The 2004 Delaware Bay Horseshoe Crab Spawning Survey

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Abstract

The start of the 15th Delaware Bay Horseshoe Crab Spawning survey (May 2004) had volunteers counting numerous horseshoe crabs on many survey beaches (13 in Delaware and 11 in New Jersey). Counting was conducted on 12 dates surrounding the full and new moon phases in May and June with 12.1% of the scheduled surveys forfeited, primarily weather related.

Early spawning activity was enhanced by calm, mild weather throughout the month of May with four times as many spawning individuals estimated than in June. May 21st revealed our peak numbers of 356,739 spawners (250,766 in Delaware and 105,973 in New Jersey). This peak was an increase over the years 2000-2003. The six survey dates in June showed decreased numbers of 276,184 individuals estimated along the Delaware Bay shoreline. Total population comparisons (12 nights) between 2003 and 2004, 1,206,521 and 1,493,033 respectively, clearly show an increase of 286,512. However this increase is attributed to increased number of males in 2004.

As noted, much of this increase in total numbers appears to be additional males on the beaches as the ratio of males to females increased for 2004. The calmness of Delaware Bay waters in May may have contributed to a high male to female ratio of 3.85 (4.01 in New Jersey and 3.76 in Delaware). This seasonal average is greater than ratios from the years 1999-2003 of 3.72, 3.67, 3.38, 3.48, 3.61 respectively. Sex ratios along the shoreline vary considerably from beach to beach, day to day and are extremely affected by the weather as increased wave height cause males to avoid beaches. It should noted that while the total number of animals did increase in the count, the actual spawning activity has decreased slightly as stated in the report to the Atlantic States Marine Fisheries Commission.

Introduction

Fifteen years ago, the enumeration of horseshoe crabs along the Delaware Bayshore began. Over the years the survey was continuously refined to reach its present methodology which has been in place for six years. This survey has made tremendous progress and is presently recognized as the best method utilized to estimate the spawning populations of this critical species. The continuation of the census relies on the assistance of many groups and volunteers who rigorously count the crabs under the cover of darkness and often trying weather conditions.

Methods

Horseshoe crabs were enumerated in the months of May and June 2004 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, Bennetts Pier, Big Stone, Slaughter, Fowler, Primehook, Broadkill and Cape Henlopen. New Jersey beaches included Sea Breeze, Fortescue, Gandys, Reeds, Kimbles, Pierces Point, Highs, South Cape Shore Lab, Norburys Landing, Townbank and North Cape May.

Counts were taken simultaneously along the beaches at the high tides encompassing the new and full moons. The dates were May 2nd, 4th, 6th, 17th, 19th, 21st, and June 1st, 3rd, 5th, 15th, 17th and 19th. High tide times ranged from 7:40 pm to 11:33 pm which necessitated some volunteers, along the northern beaches, counting in the wee am hours as a result of the time adjustments for tidal flow entering the Bay. All counts are initiated with the start of ebb tide.

Results

The date of May 21st (2 days after the new moon) produced the greatest spawning activity with 356,739 individuals estimated. Delaware spawners were calculated to be 250,766 on this date, which was Delaware's highest estimate for a single night during the season. New Jersey animals were estimated to be 105,973. However, the highest estimate for New Jersey was 146,356 individuals on May 19th, the new moon date. Table 1 and Figure 1.

The beginning of the survey counts coincided with the start of the horseshoe crab spawning activity. Calm and mild days in May 2004 created ideal weather for beach access by the spawners with four times as many spawning than estimated in June. Early May dates (2nd, 4th and 6th) produced moderate spawning activity (256,677 spawners during the three nights). By far, the greatest spawning numbers were achieved surrounding the new moon date with numbers in both New Jersey and Delaware remaining consistently high May 17th, 19th and 21st (960,171). Spawning then dropped off considerably in June with both the new moon dates and the full moon dates producing low numbers of spawners (125,649 and 150,535, Table 1 and Figure 1). Spawning along the New Jersey shoreline during early May was concentrated predominately on the middle beaches, South Cape Shore Lab, Highs Beach and Pierces Point. Good spawning activity was observed on all the New Jersey beaches during the three dates surrounding the new moon, May 17th, 19th and 21st with 81,109, 146,356 and 105,973 estimated spawners respectively. Spawning activity for the overall season was greatest at South Cape Shore Lab (132,044 individuals), followed by Fortescue (78,962). The highest densities showed 16.37 crabs per meter on South Cape Shore Lab beach noted on the May 21st date and 15.78 crabs per meter on Highs Beach on May 17th. (Table 1 A).

In Delaware, the May 2nd and 4th dates revealed the most concentrated activity at the Ted Harvey Wildlife Management Area (WMA) and Slaughter beach. By May 6th, higher spawning densities were found on additional Delaware beaches with peak spawning numbers

reached May 21st. Spawning in June decreased greatly, with the exception of Ted Harvey WMA, Kitts Hummock and Pickering beaches that continued to have moderate density levels during June. The highest seasonal activity occurred on Slaughter beach with 259,590 individuals and Big Stone, due to its long expanse, was estimated at 196,450. Excluding June 1st and 3rd, densities at Slaughter were greater than 4.78 horseshoe crabs per meter for the entire season. The greatest densities overall were found at Pickering Beach May 17th, May 19th and May 21st of 18.82, 18.13 and 23.89 respectively. (Table 1 B).

