# The 2005 Delaware Bay Horseshoe Crab Spawning Survey

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## Abstract

This year (2005) marks the fifteenth year of the annual horseshoe crab survey and of the fifteen, the last six (1999-2005) employ the currently accepted survey methodology. The hallmark of the program is its use of well over 100 volunteers sampling within the Delaware Bay on twelve moon phase correlated dates in May and June. In 2005, 24 beaches (13 in Delaware and 11 in New Jersey) were sampled. Hazardous weather conditions (lightning and/or beach accessibility due to tidal flooding) limited sampling to 82% of all beaches for all nights. Counts were severely hindered on May 7, 25 and June 6 due to high winds and flooding of access roads leading to beaches. Such conditions also negatively impact spawning as spawning crabs avoid wave impact on beaches thus temporarily halting most, if not all, spawning for the period. Due to early and on going poor weather and cold water conditions in May, the authors believe peak spawning was delayed until the June 6$^{th}$ new moon cycle period.

The highest single peak day for the Bay, the June 8th count, was 527,520. This is the first time since inception that both sides of the bay peaked on the same day. While Delaware's single peak day represents the highest since 1999, the overall seasonal estimate was the lowest since 1999. For New Jersey, not only was the peak the same day but also the total seasonal population reached a new high since the 1999 inception of the new methodology. It should be noted the male to female ratio for the 2005 survey of 3.89 was greatest since the new methodology was employed. However, the sex ratios did vary drastically from beach to beach. Total season count for 2005 was 1,307,429.

## Introduction

The original survey as initiated in 1990 has gone through numerous technique modifications that typically reflected perceived needs to overcome concerns of specific sample size per linear foot and sample number per beach. Since 1999, measurement techniques such as sample size and sample numbers have been stable allowing for consistent and reliable data and now the survey is considered to be the best method for estimation of the spawning population of horseshoe crabs. The techniques and methodologies employed can be found at the following website:

http://www.ocean.udel.edu/mas/bhall/hsccensus/index.html#2005survey

The site not only includes the methodology but also information on how to volunteer and past annual spawning reports.

## Methods

Horseshoe crabs were enumerated in the months of May and June 2005 along the shores of the Delaware Bay. The beaches represented in this year's count totaled 24 (13 along the state of Delaware's coast and 11 along the Delaware Bay coast of New Jersey). The Delaware beaches north to south were Woodland, Pickering, Kitts Hummock, Ted Harvey Wildlife Management Area, North Bowers, South Bowers, Bennett's Pier, Big Stone, Slaughter, Fowler, Primehook, Broadkill and Cape Henlopen. New Jersey beaches included Sea Breeze, Fortescue, Gandys, Reeds, Pierces Point, Highs, South Cape Shore Lab, Norburys Landing, Villas, North Cape May and Higbees Beach.

Counts were taken simultaneously along the beaches at the high tides encompassing the new and full moons. The dates were May 6th, 8th, 10th, 21st, 23rd, 25th, and June 4th, 6th, 8th, 19th, 21st and 23rd. High tide times ranged from 7:04 pm to 10:51 pm with time adjustments for tidal flow entering the Bay.

## Results

Coverage by the volunteers accounted for 82% or 235 of the entire 288 scheduled counts. In New Jersey, 28 dates were missed with eight dates of these due to volunteer no-shows, 4 due to weather and 16 due to flooding. Eight of the cancellations due to flooding occurred at Gandys beach. The other cancellations due to weather were May 6th at North Cape May and Villas and May 25th at North Cape May, Villas, Norburys Landing, South CSL and Reeds Beach. The access road to Sea Breeze was flooded May 23rd preventing the count to be performed. (See Table 1A)

Twenty five cancellations occurred in Delaware during the dates of May 6th, May 25th and June 6th. Of these, 14 were canceled due to weather and 11 for no access on many beaches. Counts were not able to be performed at Cape Henlopen, Broadkill, Fowler, Slaughter, Big Stone, Bennetts Pier, South Bowers, North Bowers and Kitts Hummock on May 6th and again May 25th at Cape Henlopen, Fowler, Slaughter, Big Stone, Bennetts Pier, South Bowers and Woodland. Weather impeded counting June 6th on many of the same beaches, Fowler, Slaughter, Bennetts, South Bowers, North Bowers, Ted Harvey WMA, Kitts Hummock, Pickering and Woodland beaches. (See Table 1B)

This year's survey began with a Northeaster storm that canceled 11 counts on May 6th due to the high water. Brave volunteers that were able to get to the beach saw very few animals (11 beaches had zero crabs). On the next round of counts, May 21st and 23rd, small groups were observed on many of the beaches with totals in New Jersey numbering 93,719 and in Delaware 75, 857. High water again on May 25th count prevented counting on 12 beaches (12 cancellations). (See Table 1 and Figure 1)

