

October 1, 2021

**End-of-Year Report for 2021  
NJ Permit # 2021-1812**

*Limulus polyphemus*

Horseshoe Crab Monitoring & Tagging Activity in Raritan Bay & Sandy Hook Bay, Monmouth County, New Jersey, May & June 2021. Conducted by Volunteers with Save Coastal Wildlife Nonprofit.

Copy of report to:

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M.A.S.T (Marine Academy of Science and Technology)  
Monmouth University  
National Park Service/Gateway National Recreation Area  
NJDEP/Fish & Wildlife Division  
US Fish & Wildlife



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The full HSC monitoring database is available for downloading from Save Coastal Wildlife website at: <https://www.savecoastalwildlife.org/horseshoe-crab-monitoring>

# Summary

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This is an end-of-year report for a study in 2021 to monitor Horseshoe Crab mating activities at five estuarine sites along Sandy Hook Bay & Raritan Bay in Monmouth County, New Jersey. The project began in 2009 and is ongoing. This report marks the thirteenth year of the study.

A Raritan Bay – Sandy Hook Bay, Monmouth County, New Jersey Horseshoe Crab spawning survey was implemented by volunteers with Save Coastal Wildlife Nonprofit (formerly known as the Bayshore Watershed Council, an all-volunteer group), and with cooperation from high school students with the Marine Academy of Science and Technology (M.A.S.T.), located at Sandy Hook, Gateway National Recreation Area. Volunteers with the Monmouth County Park System & Bergen County Parks have also lent a hand for many years. More than 50 volunteers in total are involved every year to implement this survey. By collaborating with efforts from the public, the benefits of citizen-based conservation activities become clear: education and public involvement are key components to the most effective wildlife conservation programs.

## **OLD BUSINESS for 2021**

- Volunteers under the leadership of Save Coastal Wildlife Nonprofit conducted monitoring and tagging activities at five (5) sites during periods of high tide and full & new moon phases in May and June, the representative spawning season for horseshoe crabs in the State of New Jersey, and the Mid-Atlantic.

## **FINDINGS for 2021**

- The total Horseshoe Crab population in the study area was 3,522 crabs. This number is still estimated by historical data to be less than the Hudson-Raritan Estuary's carrying capacity that once existed ([History of the Fisheries of Raritan Bay New York & New Jersey by Clyde L MacKenzie Jr.](#)).
- Total female horseshoe crabs in 2021 made up approximately 20 percent of the population. Adult male crabs continue to far out-number the adult female population.
- The hot spot for HSC mating activity was Keyport Harbor in the Borough of Keyport and Leonardo Beach in Middletown Township. The spawning population of horseshoe crabs at both Plum Island at Gateway Sandy Hook and Cliffwood Beach seems to be suffering from beach erosion issues.

## **Background**

Horseshoe crabs are 'living fossils', the last survivors of a group of organisms that first appeared in the fossil record over 400 million years ago. Horseshoe crabs play a vital role ecologically along the shores of the Hudson-Raritan Estuary, as well as Sandy Hook Bay & Raritan Bay. Migratory shorebirds, including ruddy turnstones (*Arenaria interpres*), dunlins (*Calidris alpina*), and sanderlings (*Calidris alba*) rely on a large amount of horseshoe crab eggs to provide nourishment during their migrations from the tropics to northern Canada to breed. Since these birds have beaks that are unable to dig deep into the sand to uncover fatty horseshoe crab eggs, there needs to be a large population of horseshoe crabs already mating on a single beach for eggs to be uncovered from the mating efforts made by horseshoe crabs that spring.

One bird in particular, the red knot (*Calidris canutus*) feeds almost exclusively on horseshoe crab eggs during its spring stopover along the Atlantic Coast of the United States on their way to breeding grounds in the tundra of northern Canada. Although red knots have a limited migratory population along Raritan Bay and Sandy Hook Bay, regular sightings by volunteers with Save Coastal Wildlife Nonprofit have observed birds during spring migration at the tip of Sandy Hook peninsula and at Conaskonk Point in Union Beach. Sightings usually occur in May with a small population of less than a dozen birds. The red knot population in November 2013 was listed as a threatened species under the federal Endangered Species Act by the U.S. Fish and Wildlife Service.

