2012 Sea Nettle Barrier Project

Final Report

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Introduction

The Atlantic Sea Nettle (*Chrysaora quinquecirrha)* has become a familiar nuisance at many of the public bathing beaches in the northern portions of the Barnegat Bay. In response to public requests, a number of municipalities have taken preventative actions to protect their swimmers. In 2010 and 2011, the Barnegat Bay Partnership (BBP) along with the Ocean County Health Department and several bay and riverfront municipalities developed a "Sea Nettle Warning Network System", in which lifeguards walked along the water's edge, visually counted the number of nettles present at various times throughout the day, and posted advisories at their respective beaches (Barnegat Bay Partnership 2011).

After two successful seasons employing the Warning Network at the bay beaches, the BBP developed a project to further assess the quantity of nettles in the bays and rivers while also protecting the swimmers at these beaches. Based on successful barrier net projects in other locations, including Australia, the Mediterranean Sea and the Chesapeake Bay (Shultz and Cargo 1969), the BBP piloted the "Sea Nettle Barrier Net Project" in the summer of 2011 (Barnegat Bay Partnership 2012). This project implemented the use of mesh barrier nets at Brick Township and Lavallette to serve as a barrier between sea nettles and beachgoers while also having minimal impact on other bay biota.

The goal of the 2012 project was to investigate if a reduced mesh size would result in increased exclusion of sea nettles within a bathing area as compared to the mesh size used in 2011 while continuing to have minimal impacts on local fauna. In addition to changes in mesh size, the project will also assess faunal entanglement rates between the different twine thicknesses used in 2011 and 2012. Ultimately, we hope to develop a recommendation on gear type, deployment method, and deployment timing for municipalities interested in using a barrier device n their bathing beaches.

Materials and Methods

Sea nettle barriers were deployed during the summer of 2012 at two locations in the Barnegat Bay (Figure 1). Sampling sites (Windward Beach in Brick Township and Brooklyn Avenue Beach in Lavallette) were selected based on their locations in two different types of open water habitat (tidal river and open bay, respectively) as well as sediment type (soft, muddy

substrate compared to sandy bottom and eelgrass patches). The bathymetry at both beaches was similar: at 20 meters from shore, the water was generally between 0.7 and 1.0 meters in depth. Public beaches were given preference based on the ability of municipal staff to assist in the project as well as the high public visibility and educational opportunities afforded by these sites. These were the same sites utilized in the 2011 project (Barnegat Bay Partnership 2012)

The construction of the barriers in 2012 was modified compared to that of 2011, though the deployment of the nets was similar. The barrier nets utilized were 115 meter long seines (25mm (1 inch) square, #15 multifilament nylon) rigged for coastal waters (extra floats on the surface line and 30-lb leadcore sinking line). Barrier deployment was on a rotating schedule such that the barrier was set on Mondays and Wednesdays at Lavallette and Tuesdays and Thursdays at Windward Beach. The barrier devices were deployed on their respective days between 9:30 am and 10:00 am by BBP technicians or by municipal staff after a multi-week training period. The barriers were secured onto the beach using a fluke anchor on each end and pulled into a trapezoidal shape. At Windward Beach two 13-inch diameter buoys secured approximately 20 meters perpendicular to the shoreline served as the corners to which the net was attached, while in Lavallette PVC poles were jetted into the sand and the net attached to those.

Figure 1: Sampling beach locations

Effectiveness of the barrier net and its impacts on local fauna was assessed by seining outside and within the protected area as well as identifying entanglements in the barrier itself. BBP staff conducted two hauls of a 15-meter bag seine (6-mm mesh) within the barrier and two outside and immediately adjacent to it. The seine was deployed approximately 20 meters from

the shoreline and pulled onto the beach. Any fish, crabs, jellyfish, or ctenophores collected in the net were identified and measured to the nearest millimeter (fork length, total length, carapace width, or bell diameter, as appropriate). If more than twenty individuals of a species were encountered, a random subsample of twenty was measured and the remainder enumerated. For large quantities of ctenophores the first twenty were measured and then placed in a volumetric container. That volume was then recorded and the remainder of the ctenophores in the sample were measured volumetrically. Upon completion of seining the barrier nets were retrieved and any fish, jellyfish, or crabs entangled in the net were subject to the same procedure described for the seine.