The date of June 8th (2 days after the new moon) produced the greatest spawning activity with 527,520 individuals estimated. Delaware spawners were calculated to be 305,352 on this date and New Jersey spawners 222,168. Both estimates were the highest estimates for a single night during the season. (See Table 1 and Figure 1)

Spawning activity for the season was at its peak during the dates surrounding the new moon in early June with the peak spawning occurring on June 8th. During this lunar phase, 68% of the total spawners during the entire season were estimated (892,616/1,307,429). Numbers in late June dropped off considerably with Delaware numbers at 140,703 and New Jersey spawners at 40,366. (See Table 1 and Figure 1)

Spawning along the New Jersey shoreline was greatest during the early June dates of June 4th, June 6th and June 8th. Seventy-two percent of the seasonal estimate for New Jersey was observed during this time. The highest spawning count was June 8th, two days after the new moon date frame. Spawning activity for the overall season was greatest at South Cape Shore Lab (153,978 individuals), followed by Norburys Landing (103,980) and Villas (95,508). The highest densities recorded were 23.87 crabs per meter on South Cape Shore Lab beach, 19.57 crabs at Norburys Landing and 18.08 crabs per meter on Highs Beach. These densities were achieved on June 8th. (See Table 1A)

In Delaware, 66% of the estimated numbers of spawners were observed during the new moon counts of June 4th, June 6th and June 8th. The highest seasonal activity occurred on Big Stone beach and was estimated to be 192,650. The other top estimates were considerably lower (South Bowers at 82,984, Bennetts Pier at 79,612, Slaughter at 78,480 and Pickering at 74,710). The greatest densities were occurred at Pickering Beach with 22.67 crabs per meter and at Kitts Hummock with 21.65. (See Table 1B)

The 2005 male to female ratio of 3.89 (4.13 in New Jersey and 3.71 in Delaware) was higher than the 1999-2004 ratios of 3.72, 3.67, 3.38, 3.48, 3.61, 3.85 respectively. The above sex ratios are computed by averaging the total number of males and females counted throughout the entire season. This ratio ranged from 1 male per female at Woodland Beach (a total of 5 males and 5 females were observed for the season) to a high seasonal ratio of 5.78 at South Bowers beach in Delaware. In New Jersey, the average seasonal ratio ranged from 2.5 at North Cape May to 4.92 at Pierces Point.

We employ four levels of spawning activity. No spawning activity = 0 crabs, low activity = less than 5 crabs per meter, moderate = 5-10 crabs per meter and high activity = greater than 10 crabs per meter) were used to categorize the densities for each count. Data was analyzed in percentages since the number of dates and/or beaches may change yearly. As in previous years, the majority of the dates surveyed (51% in DE and 48% in NJ) showed horseshoe crab densities lower than five crabs per meter. In New Jersey, the percentage of densities greater than 10 crabs per meter was the highest of the past years 2001-2004. (See Table 3 and Figure 3)

Forty one dates (14%) with zero crabs noted were in the beginning of the season May 6th and 8th in both New Jersey (11) and Delaware (8). The June 19th date in Delaware resulted in seven more dates with zero crabs. Woodland, the most northern site surveyed in Delaware contributed to 9 of the total 22 Delaware dates with zero crabs. The majority of the dates containing moderate to high densities of horseshoe crabs were observed in the three days surrounding the new moon phase in June when peak spawning was achieved.

## Discussion

This year produced intermittent spawning with counts on three dates May 6th, May 25th and June 6th adversely affected by weather conditions. The tides coupled with windy conditions produced flooding upon access roads and leaving little if any area to safely count the horseshoe crabs. Weather conditions adversely affected the spawning activity surrounding the new moon and full moon dates in May. This occurrence delayed the spawning activity and may have created the enhanced activity on June 8th. The June 8th date produced a record peak estimate of spawning individuals.

However, overall spawning numbers during the entire season were consistent with prior years. The Delaware side of the Bay for many years has contained greater numbers of horseshoe crabs during the peak counts (Table 2 and Figure 2) and seasonal activity (Table 4 and Figure 4). Interestingly this year, Delaware's overall spawning numbers were decreased to the same extent New Jersey individuals were increased (Table 4 and Figure 4). The inclement weather may have shifted the spatial distribution of horseshoe crabs to the New Jersey shores of Delaware Bay.

## Acknowledgements

Our sincere thanks once again to all the volunteers. The survey is an important undertaking that is shared by all and we truly thank you for your donation of time and energy. The States of New Jersey and Delaware deserve our thanks as well for their monetary and labor contributions. Of course, a big thank you to Dave Smith for his statistical guidance and adding the extra incentive of observing a tagged animal.