In 2009, volunteer members of Save Coastal Wildlife Nonprofit (then known as the Bayshore Regional Watershed Council) approved a measure to conduct a study to monitor and tag adult horseshoe crabs at five (5) sites along Sandy Hook Bay & Raritan Bay in Monmouth County, New Jersey. The goal of the study was to obtain a better determination of the spawning population of this aquatic species, and to ascertain if the population is stable, increasing, or decreasing. In addition, by tagging horseshoe crabs, this study helps to better understand the migration patterns, abundance, and survival rates of recaptured tagged horseshoe crabs over the course of the study in the project area.

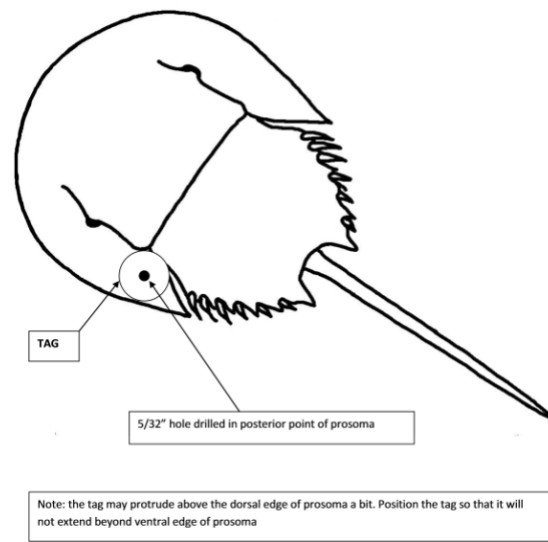
The five (5) monitoring sites along Raritan Bay & Sandy Hook Bay in Monmouth County, New Jersey include: 1) Plum Island at Sandy Hook Gateway National Recreation Area, 2) near the mouth of Many Mind Creek in the Borough of Atlantic Highlands, 3) Leonardo Beach in Middletown Township, 4) Keyport Harbor, in the Borough of Keyport, and 5) Cliffwood Beach in Aberdeen Township.

## **Field Methods**

Data was collected during full moon and new moon high tide event cycles in May and June. Monitoring activities by volunteers were divided into two activities: (1) counting spawning populations of Horseshoe Crabs and (2) tagging single adult Horseshoe Crabs. Both activities took place at the same time (simultaneously) by volunteers during a monitoring event.

Field methods and activities for counting crab populations by watershed volunteers were similar to protocol described by the USGS in their volunteer information entitled, "SURVEYING HORSESHOE CRABS" (please see USGS web site: <http://www.lsc.usgs.gov/aeb/2065/protocol.asp>)

## **Protocol to Tag HSC**



Only single crabs are tagged. We never tag crabs that are in pairs or clusters. Crabs are selected for tagging activities within the monitoring area or transect zone on the beach after a crab has been counted or surveyed by an observer.

We attach only one tag per animal. If the animal is damaged near the attachment area, we do not tag the animal.

1. Tags will be attached to the left posterior (rear) point of the prosoma (first section of body). There is a high concentration of fibrous material within the body in this area, which minimizes bleeding. Before drilling the attachment hole, clean off any epibionts (barnacles, etc.) near the attachment site.
2. USFWS (US Fish & Wildlife) recommends first cleaning the area where the hole will be drilled by rubbing the spot with alcohol.

3. Next the drill should be dipped into a Betadine antiseptic solution to disinfect the drill before making the hole in the shell (prosoma).

4. The tag is attached by drilling a 5/32" hole (7/64" for small tags) through the left side of the prosoma near the dorsal edge and then pushing the plastic pin (with tag) 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).

5. This procedure should be repeated for every individual that is being tagged.

6. Any crabs found with tags already attached to the shell are to be reported to the Beach Captain and recorded on the re-sighting form.

Field methods for tagging crab population were the same protocol as described by USFWS. Only single adult Horseshoe Crabs were tagged. Crabs that were in the process of mating were left alone so as not to interrupt the course of action. In brief, the protocol called for volunteers to attach a circular individual numbered disc to the left posterior (rear) of the prosoma (first section of body) by drilling a 5/32" hole through the side and then pushing the plastic pin (with tag) into the hole as far as it can go. Data sheets recorded the tag number, sex, prosomal width (PW) in millimeters (widest point of the crab), the date tagged, beach name, waterbed name, and state.