Salinity, pH, dissolved oxygen, and temperature of the surface waters were determined at the time of seining and/or barrier retrieval using a YSI ProPlus Quatro handheld water quality instrument (Yellow Springs Instruments, Yellow Springs, Ohio). At the time of net retrieval, wind direction was recorded to sub-cardinal directions (*i.e*, NE, SW), and wind strength was visually assessed according to the Beaufort scale, which compares wind speed to observed sea or land conditions (waves, blowing leaves, etc.).

To avoid pseudoreplication seine hauls were aggregated by sample event (date, beach, inside/outside) for data analyses. Abundances were standardized to catch-per-unit effort (CPUE, number of individuals divided by number of hauls) for each event. Reduction rates of sea nettles (outside total minus inside total, divided by outside total) were calculated to quantify barrier efficiency. Statistical analyses were conducted in Microsoft Excel or R software package (R version 2.15.1)

Results

2012 Sea Nettle Abundance and Size Distribution

Sea nettles were more abundant at Windward Beach than in Lavallette during 2012 (Figure 2). Sea nettle medusa began appearing in samples collected at Windward Beach in early July, with abundance peaking on July 24th and decreasing thereafter, with lower abundances persisting until the end of September. Sea nettle medusa were captured in Lavallette in early June, and their abundance remained stable at relatively low levels until July 23rd, when abundances increased over the following two weeks to a peak on August 8th. Subsequent to that

peak sea nettles began to decline, though they were present in low numbers until the end of September.

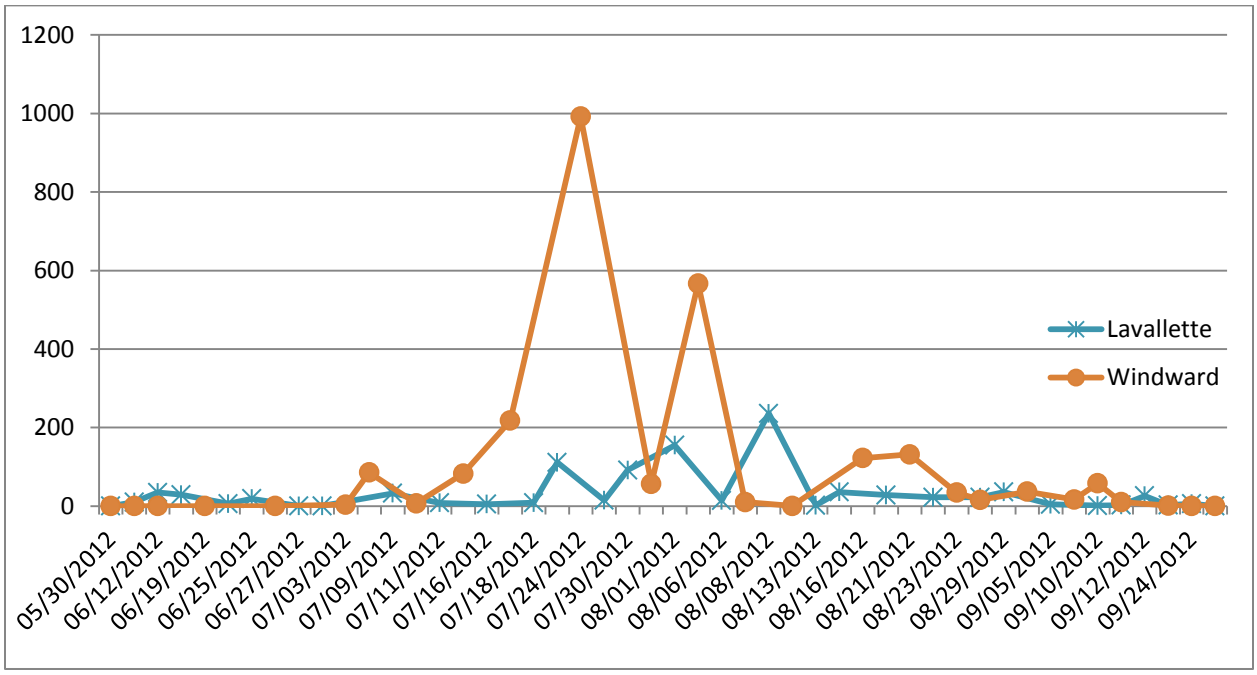

Figure 2: Catch per unit effort (CPUE) of sea nettles for seines outside of the barriers.