## Table 1. 2005 Survey Results - Densities and Estimates
## A. New Jersey Beaches (2 pages)

| Moon Phase | New -2 | New | New +2 | Full -2 | Full | Full +2 | Moon Phase | New -2 | New | New +2 | Full -2 | Full | Full +2 | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **6-May** | **8-May** | **10-May** | **21-May** | **23-May** | **25-May** | **Date** | **4-Jun** | **6-Jun** | **8-Jun** | **19-Jun** | **21-Jun** | **23-Jun** | |
| **Higbees Beach (0.98 km)** | | | | | | | **Higbees Beach (0.98 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.00 | 0.00 | 0.02 | 0.10 | 0.01 | Density of HSC, Crabs/m | 0.51 | no survey | 3.46 | no survey | 0.04 | no survey | |
| Estimated Number of HSC | 0 | 0 | 0 | 20 | 98 | 10 | Estimated Number of HSC | 500 | no show | 3,391 | no show | 39 | no show | 4,057 |
| **North Cape May* (3 km)** | | | | | | | **North Cape May* (3 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.00 | 0.04 | 0.00 | 0.17 | canceled | Density of HSC, Crabs/m | 0.10 | 0.66 | 3.34 | 0.00 | 0.10 | 0.66 | |
| Estimated Number of HSC | flooded | 0 | 120 | 0 | 510 | flooded | Estimated Number of HSC | 300 | 1,980 | 10,020 | 0 | 300 | 1,980 | 15,210 |
| **Villas (2.8 km)** | | | | | | | **Villas (2.8 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.00 | 0.01 | 0.14 | 1.97 | canceled | Density of HSC, Crabs/m | 5.66 | 10.66 | 11.17 | 0.63 | 1.60 | 2.27 | |
| Estimated Number of HSC | flooded | 0 | 28 | 392 | 5,516 | flooded | Estimated Number of HSC | 15,848 | 29,848 | 31,276 | 1,764 | 4,480 | 6,356 | 95,508 |
| **Norburys Landing (2.43 km)** | | | | | | | **Norburys Landing (2.43 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.14 | 0.33 | no survey | 5.57 | canceled | Density of HSC, Crabs/m | 4.41 | 11.66 | 19.57 | 0.04 | 0.46 | 0.61 | |
| Estimated Number of HSC | 0 | 340 | 802 | no show | 13,535 | flooded | Estimated Number of HSC | 10,716 | 28,334 | 47,555 | 97 | 1,118 | 1,482 | 103,980 |
| **South CSL* (2.2 km)** | | | | | | | **South CSL* (2.2 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 1.19 | 4.95 | 2.72 | 13.06 | canceled | Density of HSC, Crabs/m | 7.41 | 14.15 | 23.87 | 0.07 | 1.35 | 1.22 | |
| Estimated Number of HSC | 0 | 2,618 | 10,890 | 5,984 | 28,732 | flooded | Estimated Number of HSC | 16,302 | 31,130 | 52,514 | 154 | 2,970 | 2,684 | 153,978 |
| **Highs* (0.8 km)** | | | | | | | **Highs* (0.8 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.41 | 5.82 | 2.20 | 13.58 | 0.39 | Density of HSC, Crabs/m | 6.28 | 6.67 | 18.08 | 0.00 | 0.08 | 0.07 | |
| Estimated Number of HSC | 0 | 328 | 4,656 | 1,760 | 10,864 | 312 | Estimated Number of HSC | 5,024 | 5,336 | 14,464 | 0 | 64 | 56 | 42,864 |
| **Pierces Point (0.7 km)** | | | | | | | **Pierces Point (0.7 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.01 | 0.65 | 3.20 | 2.33 | 2.22 | 1.95 | Density of HSC, Crabs/m | 10.35 | canceled | canceled | 18.47 | 0.10 | 0.18 | |
| Estimated Number of HSC | 7 | 455 | 2,240 | 1,631 | 1,554 | 1,365 | Estimated Number of HSC | 7,245 | weather | weather | 12,929 | 70 | 126 | 27,622 |
| **Reeds* (1.53 km)** | | | | | | | **Reeds* (1.53 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.00 | 0.75 | 0.04 | 2.74 | canceled | Density of HSC, Crabs/m | 0.25 | 3.00 | 6.12 | 0.00 | 0.00 | 0.04 | |
| Estimated Number of HSC | 0 | 0 | 1,148 | 61 | 4,192 | flooded | Estimated Number of HSC | 383 | 4,590 | 9,364 | 0 | 0 | 61 | 19,798 |
| **Gandys* (1.2 km)** | | | | | | | **Gandys* (1.2 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.05 | canceled | canceled | canceled | canceled | canceled | Density of HSC, Crabs/m | 0.72 | canceled | 15.62 | canceled | canceled | canceled | |

