

Seining Beneath the Bridge: Reconnecting New Yorkers to their Marine Neighbors

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Brooklyn Bridge Park is a sustainable waterfront park that spans 1.3 miles of Brooklyn's East River shoreline. Opened in 2010, this world-class 85-acre greenspace serves over 4.5 million visitors annually. Comprised of formerly derelict industrial shipping piers and "upland" park space, it is an allegory of urban decay and consequent remediation as a result of community activism. As shepherds of this vital greenspace, Brooklyn Bridge Park Conservancy (hereafter referred to as "The Conservancy") worked for over 30 years to help bring Brooklyn Bridge Park to fruition. Beginning as a grassroots coalition, the Conservancy brought together residents, government, and local supporters to transform a neglected waterfront space into the vibrant park you see today. At present, the park includes sports courts, bike paths, trails, lawns, playgrounds, and most importantly, in the context of seining, soft shorelines and access to the East River as a living waterway. It has become a place to explore and protect.

In 2008, before Brooklyn Bridge Park officially opened, the Conservancy sought to engage the public in learning about the East River and what would soon become a thriving waterfront park for all. With the unique opportunity of beach and shoreline access (a rarity in NYC), we recruited experts Cynthia Fowx and Courtney Worrall from the Coastal Marine Resource Center (CMRC) and the New York State Department of Environmental Conservation (NYSDEC) to pilot a public

seining program. The three initial goals of this project were to (1) reconnect New Yorkers to their neglected waterfront, (2) inspire citizens to envision a future park, and (3) demonstrate that there is an abundant ecosystem just beneath the water's surface.

In partnership with Steve Stanne of NYSDEC, we began investigating different sites throughout the park's footprint, and determined that the beach under the Manhattan Bridge (hereafter referred to as "Main Street Beach") would be an ideal place for a seining program. There was a gentle gradient, a gravely bottom, and enough beach space to host the public at low tide. The beach had a natural cove, rip rap, jetty, and decaying pilings, all which offered structure as habitat for East River organisms. With a site identified, it was time to get more closely acquainted with our estuarine neighbors.

At the first public seining session in 2008, our hauls brought in various kinds of garbage and debris: trash cans, traffic cones, decaying railroad ties, and multiple tires. However, within these man-made objects, we found that nature had made use. In a traffic cone, there were several species of tunicates, sponges, snail eggs, mud snails, sandworms, and mud crabs. In a discarded wastebasket, we found that a spider crab had made it their home. Our actual catch was just as exciting, with Atlantic tomcod, Atlantic silverside, striped bass, flounder, bay anchovy, green crabs, shrimp, lion's mane jellyfish, and many comb jellies. Additional seines throughout our first season brought further diversity of species and even more people, with attendance regularly exceeding 100 participants. In subsequent sessions, attendance remained high (ranging from 46-135 participants per session) and the diversity of species continued to broaden. As community members began to shift from disbelief and incredulity of the East River's health, our working knowledge of this waterway began to develop. In developing this ecological literacy, there were

many wonderful surprises in store. The Conservancy and partners had discovered a flourishing ecosystem indeed.



Due to the success and popularity of this program, we increased the number of seining sessions the following year. Dubbed as “Year of the Seahorse,” 2009 was a banner year for the seining program. Not only did we catch several seahorses (quite the crowd pleaser), we piloted seining demonstrations during a few of our summer camp programs. In 2010, we made seining a more prominent feature of our summer class offerings, which doubled the total number of sessions provided. Previously, only staff and volunteers were allowed to wader up and seine, but in 2011 the Conservancy’s board of directors agreed to allow students and campers over the age of 14 to get in the water and work the net, provided they had a waiver signed by a caregiver. With the older groups now able to seine, we changed the program structure from 3 adults working the net

to 1-2 staff members assisting the 2-3 fledgling seiners as they worked. The river bottom proved to be the largest challenge in bringing teens into the water, as there was abundant debris that changed daily with tides and wakes. Additionally, the sheer novelty of wading into the East River was quite a distraction from actually catching fish. Although these challenges made bringing young New Yorkers into the East River a little tricky, the results were well worth the effort. Not only did this activity help with team and confidence building, young New Yorkers were interacting directly with waterways that so crucially need protection. As one student stated, “When I found out that there was stuff in the water I thought, ‘that’s really cool!’ In the city, we aren’t aware because we are so busy and there isn’t much nature around us that we see. I’m honestly so grateful to be able to participate in this project with my classmates. I never thought fish could be so interesting.”

In the following years, the Conservancy’s seining program expanded the number of seining opportunities for school and camp groups, as well as the general public. We broadened our partnership with NYSDEC by participating in estuary-wide snapshot data collection days such as Day in the Life of the Hudson River and Harbor and the Great Hudson River Estuary Fish Count. In further expansion of these efforts, we currently facilitate public seining events in conjunction with regional, national, and international waterfront festivals and celebrations. These include The Great Fish Count with World Science Festival, City of Water Day with the Waterfront Alliance, and Netherlands-based World Fish Migration Day. Events of this magnitude are well publicized and provide further opportunity to connect with a much wider audience than our typical gathering of attendees.

We also began reaching new teen audiences through a partnership with St. Francis College. Dr. Kathleen Nolan, Department Chair of Biology and Health Sciences, was an early advocate for

seining and data collection along the urbanized waterfront. In this collaboration, numerous college students were able to venture out of the classroom and down to the Main Street Beach for a lesson in seining and marine biology. In 2012 the St. Francis After-School Science Program launched, which provided middle school students from Title 1 schools an opportunity to seine and collect data beneath the Manhattan Bridge as well as participate in several other park programs and scientific studies. Similarly, the college's Summer Science Academy (a program for high schoolers) brought teens down to the waterfront for seining. These early successes with college, high school, and middle school students paved the way for the development of a full 1.5 hour seining class, periodically available during the school year. Spearheaded by Kara Gilmour, Nim Lee and Cynthia Fowx, (later enhanced and updated by Isa Del Bello and Christina Tobitsch), the class entitled "Seining the River Wild" was born. This class gave participants of all ages the opportunity to explore a natural shoreline and get a glimpse of the estuarine life found below the East River's surface.

