NEW JERSEY'S HORSESHOE CRAB RESCUE PROGRAM: *2017 Summary Report*

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Program Overview

Background Information

The Delaware Bay population of horseshoe crabs (*Limulus polyphemus*) is globally significant. Surveys estimate between 300,000-1,300,000 horseshoe crabs annually climb onto Bayshore beaches in New Jersey to spawn and are in greatest numbers during spring tides in May and June (Swan et al. 2016). During spawning, crabs risk becoming stranded on the beach. Waves can overturn crabs, or they may become impinged in man-made structures, marine debris, or natural obstacles. Though horseshoe crabs often are able to get back to the water unassisted, degraded beach conditions, structures, or storm-enhanced high tides may prohibit the crabs from returning to the water without assistance. Stranding can result in the mortality of a significant number of horseshoe crabs due to desiccation, predation, or overheating. The risk of stranding is compounded by the fact that crabs may come ashore to spawn multiple times each season.

During peak spawning, Delaware Bay beaches also support hundreds of thousands of shorebirds stopping over to refuel and rest during northbound migrations of 7,000 miles or more to their breeding grounds. These shorebirds depend on the availability of abundant horseshoe crab eggs to gain the nutrition necessary to complete their migration and nest successfully.

Due to a combination of factors, including overharvest and habitat loss, the Delaware Bay horseshoe crab population experienced a substantial decline in recent decades (Niles et al. 2009). As the number of horseshoe crabs dropped, so too did the populations of shorebirds stopping over during migration (Niles et al. 2009). In response, many Bayshore beaches in New Jersey are closed to the public from May 7 to June 7 each year so that shorebirds can forage undisturbed. During the beach closure, horseshoe crabs that become stranded on the beach are unable to be assisted to a safer position.

The reTURN the Favor (RTF) program was initiated five years ago, in the spring of 2013, to reduce strandings and subsequent preventable losses of horseshoe crabs on New Jersey beaches while complying with state laws and regulations that protect horseshoe crabs and shorebirds. reTURN the Favor is a collaborative program, sanctioned by the New Jersey Division of Fish & Wildlife (NJDFW) and supported by nine organizations, that permits volunteers to rescue horseshoe crabs stranded on New Jersey's spawning beaches, including those that are seasonally closed to protect shorebirds.

The program is managed by a steering committee consisting of representatives from NJDFW and three member organizations (Table 1) who develop and coordinate program logistics. reTURN the Favor's partner organizations and trained program volunteers serve 22 beaches on the Bayshore (Table 1). The overall goals of reTURN the Favor are to: 1) rescue stranded horseshoe crabs, 2) provide an organized way to rescue horseshoe crabs on New Jersey's seasonally closed beaches, 3) increase awareness of horseshoe crabs, shorebirds, and their management, and 4) collect data and information on stranded crabs, potential hazards, and tagged crabs to aid in management and restoration.

Sidebar photograph: L. Chamberlin

Results presented in this report are preliminary and represent all data submitted to the reTURN the Favor program through August 1, 2017.

Table 1. Sponsoring partner organization for each reTURN the Favor location in 2017. * indicates Steering Committee Partner.

Location	Partner
Sea Breeze	Western Hemisphere Shorebird Reserve Network (WHSRN)*
Money Island	Bayshore Center at Bivalve
Gandys Beach	Bayshore Center at Bivalve
Dyers Cove	Western Hemisphere Shorebird Reserve Network (WHSRN)*
Fortescue/Raybins	Bayshore Center at Bivalve
Port Norris	No sponsor (RTF volunteers)
Heislerville	No sponsor (RTF volunteers)
East Point	Citizens United for the Maurice River and its Tributaries
Thompsons Beach	Western Hemisphere Shorebird Reserve Network (WHSRN)*
Moores Beach	Bayshore Center at Bivalve
Goshen Beaches	No sponsor (RTF volunteers)
Reeds Beach	The Wetlands Institute*
Cooks Beach	New Jersey Audubon
Kimbles Beach	Friends of Cape May NWR
Bay Cove	No sponsor (RTF volunteers)
Pierces Point	New Jersey Audubon
Highs Beach	New Jersey Audubon
Rutgers Beach	Rutgers University
Sunray/Norbury	The Nature Conservancy
Villas	The Wetlands Institute*
North Cape May	The Wetlands Institute*
Higbee Beach	The Nature Conservancy

Program Developments

2017 marked the fifth year for the reTURN the Favor program. The program has expanded and strengthened each year – from the number of people engaged, to the number of horseshoe crabs rescued, to improved data collection. With the help of enthusiastic partners and volunteers, and the support of funders, we're doing more with the data too, by addressing threats on beaches to improve conditions and decrease impingement risk to spawning crabs.