* Beaches Surveyed Every Year

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## Table 1. 2005 Survey Results - Densities and Estimates
## A. New Jersey Beaches (2 pages)


| Estimated Number of HSC | 60 | flooded | flooded | flooded | flooded | flooded | Estimated Number of HSC | 864 | weather | 18,744 | flooded | flooded | flooded | 19,668 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fortescue (2.6 km)** | | | | | | | **Fortescue (2.6 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.01 | 0.11 | 0.57 | 3.68 | 0.69 | Density of HSC, Crabs/m | 3.73 | canceled | 13.40 | 0.22 | 0.52 | 0.48 | |
| Estimated Number of HSC | 0 | 26 | 286 | 1,482 | 9,568 | 1,794 | Estimated Number of HSC | 9,698 | weather | 34,840 | 572 | 1,352 | 1,248 | 60,866 |
| **Sea Breeze* (1.65 km)** | | | | | | | **Sea Breeze* (1.65 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | no survey | no survey | 0.00 | canceled | 2.63 | Density of HSC, Crabs/m | no survey | 5.82 | 0.00 | 0.25 | 0.03 | no survey | |
| Estimated Number of HSC | 0 | no show | no show | 0 | flooded | 4,340 | Estimated Number of HSC | no show | 9,603 | 0 | 413 | 50 | no show | 14,405 |
| **Totals** | **67** | **3,767** | **20,169** | **11,330** | **74,569** | **7,820** | **Totals** | **66,880** | **110,821** | **222,168** | **15,929** | **10,443** | **13,994** | **557,956** |
| Moon Phase | New -2 | New | New +2 | Full -2 | Full | Full +2 | Moon Phase | New -2 | New | New +2 | Full -2 | Full | Full +2 | **Totals** |


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## Table 1. 2005 Survey Results - Densities and Estimates

