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# Monitoring River Herring, American Eels, and Eastern Oysters in the Bronx River: A How-To Guide for Staff and Stewards



**City of New York Parks and Recreation**  
Forestry, Horticulture and Natural Resources  
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The mission of **NYC Parks' Natural Resources Group (NYC Parks)** is to conserve and restore New York City's natural resources for the benefit of ecosystem and public health through acquisition, management, restoration, and advocacy using scientifically supported and sustainable research. Since its inception, NYC Parks has conducted vegetation and wildlife surveys of approximately 10,000 acres of wetlands, woodlands, and meadows; secured tens of millions of dollars for acquisition and restoration projects; and restored more than 2,000 acres of salt marsh, grassland, freshwater wetland, and forest.

**The Bronx River Alliance (the Alliance)** works closely with NYC Parks, and serves as a coordinated voice for the river. The Alliance works with project partners to protect, improve, and restore the Bronx River corridor as a healthy ecological, recreational, educational, and economic resource for the communities through which it flows. The Alliance is an expert in bringing together teachers, community-based educators, and scientists to use the river as a classroom, and train volunteers to monitor the river's conditions. The Alliance's Ecology Director, Conservation Manager, and Conservation Crew organize programs for the public to participate in, including water quality monitoring and hands-on restoration work.

**NY/NJ Baykeeper** also works with NYC Parks, and their mission is to protect, preserve, and restore the ecological integrity and productivity of the Hudson-Raritan Estuary. NY/NJ Baykeeper's Oyster Restoration Program Director works to create, maintain, and expand oyster reefs in addition to organizing volunteer monitoring events. In 2013, NY/NJ Baykeeper developed the EcoVolunteer program to provide volunteer opportunities for adults and minors in the lower Hudson Raritan Estuary who wish to become involved with restoration efforts of key intertidal species. In Soundview Park, NY/NJ Baykeeper has partnered with NYC Parks to monitor the Soundview Park Oyster Reef, a long running oyster restoration and re-establishment site at the confluence of the Bronx River and East River.

NYC Parks has partnered with multiple organizations to reintroduce and restore healthy populations of river herring, American eels, and eastern oysters in the Bronx River. The key organizations include:

- Billion Oyster Project
- Bronx Borough President
- Hudson River Foundation
- Lehman College
- National Oceanic and Atmospheric Administration
- NY State Department of Environmental Conservation
- Rocking the Boat
- SUNY Maritime College
- Wildlife Conservation Society

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# Introduction and Background

## 1.1 Purpose of Guide

The purpose of this guide is to support efforts to return river herring, American eels, and eastern oysters to New York City's only freshwater river, the Bronx River, which flows for 23-miles from Westchester through the Bronx and into the East River. The Bronx River was an historic migratory route and spawning ground for river herring, American eels, and other migratory and resident fish species. Development and industrialization dramatically impacted the river, and by the 1970s it was overwhelmed by trash and pollution. The community insisted on restoring it to health and, after decades of efforts to clean and reclaim the river, these three species symbolize its ecological restoration.

To achieve this restoration, many government and non-governmental partners worked together to remove tons of waste from the river, to stop illegal discharges to the river, and to restore native forests and wetlands along the stream banks. In the last decade, NYC Parks, the Bronx River Alliance, and other partners focused on habitat restoration activities, including the actions that could restore and increase the populations of river herring, American eels, and eastern oysters. Recently, we installed two fish passages at the river's most southern dam allowing migratory river herring and American eels to swim upstream to critical freshwater spawning habitat.

This guide provides instructions for staff, educators, community groups, and non-profits on how to maintain the river herring fish ladder and American eel passage at the East 182<sup>nd</sup> Street Dam in River Park and on how to monitor the species' populations and migration. It also provides an overview of the monitoring of the oyster reef offshore Soundview Park in the Bronx River Estuary.

## 1.2 Why We Care

**River herring, American eels, and eastern oysters** are key aquatic species that play an important role in the ecosystems of the Atlantic Ocean, the Long Island Sound and surrounding watersheds. River herring and American eels are diadromous fish that migrate to and from freshwater streams and the ocean to complete their life cycles. Diadromous fish species include **anadromous** fish that migrate up rivers from the sea to spawn in freshwater, and **catadromous** fish that migrate out of rivers to spawn in the sea.<sup>1</sup>

**River herring**, including alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), are **anadromous** fish native to most of the coastal rivers, lakes, and streams that drain into the ocean stretching from Newfoundland to North Carolina (see figure 1 below). They are important sources of food for many different organisms in the ocean, estuaries, and rivers. Predatory fish, such as striped bass, northern pike, and pickerel rely on river herring for a large part of their diet. River herring are also prey for birds, including osprey, bald eagles, cormorants, and great blue herons, as well as for mammals in freshwater streams. River herring provide a connection between aquatic and terrestrial ecosystems by bringing nutrients to freshwater systems in the form of eggs, young-of-the-year alewives, waste, and dead and decaying fish.

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<sup>1</sup> Biologists have discovered American eels maturing in both marine and freshwater habitats. This has led to a revision that American eels are facultative catadromy, which means eels may be found in both saltwater and freshwater habitats during maturation.





Figure 1: A photo of an alewife found in the Bronx River in 2009 downstream of the southernmost dam

**American eels** (*Anguilla rostrata*) are **catadromous**<sup>2</sup> fish that mature and live their adult lives in freshwater systems and swim thousands of miles to return to the Sargasso Sea in the North Atlantic to spawn and die (see figure 2 below). When juvenile eel larvae hatch in the Sargasso Sea, they are carried on a series of complex ocean currents to coastal rivers, from Greenland to South America, where they reside in the estuary or swim upstream to freshwater habitat. By the time they reach coastal rivers they have metamorphosed into glass eels, which are one to two inches long and transparent. American eels can live in a river for 30 to 40 years and serve as a food source for a wide variety of species.

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<sup>2</sup> Biologists have discovered American eels maturing in both marine and freshwater habitats. This has led to a revision that American eels are facultative catadromy, which means eels may be found in both saltwater and freshwater habitats during maturation.



Figure 2: A photo of two American eels found in the Bronx River in 2015 approximately 40 cm in length

When river herring and American eel populations are healthy and stable, they support other fish and wildlife from the ocean to the estuaries and rivers, increasing the health of the entire ecosystem. They are also an important part of the fishing economy and cultural heritage of the Atlantic States.

**Eastern oysters** (*Crassostrea virginica*) are not only tasty bivalves consumed by humans for millennia, they are also ecosystem engineers, **creating habitat** and **improving water quality** and clarity by filtering excess nutrients (see figure 3 below). Oysters provide habitat for fish, crabs, worms, and other aquatic organisms by creating multi-dimensional reefs, which offer shelter from predators. On a larger scale, oyster reefs can provide protection against erosion by **absorbing and reducing wave energy** before it reaches the coast. Oysters also filter excess nutrients that can decrease dissolved oxygen and submerged aquatic vegetation, and increase turbidity from high levels of phytoplankton, harmful algal blooms, and parasitic diseases.