The success of the program depends on the support of NJDFW and contributions of a group of nine partner organizations. Each partner sponsors one to four beaches and has the flexibility to manage program walks as best fits their organization—with independent volunteers, staff, public walks, or a combination of activities. Partners are the first line of support and communication with volunteers, ensure program protocols are followed and data are submitted, and spend time out on the beaches rescuing crabs, bringing attention to problem areas and program needs.

A record number of volunteers engaged with the program this year, and thousands of people have been reached directly through program trainings and walks. Countless others learn about the conservation needs and biology of horseshoe crabs, shorebirds, and other residents of the Delaware Bay through conversations on the beach or with community groups, educational and outreach programs, and by joining our volunteers on rescue walks. As our volunteer base grows, the constituency of people engaged grows exponentially, as volunteers often bring their passion for the program back to their network. A Facebook group that formed at the end of the season last year proved to be a useful tool for engaging this community by providing a platform for sharing stories and photos, mobilizing for storm event emergencies, supporting volunteers, and solving natural history mysteries from the beach.

Figure 1. Hands on for all ages.
Photo: A. Zito-Livingston

Dedicated volunteers are the keystone to reTURN the Favor. We are training new volunteers each year. Prior to the start of the season, we hold volunteer recruitment and training workshops at the Bayshore Center at Bivalve in Bivalve, NJ and at The Wetlands Institute in Stone Harbor, NJ. In 2017, trainings were attended by 188 volunteers. Over five years, volunteers have stepped up to lead reTURN the Favor walks and people of all ages have joined walks, altogether contributing 7,017 hours. Volunteers are provided protocols, datasheets, permits, and handouts. We have also developed Fact Sheets for nearly all of our sponsored beaches to provide volunteers information on the beach features, known impingement hazards, closure status, and other details. In turn, volunteers submitted data through our website with detailed information on impingement hazards to help us better understand the degree to which these potential hazards may impact horseshoe crabs.

We use the data collected over the years to locate impingement areas that can be addressed through small-scale restoration efforts. We started with East Point Lighthouse in 2015, focused on Moores Beach in 2016 and 2017, and added Fortescue Beach in 2017, along with debris cleanup days on important spawning beaches prior to the start of the season (Figure 2). Through these efforts, we are removing debris, patching holes, and improving conditions for spawning crabs.