**B. Delaware Beaches (2 pages)** * Beaches Surveyed Every year

| Moon Phase | New -2 | New | New +2 | Full -2 | Full | Full +2 | Moon Phase | New -2 | New | New +2 | Full -2 | Full | Full +2 | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **6-May** | **8-May** | **10-May** | **21-May** | **23-May** | **25-May** | **Date** | **4-Jun** | **6-Jun** | **8-Jun** | **19-Jun** | **21-Jun** | **23-Jun** | |
| **Cape Henlopen (1.5 km)** | | | | | | | **Cape Henlopen (1.5 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.02 | 0.06 | 0.06 | 0.81 | canceled | Density of HSC, Crabs/m | 2.40 | 1.50 | 6.97 | 0.05 | 0.54 | 1.00 | |
| Estimated Number of HSC | no access | 30 | 90 | 90 | 1,215 | no access | Estimated Number of HSC | 3,600 | 2,250 | 10,455 | 75 | 810 | 1,500 | 20,115 |
| | | | | | | | | | | | | | | |
| **Broadkill (1.5 km)** | | | | | | | **Broadkill (1.5 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.05 | 0.07 | 0.11 | 0.01 | 0.21 | Density of HSC, Crabs/m | 0.01 | 5.23 | 0.13 | 0.00 | 0.40 | 1.11 | |
| Estimated Number of HSC | weather | 75 | 105 | 165 | 15 | 315 | Estimated Number of HSC | 15 | 7,845 | 195 | 0 | 600 | 1,665 | 10,995 |
| | | | | | | | | | | | | | | |
| **Primehook* (2.0 km)** | | | | | | | **Primehook* (2.0 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.00 | 0.10 | 0.39 | 2.79 | 0.04 | Density of HSC, Crabs/m | 3.39 | 7.54 | 8.96 | 0.03 | 0.45 | 2.21 | |
| Estimated Number of HSC | 0 | 0 | 200 | 780 | 5,580 | 80 | Estimated Number of HSC | 6,780 | 15,080 | 17,920 | 60 | 900 | 4,420 | 51,800 |
| | | | | | | | | | | | | | | |
| **Fowler* (3 km)** | | | | | | | **Fowler* (3 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.08 | 0.01 | 0.02 | 0.13 | canceled | Density of HSC, Crabs/m | 1.44 | canceled | 4.58 | 0.03 | 0.11 | 1.02 | |
| Estimated Number of HSC | weather | 225 | 30 | 60 | 390 | weather | Estimated Number of HSC | 4,320 | weather | 13,740 | 90 | 330 | 3,060 | 22,245 |
| | | | | | | | | | | | | | | |
| **Slaughter (3 km)** | | | | | | | **Slaughter (3 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.43 | 0.54 | 0.14 | 0.62 | canceled | Density of HSC, Crabs/m | 3.62 | canceled | 15.10 | 0.04 | 0.63 | 5.04 | |
| Estimated Number of HSC | no access | 1,290 | 1,620 | 420 | 1,860 | no access | Estimated Number of HSC | 10,860 | weather | 45,300 | 120 | 1,890 | 15,120 | 78,480 |
| | | | | | | | | | | | | | | |
| **Big Stone* (5.0 km)** | | | | | | | **Big Stone* (5.0 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.44 | 4.25 | 0.00 | 0.04 | canceled | Density of HSC, Crabs/m | 0.69 | 12.87 | 14.73 | 0.05 | 4.60 | 0.86 | |
| Estimated Number of HSC | weather | 2,200 | 21,250 | 0 | 200 | no access | Estimated Number of HSC | 3,450 | 64,350 | 73,650 | 250 | 23,000 | 4,300 | 192,650 |
| | | | | | | | | | | | | | | |
| **Bennetts Pier (2.6 km)** | | | | | | | **Bennetts Pier (2.6 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.00 | 0.16 | 0.05 | 5.23 | canceled | Density of HSC, Crabs/m | 3.24 | canceled | 9.20 | 0.00 | 8.25 | 4.49 | |
| Estimated Number of HSC | no access | 0 | 416 | 130 | 13,598 | no access | Estimated Number of HSC | 8,424 | weather | 23,920 | 0 | 21,450 | 11,674 | 79,612 |
| | | | | | | | | | | | | | | |
| **South Bowers (2.3 km)** | | | | | | | **South Bowers (2.3 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.37 | 0.92 | 2.54 | 5.07 | canceled | Density of HSC, Crabs/m | 5.80 | canceled | 17.59 | 0.23 | 2.26 | 1.30 | |
| Estimated Number of HSC | no access | 851 | 2,116 | 5,842 | 11,661 | no access | Estimated Number of HSC | 13,340 | weather | 40,457 | 529 | 5,198 | 2,990 | 82,984 |
| | | | | | | | | | | | | | | |
| **North Bowers* (1.3 km)** | | | | | | | **North Bowers* (1.3 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.48 | 3.58 | 0.98 | 5.28 | 0.06 | Density of HSC, Crabs/m | 8.07 | canceled | 13.45 | 0.00 | 0.78 | 0.76 | |
| Estimated Number of HSC | weather | 624 | 4,654 | 1,274 | 6,864 | 78 | Estimated Number of HSC | 10,491 | weather | 17,485 | 0 | 1,014 | 988 | 43,472 |
| | | | | | | | | | | | | | | |
| **Ted Harvey WMA (1.0 km)** | | | | | | | **Ted Harvey WMA (1.0 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.04 | 2.23 | 0.15 | 1.97 | 0.08 | Density of HSC, Crabs/m | 10.54 | canceled | 17.86 | 0.00 | 4.20 | 6.15 | |


## Table 1. 2005 Survey Results - Densities and Estimates

**B. Delaware Beaches (2 pages)** * Beaches Surveyed Every year


| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estimated Number of HSC | 0 | 40 | 2,230 | 150 | 1,970 | 80 | Estimated Number of HSC | 10,540 | weather | 17,860 | 0 | 4,200 | 6,150 | 43,220 |
| | | | | | | | | | | | | | | |
| **Kitts Hummock* (1.0 km)** | | | | | | | **Kitts Hummock* (1.0 km)** | | | | | | | |
| Density of HSC, Crabs/m | canceled | 0.00 | 0.30 | 0.51 | 2.32 | 0.20 | Density of HSC, Crabs/m | 10.92 | canceled | 21.65 | 0.00 | 7.62 | 5.62 | |
| Estimated Number of HSC | weather | 0 | 300 | 510 | 2,320 | 200 | Estimated Number of HSC | 10,920 | weather | 21,650 | 0 | 7,620 | 5,620 | 49,140 |
| | | | | | | | | | | | | | | |
| **Pickering (1 km)** | | | | | | | **Pickering (1 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.16 | 1.66 | 7.54 | 12.05 | 0.42 | Density of HSC, Crabs/m | 15.13 | canceled | 22.67 | 0.00 | 7.06 | 8.02 | |
| Estimated Number of HSC | 0 | 160 | 1,660 | 7,540 | 12,050 | 420 | Estimated Number of HSC | 15,130 | weather | 22,670 | 0 | 7,060 | 8,020 | 74,710 |
| | | | | | | | | | | | | | | |
| **Woodland* (0.5 km)** | | | | | | | **Woodland* (0.5 km)** | | | | | | | |
| Density of HSC, Crabs/m | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | canceled | Density of HSC, Crabs/m | 0.00 | canceled | 0.10 | 0.00 | 0.00 | 0.00 | |
| Estimated Number of HSC | 0 | 0 | 0 | 0 | 0 | no access | Estimated Number of HSC | 0 | no access | 50 | 0 | 0 | 0 | 50 |
| **Totals** | **0** | **5,495** | **34,671** | **16,961** | **57,723** | **1,173** | **Totals** | **97,870** | **89,525** | **305,352** | **1,124** | **74,072** | **65,507** | **749,473** |