In 2014, two new tagging protocols were instituted as directed by US Fish and Wildlife and the National Park Service:

1. All single crabs to be tagged will first have the area where the hole will be drilled to be cleaned by rubbing the spot with alcohol.
2. Then the drill should be dipped into a Betadine antiseptic solution to disinfect the drill before making the hole in the shell (prosoma).
3. This procedure should be repeated for every individual to be tagged.
4. Any crabs found with tags already attached to the shell will be reported to the Beach Captain and recorded on a re-sighting form.

**Save Coastal Wildlife Nonprofit received a total of 400 tags in 2021 supplied by USFWS. About 192 tags were employed this year. The tally is as follows:**

**83 crabs were tagged at the mouth of Many Mind Creek in Atlantic Highlands.**

**62 crabs were tagged at Plum Island at Sandy Hook.**

**35 crabs were tagged at Cliffwood Beach in Aberdeen Township.**

**12 crabs were tagged at Leonardo Beach in Middletown Township**

**All horseshoe crabs tagged were single males.**

## **Protocol to Conduct Spawning Survey**

Each site will be sampled along a transect of 1,000 feet of beach.

1. The “horseshoe crab line” you will follow is not a straight line and may be above or below the water line or the surf zone - typically the area where the waves break and wash over the horseshoe crabs, especially males seeking females.

If there is an obstruction or discontinuation in the beach section (bulkhead, large boulder, etc.), pace up to the obstruction, walk to the other side of it, and then continue your pace count on the other side. Do not include the width of the obstruction in your transect.

2. Count the animals of each sex separately. If a 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 crowded on top of females. The first pair of appendages for males is also bulbous (like a marble), so they have the strength to clasp a female tightly. The bulbous shape is diagnostic for males.

3. To survey horseshoe crabs, you will start at one end of a marked section of beach. At the “start time,” you should begin counting all horseshoe crabs (dead or alive, single males and females, swimming pairs, buried pairs, and clusters) along a 1,000 feet of beach.

4. The Observer (first person) will walk along the "horseshoe crab line" and count out loud the number of horseshoe crabs and the Recorder (second person) records these observations on the Data Sheet. The Observer should always focus on counting horseshoe crabs that are spawning on the beach according to the following rules:

- a. Crabs above the Surf Zone (on beach): Count all that are present.
- b. Crabs in the Surf Zone: Count all that are present and include the submerged crabs that are obviously part of the spawning event.

5. Continue this way until you have sampled a 1,000 foot transect. You can stop while counting, but do not walk backwards and re-count.

# RESULTS FOR 2021:

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Below are the results for the thirteenth (13th) year of monitoring HSC at five sites along the edge of Sandy Hook Bay and Raritan Bay in Monmouth County, NJ. Data was collected on a total of four nights, which corresponded with full and new moon evenings.

## **FIRST NIGHT**

Tuesday, May 11, 2021

Raritan Bay & Sandy Hook Bay

Starting time: 8:45pm

Moon Phase: NEW Moon

### Water & Weather Conditions

Surface Water temperature: Mid 50s F.

Water condition: Clear to Cloudy

Wave condition: 1 foot waves

Air temperature: mid 50s F.

Sky conditions: Cloudy

Winds: NW 5-15 mph

Site Name	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Plum Island	9	6	3	3	0	3	0	1	0	0
Mouth Of Many Mind Creek	64	38	26	12	1	22	3	0	1 m	13
Leonardo Beach	153	94	59	33	3	34	18	4	1 u	6
Keyport Harbor	18	11	7	4	0	3	0	0	0	0
Cliffwood Beach	184	119	65	42	0	36	23	6	0	20

m = males, f = females, u = sex unidentified

### **Total for all five sites monitored on Tuesday, May 11, 2021**

	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Total	428	268	160	94	4	98	44	11	2	39

## **SECOND NIGHT**

Wednesday, May 20, 2021

Raritan Bay & Sandy Hook Bay

Starting time: 8:45pm

Moon Phase: FULL (Flower) Moon

### Water & Weather Conditions

Surface Water temperature: mid 60s

Water condition: Clear to Cloudy

Wave condition: Waves up to 1 foot

Air temperature: mid 70s F

Sky conditions: Cloudy

Winds: WNW 5-10 mph

Please note: this monitoring event followed a very intense thunderstorm that lasted for about 90 minutes.