While the borders of Manhattan are primarily bulkhead and seawall, Brooklyn Bridge Park's incorporation of softer edges such as beaches, rip rap, and salt marshes allow for a more publicly accessible and interactive waterfront. For our seining school program, this gives students an enriching outdoor classroom. At one station, students are encouraged to beach comb and dig into the tide pools. They often create piles of their most exciting finds and are ecstatic when that tiny shell they found turns out to be housing a hermit crab. At another station, students practice using dichotomous key to identify the mystery fish swimming in a large, temporary holding tank. The highlight of every program, however, is the moment when the net returns to shore. Students are visibly and physically excited as they wait for the seiners to return with their haul, which is followed by a moment of surprise and wonder once the net is pulled onto dry land. If they have

proven to be responsible, many lucky youngsters get the opportunity to wet their hands and help gently scoop the organisms out of the net and quickly into a bucket. “I can’t believe you caught something!” is an exclamation we usually hear at least once per class. This occurs all while river boats, barges, and ferries speed by in the distance and the glare of Manhattan’s towering skyscrapers are reflected in the rippling water.



Five years in, our seining program and classes were well-established our Conservancy education team had grown. The next five years would focus heavily on improving our seining technique and data collection practices. Numerous seasonal and part-time staff, as well as devoted volunteers, were enlisted every spring and summer to help run our programs. While many hands

do make light work, it became apparent that we needed to establish a set of best-practices so that all our seiners were performing harmoniously. One of the biggest mistakes when seining is proper pole handling. When dragging the net through the water, poles should always remain on or as close to the bottom as possible. The poles should also be held slanted with the bottom ahead leading in the direction you are moving. With the use of visuals and diagrams, it was a lot easier to walk a new participant through those dos and don'ts before even stepping foot into the water. We crafted our seining techniques and tips into a succinct three-page document, which we still share to this day with all new seiners, as well as, seining colleagues up and down the river. Our seining technique and methodology continues to improve and evolve every season. Most recently, we began numbering our floats. One of the challenges of seining a rocky or debris ridden area is the likelihood that your net will get snagged under something. Beginner seiners usually see two options once caught under a heavy object; plow forward with a rock in tow and risk breaking the net, or pull the net out and over the obstacle and risk letting your fish escape. With the floats numbered, it is easier for the seiners to signal to each other where they sense the snag is located. Spotters, as we call them, remain behind the net so that in such scenarios they can carefully lift the net very minimally in just the problem area while the poles are held down to prevent further movement of the net.

As our technique and expertise has progressed, the location and landscape of our seine sites has also shifted several times. Our first relocation was to the nearby Empire Fulton Ferry Beach, a cove sandwiched between the Brooklyn and Manhattan Bridges. The site, though very scenic, was very difficult to access because of the steep, dense layer of rip rap boulders dividing the park above from the beach below. For this reason, fewer seining events happened that year. But the temporary relocation was worth it, the land surrounding our former beach was officially

converted into parkland and other amenities. By 2015, we were back under the Manhattan Bridge at our regular beach and now had a new, world class Environmental Education Center just steps away. This indoor educational space features several large estuary aquariums which become home to a few of our best seining catches. The over 20,000 students and families visiting per year are able to get a glimpse of the rich diversity hidden beneath the nearby waters, The remnant pilings and large debris once lingering at the northern tip of Main Street Beach had been replaced with rip rap. The waterfront was beautified, which is an indisputable benefit, but we suspect the removal of so many untouched hiding spots might be why some of our rarest findings, like a Northern sea star, haven't been spotted again after the inaugural year.

Each season, as warm days start to become more frequent, Brooklyn Bridge Park's shorelines become heavily populated with photographers enjoying the view, office workers taking an outdoor lunch break, and children energetically skipping rocks at the water's edge. One such spring in 2017 brought about a startling incident along our park's waterfront: a transformer from a neighboring electrical substation had rapidly leaked approximately 31,000 gallons of dielectric oil, a substance commonly used as an industrial coolant and for electrical insulation. Though a majority of the oil seeped into the soil at the substation, at least 5,000 gallons are believed to have entered the East River. The narrow channel and strong currents in the East River caused the oil to travel quickly and made recovery of the substance very difficult. According to Gothamist, just a few hours later, witnesses reported an oil slick on the East River in Long Island City, Queens. As a precaution, the Coast Guard initiated a safety zone from the Williamsburg Bridge down to the Brooklyn Bridge. This meant only authorized vessels could enter the area and all recreational boats such as kayaks, sailboats, or paddle boards were prohibited.

As a result of the oil spill, access points were closed off to the public, and the Conservancy took a moratorium on waterfront programming until the safety zone ban was lifted. Throughout that month, Conservancy educators wondered and worried about the impact this would have on our seining program, and more specifically, the populations of fish and invertebrates that call the East River their home. It was at that time that we realized the importance and value of long-term data sets. Fortunately, this spill was not of catastrophic proportions, like the BP or the Exxon Valdez oil spills. We did not notice any significant decline of species richness or diversity once the seining season commenced. However, the occurrence prompts the question: what if? What if the river experiences a significant chemical or other pollutant spill? Is there accurate and continuous baseline data on the water quality of this area? What if another hurricane hits New York City? Will there be data available to directly compare ecosystem conditions before and after said phenomenon? Climate change is expected to warm waters and drive changes in the geographic range of many species. Do we have a robust enough historical record of fish abundance and diversity over time to assist in accurately tracking these changes?