**Table 2. Comparison of Data on Horseshoe Crabs Spawning on Delaware Bay Shores**
**Years 1997-2005**

| | 8-Jun-05 | 21-May-04 | 14-Jun-03 | 28-May-02 | 5-Jun-01 | 18-May-00 | 30-May-99 | 23-May-98 | 24-May-97 |
|---|---|---|---|---|---|---|---|---|---|
| **Estimated Number of HSC PM Tide** | 527,520 | 356,739 | 259,957 | 333,553 | 216,929 | 272,770 | 422,775 | 464,934 | 475,810 |
| **Estimated Number of HSC (PM) -NJ** | 222,168 | 105,973 | 60,272 | 130,164 | 19,726 | 70,293 | 141,720 | 148,444 | 98,487 |
| **Estimated Number of HSC (PM) -DE** | 305,352 | 250,766 | 199,685 | 203,389 | 197,203 | 202,477 | 281,055 | 316,490 | 377,323 |
| **Beaches Surveyed in Delaware** | 13 | 13 | 13 | 13 | 13 | 11 | 9 | 7 | 7 |
| **Beaches Surveyed in New Jersey** | 11 | 11 | 10 | 10 | 10 | 11 | 13 | 12 | 12 |
| **Main Spawning Beaches in DE** | Big Stone | Slaughter | Slaughter | S. Bowers | Slaughter | Slaughter | Slaughter | Slaughter | Slaughter |
| | S. Bowers | Big Stone | Big Stone | Slaughter | Big Stone | Big Stone | Big Stone | Big Stone | Big Stone |
| | Bennetts | Pickering | Pickering | Big Stone | | | | | |
| | Slaughter | | Ted Harvey | Pickering | | | | | |
| | Pickering | | | | | | | | |
| **Main Spawning Beaches in NJ** | South CSL | South CSL | South CSL | South CSL | South CSL | South CSL | Townbank | South CSL | Norburys |
| | Norburys | Fortescue | Fortescue | Gandys | | | Norburys | Reeds | South CSL |
| | Villas | Norburys | Norburys | Sea Breeze | | | South CSL | Cooks | |

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**Figure 1. NJ and DE Spawning Estimates During 2005 Survey**