Figure 3: A photo of an eastern oyster and oyster spat (or baby oyster) located inside the red circle

### **1.3 Threats**

#### **River Herring**

Dams built on streams and rivers for water-supply, hydropower and flood control have severely restricted access to spawning grounds for river herring. There are nearly 6,000 state-regulated dams in New York alone. Fragmentation of freshwater habitat due to dams, as well as water pollution, has contributed to the decrease in river herring populations and in some cases has resulted in the extinction of local populations. Since the 1600s, approximately eight man-made dams that prevent fish migration have been constructed along the Bronx River, including three in the Bronx. River herring face several other threats along their migratory routes, including commercial fishing, predation, and water pollution. The New York State Department of Environmental Conservation (NYS DEC) has acknowledged these threats to river herring populations and has classified them as a species of greatest conservation need.

#### **American Eels**

Similar to river herring, American eels are impacted by dams that block access to upstream habitat, poor water quality, and overfishing. Their populations have severely declined, and NYS DEC has listed them on the high priority list of species of greatest conservation need.

#### **Eastern Oyster**

The eastern oyster has a complicated life cycle. Oysters are protandrous hermaphrodites, which means an individual oyster will start out with male reproductive organs and release sperm into



the water. As the oyster grows larger it will transform to have female reproductive organs and release eggs into the water. Male oysters are small and not of interest to fisherman, whereas larger female oysters have been overharvested and since they live longer, are more exposed to disease, resulting in a population imbalance between male and female oysters and possible collapse. In New York Harbor, local oyster reproduction and recruitment is further restricted by the small remnant size of the populations and lack of substrate that limit the surface area for oyster larvae to settle, attach, and grow on. High sedimentation rates and poor environmental conditions such as water pollution have also contributed to their decline.

Despite their environmental and economic importance, oyster reefs have declined globally, primarily due to overharvesting but also from increased predation, siltation, incidence of severe storms, channel dredging, harvesting by dredging, and prevalence of oyster diseases. In New York Harbor, like across most of the world, the vast majority of oyster reefs have disappeared and those that remain are so small that they no longer provide important ecosystem services, such as habitat, food, and water filtration.

## **1.4 Restoration Efforts**

### **Fish Passage for River Herring**

In December 2014, NYC Parks completed the construction of the first fish ladder on the Bronx River. The ladder provides fish with access to the freshwater spawning habitat upstream of the East 182<sup>nd</sup> Street Dam, the most southern dam on the Bronx River. The most effective approach to restoring fish migration in a river that has been fragmented by dams is to remove them. If this is not possible the second best option is constructing a fish ladder.

The Bronx River fish ladder was modeled after the traditional Alaska Steeppass Fish Passage. In contrast to other fish passage designs<sup>3</sup>, the steeppass is more efficient at controlling water velocity and can properly operate at a variety of slope intervals, allowing it to pass a wide range of fish. In March 2015, the Bronx River fish ladder was first opened to river herring. At the same time, monitoring equipment to observe and record activity was installed. Based on the underwater video footage for spring 2015 and 2016, the fish ladder facilitated the passage of 21 fish (sunfish, white suckers, and Asian carp) but notably not river herring.

### **Fish Passage for American eel**

In June 2015, NYC Parks also installed the first American eel passage on the Bronx River at the East 182<sup>nd</sup> Street Dam. The eel passage is smaller than the fish ladder, does not provide direct access over the dam, and is a temporary structure that is dismantled, cleaned, and stored during the winter season. Eels enter the passage, climb up several ramps, and enter a holding tank where they are counted by staff and volunteers. NYC Parks and project partners drain the holding tank two to five times per week and then document and release any eels in the tank upstream of the dam. In 2015 and 2016, a total of 229 eels were released upstream of the dam.

### **Oyster Reef Pilot Projects**

In 2004, NYC Parks initiated the first oyster reef restoration pilot project in NYC at the mouth of the Bronx River offshore Soundview Park in the South Bronx. Since this effort, NRG has been supporting projects to restore the eastern oyster with local and city-wide organizations. In 2008, WCS/NOAA funded a second phase of NRG's oyster reef restoration work in the Bronx River estuary. Phase 2 of the project focused on collecting data to better understand the growth and survival of oysters on the pilot reefs, developing an adaptive management plan to maintain the

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<sup>3</sup> Pool-weir fishway, vertical slot fishway, standard denil fishway, and natural fishways are other types of fish passages.

reefs, and supporting partners in providing on-going opportunities to conduct research, environmental education, and develop improved reef restoration designs. In 2010, the organizations working on oyster reef restoration citywide formed a partnership called the Oyster Reef Restoration Project (ORRP). The ORRP is an alliance of 19 organizations formed to determine the feasibility of large-scale oyster reef restoration in New York Harbor. This ongoing oyster reef restoration effort in the Bronx River Estuary is part of the overall effort led by NYC Parks to restore the Bronx River watershed.

## River Herring, American Eel, and Eastern Oyster Monitoring Protocols

This section provides step-by-step instructions on when and how to monitor and maintain the fish ladder, eel passage, and oyster reef on the Bronx River.<sup>4</sup> Table 1 provides an overview of the monitoring, including location, monitoring season, and contact information for the lead organizations. All monitoring requires the presence of NYC Parks or Alliance staff, or an authorized representative. Volunteers, students, or teachers interested in a monitoring activity should:

- Read the background information in Section 1
- Review the protocol(s) associated with the monitoring activity of interest
- Contact the staff listed below to learn about volunteer opportunities and public events

Table 1: Overview of Fish and Shellfish Monitoring in the Bronx River

|                                 | Aquatic Species in the Bronx River  |   |  |
|---------------------------------|---|---|--|
|                                 | River Herring   | American Eels   | Eastern Oysters  |
| Location                        | Fish Ladder at River Park / East 182 <sup>nd</sup> St Dam   | Eel Passage at River Park / East 182 <sup>nd</sup> St Dam   | Eastern Oyster Constructed Reefs offshore of Soundview Park  |
| Season                          | March – June  | April – November  | May – October  |
| Monitoring Metric               | - Number and size of the fish using the ladder<br><br>- Direction the fish were swimming  | - Number, size, and life stage of each eel found in the holding tank  | - Number and size of live and dead oysters<br><br>- Number and size of other species   |
| Frequency                       | Daily   | Daily to weekly   | Twice per month  |
| Skill Level                     | 16 years or older; can carry up to 50 lbs.; can work in all weather conditions; and can find their own transportation   | 16 years or older; can carry up to 50 lbs.; can work in all weather conditions; and can find their own transportation   | Adult volunteers (18 years or older); can carry up to 50 lbs.; can work in all weather conditions; and can find their own transportation   |
| Lead (and partner) Organization | NYC Parks   | NYC Parks   | NY-NJ Baykeeper, New Jersey City University (NYC Parks, Billion Oyster Project)  |
| Contact Information             | Danielle Bissett, Ecological Restoration Project Manager, NYC Parks, 212-360-1453<br><a href="mailto:danielle.bissett@parks.nyc.gov">danielle.bissett@parks.nyc.gov</a> | Danielle Bissett, Ecological Restoration Project Manager, NYC Parks, 212-360-1453<br><a href="mailto:danielle.bissett@parks.nyc.gov">danielle.bissett@parks.nyc.gov</a> | Allison Fitzgerald, Research Scientist, NY-NJ Baykeeper<br><a href="mailto:Allison@nynjbaykeeper.org">Allison@nynjbaykeeper.org</a><br><br>Meredith Comi, Oyster Restoration Program Director, NY-NJ Baykeeper<br><a href="mailto:Meredith@nynjbaykeeper.org">Meredith@nynjbaykeeper.org</a> |
| Partner Organizations           | Bronx River Alliance, Rocking the Boat  | Bronx River Alliance, Rocking the Boat, Wildlife Conservation Society   | NYC Parks, Bronx River Alliance, Hudson River Foundation, Rocking the Boat, Harbor School, Billion Oyster Project  |

<sup>4</sup> This guide does not include the installation and removal procedure for the fish ladder and eel passage.



