Horseshoe Crab (Limulus polyphemus) Spawning Activity Survey Protocol for the New York State Marine District
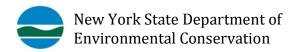
Quadrat Protocol

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www.NYhorseshoecrab.org

Cornell University
Cooperative Extension
of Suffolk County

New York State Department of
Environmental Conservation

HORSESHOE CRAB SPAWNING SURVEY FOR NY MARINE DISTRICT

Thank you for choosing to participate in our annual survey of spawning horseshoe crabs. Your help with this project is crucial to reaching our goals of developing reliable sampling methods for data collection, and to acquire biological information on horseshoe crabs in New York's Marine District. This data will be used by the NYS Department of Environmental Conservation to help assess the status of horseshoe crabs in the NY Marine District and assist with the management and conservation of this important species. By participating in this survey, you will be helping to measure spawning abundance, size, and gather tagging data around full and new moon events from May to July. Trained site coordinators will be present to teach you how to assist with the survey, however, it is important that you take the time to read through this document beforehand. By doing so, you will come properly prepared and allow the survey to run efficiently.

Contents:
1. This set of instructions.
2. Date of census and Sampling Schedules.
3. Data sheets for recording observations.

Additional field monitoring equipment that is required for this project will be provided by site coordinators (Table 1) on the night of sampling. Monitoring program questions or comments can be directed to the lead project coordinators at Cornell University Cooperative Extension (631) 727-7850 x353; and NYS DEC, (631) 444-0469. Also, visit our website: www.NYhorseshoecrab.org

PREPARATION FOR THE SURVEY

- If you are participating directly through Cornell Cooperative Extension or the NYS DEC, you **MUST** fill out the "Risk Waiver Forms" that are available on our website: www.NYhorseshoecrab.org or from the site coordinator. If you plan to participate in the survey more than one night, you must also fill out the consent form for a background check (also found on the website). If you are participating through another organization, please be sure to fill out any of their required forms too.

Clothing and Accessories:

• Wear appropriate clothing for night walks. Foul weather, and wet conditions at the water's edge may require appropriate attire. Consider using sunscreen during the day and insect repellent at night.

• **IF THUNDERSTORMS ARE PRESENT, OR CONDITIONS ARE UNSAFE, DO NOT GO ONTO BEACH.** The site coordinator will determine if the survey should be cancelled.

• Bring a headlamp or flashlight. Headlamps are useful because they free up both hands.

• Bring a clipboard or hard surface to write on. Also, bring a couple of pencils and a sharpener.

• Work gloves may be useful if there are high densities of horseshoe crabs on the beach, as you may have to occasionally lift animals up to count those underneath.

• NO BARE FEET! Shoes are a necessity. We recommend rubber boots, water shoes, or old sneakers.

• An accurate wristwatch is needed for recording arrival time, survey starting and finishing times.

• Cell phone for emergencies or calling lead coordinator(s) for assistance with problems.

SURVEY PROTOCOL

SETUP
- If you are participating directly through Cornell Cooperative Extension or the NYS DEC, you **MUST** fill out the "Risk Waiver Forms" that are available on our website: www.NYhorseshoecrab.org or from the site coordinator. If, however, you are participating through another organization, please be sure to fill out any of their required forms too.

- The survey protocol, aerial photo and driving directions to the survey sites are also available on our website and from the site coordinator.

- You will be surveying in groups of **at least two people** (e.g. minimum of a Site Coordinator and one participant).

- ***Please note that children under the age of 18 must be accompanied by their parent or a legal guardian.***

- Arrive at the designated beach **at least 30 minutes prior to** the scheduled sample time to meet the Site Coordinator (see our website for sampling schedules). Please access the sample locations from the appropriate areas we have indicated on our website. The site coordinators can also provide any specific instructions for your location if needed. Record the time you arrive in the space marked ARRIVAL TIME on the Data Sheets.

- When surveying, fill out as much of the Survey Data forms as possible. Addresses and phone numbers of each survey team member are important in case we have questions about the data. ***Note: even if the weather 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.***

- Enter the required environmental data on the Survey Data Form before starting the horseshoe crab counts.

- Each beach will be sampled along a transect that will be pre-marked with signs posts indicating the beginning and end points of the survey site.

- To survey the horseshoe crabs, you will start at one end of the marked section of beach. Flip a coin to decide which end of the beach you will start (Start Point): if heads, start at the stake furthest west (or north); if tails, start at the stake furthest east (or south). Circle Starting Point Location on the Data Sheet.

- At exactly the scheduled "start time" (See site tables), you should begin counting spawning horseshoe crabs at the 'Start Point'. Record your start time on the Data Sheet where it says START OF SURVEY.