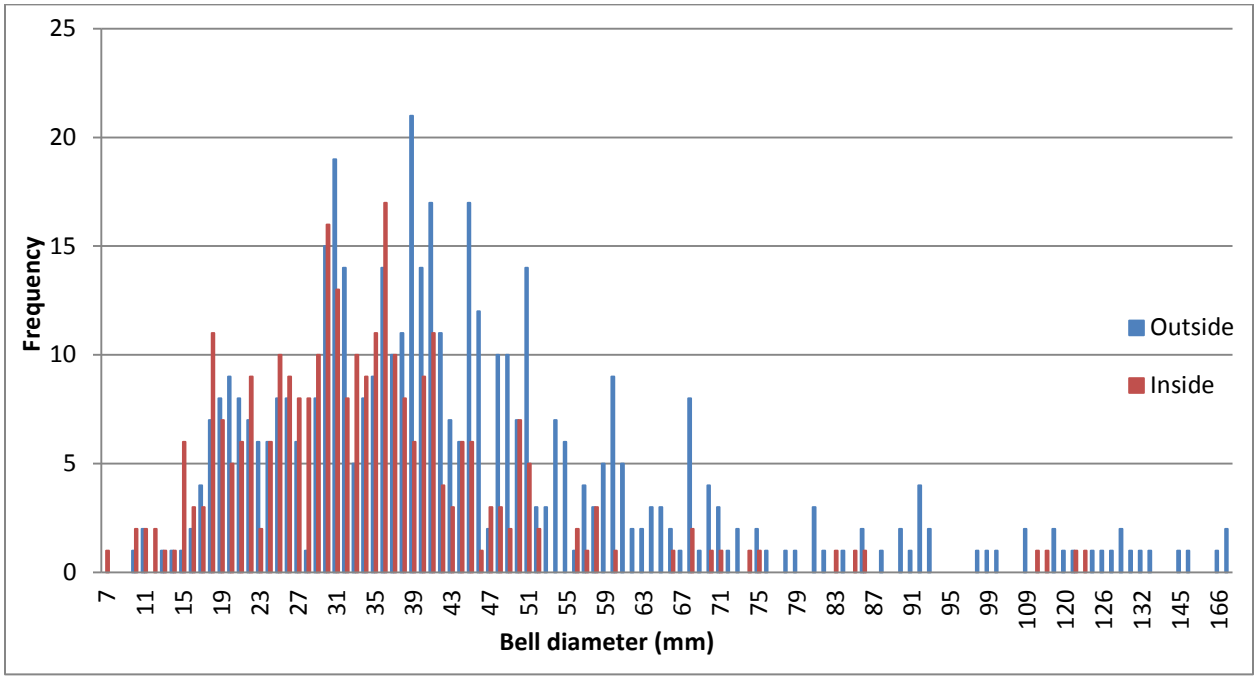

Figure 3: Sea nettle medusa bell diameter distribution outside (blue) and inside (red) of the barrier net at Lavallette in 2012.