## 2.1 Fish Ladder Monitoring and Maintenance Protocol



Fish ladder at 182<sup>nd</sup> Street Dam on the Bronx River

### 2.1.1 Fish Ladder Monitoring and Maintenance Overview

The following tasks, described in detail below, are required for monitoring and maintenance at the fish ladder:

- Transport and organize monitoring equipment
- Take photos of the fish ladder and site conditions, and retrieve the life ring
- Remove debris from the exitway and inside the fish ladder
- Clean the monitoring equipment located inside the fish ladder
- Inspect the steep-pass (sloped ramps of the fish ladder) for stuck debris
- Inspect the water flow exiting the fish ladder and the entrance (base of dam)
- Collect fish counter data and download video footage of fish

All of the equipment to monitor and maintain the fish ladder is identified and explained below.

### 2.1.2 Volunteer Information

Monitoring and maintenance of the fish ladder is conducted during the fish migratory season, from March to June. Volunteers must be in high school or older, and be able to work in all types of weather, find their own transportation to the site, and complete or assist with all of the tasks listed below. Since access is restricted at the work locations, staff from the lead or partner organizations must accompany volunteers to ensure participant safety and quality control.

### 2.1.3 Fish Ladder Equipment

NYC Parks owns and uses the equipment listed in Tables 2a-2c to maintain and monitor the fish ladder site on a daily basis. The equipment consists of a tunnel and monitoring box (welded together), video camera, plexi glass, fyke gate, fish counter, and a Toughbook laptop. The monitoring equipment must be installed prior to opening the fish ladder. Once the fish ladder is opened for the season, the additional monitoring equipment is stored on site.

Table 2a: Fish ladder monitoring equipment (hardware and software)

| Item   | Description and Use  | Needed Maintenance   | Location (see Appendix A, Figure 1) |
|--|--|--|-------------------------------------|
| Dazzle   | Software that connects the video camera to the Salmonsoft computer program   | Properly handle and store  | Enclosure Box <sup>5</sup>          |
| Fish Counter                                     | Electrical device connected to the tunnel and ticks whenever something moves through the tunnel and causes a change in water conductivity  | Properly handle and store  | Enclosure Box                       |
| Fyke Gate  | Prevents fish from swimming around the tunnel, and prevents debris from flowing down the fishway   | Remove & bag debris, look for any aquatic species stuck behind gate, document any issues | Fish Ladder <sup>6</sup>            |
| Tunnel and Monitoring Box                        | Metal chamber and tunnel; the metal chamber (monitoring box) holds the video camera that records anything that moves through the monitoring box  | Remove debris and sediment build-up  | Fish Ladder                         |
| PCSTestr 35 Multi-Parameter Water Tester         | Battery powered device used to take six water temperature readings on a daily basis (Monday-Friday) between the hours of 9-10am  | Clean and dry after use  | Enclosure Box                       |
| Plexi Glass                                      | Provides a reflective background so the video camera can collect a high quality image  | Remove algae/scum build up   | Monitoring Box <sup>7</sup>         |
| Socket wrench set and anti-vandal drill bit T-45 | Used to remove both aluminum sheets protecting the weir boards from vandalism at the entrance and exit of the fish passage   | Properly handle and store  | Enclosure Box                       |
| Toughbook  | Laptop that is connected to the video camera and has the Salmonsoft computer program   | Properly handle and store  | Enclosure Box                       |
| Tunnel   | The tunnel is connected to the Fish Counter via wire; when a fish swims through the tunnel the fish counter is triggered to tick either up- or downstream; the tunnel must be full of water to work properly | Remove debris, monitor water flow, and document any issues                               | Fish Ladder                         |
| USB Flash drive                                  | Used to upload and transport video data from the Toughbook to Arsenal North shared J: Drive  | Properly handle and store  | NYC Parks Office <sup>8</sup>       |
| Video Camera                                     | The video camera is connected via wire to the Toughbook, which is used in a software program to monitor anything that moves through the monitoring box located inside the fishway, underwater                | Properly handle and store  | Monitoring Box                      |
| Waterproof camera                                | Used to document the current conditions of the site and any issues that arise  | Properly handle and store  | NYC Parks Office                    |
| Weir boards                                      | Used for water attraction: one 2" x 4" x 19" and one 2" x 6" x 19" used to control water flow and create ideal water attraction at the entrance of the fish passage  | Properly handle and store  | Trunk <sup>9</sup>                  |
|  | Larger boards of various sizes used to block the flow of water and fish from entering the fish passage   | Properly handle and store  | Fish Ladder                         |
| Wrench   | Used to remove one screw that secures the lid to the monitoring box; lid is removed when cleaning and checking the inside of the monitoring box (video camera, plexiglass, and tunnel)                       | Clean and dry after use  | Trunk                               |

<sup>5</sup> The enclosure box is located inside the Bronx Zoo, adjacent to the trunk

<sup>6</sup> The fish ladder is on the Bronx River, adjacent to River Park (E 180<sup>th</sup> Street and Boston Road)

<sup>7</sup> The monitoring box is located inside the fish ladder

<sup>8</sup> Arsenal North, 1234 5<sup>th</sup> Avenue, NY, NY 10029

<sup>9</sup> The trunk is located inside the Bronx Zoo, adjacent to the enclosure box

Table 2b: Fish ladder Maintenance Supplies

| Item                         | Description and Use  | Needed Maintenance      | Location (see Appendix A, Figure 1) |
|------------------------------|--|-------------------------|-------------------------------------|
| Arm length waterproof gloves | Wear to protect arms while removing debris from passage and cleaning the monitoring box                      | Clean and dry after use | Trunk                               |
| Boat hook                    | Used to remove/move large debris from dam, entrance of fish passage, and inside the fish passage             | Clean and dry after use | Enclosure Box                       |
| Garbage tongs                | Used to remove hard-to-reach trash from river and passage  | Clean and dry after use | Enclosure Box                       |
| Microfiber towel             | Used to remove algae and sediment from video camera, plexiglass, and the monitoring box (inside and outside) | Clean and dry after use | Enclosure Box                       |
| Milk crate                   | Used to carry equipment and transport collected debris from the fish passage to garbage receptacles          | Clean and dry after use | Trunk                               |
| Scuba knife                  | Underwater knife used to cut rope or objects that obstruct and/or tangle underwater equipment                | Clean and dry after use | Enclosure Box                       |
| Swiss Army Pocket knife      | Use the flat edge of the file tool to calibrate the fish counter   | Clean and dry after use | Enclosure Box                       |
| Skimmer                      | Used to remove plant debris from the river and fish passage  | Clean and dry after use | Trunk                               |
| Work gloves                  | Used to protect hands while working  | Clean and dry after use | Enclosure Box                       |
| Zip-ties                     | Used to secure equipment if necessary  | None                    | Enclosure Box                       |