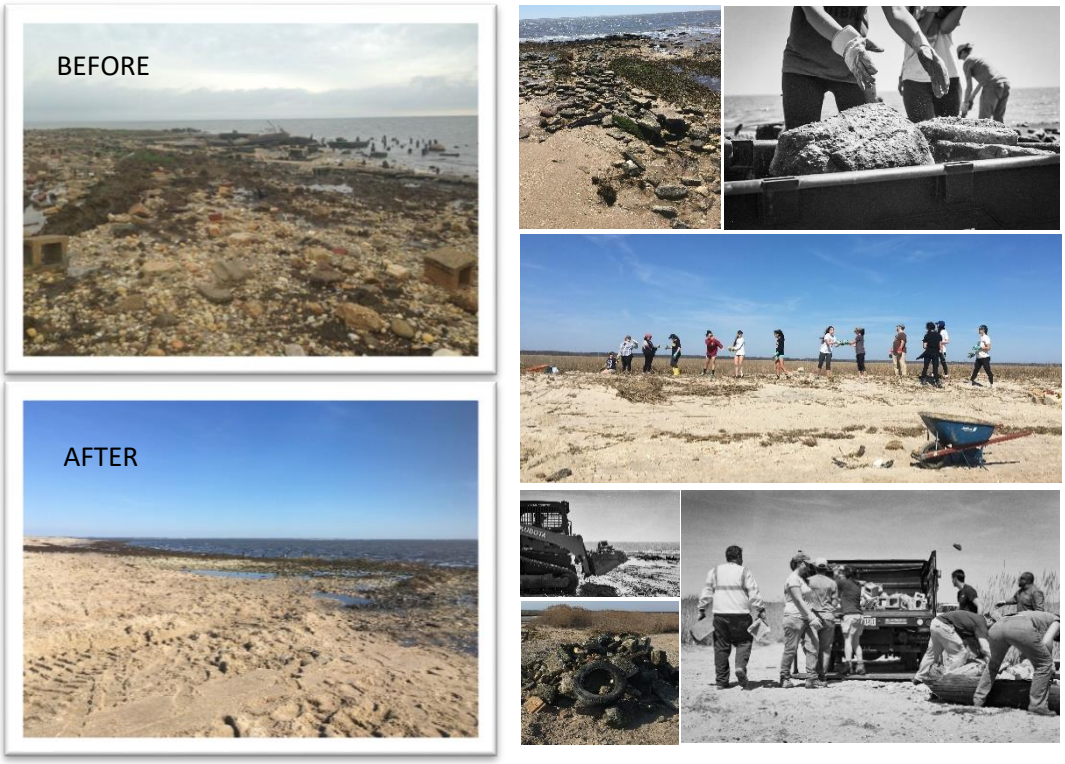


Figure 2. Moores Beach before in 2016 (top left) and after (bottom left) cleanup efforts in 2016 and 2017 (right compilation). Photos: L. Ferguson (color photos) and M. McCutcheon (black and white photos).

To further address the large concentrations of crabs that overwashed far above the high tide line on certain beaches or under tidal flooding conditions, we received permission to trial the use of bins and containers to move crabs to safer locations. This added permission became particularly valuable over Memorial Day weekend when extremely high tides coupled with a large spawning event led to extraordinary number of crabs stranded in marshes, on roads, and in rubble. Though these types of stranding issues have been documented occasionally throughout the program, the Memorial Day weekend event highlighted important hotspot areas prone to high volume strandings when conditions are extreme. This event, combined with the trialed use of containers to return crabs to the beach, allowed program volunteers to substantially increase the number of crabs rescued from overwash and marsh areas in 2017.

Several milestones were reached this year:

- The 5,000th volunteer hour was logged in April;
- 32,000 lbs of rubble was cleared from Moores Beach by volunteers in April;
- The 1,500th reTURN the Favor walk was led in June;
- The total number of rescued crabs reached and surpassed 250,000 in June.

2017: Program Results

In total, 131,024 horseshoe crabs were rescued at 22 New Jersey spawning beaches during 847 rescue walks by reTURN the Favor partners and volunteers between April and July 2017 (Figure 3, Table 2). We continued to see an increase in volunteer engagement, with outreach materials, the reTURN the Favor website, partner efforts, social media, and word of mouth attracting new participants to the program. The number of walk leaders was up this year, with 118 people conducting rescue walks for their partner organization and increasing the number of walks at nearly all sponsored beaches. Together, reTURN the Favor walk leaders and participants spent 2,975 hours rescuing crabs. Over 1,500 volunteers participated in program walks comprised of solo volunteers to groups of up to 20 participants. The average walk lasted one hour sixteen minutes and covered a distance of 0.94 km, with an average of three participants.