I. Counting Horseshoe Crabs

A) Quadrat Method

Determine your average pace per meter:
Before using the "Quadrat Method", you will need to determine your pace per meter. Please try to do this well in advance of the scheduled survey time, and preferably on a beach since pace length is affected by the surface you are walking on. This should take 15-20 minutes to complete. Note: Each person only has to determine his or her pace once for the season.

1. Lay the 20-meter (66 feet) string out straight on the ground. You will use this to fill out the Pacing Trial Form found in this document.
2. Count the number of paces it takes you to walk the length of the string using your normal stride. Remember that our protocol defines a pace as a single step. Enter this number in the space next to TRIAL 1 on the Pacing Trial Form.
3. Repeat this process twice more. Enter the second number next to TRIAL 2 and the third number next to TRIAL 3.
4. These three numbers are A, B, and C on the Pacing Trial Form. Add A, B, and C, and divide this number by three to find D; your average number of paces per 20 meters.
5. Divide D by 20 to find your average number of paces per meter (E on the form).

Note: The average number of paces per meter is probably different for each person, because it depends on your stride length. It is important you do this and know these numbers before you arrive at the beach if possible.

B) Sampling with the Quadrat Method

After completing the Pace Trial Form, you can begin to count horseshoe crabs using the Quadrat Method. If there is only 1 observer and 1 recorder (i.e. a "Single Survey Team"), then use the protocol described here. If there are enough volunteers to form 2 separate survey teams, then skip to the next section "Two Survey Teams" below. The site coordinator will help decide this.

Single Survey Team

1. The quadrats on the Data Sheet are numbered 1-100 for recording (page 16). If the beach section is 1 kilometer (km)*, choose two random numbers from 0m to 19m (use random number table in the Appendix) to locate the placement of the 1st and 2nd quadrats within the first 20m stretch of the beach. Then pace 20m from each random starting point to place the 3rd and 4th quadrats in the next consecutive 20m interval. Continue in this way until you have sampled 100 quadrats.

1. *Note: If the beach section is shorter than 1 km: Divide the length of the beach section by 50 to find the distance between every quadrat. For example, if the beach is 400m; 400m/50 = 8. This means every 8m stretch of beach you pace, you will place 2 quadrats. Choose 2 random numbers from 0 to 7 to locate the placement of the 1st and 2nd quadrats within the first stretch of the beach. Continue in this way until you have sampled 100 quadrats.

2. When you have paced to the correct quadrat location, place the quadrat at the toe of your last step. Place one side of the quadrat even with the line of horseshoe crabs and the opposite side towards the bay. Once the quadrat is in place, you will count horseshoe crabs (see: "How to Count Horseshoe Crabs in a Quadrat" section c. below for more details).

3. Once you are done counting and all information is recorded, pick up the quadrat, and pace to the next quadrat. Begin pacing from the toe of your last step.

4. It is the observer's responsibility to make sure the recorder gets all the tallies before pacing to the next quadrat.

Two Survey Teams *(Skip this section if using the single survey team method above)*
If there are enough volunteers for two survey teams (2 observers, 2 recorders and 2 quadrats), it may be easier to "leapfrog", with team B pacing ahead of team A. After team A counts their quadrat, they will pace ahead of team B. This continues until 100 quadrats are counted (50 per Team- Team A with the odd data entries and Team B with the even data entries). It is important that both teams pace the same distance between quadrats. This is described in more detail with the following protocol:

1. The quadrats on the Tally Sheet are numbered 1-100. If the beach section is 1 kilometer (km)*: Choose two random distances from 0m to 19m to locate the 1st quadrats for Team A and Team B within the first 20 m stretch. Then each team will pace 20m from the random starting point to place the 3rd (Team A) and 4th (Team B) quadrats in the next consecutive 20m stretch. The teams will continue to "leapfrog" in this way until they have sampled 100 quadrats (50 per team).

   Note: If the beach section is shorter than 1 km: Divide the length of the beach section by 50 to find the distance between every other quadrat. For example, if the beach is 400 m, 400/50 = 8. Within each 8 m stretch of beach each team will place one quadrat. To start, choose 2 random distances from 0 to 7 to locate the 1st quadrats for Teams A and B within the first 8m stretch for each team. Teams will continue to leapfrog each other by placing evenly spaced quadrats until they have sampled 100 quadrats (50 per team- Team A with the odd data entries and Team B with the even data entries).