Table 2c: Other fish passage monitoring equipment / storage space

| Item      | Description and Use  | Needed Maintenance  | Location (see Appendix A, Figure 1) |
|-----------|--|---|-------------------------------------|
| Enclosure | Stores and protects the computer and fish counter  | Ensure it is locked   | Bronx Zoo <sup>10</sup>             |
| Life Ring | Safety precaution; throw life ring to someone that is in the water, to provide buoyancy and prevent drowning | Ensure it is located in the bright orange life ring container | Top of fish ladder / dam            |
| Trunk     | Storage space for equipment used daily   | Properly maintain, ensure the trunk is locked                 | Bronx Zoo                           |
| Waders    | Wear while in the water to stay dry  | Clean and dry after use                                       | Enclosure Box                       |

#### 2.1.4 Fish Ladder Photo Documentation

Upon arrival at the fish ladder, take photos of the conditions of the ladder, the separate pieces of equipment, and the conditions near the ladder.

Take photos of the following views:

- Upstream towards the dam; photograph both the fish ladder and the dam in the same picture without any trees blocking the view (see Appendix A, Photos 1 and 2)
- Downstream of the dam and surrounding area from the top of the fish ladder (see Appendix A, Photo 3)
- Fish ladder entrance located at the downstream end / base of dam (see Appendix A, Photos 4 and 5)

<sup>10</sup> Enter the Bronx Zoo at Bronx Park South and Boston Road (Asia Gate)



- Fish ladder exit way located at the upstream end / top of dam (see Appendix A, Photos 6 and 7)
- Signs of vandalism, including graffiti, the life ring if out of its container, any damages to the fish passage itself such as broken locks or damaged pieces
- Signs of water leakage from the dam or fish ladder (see Appendix A, Photo 8)
- Any debris around the fish ladder and on top of the dam (see Appendix A, Photo 9)

### 2.1.5 Fish Ladder Inspection and Maintenance

Keeping the ladder clean and free of debris is essential for effective operation. All parts of the ladder must be meticulously cleaned, including removing collected debris—lumber and wood, leaves, pollen, twigs and garbage. Debris can disrupt the water level, cause more debris to flow into the fish ladder, and injure any fish trying to traverse the ladder. Complete the following steps to properly maintain and monitor the fish ladder.

Step 1: Inspect site for debris accumulation and blockages

- Walk the entire fish ladder and document any debris accumulation or blockages, starting from the top (exit way) of the passage moving to the bottom (entrance) of the passage
- **NOTE: Water flow moves from upstream to downstream, starting at the top of the fish ladder to the bottom at the base of the dam, thus the removal of debris needs to occur in the same order**

Step 2: Clear the area just outside and upstream of the fish ladder

- Use the skimmer and milk crate (or large garbage bag)
- Place milk crate or garbage bag in an area that is not in the way but close by
- Remove any visible garbage in the pocket area adjacent to the exit way of the fish ladder with the skimmer and place in the milk crate
- With the boat hook or skimmer, direct plant debris toward the dam and try to not allow any debris to enter the fish ladder exit way
- Remove any other trash with the skimmer and place the trash in the milk crate or bag

Step 3: Remove debris inside of the fish ladder just upstream of the monitoring box

- Unlock the grate lock with the correct key<sup>11</sup>
- Place the lock and key ring in a safe area, where neither will fall into or off of the fish ladder
- Pull the metal pole that the lock was attached to out of the eye hook(s) to uncover the grate(s) you need to open
- Move the grates to a safe location so they do not fall into the fish ladder, the river, or on top of someone or yourself (see Appendix A, Photo 10)
- **NOTE: Be cautious while moving the grates – they are heavy and if handled improperly can cause severe damage to yourself or equipment**
  - Before moving the grate, identify a location to place it
  - Grab the area on the grate where there is no concrete located under the grate
  - While moving the grate stand in a secure, stable location
  - Always squat for back support and do not hold the grate in an area that may injure your fingers if the grate slips
- Put on the shoulder-length rubber gloves and step into the fish ladder to remove debris
- Remove as much debris as possible by hand (all garbage and as much plant material)

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<sup>11</sup> The Project Manager / group leader will have the fish ladder keys and will know which keys to use to access the fish ladder and monitoring equipment

- Return the grates with caution and properly secure them by looping the padlock through the eye hook and then threading the padlock through the hole on the metal pole
- **NOTE: The grates have a smooth and a bumpy side**
  - The bumps provide traction while walking so make sure the grates are placed properly

#### Step 4: Clean monitoring box

- Once the debris just south of the exit way is removed, unlock and remove the top of the monitoring box
- **NOTE: There is also a screw securing the lid to the monitoring box**
  - Remove screw securing lid to the monitoring box and place in a safe place
  - Place the lock and keys in a safe location so they do not fall into the fish ladder or the river
  - Place the top of the monitoring box on one of the grates
- Once the monitoring box has been properly opened, remove any debris inside the box and place in garbage bag or crate
- **NOTE: Do not twist or move the underwater video camera**
  - Pay close attention to how the underwater video camera is positioned if it moves
  - If it is positioned incorrectly the image will be upside down
- Remove and the two sheets of plexiglass, individually
  - Use a microfiber hand towel
  - Remove one sheet at a time and clean it by wiping it down and rubbing off any build up with the microfiber towel
  - Plexiglass is properly cleaned when it is transparent (see Appendix A, Photos 11 and 12)
  - After cleaning each plexiglass sheet, gently place the sheet in an upright position leaning against the side of the fish ladder on top of the grate next to you
  - Wipe down the sides and bottom of the monitoring box to loosen any sediment that settled inside the monitoring box
  - While holding the video camera in the same position it was found, wipe off any build up that might be reducing the video quality
  - Slide the plexiglass sheets back into the slots inside the monitoring box
- Ensure there is no debris inside the tunnel by inspecting by hand
  - Use the boat hook to reach further into the tunnel to loosen any debris stuck inside
    - This is important because the tunnel is electronically attached to a fish counter. If there is any debris stuck inside the tunnel then the fish counter readings will be inaccurate
- Return and secure the lid to the monitoring box.
  - Line up the holes and insert the screw (this step can be tricky depending on water flow)
  - Hold the screw the entire time while under water
  - Properly insert the screw (this task is done most effectively without gloves if water temperature permits)
  - Attach the lock and properly return and lock the grates

#### Step 5: Remove debris from behind the fyke gate

- The lock is at the downstream end of the fyke gate
- Remove the grate directly over the downstream end of the fyke gate (the fyke gate is locked to an eye hook)
- Place the locks in a safe place and position the grates safely

- Once inside the fish ladder remove the lock securing the fyke gate to the wall inside the passage
- Store this lock and the keys in a safe place
- Slowly open the gate to grab as much debris as possible and place in a garbage bag or crate
- **NOTE: Turtles and fish have been found behind the gate, therefore, be mindful while opening the gate:** If a turtle or other wildlife is stuck, first remove the animal and place it back in the river (downstream of the dam)
- Once the debris from behind the gate is removed, lock the gate back to the passage wall, and then return and lock the grates

Step 6: Remove debris from the remaining sections of the fish ladder

- Inspect the lower portions of the fish ladder for debris accumulation and blockages, especially at the top of each steep pass
- **NOTE: Even if there is a single stick popping up through the water, it needs to be removed.** These sticks can cause more debris accumulation and also injure any fish trying to traverse the fish ladder
- Properly unlock and move the grates, collect and throw away debris, return the grates to their correct position, lock the grates, and then move on to the next location

### 2.1.6 Fish Ladder Data Collection

The following information needs to be documented at the fish ladder on a daily basis from Monday through Friday on the daily log form (see Appendix D).