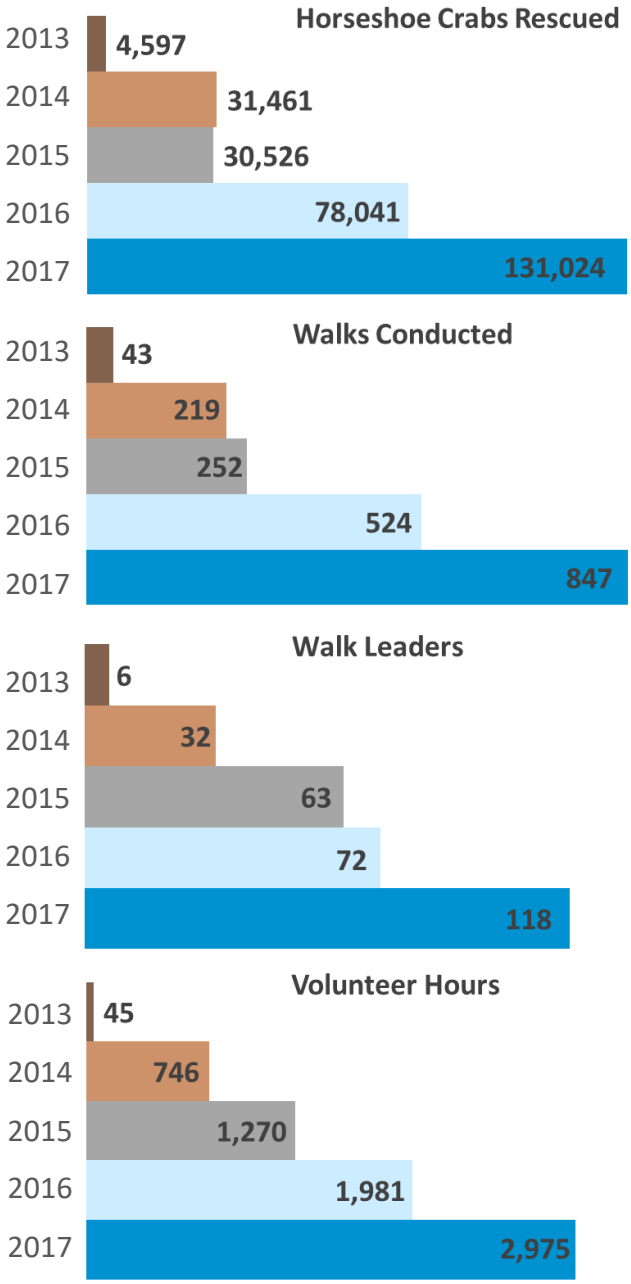


Figure 3. Comparison of program results from 2013 - 2017; Photos from reTURN the Favor walks: M. Zimmerman (top), A. Anholt (bottom).

Table 2. Results from the 2017 reTURN the Favor season by beach, ordered north to south. Average crabs rescued/100m is based on Total per walk and average distance walked at each site.

		Crabs Rescued						
Location	Walks	Overturned	Man-made Impingement	Natural Impingement	Overwashed (Unknown)	Total	Avg per walk	Avg per 100m
Sea Breeze	49	2,305	1,781	1,154	1,554	6,794	139	20
Money Island	79	6,233	2,773	896	3,124	13,026	165	18
Gandys Beach	46	1,036	3,211	17	584	4,848	105	16
Dyers Cove	51	7,226	638	370	377	8,611	169	28
Fortescue/Raybins	129	11,743	11,703	1,313	422	25,181	195	16
Port Norris	34	41	282	853	0	1,176	35	115
Heislerville	1	0	0	0	0	0	0	0
East Point	67	2,625	1,780	2,177	775 (2)	7,359	110	14
Thompsons Beach	42	6,960	300	230	58 (6)	7,554	180	13
Moores Beach	53	7,549	129	847	2,506 (14)	11,045	208	18
Goshen Beaches	5	1,224	0	541	0	1,765	353	31
Reeds Beach	87	13,951	943	727	4,967 (1)	20,589	237	26
Cooks Beach	8	18	0	120	1,200	1,338	167	34
Kimbles Beach	15	242	3	28	0	273	18	2
Bay Cove	1	27	0	155	0	182	182	61
Pierces Point	14	175	79	3	8,262	8,519	609	94
Highs Beach	26	593	69	0	9	671	26	1
Rutgers Beach	14	772	108	14	0	894	64	9
Sunray/Norburys	26	645	275	15	41	976	38	7
Villas Beach	44	5,131	325	3	25	5,484	125	11
North Cape May	22	869	146	3	57	1,075	49	5
Higbee Beach	34	3,652	11	0	1	3,664	108	8
Total	**847**	**73,017**	**24,556**	**9,466**	**23,962 (23)**	**131,024**		

Overturned Horseshoe Crabs

A majority of the total rescued crabs in 2017 were overturned (73,017 crabs, 56%) during spawning activity, which is a lower percentage than program results from previous years (74% - 81%). Spawning beaches with the most overturned crabs were Reeds Beach (13,951 crabs) and Fortescue/Raybins (11,743), which also had the two highest number of total crabs rescued and number of rescue walks (Figure 4, Table 2). On a per walk basis, Goshen Beaches (245 crabs/walk) and Thompsons Beach (166 crabs/walk) had the most overturned crabs. Several years of program results demonstrate that the number of crabs overturned due to local habitat characteristics such as beach slope, density of spawning crabs, or wind direction /wave conditions vary with time and among beaches, but the consistency of the issue means that more walks result in more overturned crabs rescued. The need to continue the program is apparent as mortality of overturned crabs due to predation and desiccation are also evident during rescue walks, though the number of dead crabs are not documented on walks.