2. When you have paced to the correct quadrat location, place the quadrat at the toe of your last step. Place one side of the quadrat even with the line of horseshoe crabs and the opposite side towards the bay. Once the quadrat is in place, you will count horseshoe crabs (see: "How to Count Horseshoe Crabs in a Quadrat" section c. below for more details).

3. Once you are done counting and all information is recorded, pick up the quadrat, and pace to the next quadrat. Begin pacing from the toe of your last step.

4. It is the observer's responsibility to make sure the recorder gets all the tallies before pacing to the next quadrat. If the Observer looses track of which pace interval they are on, an easy way to check is to ask the recorder which quadrat number you are sampling next. If it is an "odd" number, use the first pace step

c. How to Count Horseshoe Crabs in a Quadrat

Once the quadrat is in place try not to move it again until you are done counting.
- You will count all horseshoe crabs "in the quadrat." A horseshoe crab is considered 'in the quadrat' if more than half of its body is inside the quadrat.

- When there are numerous animals, you may have to lift some up to assure you've counted all of those underneath. Heavy work gloves will be useful for this. Try to minimize disturbance to the

spawning horseshoe crabs. Spawning females will be partially buried in the sand while laying eggs. DO NOT LIFT UP A PARTIALLY BURIED HORSESHOE CRAB.

- Count the animals of each sex separately. If a female horseshoe crab is not buried, the two most common ways to determine its sex are its size and position. Males are, for the most part, smaller and 'clasped' or crowding on top of females. There also tends to be more males than females.

- Report your count of each sex to the recorder who will record the information under TOTAL on the Tally Sheet. If the recorder is working with another observer, keep the tally in your head until the recorder can record the quadrat counts for you. Don't pick up the quadrat and move to the next quadrat location until you know the recorder has recorded all information for your present quadrat.

- Report zero (0) when there are no horseshoe crabs within the quadrat. Do not try to move the quadrat from the pre-selected quadrat location just to include one or more nearby animals. Empty quadrats are just as important as those with horseshoe crabs.

II. Button Tagging and Measuring Horseshoe Crab Size

Setup:
 After completing the spawning count, the Site Coordinator will lead the button tagging and size (prosoma width) measurements on horseshoe crabs.
1. The HORSESHOE CRAB TAGGING & SIZE DATA FORM must be used to record all size and tagging information.
2. When tagging and measuring horseshoe crab size please observe these general rules:
    a. Do NOT go in the water to collect animals.
    b. You can measure and possibly tag a female horseshoe crab that is partially buried in the sand and not yet depositing eggs (i.e. starting to nest only), but do not move her.
    c. If you measure a mating pair, do not separate them.
    d. NEVER lift or move a horseshoe crab by its' tail.
    e. Return any crabs that were moved during this process, facing down-slope in the "Surf Zone" with legs in sand.
3. The team will walk from the "End Point" back toward the "Start Point" and try to tag and size as many male and female horseshoe crabs along the transect as possible, or as time permits. A recommended minimum number for size measurements and tagging is: 20 males and 20 females, but do as many as the team feels they can manage or permitted to do by a regulatory agency
4. ONLY consider tagging and measuring crabs that are above or within the Surf Zone. NEVER collect any crabs that are fully submerged to tag or size.

Button Tagging Protocol:

Crabs that will be tagged and sized can gently be manipulated, but using only the prosoma (head region).
- The site coordinator will lead the tagging effort and be the 'Observer'.
- The 'Recorder" will use the Data form entitled: "Tagging and Size" to record data.
- Tags will be attached to the left posterior (rear) point of the prosoma (first section of body, see Figure 2) for both male and female horseshoe crabs. It may first be necessary to clean off any epibionts (barnacles, etc.) near the attachment site.

- The 'Observer' will indicate the sex of the individual and then state the "Tag Identification Number" for the Recorder to write on the data form.
- The button Tag is attached by carefully creating a small (5/32") hole on the LEFT side of the prosoma near the dorsal edge with a hand driver. The tag is then pushed into the hole as far as it will go (it should NOT go all the way through the prosoma and come out the other side). Only attach one tag per animal. If the animal is damaged near the attachment area, attach the tag to the opposite side, or do not tag it.
- The Observer will then measure the Size of the tagged individual as described below (Please note that you can measure size first and then tag).

Size Protocol:

Size can be recorded as part of the tagging process, and also if no animals are going to be tagged that evening.
1. The Recorder will use the Data form entitled "Tagging and Size".
2. The Observer will measure prosoma width (size) of the horseshoe crab (Figure 2).
3. Size: The Observer will use calipers to measure (centimeters) the horseshoe crab's prosoma at the widest point (Figure 2, typically a little behind the large compound eyes) on the dorsal side (i.e. crab's legs facing down in sand).
4. The Recorder will write the size (centimeters) on the appropriate data sheet.
5. If a female is buried, use your hands to gently excavate enough sand around the prosoma to measure with the calipers, and then replace the sand. However, do NOT remove the crabs from the sand to attain a measurement.
6. Repeat this process on all crabs that were tagged. If no tagging was done, size measures should be recorded on as many individuals as time allows (e.g. 20 males and 20 females).