The oil leakage, though an unfortunate event, brought about a few positive effects. Thanks to state penalties requiring polluters to pay, we were chosen as a recipient for an Environmental Benefit Project funding. Part of this funding went into purchasing a multi-parameter water quality probe. This dramatically improved the ease and accuracy in collecting measurements on water temperature, pH, dissolved oxygen, and turbidity at each and every seine. The Conservancy's education team had a fire in our bellies and a heightened sense of appreciation and responsibility. We wanted to be hosting seines that not only served as an exceptional educational experience, but also focused on collecting meaningful and accurate citizen science data. We were more motivated, and more eager than ever don on our chest waders and scope out

what was lurking beneath the bridge. As the beach reopened and the seining season began, someone on our team began coining the phrase, “Keep Calm, and Seine On!”

Beyond changes in site conditions, several other transformations enhanced our seining practices. Numerous staffing changes brought in new faces to our education team, each with their own relevant set of skills and specialties to contribute. Additionally, we began a partnership with another biologist, Peter J. Park from Nyack College. Park’s expertise as an ichthyologist helped ensure accurate and precise species identification. In past seasons, some of the very challenging young-of-year fish were often recorded in our data sheet as either “unknown,” listed as the general family name such as herring, or listed with an “either/or” suggestion. With an expanded team of curious marine enthusiasts, we focused hard on teaching ourselves and each other how to be better identifiers. Knowing the length of an organism can help to differentiate young-of-the-year or species within the same genus, so we began to measure organisms when staffing and time permitted. We began tracking the number of hauls and tide levels too. The purchase of new nets, one featuring a central bag, encouraged us to also track which nets were being used at each seine. The roles and staffing structure for public seines was outlined in an official seining manual to ensure best practices for crowd management and engagement, data collection and, of course, seining technique. We strategically assigned a combination of experienced seiners and new interns/volunteers to each haul. Often times, the ample support and desire from experienced seiners allowed us to have two seine nets going at once! We were better catching, better identifying, and better tracking. During the winter, after completing our 10th seining season, we sat debriefing about our past events and planning next steps for the upcoming seining season. Our Director of Education, Isa Del Bello, began by reflecting on the decade we had under our belt and the tremendous strides that had been made in the quality of our program. The small

initiative that began back in 2008 had evolved into a thriving citizen science program by 2017. As she put it, we had finally reached “seining 2.0.”

No seining season, no seining day, or even a single haul is ever quite the same. You must always be ready to expect the unexpected, and 2018 was no exception. Due to an unexpected closure of Main Street Beach, we relocated our seining home base to Pier 4 beach at the southern end of Brooklyn Bridge Park. Named because it was once the site of an industrial shipping pier, all that remains are a few long metal railcar tracks that jut out slightly above the water in the center of the beach. The protrusion provides an ideal perch for waterfowl like ring-billed gulls, cormorants and night herons. The area directly in front was filled in with additional soil, vegetation, and sand and fortified with rip rap rock to create the small peninsula that exists today.



With a single beach separated into two small coves, there were exciting new opportunities as well as challenges afoot. This beach is in close proximity to a combined sewer overflow outfall site (CSO). New York City's combined sewer system collects rainwater and runoff in the same underground pipes as our sewage and wastewater. During heavy rainfall or snow melt, these pipes and nearby wastewater treatment plants are filled to capacity, and additional wastewater is discharged through CSO pipes directly into New York City waterways. Outflow pipes were also visible at Main Street Beach, however at a slightly further distance from the primary seining perimeter. We've noticed that algae growth is significantly greater within the small southern cove of Pier 4 Beach, which is the side that borders the CSO pipe and a boat marina. Predictably, this side is also where our net hauls in the most trash, especially if it has rained within the past week. To our surprise, any potential point source pollutants in this area haven't appeared to significantly deplete marine life. Ironically, sometimes the highest number and variety of fish come from the hauls on the CSO side of the beach.

During the peak of summer 2019, a small school of Atlantic needlefish made their way to this southern section of the beach. Not only were we able to add this species to our catch list for the very first time, but by the end of the season we had documented 4! On the same side, we've also witnessed large adult horseshoe crabs mating, along with their coin-sized offspring. In between the beach's rocky rip rap edge, four artificial tide pools are nestled. Made from a textured substrate known as ECONcete, these small pools attract mussels, algae, and ghost anemones that affix for stability. The pools also provide a sheltered zone for more mobile organisms such as crabs, snails, and most recently, baby horseshoe crabs. Measuring at nearly 1 centimeter in size, these fragile creatures remind us that while some humans may joke "I cannot live without the beach," some animals literally depend on beach access for reproductive success.

The very sheltered inlets of Pier 4 beach make for calmer wakes and waves and a more gradually sloped river bottom. Though larger rocks and other potential snags are present, the substrate beneath our feet is largely soft sand. These conditions make it a lot easier to seine and much safer for students and adults, who often haven't yet mastered the art of balancing on extremely uneven terrain while waves crash at your hips. The beach additionally provides a much greater area of physical space for our public and school seines to function. Students venture out in groups to separate areas of the shoreline to investigate the tide pools, collect water for testing, or drag the seine net through. On a public seining afternoon, the sun is shining, kids are scavenging for shells, and adults are curiously admiring the catch of the day. As the lead instructor stands near the table, tending to the living organisms, they also field all sorts of questions and stories. Inquisitive children will ask what the strange tube making bubbles in the water bins is for, while adults fondly reminisce about their own past experiences with marine life and fishing. Visitors are often overwhelmed with awe and excitement as they jiggle a comb jelly, feel a blue crab carapace, or observe a shimmering school of silversides darting around our tank. Though the skyline still in the distance, for a moment, you might forget that this fascinating estuary travels straight through New York City.