Step 1: Document general site visit information

- Include the date of field visit, weather, crew (include first and last names), and the time of visit (start and end time, and total minutes)

Step 2: Document fish ladder and debris build-up

- Record any debris build up and / or blockages listed on the datasheet
- Record any notes associated with debris blockages
  - What kind of debris (leaves, sticks, timber, water bottles, trash bags)?
  - Where was the debris collecting?
    - List multiple locations if needed (top of the dam, fish passage entrance, monitoring box, fyke gate, steep passes, etc.)

Step 3: Collect water temperature readings

The start of the river herring migration is determined by a change in water temperature. Three water temperature readings will be collected during each visit and recorded on the fish ladder datasheet (see Appendix D). Water temperature samples need to be collected at the entrance and exit way of the fish ladder (see Appendix A, Photos 13 and 14). Water temperature readings will be collected daily (Monday-Friday), if possible, between the hours of 8-10am via a PCSTestr35 Multi-Parameter water tester.

Step 4: Properly collect and record water temperature:

- Use the PCSTestr to collect six water temperature readings (three at the entrance and three at the exit) between the hours of 9am and 10am, if possible
  - Turn the device on by pressing the on/off button
  - The device will already be set to record water temperature
  - Insert the device into the water – keep the water line just below the digital screen



- Hold the device in this position for 90 seconds, or until the temperature reading is stable
- Write down the temperature onto the datasheet in the appropriate slot
- Repeat these steps for the required number of water temperature readings
- Collect three samples from the fish ladder entrance and record on datasheet
- Collect three samples from the fish ladder exit way and record on datasheet

Step 5: Collect the fish counter and underwater video data:

The fish counter is connected to the fish tunnel (located in the fish ladder). This technology records any movement (upstream or downstream) taking place inside the tunnel (see Appendix A, Photos 15 and 16). The data is recorded in upstream and downstream ticks or counts (see Appendix A, Photos 17 and 18). Since the fish counter cannot discriminate between a branch and a fish moving through the fish tunnel there is a second fish counting mechanism, an underwater video camera (see Appendix A, Photos 15 and 19). The underwater video camera is linked through FishTick software that is operating on a CF-19 Panasonic Toughbook (see Appendix A, Photo 18). Every day the fish counter and video camera data will be downloaded onto a USB flash drive.

Fish Counter:

- Walk to the Bronx Zoo entrance at the end of Boston Road (Asia Gate)
- Unlock the enclosure box, which houses the fish counter and Toughbook laptop
- Write down the upstream and downstream count, in the appropriate sections on the datasheet, displayed in the digital boxes located on top of the fish counter
- Reset the fish counter via count reset button located on top of the fish counter
- Close the top of the fish counter and ensure the latch is properly locked

Underwater Video Data:

- After recording the fish counter data, you will download the video data from the laptop located directly above the fish counter
- The laptop screen may be angled; if so, fully open the screen
- The screen should be active, viewing the monitoring box via the FishCap software program
- Press the stop recording button (blue square), and then press the start recording button (red circle)
- Go to the start menu and click on My Computer
- Then click the Local Disk (C :) drive
- Then click on the Data folder. A Windows Explorer pop-up will appear, do not press any buttons, just drag this box to the side and continue downloading the data
- Each video file is sequentially numbered starting at 1, and each file that was downloaded or modified has the associated date and time
- Select the new video files to download onto the USB flash drive
- **NOTE: Do not delete any files from the computer**
- If all of the video files cannot fit onto the USB flash drive, make a note on the datasheet and write down which files were able to fit on the datasheet
- Before removing the USB flash drive review the video files and take notes on whether or not a fish was observed or if there was something wrong with the video
- After the video files have been downloaded onto the USB flash drive and were reviewed, properly eject the USB flash drive
- Exit out of My Computer, and ensure that the FishCap software is recording
- Drag the Window Explorer pop-up and press the Don't Send button

#### Step 6: Upload data

- All collected data must be uploaded to google sheets within 24 hours of the monitoring activity via the google form link provided by the NYC Parks Project Manager
- Upload photos to Dropbox via the shared folder link provided by the NYC Parks Project Manager
- Save all hardcopies of datasheets and return to the NYC Parks Project Manager at the end of the monitoring season

#### 2.1.7 Fish Ladder Potential Maintenance Issues

Several problems may arise that could inhibit proper function of the eel pass. Ways to troubleshoot these problems are described below.

##### Trespassing:

Trespassing must be reported to NYC Parks Central Communications (646-613-1200). If trespassers remain, make a police report by calling 9-1-1. Wait for the police to arrive before approaching the trespasser(s). Trespassers tend to remove the life ring and throw it into the river. When onsite, check the life ring container at the top of the fish ladder. Return if needed. If the life ring is stuck in the river do not attempt to remove it. Take a photograph of the location of the life ring and document this in the daily log, and then inform the Alliance's Conservation Manager, Michael Mendez (718-430-1864), or NYC Parks Project Manager via email or phone.

##### Fyke gate:

As you are removing debris from behind the fyke gate, please be careful that no aquatic organisms are stuck behind the gate. Even if you do not have to remove debris from behind the gate, check to ensure there are no aquatic organisms stuck.

##### Fish Counter:

The tunnel, attached to the monitoring box inside the fish ladder, has to be completely full of water for the fish counter to provide accurate readings. If the water level is too low to fill the tunnel, you still need to record the fish counter number. Add a note on the daily log that the tunnel was not full of water.

##### Video Camera:

When cleaning the monitoring box, do not change the position of the video camera. Hold the video camera in place and then wipe it down. Check to make sure the video camera is in the right position when you collect data from the enclosure box.

##### Video Recorder:

The Toughbook laptop is located in an enclosure box, which prevents the laptop from connecting to the internet. This disconnection causes a pop-up. Drag this pop-up off to side and continue downloading the video files to the USB flash drive. Once you have the data and have removed the USB from the computer, drag the pop-up back into view and press the do not send button. This will causes the screen to refresh. Do not close the laptop screen. Ensure the video camera is recording prior to closing the enclosure box.

If there are other issues that you think need to be communicated to us, take photo documentation and make a note of it in the daily log. For any pressing issues contact the Project Manager (212-360-1453).