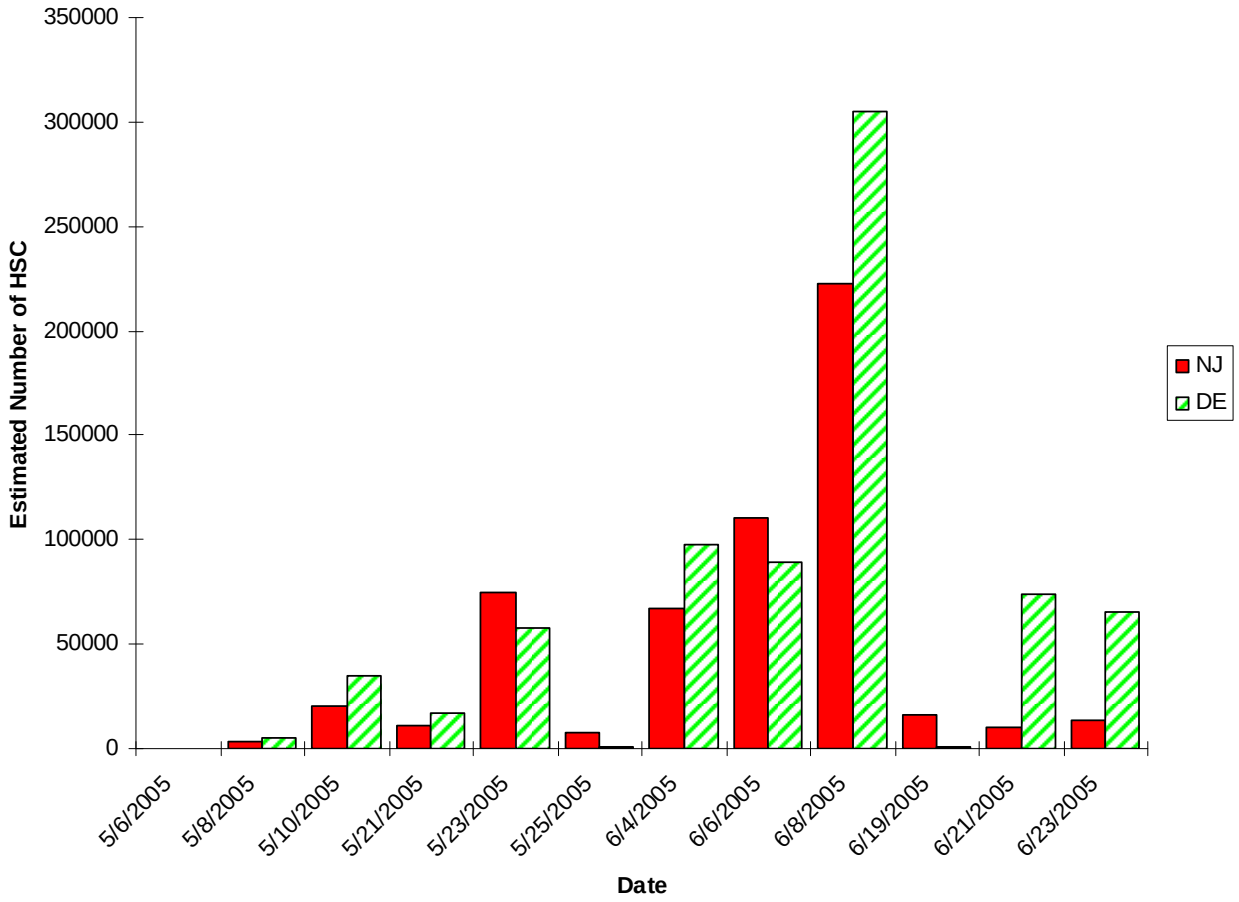
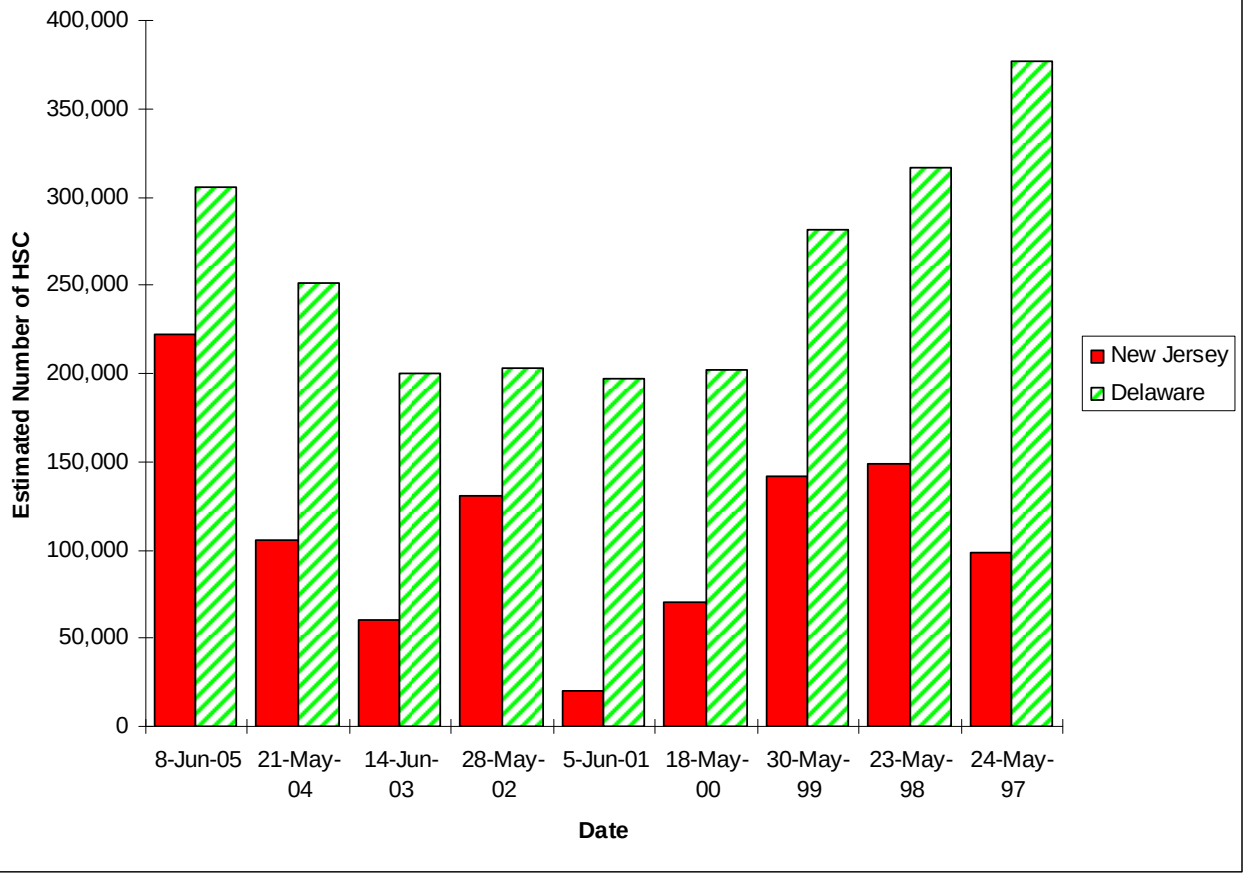
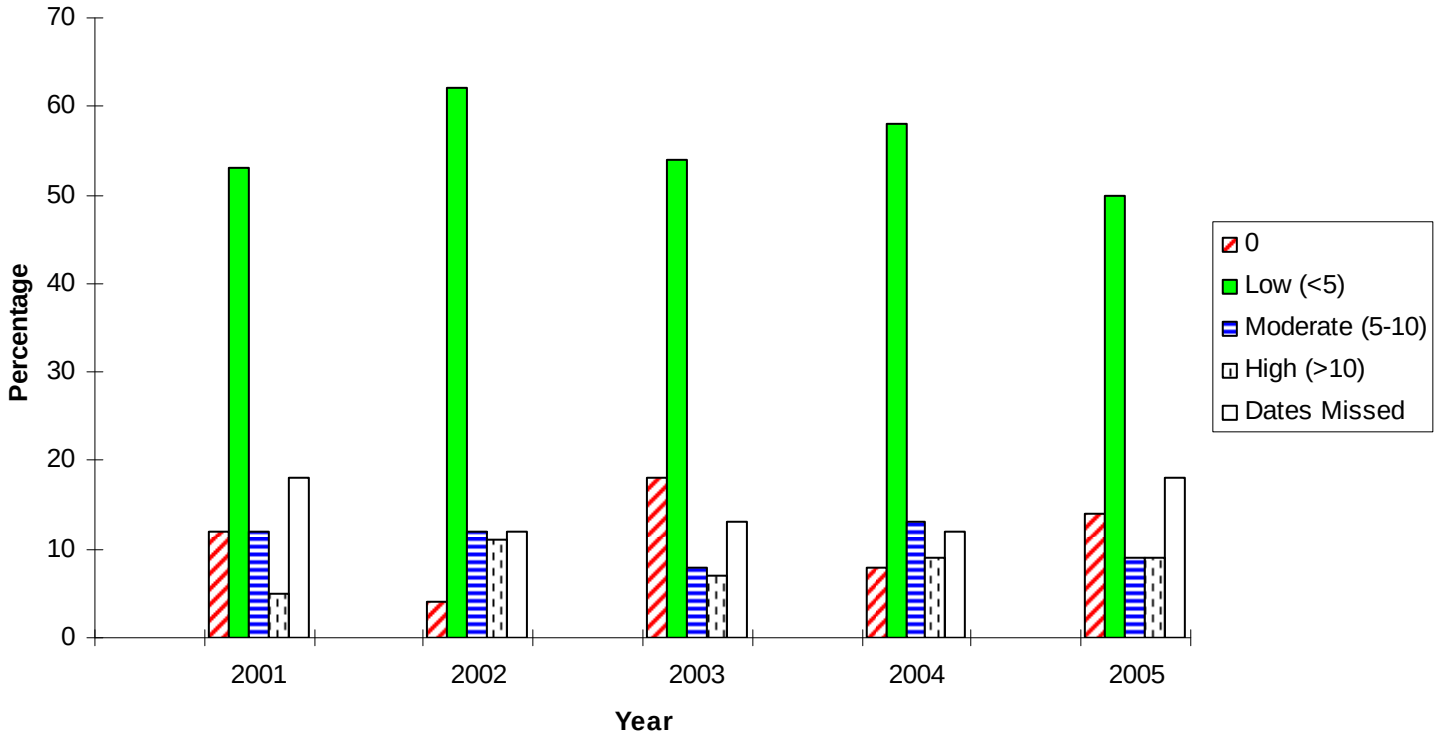



**Figure 2. Peak Estimates of Spawning Horseshoe Crabs 1997-2005**



## Figure 3. Densities of Horseshoe Crabs 2001-2005




## Figure 4. Seasonal Estimates of Spawning Horseshoe Crabs