



Project  
**Limulus**  
SHU Biology Department



## Horseshoe Crab Spawning Survey Protocol

Adopted from Cape Cod and Delaware Bay Survey Protocols

### Supplies needed for each site:

- 10.0m rope
- 3.0m rope
- Thermometer
- Pencils
- Datasheets and clipboard
- Flashlights (waterproof)
- Hip or knee boots or good water shoes

### Clothing and accessories

- Wear appropriate clothing for the weather and wet conditions at the water's edge. Consider using sunscreen during the day. If thunderstorms are present do not go onto the beach. If the surf is extremely choppy, wait until the next tidal cycle to complete the survey.
- For night surveys bring a headlamp or flashlight (preferably waterproof).
- Do not go barefoot!
- An accurate wristwatch is needed for recording start and stop times of the survey.

### SURVEY PROTOCOL

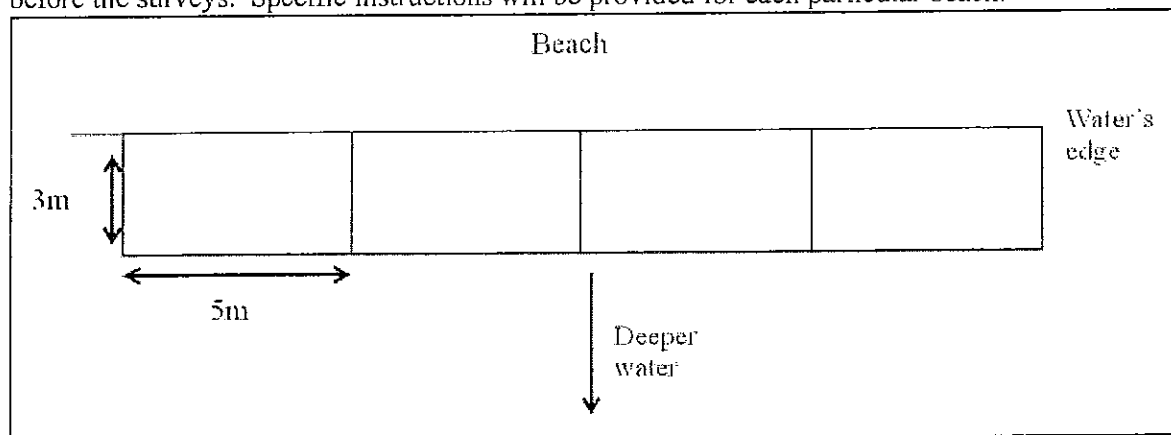
- Arrive at the beach at least 30 minutes prior to the high tide.
- Fill out the Survey Data sheet completely as possible. Even if the weather/water conditions prevents you from doing the survey, please fill out the survey sheet with all possible information and explain why the survey could not be completed.
  - Record the **Beach Name, Town, and Date.**
  - Record the **names** of the surveyors and the **group** affiliation
  - Record the **Air and Water Temperature.** For the water temperature, stick the thermometer in the water 3 meters from shore (use the yellow rope!)
  - Record the **Wind Speed and Direction:** Best guess of wind speed and direction wind is coming from.
  - Record the **Wave Height** using your best judgment (less than 6inches, 6-12 inches, or more than 1 foot)
  - Record **Precipitation** (None, Fog, Light Rain, Heavy Rain)
  - Record **Light Levels:** Full Sun, Partial Sun, Full Darkness, Moonlight
  - Record whether or not the beach is a:
    - Public Beach
    - Raked Beach
    - Evidence of recent raking

- Harvested beach
- If harvesters are present
- Record the **Survey Start Point** from coin toss. Flip a coin to decide which end of the beach section you will start. If heads, start at the south or west end of the beach; if tails, start at the north or east end of the beach.
- Finally record the **Starting Time of the Survey** (please circle AM or PM)

## Survey Protocol #1: Beaches Less than 100m in Length

You will be surveying in groups with usually 2-3 people. A survey protocol diagram (below) illustrates the placement of quadrats. You will be recording the number of horseshoe crabs within EACH 5m quadrat or block of beach. It is important to record each block so the distribution of the crabs on the beach can be known.