## 2.2 Eel Passage Monitoring and Maintenance Protocol



Eel passage at 182<sup>nd</sup> Street Dam on the Bronx River

### 2.2.1 Eel Passage Monitoring and Maintenance Overview

The following tasks, described in detail below, are required for monitoring and maintenance of the eel passage

- Transport and organize monitoring equipment
- Take photos of the eel passage and site conditions, and retrieve the life ring
- Inspect the water flow from the upper and lower spray bars
- Inspect the sloped ramps for debris
- Drain the holding tank while catching American eels that exit the tank
- Clean the tank and clear any blockages in the water system
- Count and measure the eels from the holding tank, and release the eels upstream of the dam

### 2.2.2 Eel Passage Volunteer Information

American eel passage monitoring and maintenance should be conducted from March – November. Volunteers must be in high school or older, and be able to work in all types of weather, find their own transportation to the site, and complete or assist with all of the tasks listed below. As with the fish ladder, staff from the lead or partner organizations must accompany volunteers due to the challenging tasks and restricted access for safety at the fish ladder and eel passage.



### 2.2.3 Eel Passage Equipment

NYC Parks owns and uses the equipment listed in Tables 3a and 3b below to maintain and monitor the eel passage on a daily basis. The eel passage is installed in mid-to-late March, depending on the water temperature. The installation process takes approximately five to six hours.

Table 3a: Eel Passage Monitoring Equipment and Components of the Eel Passage

| Item                       | Description and Use  | Needed Maintenance   | Location (see Appendix B, photo 20) |
|----------------------------|--|--|-------------------------------------|
| Aluminum Sheets and Covers | Create the three ramps that American eels climb to enter the holding tank              | Occasionally check the substrate to ensure it is lying flat; clean and dry at the end of season        | River Park <sup>12</sup>            |
| Concrete Filled Bucket     | Provides stability to the eel passage structure  | None required  | River Park                          |
| Holding Tank               | Holds the eels that successfully climb the eel passage                                 | Check 2-5 times per week   | River Park                          |
| Screen                     | To prevent eels from exiting the holding tank while draining the water                 | Clean if necessary   | Holding tank                        |
| Spray Bar                  | Upper spray bar provides water to the entire eel passage                               | During every visit, clean debris out of spray holes to ensure proper water flow <sup>13</sup>          | Eel passage (top)                   |
|                            | Lower spray bar attracts eels into the passage   | During every visit, clean debris out of spray holes to ensure proper water flow is at maximum capacity | Eel passage (bottom)                |
| Spray Bar Valve            | Controls water flow to spray bar   | Check during every visit   | Trunk <sup>14</sup>                 |
| Substrate Material         | Mesh material facilitates climbing for glass and elver eels (smaller eels)             | Clean and dry at the end of season; ensure substrate is properly glued before the season starts        | Inside aluminum ramps               |
|                            | Peg-board material facilitates climbing for yellow eels of various sizes (larger eels) | Clean and dry at the end of season; ensure substrate is properly glued before the season starts        | Inside aluminum ramps               |
| Water Pump                 | Pumps river water into PVC piping to provide water to the eel passage                  | Clean and dry at the end of season; clean if water flow has stopped                                    | Top of dam inside fish ladder       |
| Wooden Platforms           | Provide a level surface for the eel passage  | Ensure the wooden platforms are level.   | River Park                          |

<sup>12</sup> River Park, Boston Road and East 180<sup>th</sup> Street, Bronx, NY 10460

<sup>13</sup> Proper water flow means that the water flow and pressure are not being obstructed by debris. The pressure should be coming out strong. If you are unsure, you can open and close the water valve to flush out the hose. If you see that any of the spray bar water holes are jammed with debris then you will need to clean them out to facilitate proper water flow. Please refer to section 2.3, Step 4 located below for more information.

<sup>14</sup> Located directly underneath the eel passage secured to a wooden platform

Table 3b: Eel Passage Maintenance Supplies

| Item                                     | Description and Use  | Needed Maintenance  | Location (see Appendix B, various photos) |
|--|--|---|---|
| Arm length waterproof gloves             | Wear to protect arms while removing debris from passage and cleaning the monitoring box                      | Clean and dry after use   | Trunk                                     |
| Daily Log                                | Datasheet to document daily site visits  | Store properly  | Fish ladder Binder                        |
| Eel Passage Binder                       | Contains all needed material to monitor and maintain the fish ladder, including this protocol                | Store properly  | Enclosure box <sup>15</sup>               |
| Locks & Chains                           | Prevents vandalism and theft   | Check during every visit; ensure the passage is locked after monitoring | Eel passage                               |
| Microfiber towel                         | Used to remove algae and sediment from video camera, plexiglass, and the monitoring box (inside and outside) | Clean and dry after use   | Enclosure box                             |
| PCSTestr 35 Multi-Parameter Water Tester | Used to take water temperature   | Clean and dry after use   | Enclosure box                             |
| Pocket knife                             | Use the file tool to calibrate the fish counter  | Clean and dry after use   | Enclosure box                             |
| Skimmer                                  | Used to remove plant debris from the river and fish ladder and to catch eels while draining the holding tank | Clean and dry after use   | Enclosure box                             |
| Trunk                                    | Storage space for equipment used daily   | Properly maintain, ensure the trunk is locked                           | Bronx Zoo <sup>16</sup>                   |
| Waterproof camera                        | Used to document the current conditions of the site and any issues that arise                                | Properly handle and store   | Enclosure box                             |

### 2.2.4 Eel Passage Photo Documentation

Upon arrival at the eel passage, take several photos of the conditions for that day, including but not limited to the following:

- Looking towards the dam
- Water leakage
- Vandalism
- Eels found in holding tank (take picture of eels in bucket with clear water)

### 2.2.5 Eel Passage Inspection and Maintenance

After taking photos, complete the following steps to maintain and monitor the eel passage.

Step 1: Visually inspect the eel passage condition:

- Visually inspect the eel passage starting from the top (upper spray bar) of the passage moving to the bottom (lower spray bar) of the passage (see Appendix B; Photo 21)
  - The upper spray bar supplies water to the holding tank and the eel passage
  - The lower spray bar sprays water into the river to attract eels to the entrance of the passage

<sup>15</sup> Located inside the Bronx Zoo via the Asia Gate entrance

<sup>16</sup> Bronx Zoo via Asia Gate entrance

Step 2: Remove the wooden top on the holding tank and drain the water

- Stand on the rock adjacent to the holding tank; the top of the tank will be about chest height or lower (see Appendix B; Photo 22)
- To remove the wooden top of the holding tank, unlock the lock and chain that is roped around the holding tank, which prevents vandalism / theft
  - Pull the side of the wooden top that is adjacent to the eel passage up
  - Lean the wooden top against the dam wall while it is balanced on the frame of the holding tank
- After the top is off, look to see if there are any issues such as the screen being detached and floating in the water or the holding tank overflowing with water and document them via camera and on the datasheet
- If the water from the upper spray bar is flowing, open the trunk by unlocking the lock
- **NOTE: Do not push the top of the trunk past the eel passage ramp, it will get stuck!**
- Turn the handle that is supplying the water flow device to reduce water flow to the upper spray bar
  - Follow the hose attached to the upper spray bar to the handle to be sure it is connected to in the trunk
- Look inside the holding tank to gauge how many eels (if any) are in the tank
  - If there are a lot of eels, you will need to set up two fish buckets so you can count the total number of eels in the holding tank
- Do not remove the screen inside the holding tank attached to the bottom of the tank (see Appendix B; Photo 21)
- Before draining the water from the holding tank ensure the screen is attached to the bottom (this allows the water to drain without any eels exiting the holding tank)
- Drain the water by opening the knife valve at the base of the holding tank (see Appendix B; Photo 23)
- While the water in the tank is being released, fill up the fish bucket(s) less than half way with the water exiting the holding tank
  - The bucket is where you will place the eels exiting the tank
  - The bucket needs to be filled halfway or less so the eels cannot climb out of the bucket
- Place the bucket (less than halfway filled with water) on top of the trunk
- Once the water stops draining, look inside the holding tank again to gauge how many eels (if any) are in the tank
- **NOTE: Even though a large amount of water will drain from the holding tank, there will still be some water remaining in the tank**
- Confirm with the staff member leading your group if all of the eels in the tank can fit into one fish bucket or will need a second bucket
- Completely close the knife valve and then remove the screen inside the holding tank
- Place the screen in a secure location so it does not fall down the rocks and into the river