A Dive into Data

At the onset of our seining program, we focused primarily on overcoming misconceptions about the East River and showcasing some of the amazing organisms that live in our own backyard. At that time, the Conservancy's role was to connect community members to their Brooklyn waterfront, which sat neglected, isolated, and underutilized for decades. The task at hand was to inspire Brooklyn residents to envision what it could become once the park was built. Simply giving people the experience of standing on a beach along one of the most urbanized cities in the world was a feat in its own; successfully catching living organisms was an added bonus that helped debunk the popular myth that the East River is merely a polluted wasteland.

Because the Conservancy's education department initially consisted of a single full-time staff member, with additional per-diem educators as needed, our data collection practices were very basic and ad hoc for the first several years. From 2008-2010 we record of some of the various species identified during each seine. However, not all seining dates are accounted for, nor is there any count of how many of each species were caught. In 2011, we began using a true data sheet which was shared with us by Vicky Garufi at Center for the Urban River at *Beczak* (CURB). The following year, we were not only intentional about accurately tallying the number of each species caught, but we also began to record some rudimentary data on the site conditions. This included aspects such as weather conditions, air and water temperature, date, time, and instructors on site. Over the course of the next few years, we worked towards improving our consistency in record keeping and began testing for salinity, pH, and dissolved oxygen. Some seining events had more thorough data recorded, others have gaps or notations that measurements and tests were not performed. Often, we simply didn't have the resources (staff, time, materials) to collect and record robust data. Staff present at each seine usually varied and fluctuated, and we relied heavily on summer interns and volunteers for additional support. We usually had one marine biologist or "expert" on hand at each seine as the lead educator. Cynthia Fowx and Nim Lee, two of our most dedicated instructors, helped to ensure we were identifying and recording everything our net hauled in.

By 2016, we had expanded our team of educators and had established a robust seining protocol of our own. Nyack College ichthyologist, Peter J. Park, enthusiastically began assisting and participating in our seining events. His deep passion and knowledge for local fish helped us

dramatically improve our accuracy in properly identifying fish species, particularly the hard to differentiate young-of-the-year that frequent our sheltered coves. The most challenging of our fish identifications have been from the Family Clupeidae. Colloquially known as the herring family, this group includes American shad, blueback herring, alewife, and Atlantic menhaden, among others. In the early years of our data collection, we often were not precise with our identifications. For example, we have records that simply state flounder or herring with no further notes to allow precise species identification. Marine invertebrates are even more challenging to document with exact binomial nomenclature because small, delicate organisms such as comb jellies or tunicates are studied and written about significantly less than their marine vertebrate counterparts. It was not until very recently that Conservancy staff, as well as other fellow Hudson River Estuary educators, began taking a closer examination of ctenophores, true jellies, and hydrozoans and photo documenting the sightings of each.

The use of video and photography has been a significant driver in improving accurate species identification. Visual documentation provides a reliable resource to consult as a reference once our team is back from the field. This allows for easier comparison if continuing research through the internet or field guides after the release of fish. Most importantly, it allows the opportunity to seek out other specialists not present at a seining session on any given day. NYS DEC naturalists, such as Tom Lake, have been a significant asset in confirming and clarifying identifications. Initially, photos were mostly taken for promotional purposes and focused on the more unique or “exotic” of catches. As we aimed for improved count and record of every organism caught we began capturing photos mainly of the unknown species. Today, we strive to get a photograph of nearly every fish species caught. In 2019, we invested in a fish measuring

board. While the idea of measuring the largest and smallest fish of every species caught seemed daunting at first, we found that snapping a picture while on the board was a sure way to get a quality photo and accurate documentation of measurement all at once. Our archive of photographs from the early years has been our most reliable documentation of what organisms were caught at those very first few seines. Despite not having data recorded at the time, we've found that by reviewing photos and anecdotal observations submitted to the Hudson River Almanac, we can piece together an idea of what was caught. Furthermore, reviewing photos from past years has enabled us to retroactively amend misidentifications made. For example, photos believed to be of an oyster toadfish were actually of a skilletfish. It turned out in the particular year these photos were taken, no skilletfish had been documented. Thanks to a timestamp on the photograph we were able to modify our past spreadsheet.

Over time, we've learned that in order to make your database as valuable as possible, it is best to collect as much detail and information about each seine as possible. Our once simple checklist of fish caught is now an intricate spreadsheet. Our fish catches, abundance, and diversity is influenced by a variety of factors and it is important to make note of such. We are able to begin observing trends by documenting everything from scientific parameters such as tides, salinity, and turbidity to event logistics such as number of seiners, number of hauls, and size of nets used.