Remember: Do not go into the water to collect animals, do not move a female that is nesting (buried in the sand), do not separate mating pairs. Please also place the crabs back in the "Surf Zone" facing down-slope if they were moved above the water line during these measurements.

Figure 2. Size measurements and placement of button tag on horseshoe crabs.

Additional Notes:

- When there are numerous animals, you may have to lift some up to assure you've counted all of those underneath. Heavy work gloves will be useful for this. Do NOT remove a spawning female that is buried in the sand, or lift horseshoe crabs by their tails.

- If there is an obstruction or discontinuation in the beach section (large debris, large boulder, etc), pace up to the obstruction, walk to the other side of it, and then continue your survey count on the other side. Please indicate the type of obstruction and size on the Data Sheet.

- Report zero (0) when there are no horseshoe crabs on the beach. If you observe horseshoe crabs that are fully submerged and not part of the spawning cluster in the "Surf Zone", you can choose to record the information, but NEVER go into the 'Submerged' Areas to count. Zero counts are just as important as those with horseshoe crabs present because they will reflect changes in the abundance.

When you are finished surveying: Record the time in the space marked END OF SURVEY on the Data Sheet. Send all ORIGINAL Data sheets to the address below (Note: PLEASE DO NOT SEND A FAX ONLY. WE NEED THE ORIGINAL DATA SHEETS!). Please make a backup photocopy of the Data Sheet before mailing the original to us at:

Matthew Sclafani
Cornell University Cooperative Extension
423 Griffing Ave.
Riverhead, NY 11901
Phone: (631) 727-7850
Fax: (631) 727-7130
Email: ms332@cornell.edu

Table 1. Site Coordinator contacts. Please contact the site coordinators for the locations that you wish to volunteer at prior to the night of sampling. If you have any difficulties, please contact any of the principal coordinators.

Principal Project Coordinators	**Barry Udelson**	**631-727-7850, x365; bu25@cornell.edu**
	Sherryll Jones	**631-727-7850 x353; sj497@cornell.edu**
	Matthew Sclafani	**631-727-7850, x377; ms332@cornell.edu**

Sampling Sites	**Coordinators**	**Contact Information**
Big Egg, Brooklyn	Debra Kriensky	617-835-3000; email: dkriensky@nycaudubon.org
Calvert Vaux & Kaiser Park, Brooklyn	Ellen Hartig	212-360-1481; email: Ellen.Hartig@parks.nyc.gov
Captree, Babylon	Peter Walsh	631-581-6908; email: Pwalsh@seatuck.org
	Enrico Nardone	631-487-0071; email: egnardone@seatuck.org
Centerport Yacht Club	Susan Hirshman	hirschmarine@aim.com
Conference House Park, Staten Island	Karen Roos	718-667-7475 ext 1; email: Karen.Roos@parks.nyc.gov
	John Kilcullen	email: john.kilcullen@parks.nyc.gov
Crab Meadow	Virginia Mallon-Ackerman	631-262-1487; email: virginiamallon@yahoo.com
Dead Horse Bay, Brooklyn	Christine Nealy	646-648-2326; email:Christine.Nealy@trinityschoolnyc.org
	Debra Kriensky	617-835-3000; email: dkriensky@nycaudubon.org
Fishers Island	Carol Giles	email: c.giles@fischool.com
Great Kills Park, Staten Island	Kathy Garofalo	718-354-4655; email: kathy_garofalo@nps.gov
Jones Beach, Wantagh	Suzanne Montefinise	516-780-3295; email: Suzanne.Montefinise@parks.ny.gov
Mt. Sinai Harbor	Patrick McKeown	email: pmckeown214@gmail.com
Oyster Bay (Beekman & TR)	Cameron Jenness	516-922-7245 ext 24; email: Cameron@thewaterfrontcenter.org
Pikes Beach, Westhampton	Gina Mulhearn	631-288-8014; email: ginamulhearn@gmail.com
	Mark Cappiello	cappiellomark@yahoo.com
Plum Beach East, Brooklyn	Debra Kriensky	617-835-3000; email: dkriensky@nycaudubon.org
Plum Beach West, Brooklyn	Phil Cusimano	Email: philip_cusimano@msn.com
South Harbor Rd., Southold	Jessica Kennelly	631-765-6450 ext215; email: jkennelly@eastendenvironment.org
	Christine Tylee	631-765-6450 ext208; email: ctylee@eastendenvironment.org
Squire Pond, Hampton Bays	Brian Frank	631- 324-2178; email: brifrank@optonline.net
West Meadow Beach, Stony Brook	Phylis Chin	PChin@theofficeworx.com
	Frank Chin	631-689-1080; email: frank.chin@sunysb.edu