Site Name	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Plum Island	98	81	17	40	1	12	0	4	0	24
Mouth Of Many Mind Creek	489	395	94	12	1	60	16	17	0	0
Leonardo Beach	581	458	123	263	2	63	22	36	0	0
Keyport Harbor	629	478	151	307	0	86	49	16	0	0
Cliffwood Beach	361	319	42	252	0	23	9	10	0	0

\* m = males, f = females, u = sex unidentified

### **Total for all five sites monitored on Wednesday, May 20, 2021**

	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Total	2,158	1,731	427	874	4	244	96	83	0	24

### **3 tagged crabs were also discovered:**

**#405403 – Mouth of Many Mind Creek**

**#437548 – Mouth of Many Mind Creek**

**#436720 – Keyport Harbor**

**These crabs were originally tagged at Plum Island, Jamaica Bay, New York City.**



### **THIRD NIGHT**

Thursday, June 10, 2021

Raritan Bay & Sandy Hook Bay

Starting time: 8:45pm

Moon Phase: NEW Moon

#### Water & Weather Conditions:

Surface Water temperature: Upper 60s F.

Water condition: Clear to Cloudy

Wave condition: Waves to 1 foot

Air temperature: Upper 60s F

Sky conditions: Partly Cloudy

Winds: East 5-10 mph

Site Name	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Plum Island	42	36	6	31	1	5	0	4	0	21
Mouth Of Many Mind Creek	188	156	32	120	1	21	8	2	0	70
Leonardo Beach	256	221	35	178	3	17	9	6	1 u	0
Keyport Harbor	281	238	43	187	2	22	13	6	0	0
Cliffwood Beach	34	24	10	15	1	6	3	0	0	12

\* m = males, f = females, u = sex unidentified

#### **Total for all five sites monitored on June 3, 2019**

	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Total	801	675	126	531	7	71	33	18	1	103

## **FOURTH NIGHT**

Thursday, June 24, 2021

Raritan Bay & Sandy Hook Bay

Starting time: 8:30pm

Moon Phase: FULL (Strawberry) Moon

### Water & Weather Conditions

Surface Water temperature: Low to mid 70s F.

Water condition: Lots of algae; very turbid

Wave condition: Waves 1 foot

Air temperature: mid 60s F

Sky conditions: Partly Cloudy

Winds: East 5-15 mph

Site Name	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Plum Island	12	11	1	8	0	1	0	4	2 m	6
Mouth Of Many Mind Creek	40	38	2	36	0	1	1	0	1 u	0
Leonardo Beach	10	8	2	6	0	1	1	0	1 m 1 f	0
Keyport Harbor	66	57	9	50	1	3	4	0	1 f	0
Cliffwood Beach	7	4	3	2	1	0	0	0	2 m 2 f	3

\* m = males, f = females, u = sex unidentified

### **Total for all five sites monitored on June 17, 2019**

	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
Total	135	118	17	102	2	6	6	4	10	9

Four (4) Tagged crabs were found:

#405294 - Mouth of Many Mind Creek

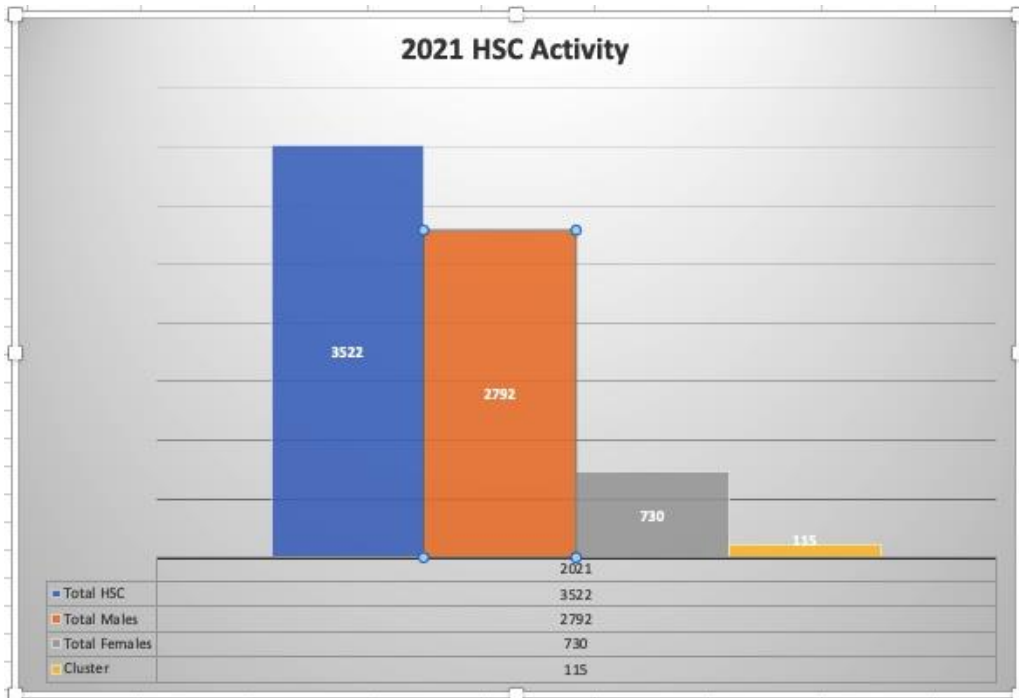
#405402 – Mouth of Many Mind Creek

#273792 – Keyport Harbor

#395011 – Cliffwood Beach (crab was found dead)

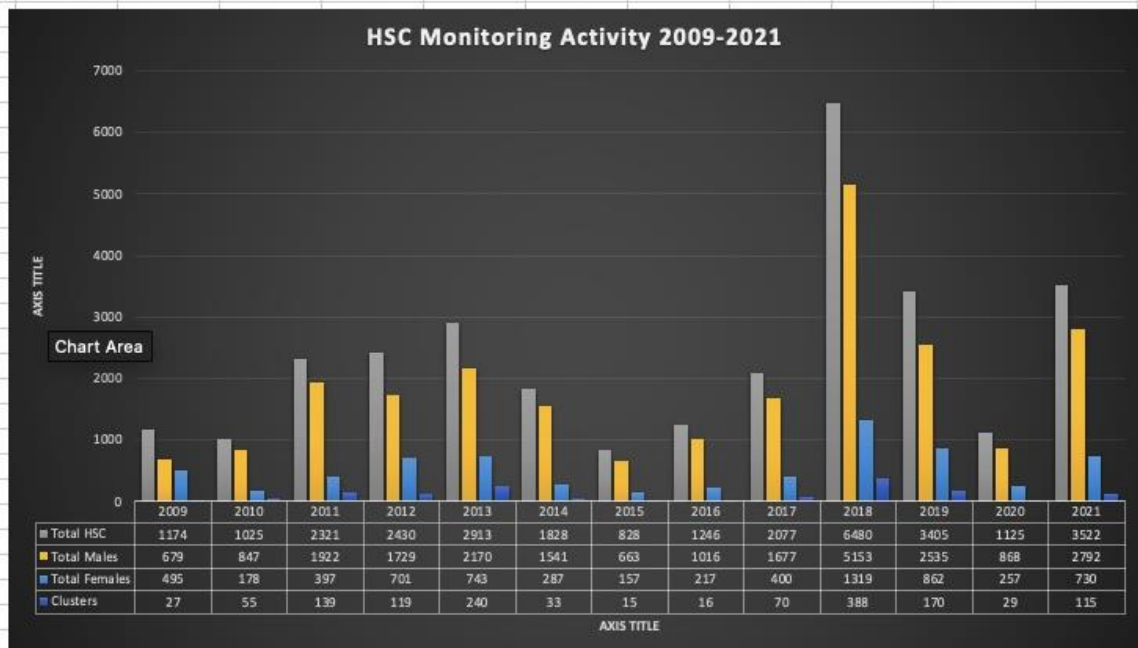
## **Total Horseshoe Crab activity for May & June 2021**