BROOKLYN BRIDGE PARK CONSERVANCY CATCH SHEET 2017

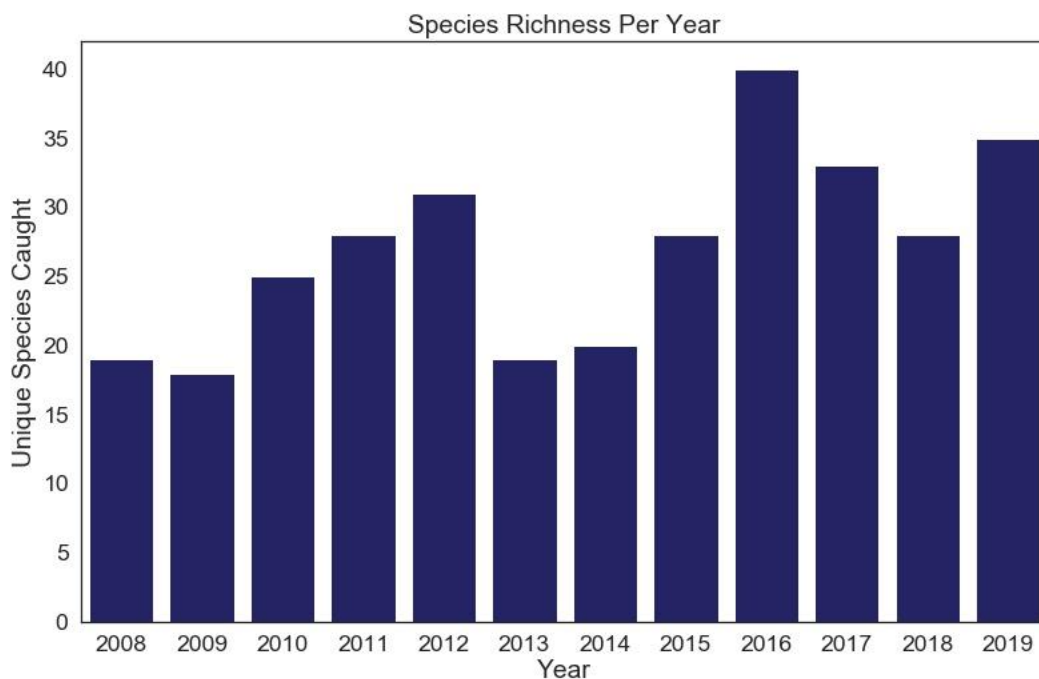


Date: 8/4/17	Air Temp/Weather: 87° Sunny	DO: 6	# Total Visitors: 113	# of Hauls: 12
Start Time: 1:35 PM	Water Temp: 76° F	pH: 7.8	Seiners: Isa, Eliza, Laura (vol), Shad (SA)	Net Length: 20 ft green net w/ bag
End Time: 3:07 PM		Salinity: 22 PPT		Instructors: Peter
High Tide: 8:17 PM	Tide is moving: <input checked="" type="checkbox"/> IN <input type="checkbox"/> OUT	Turbidity: 37 cm		
Low Tide: 1:45 PM				

Common Name	Quantity		Number brought to Ed Center	Other Info (description, size, dead or alive, etc.):
Striped Bass	111	(3)	1	YOY (young of the year)
Blue Crab	1	(1)	0	7 inches claw to claw, male
Atlantic silverside	4411	(7)	2	largest 4 inches, most ~ 2 in
snails	11		0	unknown species, photos taken about 2cm
COMB Jellies	100+, TMTc		0	

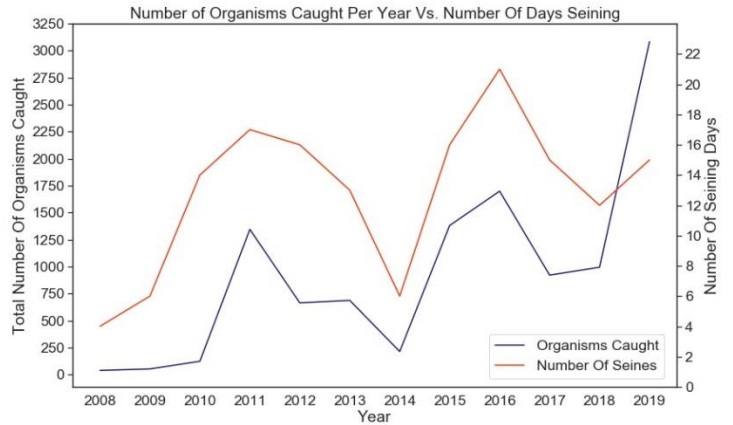
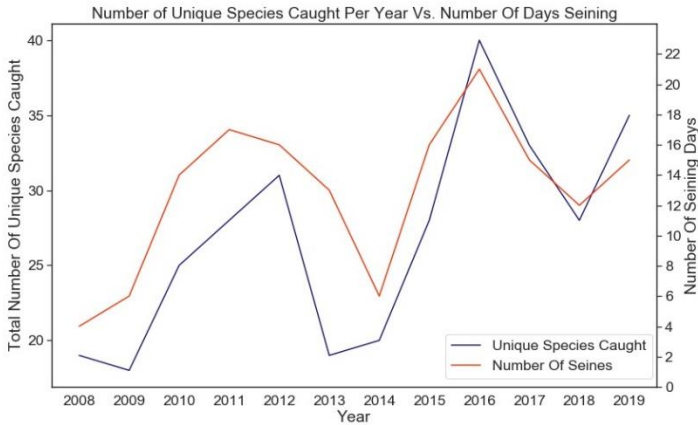
For years, we relied exclusively on LaMotte test tab kits for our pH and dissolved oxygen measurements. The low quality of these test kits, combined with sometimes having expired tablets and young students conducting the tests for us, meant the likeliness of error was high. In 2018, the Conservancy received funding to purchase a multi-parameter probe which tests for water temperature, salinity, pH, dissolved oxygen, dissolved oxygen saturation, and turbidity with a much higher level of accuracy. We still use traditional tools such as hydrometers, test tabs, and turbidity tubes because these methods provide better opportunities for students of various ages to participate in the collection of citizen science data. Collecting data using two or more methods helps validate our measurements as well as pose questions to students on why we also see discrepancies.

This is not to say that our first several years of data are entirely unusable. Presence/absence data is extremely useful in getting a snapshot of species richness over time. Decades of sewage and trash dumped directly into New York Harbor along with the spill of industrial chemicals such as PCB's turned our estuary into a toxic environment. It has taken years for the more sensitive populations of organisms to return and thrive. It is promising to see that the Conservancy has tracked an increase in species richness from 2008 to 2019. As we continue to protect and maintain the water quality of the East River, we anticipate and hope that this trend will continue.