1) Flip a coin and go to the end of the survey beach to begin the survey depending on the results of the coin toss. The site will be either marked by a pole or described to the team members before the surveys. Specific instructions will be provided for each particular beach.



*Figure 1. Diagram outlining placement of quadrats for beaches <100m in length.*

2) Each quadrat will be a 3m X 5m block (Figure 1). Fold the 10m rope in half and lay it on the beach. This will be your 5m quadrat length. Next, the recorder should stand at the water's edge with the 3m YELLOW rope attached to their person. The counter will take the other end of the YELLOW rope attached to the PVC pole and walk out into the water until the rope is taut. Then while holding the rope taut with the pole move in a parallel fashion to the water's edge for 5 meters (the recorder should move with the counter). Count all the crabs encountered between the each end of the yellow rope.

3) Counting the horseshoe crabs in the quadrat:

- A horseshoe crab is considered 'in the quadrat' if **more than half of its body is inside the quadrat.**
- If female and male(s) are mating and the female is in the quadrat but the males are outside, consider the males in the quadrat and do not recount them in the following quadrat.

- If a female is mating and is partially buried in the sand, and you can be 90% sure she is a female (because a male is clasped on to her and she is bigger). **Leave her be and do not lift her up.**
- Report the crab count on the data sheet in the specified tables (ex. Figure 2) using tally marks in the following manner:
  - Single M's - solitary males
  - Single F's – solitary females
  - Pair - One Female and One Male
  - F+2M - One Female and Two Males
  - F+3M - One Female and Three Males
  - F+ O – Enter number of males for each encounter (i.e., 4, 6, 8, 5)

Q 1	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

*Figure 2. Example quadrat table from Survey Data Sheet*

- Report zeros (0) when there are no horseshoe crabs within the quadrat. Do not move the quadrat from the preselected quadrat location to include nearby animals. Empty quadrats are just as important as those with horseshoe crabs because they will help reflect changes in the population.
  - If you see a horseshoe crab with a tag (Tags may be yellow cinch tags at the back right or left of the carapace OR White disc tags), record the tag number on the **Recapture Sheet** provided. Be sure to write down the numbers accurately.
- 4) Once you are finished counting every crab within the block it is time to move on to the next quadrat. Start the next 5 meter counting block at the end of your first counting block. Repeat until you reach the end of the beach.
- 5) When you are finished the survey, please total the number of tally marks for each quadrat and enter the number in the total column.
- 6) Finally tag, tag, tag if you have the energy! Make sure to record the tag numbers, sex, and mate tags on the Tagging Data Sheet.

## Survey Protocol #2: Beaches Greater than 100m in Length

You will be surveying in groups with usually 2-3 people. A survey protocol diagram (Figure 3) illustrates the placement of quadrats. You will be recording the number of horseshoe crabs within EACH 5m quadrat or block of beach. It is important to record each block so the distribution of the crabs on the beach can be estimated.

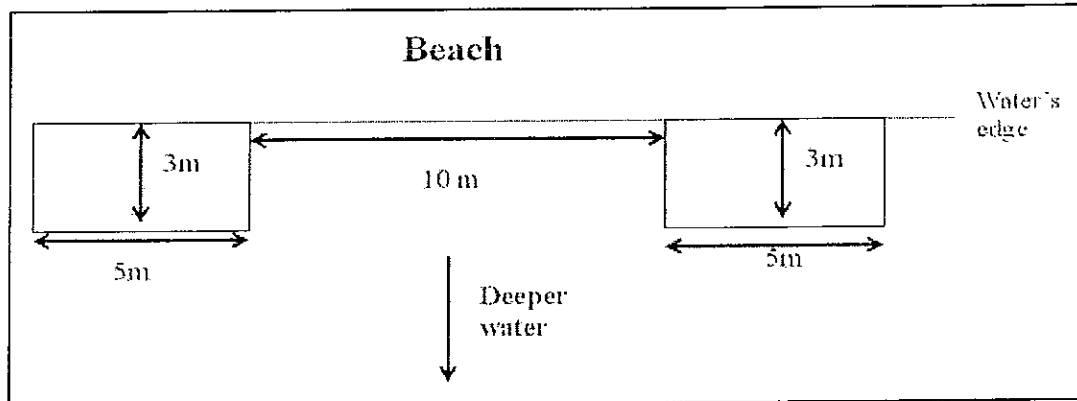


Figure 3. Diagram outlining placement of quadrats for beaches >100m in length.

