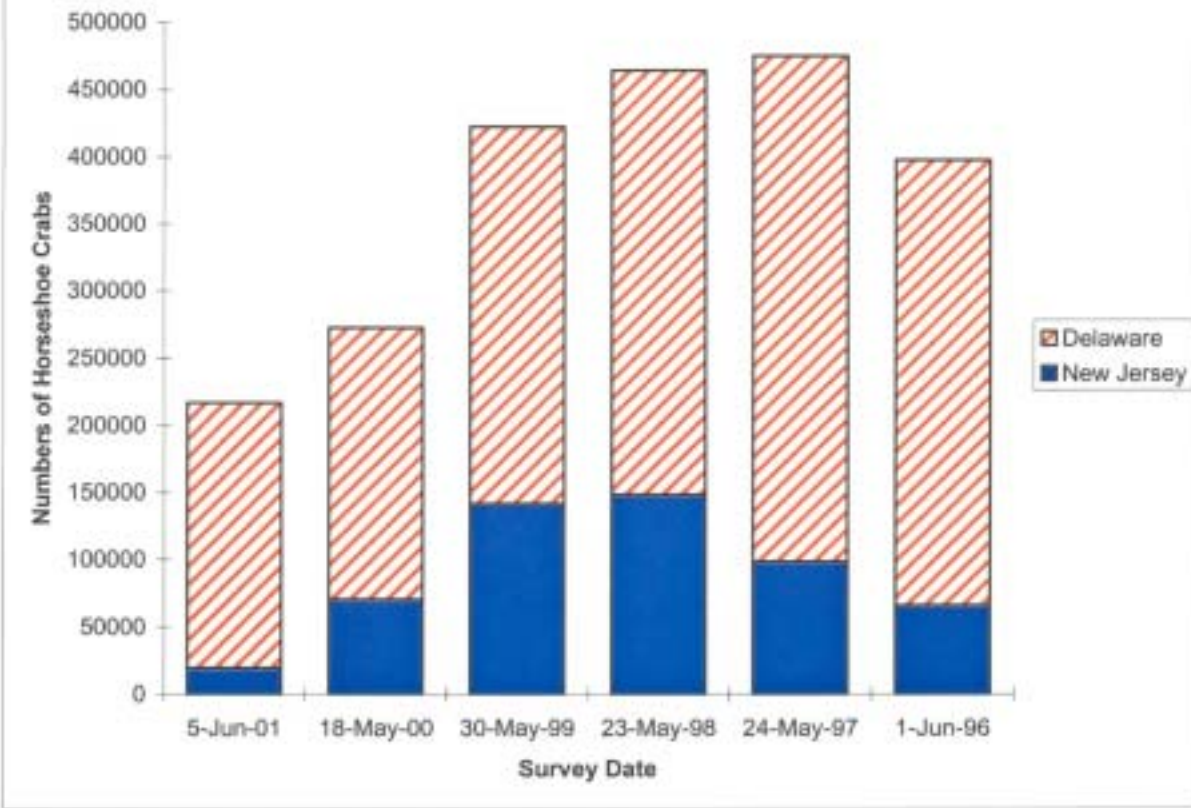


Figure 2. Yearly Estimates of Spawning Horseshoe Crabs Along Delaware Bay Shores