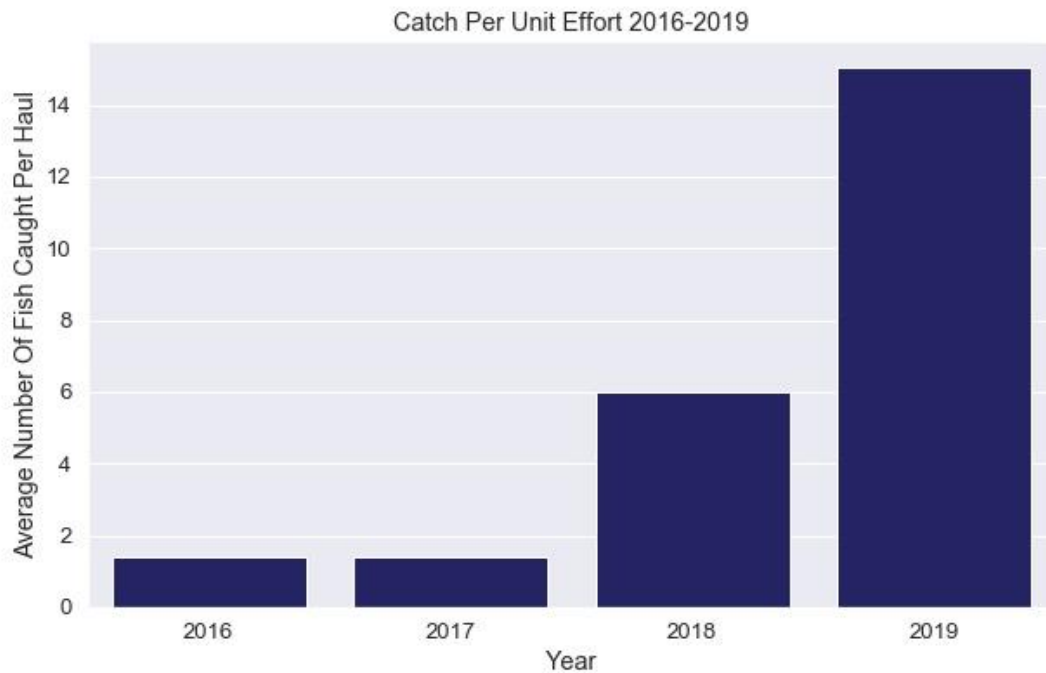


Our journey to improve data quality has made us more aware of what can or cannot be practically measured. For example, the skill level of the seiners and the number of times a net needs to be lifted up because it is caught under a rock cannot typically be tracked nor is it easy to quantify the impact of those variables. However, some variables can be tracked easily such as number of seining days and number of hauls. When looking at long-term catch data, it is important to keep in mind other variables like seine effort and number of days of fishing that

might be driving your results. If we look at graphs illustrating the number of days seined per year alongside another graph of species richness per year, we notice a striking similarity. There is also a suggestive trend between total organisms caught and number of seining days. As one would expect, the more often you seine, the more organisms will likely be tallied by end of season.



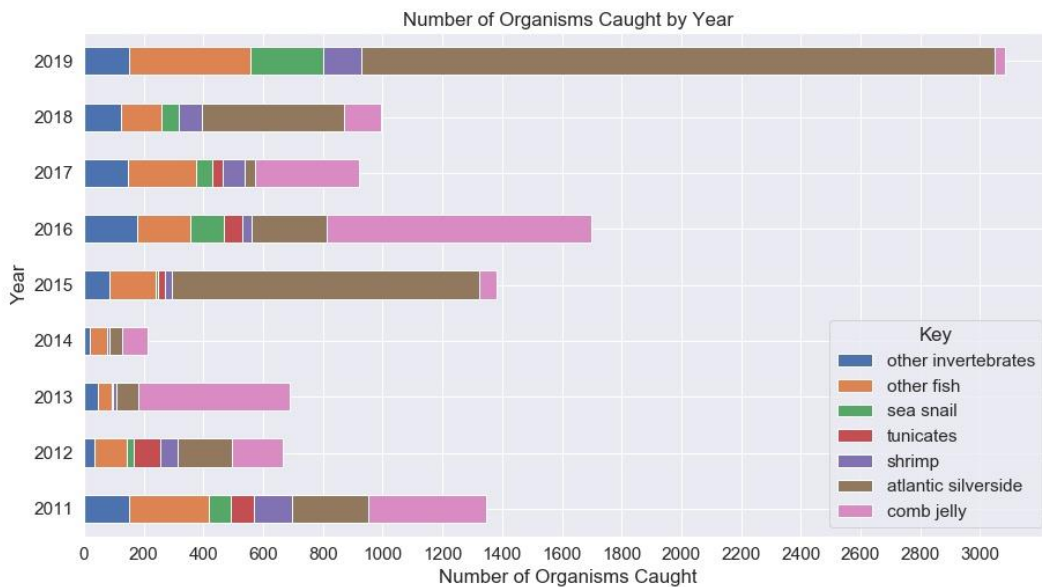
To help standardize data, scientists typically calculate the catch per unit effort (CPUE). When thinking about CPUE in fishing, the “unit of effort” can be defined in a variety of ways, but per haul is much more precise than per year or per day. For the last four years we have kept track of number of hauls at each seine event. This allows us to better calculate an accurate CPUE value, which has multiple applications, from seeking ways to improve our catch efficiency to comparing data across different time variables. There is an apparent increase in CPUE over time. We suspect increased seining experience and improved technique as well as changes in site conditions to have partially influenced that trend.