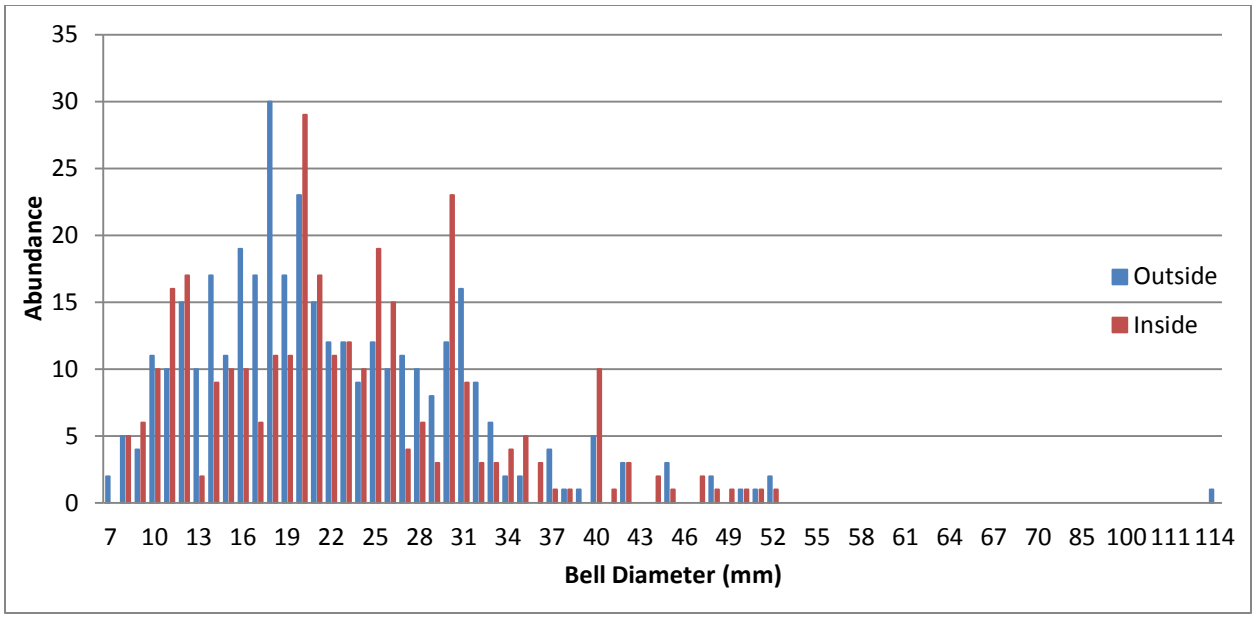

Figure 4: Sea nettle medusa bell diameter distribution outside (blue) and inside (red) of the barrier net at Windward Beach in 2012.

Table 1: Sea nettle bell diameter size range and means (in mm) for seines inside and outside the barrier at Lavallette and Windward Beach. *A single individual was found larger than 53 mm in 2012.

Location	Outside Range	Outside Mean	Outside Mode	Inside Range	Inside Mean	Inside Mode
Lavallette	7 - 171	47	39	6 - 123	35	30, 37
Windward Beach	4 – 114	22	18	8 - 53*	23	20

While the size range of sea nettles found at the two locations was similar, the mean bell diameter at Lavallette was nearly twice that of Windward Beach (Table 1). Sea nettle bell diameter ranged from 7 mm to 171 mm in Lavallette, with a mean diameter of 47 mm for those captured outside the barrier (Figure 3, Table 1). In Windward Beach sea nettles outside of the barrier ranged in bell diameter size from 7 mm to 114 mm with an average bell diameter found outside of the barrier of 22mm (Figure 4, Table 1). The mode, or most frequently encountered size, outside of the barriers was 39 mm at Lavallette and 18 mm at Windward Beach.

2012 Barrier Efficiency

The barriers were effective at reducing both the size and number of sea nettles present inside the barriers compared to outside (Tables 1-3). At both locations the sea nettle size range inside the barrier was truncated substantially, and at Lavallette this lead to a 12 mm reduction in the mean bell diameter (Table 1). Both beaches realized significantly fewer sea nettles inside the

barrier compared to outside, with nearly 64% fewer nettles inside the barrier at Lavallette (Table 2) and approximately 73% fewer at Windward Beach (Table 3).

Table 2: Reduction in sea nettle abundance inside the barrier compared to outside at Lavallette.

Net Type	Outside abundance	Inside abundance	Overall % reduction
(6/16/11-8/22/11) 39 mm #208	1108	403	63.63%
(8/22/11-9/26/11) 39 mm #18	427	157	63.23%
(6/18/12-8/28/12) 25 mm #15	1711	620	63.76%

Table 3: Reduction in sea nettle abundance inside the barrier compared to outside at Windward Beach.

Net Type	Outside abundance	Inside abundance	Overall % reduction
(6/16/11-8/22/11) 39 mm #208	6473	2943	54.53%
(8/22/11-9/26/11) 39 mm #18	1460	458	68.63%
(6/18/12-8/28/12) 25 mm #15	4619	1264	72.63%

2012 Barrier Net Impacts on Fauna

More fish and blue crabs were entangled in the barrier net per deployment at Windward Beach than at Lavallette during the course of the summer (Tables 4 & 5). Blue crabs (*Callinectes sapidus*), spot (*Leiostomus xanthurus*), and menhaden (*Brevoortia tyrannus*) were the species most often entangled in the net at both beaches, with bluefish (*Pomatomus saltatrix*) and summer flounder (*Paralichthys dentatus*) also entangled on occasion.

Table 4: Number of entanglements of various fauna in the barrier net per deployment for Lavallette.