Figure 4. Map displays overturned horseshoe crabs rescued in 2017: Graduated symbols indicate the average number of crabs that were rescued during reTURN the Favor walks at each location, standardized by the number of walks at each site. Photos: L. Kelly-Cranmer (top), L. Tedesco (middle), E. Fackler (bottom).

Man-Made Impingement Hazards

Nearly all beaches covered by the program had man-made impingements entrapping crabs. These hazards range from localized to extensive, and can pose a lethal risk to all crabs nearshore. In 2017, 24,556 crabs (19%) were freed from man-made impingements including housing structures, bulkheads and seawalls, rubble, and marine debris (Table 2). Over the past four years, the percentage of impinged crabs in man-made hazards has ranged between 14%-20% of all rescued crabs. Fortescue/Raybins and Gandys Beaches had the highest percentage of crabs rescued from man-made impingements this year, 48% and 13% of all man-made impingements, respectively, and on a per walk basis (Fortescue/Raybins: 91 crabs/walk, Gandys: 70 crabs/walk) (Figure 5). Along with Sea Breeze and East Point Lighthouse, these beaches have consistently had a large proportion of impinged crabs in man-made hazards during the program relative to the other beaches.

Data collected by beach on impingement type and location show the degree of the problem (Figure 6). In many cases, removing or improving these hazards is beyond the scope of this program. For example, 68% of impinged crabs in 2017 were rescued from rip-rap, bin blocks, and rubble and 10% from houses, seawalls, and bulkheads. In most cases, these structures protect homes and communities and

cannot be removed. Improvements to these and other hazards are easier and less costly to address. Rubble piles, marine debris, and gaps in coastal structures are hazards that the program has targeted to benefit crabs through small-scale restoration projects and beach cleanups at East Point Lighthouse, Moores Beach, and Fortescue Beach. For example, while Fortescue/Raybins remains a site with large numbers of impinged crabs and hazard areas, continued restoration efforts may be helping to reduce the issues there. The number of rescued crabs per walk initially decreased after a beach replenishment project in 2015 (2014: 245 crabs/walk, 2015: 99 crabs/walk, 2016: 83 crabs/walk); however extensive hazards remain. Small projects like the reTURN the Favor bulkhead repairs in 2017 (Figure 5, top right) improved conditions and allowed volunteers to focus on extracting crabs from other hazard areas. Anecdotally, fewer crabs were trapped at the repaired bulkheads compared to previous years, and the data may support this – 6 crabs/walk were rescued from bulkheads and houses in 2016 compared to 2 crabs/walk in 2017. reTURN the Favor data can also be valuable for prioritizing attention to hazard areas for horseshoe crabs and informing the design and selection of large restoration projects conducted by other groups. This season, volunteers freed 185 crabs from shell bags, gabions, geofabric, and fencing near oyster reefs used in Bayshore restoration projects, demonstrating the need to monitor project sites and their impacts to horseshoe crabs before and after restoration projects.

Figure 5. Map displays horseshoe crabs rescued from man-made impingements in 2017: Graduated symbols indicate the average number of crabs that were rescued during reTURN the Favor walks at each location, standardized by the number of walks at each site. Photos: L. Ferguson (top); L. Chamberlin (middle); S. Anderson (bottom).

Bin blocks/riprap/concrete rubble

Beach	Crabs/walk	Total
Fortescue/Raybins	69	8,964
Gandys Beach	66	3,022
Sea Breeze	33	1,597
Money Island	20	1,555
East Point	5	309
Dyers Cove	6	290
Thompsons	7	273
Port Norris	7	228
Reeds Beach	7	223
Moores Beach	2	102
Highs Beach	3	68
Sunray/Norburys	2	46
Villas Beach	< 1	17
Kimbles Beach	< 1	3
		16,697