Step 3: Drain the remaining water inside the holding tank and net and bucket any eels:

- While holding the skimmer at the opening to the knife valve, completely open the knife valve
- Hold the net under the opening to the knife valve to catch eels that exit the holding tank
- Do not remove the skimmer until all water has drained (see Appendix B; Photo 24)
- After the water has drained, close the knife gate and place any eels from the tank into the fish bucket
- **NOTE: Look inside the knife gate while closing the opening to the knife valve so you do not injure an eel that might be in the way of the knife valve**
- **NOTE: Not all eels exit the tank the first time**

- Ensure the knife gate is closed and use the garden hose that is attached to the PVC water system inside the trunk to add water to the tank
- After there are a couple of inches of water in the tank, open the knife valve again to drain the water and to catch any eels that exit the tank
- After the water has drained, close the knife gate and place any eels from the tank into the fish bucket
- **NOTE: Look inside the knife gate while closing the opening to the knife valve so you do not injure an eel that might be in the way of the knife valve**
- Once there are no eels in the tank, leave the knife gate open and clean out any sediment at the bottom and on the side of the holding tank with the garden hose
  - Also clean the two overflow holes that have a mesh-netting on the side of the tank (see Appendix B; Photo 25)
- After the holding tank has been cleaned, properly place the screen back inside
- For each eel in the bucket, document the life stage<sup>17</sup> (glass, elver, yellow, silver) on the datasheet (see Appendix E)
- Take a photo of all of the eels in the bucket prior to releasing them north of the dam

Step 4: Ensure the water to the upper and lower spray bars is flowing properly:

- While the top to the holding tank is off, turn on the water to the upper spray bar
- While the water is flowing out of the upper spray bar, take a screw or something small enough to insert into the spray bar holes to clean out any debris that might be stuck (see Appendix B; Photo 26)<sup>18</sup>
- There are two rows of spray bar holes; turn the spray bar to reach the second row of holes
- Clean these holes twice to ensure there is no debris blocking the holes

Step 5: Ensure everything is correctly placed and lock the holding tank:

- Once you are finished, secure the wooden top onto the holding tank by tightly wrapping the chain over the top and locking it to the other chain end with a padlock
- **NOTE: You may have to pull the chain in sections to make sure it is tight because the chain does not fit easily through the eye hooks**

### 2.2.6 Eel Passage Data Collection

American eels go through five different life stages: egg / leptocephalus, glass, elver, yellow, and silver. Glass eels do not have any pigment and are transparent (5-8cm); elver eels are a green/brown color and are at least 10cm in length; yellow eels are yellow-green to olive-brown and are nocturnal (30-152cm); and silver eels have bronze/black backs and silver undersides when they are sexually mature<sup>19</sup> (see Appendix C, Photos 30-33).

Step 1: Count the total number of eels in the holding tank:

Count all of the eels in the holding tank after they have been collected in the fish bucket.

Step 2: Document the life stage of each eel in the holding tank

- For each eel, document the life stage (glass, elver, yellow, silver) on the datasheet (see Appendix E)
- Take a photo of all of the eels in the bucket prior to releasing them north of the dam (see Appendix B; Figure 27)

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<sup>17</sup> The Project Manager / group leader will know the correct life stage of the American eel.

<sup>18</sup> The Project Manager / group leader will know the correct water pressure for both the upper and lower spray bars .

<sup>19</sup> The Project Manager / group leader will know the correct life stage of the American eel.



- After this data has been collected, the eels can then be released upstream of the dam in the area adjacent to the exit way of the fish ladder (see Appendix B; Figure 28)

### Step 3: Upload data

- All collected data must be uploaded to google sheets within 24 hours of the monitoring activity via the google form link provided by the NYC Parks Project Manager
- Upload photos to Dropbox via the shared folder link provided by the NYC Parks Project Manager
- Save all hardcopies of datasheets and return to the NYC Parks Project Manager at the end of the monitoring season

### 2.2.7 Eel Passage Potential Maintenance Issues

Several problems may arise that could inhibit proper function of the eel pass. Ways to troubleshoot these problems are described below.

Properly locking the wooden lid to the holding tank:

The chain wrapped around the holding tank that secure the top of the tank to the frame may be too loose. This may allow someone to reach into the holding tank and vandalize the inside of the tank and possibly hurt or kill the eels that are contained.

Clogged water pump:

The PVC hoses may become clogged with sediment or debris. If the water pressure is not as strong as it should be, or no water is flowing down the eel passage, then there is a blockage. To try and fix this problem, close and open the water valve to the hose several times. If the water pressure is still low or no water is flowing immediately inform the NYC Parks via email or phone.

Clogged spray bars:

The upper and lower spray bars need to be checked for any debris clogged within the water holes so water will properly supply the holding tank and eel passage. This is a critical issue to fix because eels need a fresh water supply to survive. Also, the lower spray bar needs high water pressure and full water supply to attract the eels to the opening of the eel passage.

Properly installing the filter inside the holding tank:

The filter screws into the bottom of the holding tank and allows the water in the holding tank to drain without allowing any eels to escape the tank. When screwing the filter back into the holding tank, do not tighten it too much because the filter will get stuck and will be very difficult to unscrew. Screw in the filter and while it is loosely screwed in pull up. If the filter remains attached to the holding tank then you do not have to tighten it. If the filter detaches from the holding tank then screw in the filter again and tighten the connection a little more.

Water pump:

The water pump sits inside of a bucket located inside of the fish passage with a mesh covering to prevent large debris and aquatic species from entering the bucket. When on site, check the bucket and if the bucket is covered in debris and the mesh cover is obscured, unlock and remove the metal grates and remove the debris (see Appendix A; Figure 28). Do not try to pick up the bucket. It is attached to the wall of the fish passage.

If there are other issues or interesting happenings onsite, take photo documentation and make a note of it in the daily log. For any pressing issues contact the Project Manager (212-360-1453).

## 2.3 NY/NJ Baykeeper's Eastern Oyster and Oyster Habitat Monitoring Protocol



Scientific Oyster Reef Offshore Soundview Park

### 2.3.1 Oyster and Oyster Habitat Monitoring Overview

At Soundview Park monitoring and maintaining the oyster reefs consists of assisting NY/NJ Baykeeper with the following tasks:

- Transport and organize equipment
- Collect samples of shell and benthic material from the Scientific Reefs
- Measure both live and dead oysters, and identify other aquatic organisms living within sample of shell and benthic material
- Select three random baskets from the Community Reef, transfer contents into a floatable bin, and return to shore
- Measure both live and dead oysters, and identify other aquatic organisms living within the basket

The following protocol for eastern oyster and oyster habitat was provided by NY/NJ Baykeeper (Baykeeper) and consists of fewer details than for fish or eel monitoring because NYC Parks or Baykeeper will always lead monitoring events.