Net Type	Blue Crab	Fish	Sea Nettles
(6/16/11-8/22/11) 39 mm #208	15	0.72	1.7
(8/22/11-9/26/11) 39 mm #18	0.29	1.14	0
(6/18/12-8/28/12) 25 mm #15	0.41	0.24	0.11

Table 5: Number of entanglements of various fauna in the barrier net per deployment for Windward Beach.

Net Type	Blue Crab	Fish	Sea Nettles
(6/16/11-8/22/11) 39 mm #208	57.18	0.54	0
(8/22/11-9/26/11) 39 mm #18	1.43	0.14	0
(6/18/12-8/28/12) 25 mm #15	2.3	1	0

Discussion

Sea nettle abundance and size distribution

While the patterns in sea nettle abundance and size distribution between Lavallette and Windward Beach in 2012 were similar to those found at the same locations in 2011, there were differences between abundance and sizes at each beach between years. In both 2011 and 2012 Windward Beach had substantially higher abundances of sea nettles than Lavallette, but the mean size at Windward was significantly smaller (Barnegat Bay Partnership 2012). However, in 2012 the mean bell diameter of sea nettles found at Windward Beach decreased from 2011 while those found at Lavallette increased. It is not clear from the data collected what could have driven this divergent pattern in sizes between the years. In addition, while peak abundance occurred approximately two weeks earlier at Windward Beach than at Lavallette in both years of the study, in 2012 the timing of peak abundance at both locations was approximately two weeks earlier than in 2011. The maximum water temperatures reached at each location in 2012 was also two weeks earlier than in 2011, suggesting that there may be a relationship between the time of peak abundance and peak water temperature, though this was not directly tested.

The dramatically larger abundances of small medusa at Windward Beach compared to Lavallette may reflect a preference of sea nettle polyps to settle in the fresher, more developed shoreline along the Metedeconk River than the more open bay in the vicinity of Lavallette. There are a number of marinas within the vicinity of the Windward Beach sampling site, and the shoreline along the Metedeconk River is heavily developed with bulkheads and personal docks. Recent studies of other scyphozoans (Hoover and Purcell 2009, Holst and Jarms 2007) have suggested that polyps preferentially settle on manmade building materials, and thus the Metedeconk may be serving as “nursery” habitat for sea nettles.

Barrier Efficiency and Impacts on Local Fauna

The 25 mm barrier net used in 2012 was more efficient at excluding sea nettles from the bathing areas than either of the 39 mm nets used in 2011, while impacts to blue crabs and fish were greatly reduced compared to the 39 mm #208 net used in 2011. While the overall reduction rate between the 25 mm barrier and 39 mm barrier at Lavallette were similar, the 25 mm barrier was more efficient at excluding larger sea nettles (>39 mm), which is the predominant size class

at that location and the primary concern of the bathing public. At Windward Beach the 25 mm barrier was very effective at excluding the overall number of sea nettles, but apparently did so by reducing the abundance of small (<25 mm) nettles. It is likely that the larger nettles (>39 mm) inside the barrier were being forced over the top of the barrier (which floated at the water surface) by small swells generated through boat traffic along the river.

Though the material used for the barrier is most commonly used in the commercial fishing industry to catch fish, in this particular application fish entanglement rates ranged from 0.24 to 1 fish captured per deployment. Catch rates for this type of gear are influenced by a number of factors, including the shape and orientation of the barrier, the shallowness of the habitats, the "bag" or amount of loose material that hangs in the water column, and the time of day and duration that the barrier is deployed (Hubert 1996). This project's short duration deployments in the middle of the day when many fish are less active likely led to the low catch rates. A limited number of experimental overnight deployments towards the end of the season showed higher entanglement rates.

The mesh size and type of material used in constructing the barrier played a substantial role in the number of blue crab entanglements. As discussed in the 2011 Sea Nettle Warning Network Report (Barnegat Bay Partnership 2012) the original 39 mm barrier was constructed of #208 multifilament nylon, and sustained significant damage due to crab entanglement. The damage at Windward was so severe that the original barrier material was abandoned, and a second set of barriers was constructed of #18 dipped nylon, still at 39 mm square mesh. These barriers sustained little to no damage associated with blue crabs, but the dipping process added considerable weight and made the nets more difficult to deploy. The #15 nylon used in the 2012 nets was slightly thinner than the #18 (1.3 mm vs 1.4 mm) and was undipped, but sustained no damage due to blue crabs. Furthermore, the undipped nets were lighter and were easier to store.

Acknowledgements

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