Boat ramp

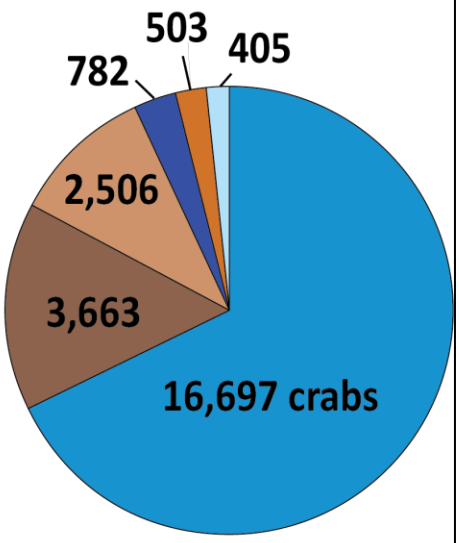
Beach	Crabs/walk	Total
Fortescue/Raybins	17	2,137
East Point	21	1,426
Money Island	1	81
Rutgers Beach	1	10
Port Norris	< 1	6
Gandys Beach	< 1	3
		3,663

House/bulkhead/seawall

Beach	Crabs/walk	Total
Money Island	13	1,008
Reeds Beach	6	521
Fortescue/Raybins	2	241
Sunray/Norburys	8	219
Dyers Cove	3	178
Gandys Beach	3	144
Sea Breeze	3	139
Villas Beach	1	46
Pierces Point	1	9
North Cape May	< 1	1
		2,506

Outfall Pipes

Beach	Crabs/walk	Total
Villas Beach	5	229
North Cape May	6	131
Sea Breeze	< 1	23
Rutgers Beach	1	11
Highs Beach	< 1	1
		405



Marine debris/other

Beach	Crabs/walk	Total
Reeds Beach	2	194
Dyers Cove	3	167
Fortescue/Raybins	1	130
Rutgers Beach	6	82
Port Norris	1	48
East Point	1	45
Moores Beach	1	27
Money Island	< 1	23
Sea Breeze	< 1	22
Thompsons	< 1	21
Villas Beach	< 1	20
Gandys Beach	< 1	2
Pierces Point	< 1	1
		782

Jetty

Beach	Crabs/walk	Total
Fortescue/Raybins	2	231
Money Island	1	106
Pierces Point	5	69
Gandys Beach	1	40
North Cape May	1	14
Higbee Beach	< 1	11
Sunray/Norburys	< 1	10
Thompsons	< 1	6
Reeds Beach	< 1	5
Rutgers Beach	< 1	5
Dyers Cove	< 1	3
Villas Beach	< 1	3
		503

Figure 6. Number of horseshoe crabs rescued from man-made impingements by hazard type and location, 2017. A total of 24,556 crabs were rescued from man-made impingements.

Natural Impingement and Overwash Hazards

Natural impingements such as marsh grasses and peat outcrops accounted for 9,466 (7.2%) of total crabs rescued, nearly double the percentage of crabs rescued from natural impingements in some years (3.7-4.4%). Crabs can become impinged in these hazards due to degraded and eroded beach conditions and/or high tides that transport crabs to dunes or marshes adjoining the spawning beaches. East Point (2,177 crabs), Sea Breeze (1,154 crabs), and Fortescue/Raybins (1,313 crabs) had the most crabs rescued from natural impingements (Table 2, Figure 7). When controlling for effort, Bay Cove (155 crabs/walk) and Goshen (108 crabs/walk) Beaches had the highest number of crabs rescued from natural impingements on the beach. Both of these unsponsored beaches were visited after full moon tides and had not been visited in previous years.

In addition to crabs impinged during normal astronomical tides, each season crabs become stranded far beyond the normal tidal range when high winds and storms create tidal flooding events that push crabs into overwash areas, marshes, and onto roads. As tides recede to normal levels on subsequent days, these overwashed crabs may not be able to access the water and can eventually die from exposure. In total, 24,099 crabs were rescued from this type of stranding in 2017. Fewer than 450 crabs were

Figure 7. Map displays horseshoe crabs rescued from natural impingements and strandings in 2017: Graduated symbols indicate the average number of crabs that were rescued during reTURN the Favor walks at each location, standardized by the number of walks at each site. Photos: K. Lee (top); L. Ferguson (middle); E. Fackler (bottom).