- 1) Flip a coin and go to the end of the survey beach to begin the survey depending on the results of the coin toss. The site will be either marked by a pole or described to the team members before the surveys. Specific instructions will be provided for each particular beach.
- 2) Choose 1 random number between 0 and 10 from the random number table (at the end of this document). The number you randomly select (point at the sheet with your eye's closed) is the random start point (in meters) where the 1st quadrat will begin. Walk off the number of paces based on the number you randomly select. Then begin your spawning survey using the protocol below.
- 3) Each quadrat will be a 3m X 5m block (Figure 2). Fold the 10m rope in half and lay it on the beach. This will be your 5m quadrat length. Next, the recorder should stand at the water's edge with the 3m YELLOW rope attached to their person. The counter will take the other end of the YELLOW rope attached to the PVC pole and walk out into the water until the rope is taut. Then while holding the rope taut with the pole move in a parallel fashion to the water's edge for 5 meters (the recorder should move with the counter). Count all the crabs encountered between the each end of the yellow rope.
- 4) Counting horseshoe crabs in the quadrat:
  - A horseshoe crab is considered 'in the quadrat' if **more than half of its body is inside the quadrat.**
  - If female and male(s) are mating and the female is in the quadrat but the males are outside, consider the males in the quadrat and do not recount them in the following quadrat.
  - If a female is mating and is partially buried in the sand, and you can be 90% sure she is a female (because a male is clasped on to her and she is bigger). **Leave her be and do not lift her up.**

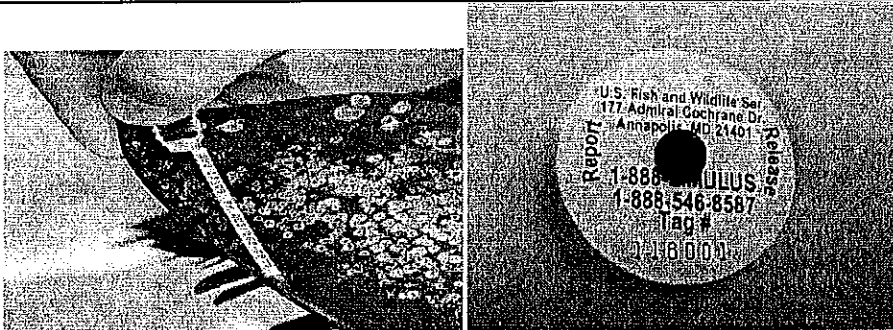
- Report the crab count using tally marks on the appropriate tables (ex. Figure 4) on the spawning survey sheet in the following manner:
  - Single M's - solitary males
  - Single F's - solitary females
  - Pair - One Female and One Male
  - F+2M - One Female and Two Males
  - F+3M - One Female and Three Males
  - F+O - Enter number of males for each encounter (i.e., 4, 6, 8, 5)

Q 1	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Figure 4. Example quadrat table from Spawning Survey Data Sheet

- Report zeros (0) when there are no horseshoe crabs within the quadrat. Do not move the quadrat from the preselected quadrat location to include nearby animals. Empty quadrats are just as important as those with horseshoe crabs because they will help reflect changes in the population.
- If you see a horseshoe crab with a tag record the tag number on the **Recapture Sheet** provided. Be sure to write down the numbers accurately. Tags may either be yellow cinch tags or White disc tags. Record the tag number of either (or both) tags.