PACING TRIAL FORM (*Please try to complete prior to the survey*)

(USED FOR QUADRAT SAMPLING METHOD- SITE COORDINATOR WILL LEAD THIS EFFORT)

DATE:_____

NAME:_____

NUMBER OF PACES IT TAKES TO WALK 20 METERS OR APPROXIMATELY 66 FEET: (note: 1 pace = 1 step)
TRIAL 1 = _____ (A)

TRIAL 2 = _____ (B)

TRIAL 3 = _____ (C)

AVERAGE PACES PER 20 METERS (Single Team):
TOTAL (A+B+C) = _____ / 3 = _____ (D) PACES PER 20 METERS

NUMBER OF PACES PER METER:
(D) _____ / 20 = _____ (E) PACES PER METER

RETURN THIS FORM WITH TALLY SHEETS AND BEACH SITE SHEET TO:

Dr. Matthew Sclafani
Cornell Cooperative Extension of Suffolk County
423 Griffing Ave. Riverhead, NY 11901
TEL. (631) 727-7850

RANDOM NUMBER TABLE

4	1	7	11	16	19	1	11	12	2	9	5	16	19	16	13	14	13	0	1
1	11	19	11	2	5	19	13	13	1	8	19	11	3	1	4	3	0	18	14
7	19	12	5	16	13	1	19	8	1	11	0	8	15	9	5	13	10	17	10
11	11	5	13	1	19	3	4	0	14	5	5	4	16	10	1	11	6	17	6
16	2	16	1	5	1	13	14	9	12	6	10	17	7	4	6	10	15	11	4
19	5	13	19	1	0	15	5	10	10	1	6	0	19	15	6	17	1	3	15
1	19	1	3	13	15	12	16	13	7	2	19	4	12	14	6	4	15	6	7
11	13	19	4	14	5	16	1	6	6	15	6	2	6	15	17	10	3	3	9
12	13	8	0	9	10	13	6	3	15	17	1	17	15	5	3	16	1	16	12
2	1	1	14	12	10	7	6	15	4	2	15	17	7	1	9	8	12	17	6
9	8	11	5	6	1	2	15	17	2	6	7	7	13	15	11	7	17	13	19
5	19	0	5	10	6	19	6	1	15	7	3	0	7	12	8	10	11	16	3
16	11	8	4	17	0	4	2	17	17	7	0	18	6	2	0	4	7	18	8
19	3	15	16	7	19	12	6	15	7	13	7	6	0	10	16	15	10	5	14
16	1	9	10	4	15	14	15	5	1	15	12	2	10	7	3	16	18	9	2
13	4	5	1	6	6	6	17	3	9	11	8	0	16	3	5	14	7	8	1
14	3	13	11	10	17	4	10	16	8	7	10	4	15	16	14	2	16	18	1
13	0	10	6	15	1	15	3	1	12	17	11	7	10	18	7	16	3	18	9
0	18	17	17	11	3	6	3	16	17	13	16	18	5	9	8	18	18	5	1
1	14	10	6	4	15	7	9	12	6	19	3	8	14	2	1	1	9	1	5

The above table of random numbers can be used to choose random starting points for quadrat sampling of spawning horseshoe crabs.

If the beach section is 1 km: Select any row or column of the table. The first number in the row, is your first random starting point. The next number is the second random starting point. If this number is equal to the fist number. skip it and go to the next number in the row or column. Each night you will choose 2 random starting points to locate the first 2 quadrats. Then follow the directions under 'Placing the Quadrats' on the instruction sheet.

If the beach is shorter than 1 km: The distance between every other quadrat is the length of the beach divided by 50. If your beach is 400 m then the distance between every other quadrat is 400/50=8 m. This means you only want to choose random numbers from 0 to 7 (or from 0 to 1 minus the distance between every other quadrat). Choose any row or column of the table. The first number in the row less than or equal to 7 is the first random starting point. The next number in the row or column less than or equal to 7 is the second random starting point. Each night you will choose 2 new random starting points to locate the first 2 quadrats. Then follow the directions under 'Placing the Quadrats' on the instruction sheet.