rescued in the previous two years from similar conditions and were not included in natural impingement totals. This season, a large overwash event took place over Memorial Day weekend, when winds exacerbated high spring tides during peak spawning, trapping crabs far above the intertidal zone. Special efforts were made to coordinate activities among partners, volunteers, NJDFW biologists and conservation officers to assist the overwashed crabs. Between May 26-30, 19,514 overwashed crabs were rescued, 81% of all overwashed crabs for the season. Overturned and impinged crab rescues also increased over this peak period, for a total of 44,534 crabs saved (more than yearly program totals in 2013, 2014, and 2015). After this event, volunteers' awareness of these natural impingement locations likely led to an increase in vigilance during regular walks and after spring tides, resulting in higher numbers of rescued crabs naturally impinged and overwashed in 2017 compared to previous seasons. Use of totes to move crabs was permitted under limited conditions this season, which also contributed to more crabs saved. The program will continue to identify areas and times overwash stranding is a problem so beach replenishment and restoration projects can include a focus on improving spawning habitat and reduce risk from natural impingement to horseshoe crabs spawning on these beaches.

Additional Results

Of the 131,024 rescued horseshoe crabs, 96,567 (74%) were male and 34,457 (26%) were female. The 3:1 male to female ratio of stranded crabs is similar to program results from most seasons and includes greater representation of rescued female crabs than what is generally recorded during spawning surveys of the Delaware Bay population (Swan et al. 2016).

During reTURN the Favor walks, 240 observations of 215 tagged individuals were recorded and batch submitted to U.S. Fish and Wildlife Service. By identifying tagged crabs, reTURN the Favor contributes to federal and statewide efforts to study horseshoe crab population dynamics and movements.

Conclusions: Five years and more to do

Figure 8. *Limulus* love. Photo: N. Babich

The 2017 reTURN the Favor season far exceeded previous years of the program in all metrics. Volunteer engagement, number of walks, and number of beaches covered all resulted in a large increase in horseshoe crabs returned to the bay. Each year of the program has seen gains in effort, efficiency, and results. And in the process, more people are visiting the Bayshore and learning about its resources, with 95% of volunteers responding to a survey indicating that they increased their knowledge of the conservation challenges facing horseshoe crabs and shorebirds. Volunteers are also ready to do more, with 75% of respondents reporting a willingness to take further action beyond rescuing horseshoe crabs to protect these species. As we identify problems along the way, we're putting the results into action too, through the small-scale spawning habitat restoration and improvement projects at Moores, Fortescue, East Point Lighthouse, Kimbles, and Reeds Beaches over the past three years. Data collected through the program will continue to help highlight sites where improvements to spawning habitat are still needed. These data also provide an indication of the extent of the conditions horseshoe crabs face while spawning.

The reTURN the Favor program continues to demonstrate that the simple act of rescuing stranded crabs can become an impactful one, as large numbers of crabs can be helped with a unified effort of engaged and knowledgeable volunteers. So far, it appears to be succeeding—through five seasons and incredible effort from volunteers and partners, the program has already rescued 275,650 horseshoe crabs that otherwise may have been lost. The results of our first five years are clear: when more people are engaged, and more walks are conducted, more crabs are rescued. And there is still more to do.

Acknowledgements

This program would not be possible without the exhaustive efforts of the volunteers, partners, and steering committee members who contribute to reTURN the Favor. Thanks to the New Jersey Division of Fish and Wildlife for program support and scientific collection permits, and to property owners who provided permission to work on their lands. Thanks also to Steward 'Gub' Maines and the Cumberland County Improvement Authority for contributing equipment and services for the Moores Beach cleanup.

Figure 9. Haddonfield High School volunteers at Moores Beach, 2017. Photo: M. McCutcheon

Program Partners – Present and Past:
Bayshore Center at Bilvalve: Meghan Wren
Citizens United for the Maurice River and its Tributaries: Lillian Armstrong, Jane Galetto, Karla Rossini
Conserve Wildlife Foundation of NJ: Lindsay McNamara, Larry Niles, David Wheeler
Executive Office of Western Hemisphere Shorebird Reserve Network: Laura Chamberlin
Friends of Cape May National Wildlife Refuge: Ralph Boerner, John King, Meghan Kolk
New Jersey Audubon Society: Mike Crewe, Brett Ewald, Don Freiday, Margeaux Maerz, David La Puma
New Jersey Division of Fish and Wildlife: Matthew Danihel, Amanda Dey, Captain Jason Snellbaker
Rutgers University: Patty Woodruff
The Nature Conservancy: Adrianna Zito-Livingston
The Wetlands Institute: Allison Anholt, Lisa Ferguson, Christine Mattera, Katie Sellers, Lenore Tedesco

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