	Total Crabs	Total males	Total females	Single males	Single females	Swimming Pairs	Burrowed Pairs	Clusters	Dead crabs	Crabs Tagged
TOTAL	3,522	2,792	730	1,601	17	399	179	11	13	175



**TOTAL HSC ACTIVITY FOR THE FIVE MONITORING SITES IN THE RARITAN BAY – SANDY HOOK BAY ESTUARINE COMPLEX FOR YEARS: 2009 to 2021 (13 years of data).**

YEAR	Total crabs	Total males	Total females	Single males	Single females	*Swimming pairs	*Burrowing pairs	Clusters	Dead Crabs	** Crabs Tagged
2009	1,174	679	495	251	96			27	6	
2010	1,025	847	178	475	16			55	20	
2011	2,321	1,922	399	1,225	86			139	28	
2012	2,430	1,729	701	753	25			119	118	
2013	2,913	2,170	743	1,259	40	265	276	240	95	
2014	1,828	1,541	287	1,168	10	145	92	33	44	
2015	828	663	157	347	32	51	43	15	30	
2016	1,246	1,016	217	769	15	130	50	16	39	
2017	2,077	1,677	400	1066	8	154	150	70	42	
2018	6,480	5,153	1,319	2923	12	735	279	338	24	
2019	3,405	2535	862	1368	12	368	325	170	11	341
2020***	1,125	868	257	554	5	150	46	29	2	0
<b>2021</b>	<b>3,522</b>	<b>2792</b>	<b>730</b>	<b>1,601</b>	<b>17</b>	<b>399</b>	<b>179</b>	<b>11</b>	<b>13</b>	<b>175</b>



\* In 2013, the parameter known as “pairs” was divided into two separate categories: “swimming pairs” and “burrowed pairs.” This was done in order to clarify better HSC mating activities at each monitoring site. Other parameters are consistent with the term of the study. The following is the total numbers of pairs (both swimming pairs and burrowing pairs) recorded from 2009 to 2012:

2009: 334  
 2010: 261  
 2011: 254  
 2012: 507

\*\* In 2019 another parameter was added – how many HSC were tagged during each monitoring event. Although volunteer members have tagged crabs since the monitoring program’s inception in 2009, the field was added to better illustrate and coordinate tagging activities alongside monitoring activities for future reference.

\*\*\* 2020 was a monitoring period that was shortened due to the COVID-19 Virus outbreak. As a result, monitoring activities only took place on two dates in June (full moon and new moon). Tagging activities did not occur due to social distancing protocols at the time.

## **RECOMMENDATIONS**

There needs to be greater protection for known mating sites in Raritan Bay and Sandy Hook Bay, including Cliffwood Beach in Aberdeen Township, Keyport Harbor in the Borough of Keyport, and the mouth of Many Mind Creek in Atlantic Highlands. Horseshoe crabs congregate along estuarine beaches seasonally to spawn, which make them especially vulnerable to exploitation, either intentionally or not, by local fishermen or beachgoers. In addition, a need exists for greater public education to inform people about the importance for horseshoe crab conservation and in local estuarine ecology; and for people not to disturb spawning horseshoe crabs.

## **APPRECIATION**

Appreciation and gratitude is given to the project partners. This study is a cooperative effort involving the U.S. Fish and Wildlife Service, National Park Service, Gateway National Recreation Area, the New Jersey Division of Fish and Wildlife, Bayshore Regional Watershed Council, Save Coastal Wildlife, Brookdale Community College, Environmental Science Department, and Marine Academy of Science and Technology (M.A.S.T.) at Sandy Hook.

In addition, appreciation is given to over 50 volunteers from the watershed council, local citizens, and volunteers with the Monmouth County Park System and the Bergen County Park System, who routinely give up a bit of their time in May and June to assist in this project, so that other people might gain a better understanding of horseshoe crab activity in Raritan Bay & Sandy Hook Bay, Monmouth County, New Jersey. Without the help of everyone involved, this project would not have been accomplished. Thank you!