It is important to acknowledge the value of replication, identification of potential variables and their interactions, accounting for human error, the difference between accuracy and reliability (e.g., faulty equipment), the need for standardization, and understanding outliers. For example, the average number of fish caught per haul on a given day might remain pretty stable throughout the course of a month, but with one haul, we may run into a school of 500 Atlantic silversides – how then must we interpret the “average” number of fish per haul? Outliers like these are extremely important to document, but can also skew the data. The concern for accuracy and reliability are also at the core of our water quality measurement techniques. For years, we relied exclusively on LaMotte test tab kits for our pH and dissolved oxygen measurements. The low quality of these test kits, combined with sometimes having expired tablets and young students conducting the tests for us, meant the likeliness of error was high. In 2018, the Conservancy received funding to purchase a multi-parameter probe which tests for water temperature, salinity,

pH, dissolved oxygen, dissolved oxygen saturation, and turbidity with a much higher level of accuracy. We still use traditional tools such as hydrometers, test tabs, and turbidity tubes because these methods provide better opportunities for students of various ages to participate in the collection of citizen science data. Collecting data using two or more methods helps validate our measurements as well as pose questions to students on why we also see discrepancies.

The most exciting pieces of data we share with our audiences is the most commonly caught organisms in the East River. Astonishing to most, comb jellies are by far the most abundant animal collected in our seine net, and it is likely that there are in fact hundreds more collected in the net each season than we actually get to count. Many other invertebrates are at the top of the leaderboard such as shrimp and sea snail.



When looking at fish exclusively, Atlantic silverside has a significantly greater catch total than the fish species that follow in second, third and fourth place. Our top 10 most commonly caught fish include many well-known estuary dwellers such as anchovies, striped bass, and

flounder. Surprising to many, pipefish, herring, and tomcod also rank very high in our seining data.

Since 2008, we have been fortunate to seine three different sites in the park. We have found that location and groundcover along the park's waterfront has a significant impact on the profile of most commonly caught fish. Main Street Beach, under the Manhattan Bridge, is rocky and muddy. The waves and wakes from boats are choppy and a rapid drop off in water depth makes this a more challenging site to seine. When we relocated to Pier 4 beach, we realized that the nearby marina and peninsula structure of the beach was a much more sheltered environment. Additionally, the substrate below the water is predominantly sand and the slope is less steep, meaning we are able to venture further out and get snagged on rocks less frequently. There are tradeoffs, however. Main Street Beach had a much longer stretch of accessible water for us to drag the seine net through parallel to shore. We cover a much smaller area of water at Pier 4, but interestingly catch just as many fish and sometimes much larger schools of fish.

We are finding that we catch many more fish per haul at Pier 4 than we usually did at Main Street. In thinking about our improved catch per effort in recent years, it is likely that location, ease of seining, and improved technique might all influence these measurements. Despite non-overlapping years, the data may suggest with a high level of certainty, however that different species of fish can be found in different abundances between Main Street Beach and Pier 4 Beach. There are some differences in rankings and percent abundance between the two lists. Incredibly, we have caught almost double the amount of silversides over 2 seasons at Pier 4 Beach than we did in the 10 years at Main Street Beach!

Top 10 Most Frequently Caught Fish at Main Street Beach (2008-2017)				Top 10 Most Frequently Caught Fish at Pier 4 Beach (2018-2019)			
Rank	Fish Name	Percent	Quantity	Rank	Fish Name	Percent	Quantity
1	Atlantic Silverside	64.0%	1841	1	Atlantic Silverside	82.7%	2595
2	Herring	10.8%	311	2	Herring	5.7%	180
3	Bay Anchovy	6.7%	193	3	Bay Anchovy	2.3%	72
4	Striped Bass	5.6%	161	4	Silver Perch	2.0%	64
5	Porgy	1.9%	56	5	Atlantic Tomcod	1.7%	54
6	Bluefish	1.9%	54	6	Bluefish	1.2%	39
7	Flatfish	1.8%	52	7	Northern Pipefish	0.8%	26
8	Atlantic Tomcod	1.6%	46	8	Striped Bass	0.7%	23
9	Northern Pipefish	1.4%	41	9	Tautog	0.5%	17
10	Black Sea Bass	0.8%	23	10	Striped Anchovy	0.4%	14

It is true that fish populations “do better” and “do things differently” some years compared to others. This is why tracking as many variables as possible, like location and CPUE, is critically important. While it is unfortunate that there have been changes and inconsistencies with our sampling site, we believe the data is still comparable and are optimistic that we will see meaningful differences between sites. Like all fishing, seining is part skill and part luck. If a school of silversides swim by right as you pivot the net, you find yourself with hundreds more fish than the usual haul. Only time will tell how the two sites truly compare. Our dataset currently provides 10 years of data at one location in the park. Eventually, we will have 10 years of data at our new beach with which we can compare. Perhaps then we can begin drawing more substantial conclusions about habitat preferences of our fish residents.

Building Better Documentation of East River Organisms

Kids and adults have been intrigued by our counting and measuring procedures. Getting a first-hand glimpse of citizen scientists in action has led to a lot of great conversations and inquiries about research and conservation from the general public. The expansion of citizen science platforms, such as iNaturalist, have helped to get more members of the general public interested in identifying local flora and fauna. The app has even helped our seining program. When we share photos of our catches, we not only receive validation of our species identification from the scientific community, but also promote awareness to the greater public on what our nets are hauling in. On the flipside, several of us have also begun using our acquired knowledge and expertise to help identify other iNaturalist postings by novice waterfront fishers or beachcombers in the New York area. For many years, New York estuary educators have shared a vision for a centralized online database that could collect and share seining data from all sites within the New York Harbor and/or the Hudson River Estuary. It has been a recurring conversation at Youth Educational Seining (YES) Symposiums and a proposal I even wrote about for my Master's thesis. Development of a public facing platform provides countless educational and research opportunities. We currently do not have a means of uploading our yearly data on our organization's website or are able to regularly share with the school's visiting for a seining class the data we've collected (as some other sites do). Making real, local data readily accessible to teachers will hopefully encourage extended their studies of NYC marine ecosystems well beyond their site visits. Pooling estuary data in one location can make is easier for student researchers, scientists, and naturalists to access and analyze. It can provide opportunities to track East River-wide trends such as the salinity distribution or movement of migrating fish. Just as iNaturalist serves as an opportunity for casual observers to share findings and communicate with a

community to discover species identifications, a harbor estuary database could provide a similar amenity. Recreational anglers, notably novice or youth fishers, might enjoy being able to share their most exciting catches or use the website as a means for improving fish ID knowledge. An effective public facing citizen science-based database for the New York Harbor would be one that:

1. Is managed and financially supported by a lead organization such as a university, government agency, or non-profit.
2. Provides opportunity for a large number and diversity of users (including the scientific and non-scientific community) to contribute observations.
3. Includes important estuary based resources such fish ID guides or dichotomous keys, lesson plans or advice for teachers on how to use the data, and fishing regulations and advisories.
4. Encourages opportunities for dialogue and identification assistance between various users of the tool.
5. Reports data in usable, easy to interpret formats such as spreadsheets, maps, and graphs.

In 2019, the dream of centralizing New York Harbor fish data took flight. Through the New York Sea Grant's Marine and Coastal District of New York Conservation, Education, and Research Small Grants Program, Isa Del Bello of the Conservancy, Peter J. Park of Nyack College, and Christopher Girgenti of Randall's Island Park Alliance were awarded funds to co-collaborate on a marine education and research initiative throughout the East River which would integrate conservation-focused fishing practices with citizen science research. With the primary objective being to enhance public understanding and awareness of the East River marine ecosystem, three primary goals were set: (1) Create an East River fish diversity database from seining and angling data for the East River, with continuous contributions from a growing

number of environmental education organizations (2) Establish beginner-level catch-and-release fishing clinics at Brooklyn Bridge Park and World's Fair Marina and establish intermediate-level fishing clinics at Randall's Island Park, each focused on utilizing ichthyology to teach about marine biology. (3) Develop inclusive marine education and angling winter workshops that will foster interest in urban marine ecology and environmental stewardship for a diverse array of NYC communities.

The summer fishing clinics at three unique East River sites served participants from a wide range of fishing skill levels. Spearheaded by Peter J. Park, all of the clinics were free-of-charge and employed environmentally responsible methods such as the use of barbless circle hooks and non-lead sinkers (e.g., Swivets™ concrete, Eagle Claw™). For all clinics, every fish caught was minimally handled as they were measured, photographed, and carefully released. As colder months approach and fishing programs take a hiatus, we wanted to continue the fishing comradery we had built up all summer with our fishing participants. The winter months are a perfect time for indoor marine biology and angling workshops. At the time of writing, our winter workshops are currently in the planning stage. They will aim to foster interest in marine biology, ecological restoration, and fishing. Covered topics will include fisheries biology, logistics of fishing licenses, consumption guidelines, and the different types of fishing equipment and technique.

While the vision remains for this platform to be public facing, serve a wide audience, and have a significant number of data contributors, it is best to start on a smaller scale. Geographically, the database will be designed to house data collected along the East River only. The East River Estuary Diversity Database will be a website that catalogues water quality, marine life, and event-based demographic data. For a time, the database will likely act as more of an internal

clearinghouse of data for a select few partner organizations. A set of 5 organizations (Brooklyn Bridge Park Conservancy, Randall's Island Park Alliance, Nyack College Fishing Club, Lower East Side Ecology Center, and Battery Park City Authority) were asked to collect and contribute data from their site's seining and rod & reel programs during the 2019 season. Having easily comparable data between sites requires consistency with methods or a documentation of the collection methods and other fishing variables. For some of the sites in our pilot, this meant an expanded collection protocol such as noting type of fishing gear, keeping track of effort by means of number of hauls, rods, or time spent fishing, as well as, accurately recording total catch counts and a measurement of each species. These organizations will be pivotal in helping us shape the usability of the data entry interface on the website. Beyond providing a system for monitoring East River species diversity and catch numbers, the database will open opportunity to pool and catalog water quality data. Most environmental organizations that provide educational seining or fishing programs usually try to collect their own water quality data, as well, often times enlisting the help of students as citizen scientists. Some sites have more advanced equipment than others or are more dedicated to routinely performing tests. At Brooklyn Bridge Park, we strive to conduct water quality at each of our programs and classes, however faulty equipment, inaccuracy in student run measurements, or simply not enough time or staffing to complete often leads to gaps in our data. Access to water quality data from other nearby sites can help fill in those gaps or act as a point of comparison or quality control check. In the future, the database may also present an opportunity to host data from a continuous, real-time data logger in the East River, similar to those of the Hudson River Environmental Conditions Observing System (HRECOS). HRECOS connects a series of stations (sensors) within the Hudson River and houses the data on a publicly accessible server. High costs associated with equipment and web server have been

prohibitive to the installation of a monitoring system by Brooklyn Bridge Park and others along the East River. However, with increased buy-in to the database over time, an alliance of organizations may be interested in joining forces to collectively fund, support, and maintain a single sensor at a central location along the East River.

This database will hopefully pioneer the establishment of a growing network of New York Harbor data collectors and provide opportunity to educate and communicate fish data in a new way. As a fellow Hudson River Estuary stakeholder once said to me, *“I always find the wide array of fish species that are routinely captured at these events something that we, as naturalists, should be broadcasting to the world. The Hudson is an incredible, highly productive estuary with many more species of fish and other organisms than the general public would ever think.”* The future of this database remains to be unknown, however as long as there are dedicated citizen scientists and educators along the river, our collective knowledge about the East River ecosystem will continue to grow; perhaps even, paving the way for similar projects along areas of the Hudson River and estuaries beyond.