The 2004 estimate proved higher than the previous four years (2000-2003) and was reached earlier in the season than the 2001, 2002 and 2003 estimates. Part of this can be attributed to the ideal spawning weather in May which also produced a male to female ratio of 3.85 (4.01 in New Jersey and 3.76 in Delaware). The 2004 ratio was higher than the 1999-2003 ratios of 3.72, 3.67, 3.38, 3.48, 3.61 respectively. Male to female ratios greater than these over the course of the 2004 season were found at South Cape Shore Lab, Highs Beach and Kimbles in New Jersey and Cape Henlopen, South Bowers, North Bowers and Pickering in Delaware. The above sex ratios are averages calculated from the total number of males and females counted throughout the entire season. (Sex ratios along the beach during mating are highly variable.)

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 (54% in DE and 63% in NJ) showed horseshoe crab densities lower than five crabs per meter in both New Jersey and Delaware.

The 2004 season contained 23 dates (7 dates in New Jersey and 16 dates in Delaware) with zero crabs. These New Jersey dates were in the early part of the survey at three New Jersey beaches, North Cape May, Townbank (the two most southern beaches surveyed) and Sea Breeze (the most northern beach surveyed). Woodland, the most northern site surveyed in Delaware contributed to 9 of the total 16 Delaware dates with zero crabs. In June, spawning decreased considerably with densities lower than five crabs per meter for all survey dates along New Jersey beaches. Only seven June dates in Delaware contained moderate densities of crabs. No dates in June on either the New Jersey or Delaware shoreline had more than 10 crabs per meter.

Coverage by the volunteers accounted for 87.8 % or 253 of the entire 288 scheduled counts. In New Jersey, 19 dates were missed with ten dates of these due to volunteer no-shows on May 17th and June 19th missed dates at Kimbles, May 19th at North Cape May, May 21st, June 17th and June 19th at Norburys Landing, June 5th at Pierces Point, and June 5th and June 15th at Sea Breeze. Ill volunteers were unable to count on May 17th at Pierces Point.

Nine surveys in New Jersey were canceled as a result of weather conditions. These were May 2nd and 4th and June 1st at Gandys, May 21st at Sea Breeze, June 5th at North Cape May and Townbank, June 17th at Highs beach, Kimbles and Fortescue. The reasons for the cancellations are noted in Table 1A.

In Delaware, 16 dates or 10.3% of the total number were not covered (Table 1B.). May 17th produced one survey at Bennetts Pier due to absentee volunteers and another at Broadkill for the same reason. The remaining missed dates were weather related and occurred primarily on two dates June 5th at Fowler, Slaughter, Big Stone, Bennetts Pier, South Bowers, North Bowers, Pickering and Woodland and June 17th at Cape Henlopen, Primehook, Fowler, Slaughter and South Bowers. The June 1st date at South Bowers was canceled due to no access.

Discussion

At first glance the total counts for all 24 beaches for 12 nights indicate a significant increase in numbers. The total population count of 1,493,033 is an increase of 286,512, over the 2003 total of 1,206,521. This increase is attributed to increased numbers of males on the beaches possibly due to a mild May. Females on the hand are in slight decline or stable as noted in the ASMFC report submitted by Smith and Bennett. The report further notes that Delaware Beaches, in particular, appear to have a declining spawning population, while New Jersey is stable.

This year, the survey is in the sixth year under the direction of the Atlantic States Horseshoe Crab Management Plan. Yearly improvements have concentrated on standardizing data entry and designing the appropriate statistical program. As it pertains to the 2004 data, the computer glitches have been eradicated and data entry standardized and upon entry into the computer, retrieving needed statistical information should be accomplished with ease.

Our volunteers are instructed in the importance of conducting the survey according to the guidelines. Timing is very crucial and counting the entire 100 quadrats is essential. Statistically, 100 quadrats per beach is an adequate sample to indicate spawning activity along a specific beach. A 1 kilometer beach would space two quadrats every 20 meters. Some beaches (especially in New Jersey) are less than 1 kilometer, therefore in order to achieve the count of horseshoe crabs within 100 quadrats, the quadrats are placed closer together. Beach lengths are mapped out to ensure the safety of the volunteers and access practicality and to endure sampling over time. Man-made structures (piers and bulkheads) and posted private properties are taken into account and avoided.

The majority of the beaches enabled our volunteers to count 100 quadrats within the northern and southern ends. On a few beaches, fewer quadrats were counted due to impending bad weather, flooding of the beach area or questionable starting and ending points (in the case of Townbank in the early counts). North Bowers beach in Delaware, half of the scheduled counts (May 4th, May 21st, June 1st, June 3rd June 17th and June 19th) did not contain 100 quadrats. Lowering the distance between the quadrats to achieve a full 100 quadrat count is a consideration.

Appendix

When the data was converted to a new computer format, some errors were detected. The Appendix lists the minor corrections that resulted from the findings.

Acknowledgements

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