**Yellow cinch tags at the back right OR left of the carapace or WHITE disc tags**



5) Once you are finished counting every crab within the 3X5m quadrat it is time to move on to the next quadrat. Use the 10m RED rope provided to measure between quadrats. Reestablish your 3X5 quadrat and begin counting. Repeat this procedure until you reach the end of your designated beach section. **All remaining quadrats should be placed 10m apart from each other.**

6) When you are finished the survey, please total the number of tally marks for each quadrat and enter the number in the total column.

7) Start Tagging! Make sure to record the tag numbers, sex, and mate tags on the Tagging Data Sheet.

### **Dates and Times to Census:**

Spawning surveys should be conducted within 2 days of the FULL and NEW moon. This gives a ~5 day period (2 days prior, the day of, and 2 days after the moon) window to complete the surveys for each lunar period. It is desirable to survey each location 2 to 3 times during each moon, preferably both day and night (4 to 6 surveys) at each location.

We realize that time can be limiting therefore we would like to establish priorities for conducting the spawning surveys. Therefore, priority for surveys should be given to those dates closer to or on the full or new moon. The minimum number of surveys for a location and moon is 1 DAY and 1 NIGHT survey.

1. The **highest priority** survey times are **night and day high tides on the full or new moon.**
2. The **second highest priority** survey times are **night surveys 2 days before and 2 days after the full or new moon**
3. The **third highest priority** survey times are **day time surveys 2 days before and 2 days after the full or new moon:**

# 2009 Project *Limulus* Horseshoe Crab Spawning Survey Data Sheet

Beach: \_\_\_\_\_ Town: \_\_\_\_\_ Date: \_\_\_\_\_

Names: \_\_\_\_\_ Group: \_\_\_\_\_

Air Temp: \_\_\_\_\_ Water Temp: \_\_\_\_\_ Wind Speed(mph)/Direction: \_\_\_\_\_/\_\_\_\_\_

Wave Height: <6in      6-12in      +1ft  
 Precip: None      Fog      Light Rain      Heavy Rain  
 Light: Full Sun      Partial Sun      Full Darkness      Moonlight  
 Public Beach: YES      NO      Probably      Don't Know  
 Raked Beach: YES      NO      Probably      Don't Know  
 Recent evidence of raking? YES      NO      Probably      Don't Know  
 Harvesting: YES      NO      Probably      Don't Know  
 Harvesters present? YES      NO      Probably      Don't Know

Survey Start Point: \_\_\_\_\_ Start Time: \_\_\_\_\_ AM/ PM

Q1	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q2	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q3	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q4	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q5	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q6	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q7	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q8	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

Q9	Tally	Total
Single M's		
Single F's		
Pair		
F+2M		
F+3M		
F+O		

**TABLE OF RANDOM NUMBERS**

39634 62349 74088 65564 16379 19713 39153 69459 17986 24537

14595 35050 40469 27478 44526 67331 93365 54526 22356 93208

30734 71571 83722 79712 25775 65178 07763 82928 31131 30196

64628 89126 91254 24090 25752 03091 39411 73146 06089 15630

42831 95113 43511 42082 15140 34733 68076 18292 69486 80468

80583 70361 41047 26792 78466 03395 17635 09697 82447 31405

00209 90404 99457 72570 42194 49043 24330 14939 09865 45906

05409 20830 01911 60767 55248 79253 12317 84120 77772 50103

95836 22530 91785 80210 34361 52228 33869 94332 83868 61672

65358 70469 87149 89509 72176 18103 55169 79954 72002 20582

72249 04037 36192 40221 14918 53437 60571 40995 55006 10694

41692 40581 93050 48734 34652 41577 04631 49184 39295 81776

61885 50796 96822 82002 07973 52925 75467 86013 98072 91942

48917 48129 48624 48248 91465 54898 61220 18721 67387 66575

88378 84299 12193 03785 49314 39761 99132 28775 45276 91816

77800 25734 09801 92087 02955 12872 89848 48579 06028 13827

24028 03405 01178 06316 81916 40170 53665 87202 88638 47121

86558 84750 43994 01760 96205 27937 45416 71964 52261 30781

78545 49201 05329 14182 10971 90472 44682 39304 19819 55799

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58697 31973 06303 94202 62287 56164 79157 98375 24558 99241