### 2.3.2 Oyster Monitoring Volunteer Information

The oyster reef should be monitored every year from May – October. Oyster Monitoring Volunteers, called EcoVolunteers by Baykeeper, must be in high school or older. EcoVolunteers

must be able to lift and carry 30 lbs., work in all types of weather, find their own transportation to the site, and complete all of the tasks listed below. This monitoring can only be conducted during low tide, which usually occurs very early in the morning or in the early evening. Staff from the lead or partner organizations need to accompany individuals or small groups interested in participating in these monitoring events. EcoVolunteers must wear hip or chest waders and gloves provided by Baykeeper so that they can enter the water at the site and assist in hands-on monitoring and restoration activities. Staff provides all monitoring equipment necessary for the day.

### 2.3.3 Oyster Monitoring Event Routine

An EcoVolunteer monitoring event lasts approximately 3-4 hours. Baykeeper and NYC Parks staff meet the EcoVolunteers an hour before low tide (the site is only accessible on low tides as it is a subtidal reef). Baykeeper and NYC Parks meet the EcoVolunteers at the Park entrance, lead the volunteers to the site, and then lead them down to the reef. There are two parts of the current reef – the Scientific Reef (consisting of loose oysters in varying densities on several mounds within a 1 acre plot) and the Community Reef (consisting of baskets of oysters easily sampled on a mound constructed of shell bags).

The monitoring tasks at the reef change depending on the time of year and the type of monitoring event. Baykeeper assigns volunteers to assist in sampling the Scientific Reef, Community Reef, or another activity such as gabion structures to test retention of shell, shoreline monitoring of live oysters, or other tasks (see Appendix F). Baykeeper and NYC Parks explain the monitoring activities and then split the volunteers into small groups to accomplish these tasks. Baykeeper pairs new volunteers with staff and/or more seasoned volunteers to ensure that adequate assistance is available. Staff assist volunteers in sampling and assessment of the oysters.

#### Activity 1: Scientific Reef Monitoring

- Staff use a GPS unit to find the central point on each loose shell mound where live oysters were previously placed
- Staff use a triplicate quadrat with a known area of 0.1m<sup>2</sup> and randomly sample around this point
- Staff and volunteers gather all material within the quadrat and above the sediment
- Staff and volunteers carefully comb through all of the collected material
  - Live and dead oysters are measured for total length (along the longest axis from the umbo<sup>20</sup>, in mm) and are marked as live or dead (note: only dead ‘boxes’ with both halves still attached are measured; no loose oyster halves are measured)
  - Any associated organisms (worms, bivalves, snails, etc.) are identified to lowest possible taxon and abundance is tallied
- Staff and volunteers return all material back to the reef it was collected from

#### Activity 2: Community Reef Monitoring

- Staff and volunteers select three random baskets to monitor each month
- Staff and volunteers place the basket into a large plastic floatable bin (to prevent loss of any mobile organisms) and transport the bin back to shore
- On shore, staff and volunteers carefully comb through all of the collected material

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<sup>20</sup> The umbo or the hinge is where the two shells of the oyster meet. This is considered the oldest part of the oyster shell because oysters grow by building new shell on the opposite end. This opposite end is where the oyster shell opens and is referred to as the bill or ventral margin.

- Live and dead oysters are measured for total length (along the longest axis from the umbo, in mm) and are marked as live or dead (note: only dead 'boxes' with both halves still attached are measured; no loose oyster halves are measured)
- Any associated organisms (worms, bivalves, snails, etc.) are identified to lowest possible taxon and abundance is tallied
- Staff and volunteers return all material back to the reef it was collected from

Activity 3: Data Collection and Entry (see Appendix F):

- Baykeeper and NYC Parks provide volunteers with datasheets to record collected data
- Baykeeper enters this data into to a computer file and on Google drive
- Baykeeper stores all hard copies in a filing cabinet

## References

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## **Appendices**

**Appendix A: Fish Ladder Photographs**

**Appendix B: Eel Passage Photographs**

**Appendix C: American Eel Life Stages and Sizes**

**Appendix D: Fish Ladder Datasheet**

**Appendix E: Eel Passage Datasheet**

**Appendix F: Eastern Oyster Datasheets**

# Appendix A: Fish Ladder Photographs



Figure 1: Aerial map of the fish ladder and monitoring and maintenance locations



Photo 1: View of the river herring fish ladder at the East 182<sup>nd</sup> Street Dam and adjacent to River Park



Photos 2-8: Examples of key locations at the fish ladder that should be photographed regularly (daily) or after any noticeable change



Photo 2: Looking upstream at the East 182<sup>nd</sup> Street Dam



Photo 3: Looking downstream from top of the East 182<sup>nd</sup> Street Dam



Photo 4: Fish entrance to the fish ladder



Photo 5: Fish entrance to the fish ladder



Photo 6: Fish exitway from fish ladder (side view)



Photo 7: Fish exitway from fish ladder (aerial view)



Photo 8: Water leaking from dam (yellow circle)



Photos 9-14: Examples of maintenance issues to address, equipment, and monitoring tasks



Photo 9: Debris build-up on top of dam



Photo 10: Metal grates placed against the railing (yellow circle)



Photo 11: Clean plexiglass until it's transparent (as shown in the picture; yellow rectangle)



Photo 12: Remove build-up on reflective board



Photo 13: Collecting water temperature data at the exitway of the fish ladder



Photo 14: Collecting water temperature data at the entrance to the fish ladder



Photos 15-19: Views of the monitoring equipment in the fish ladder, enclosure cabinet, and a sample of video footage

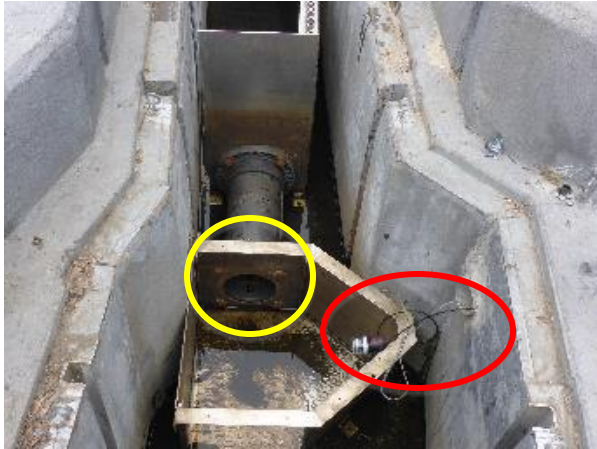


Photo 15: Fish counter tunnel inside fish ladder (yellow circle); underwater video camera (red circle)



Photo 16: Entrance to the fish counter tunnel inside fish ladder (yellow circle)



Photo 17: Fish counter device connected to tunnel



Photo 18: Fish counter device (yellow circle); underwater video camera is connected to laptop (red circle)



Photo 19: Video footage of an Asian carp swimming through the monitoring box



## Appendix B: Eel Passage Photographs

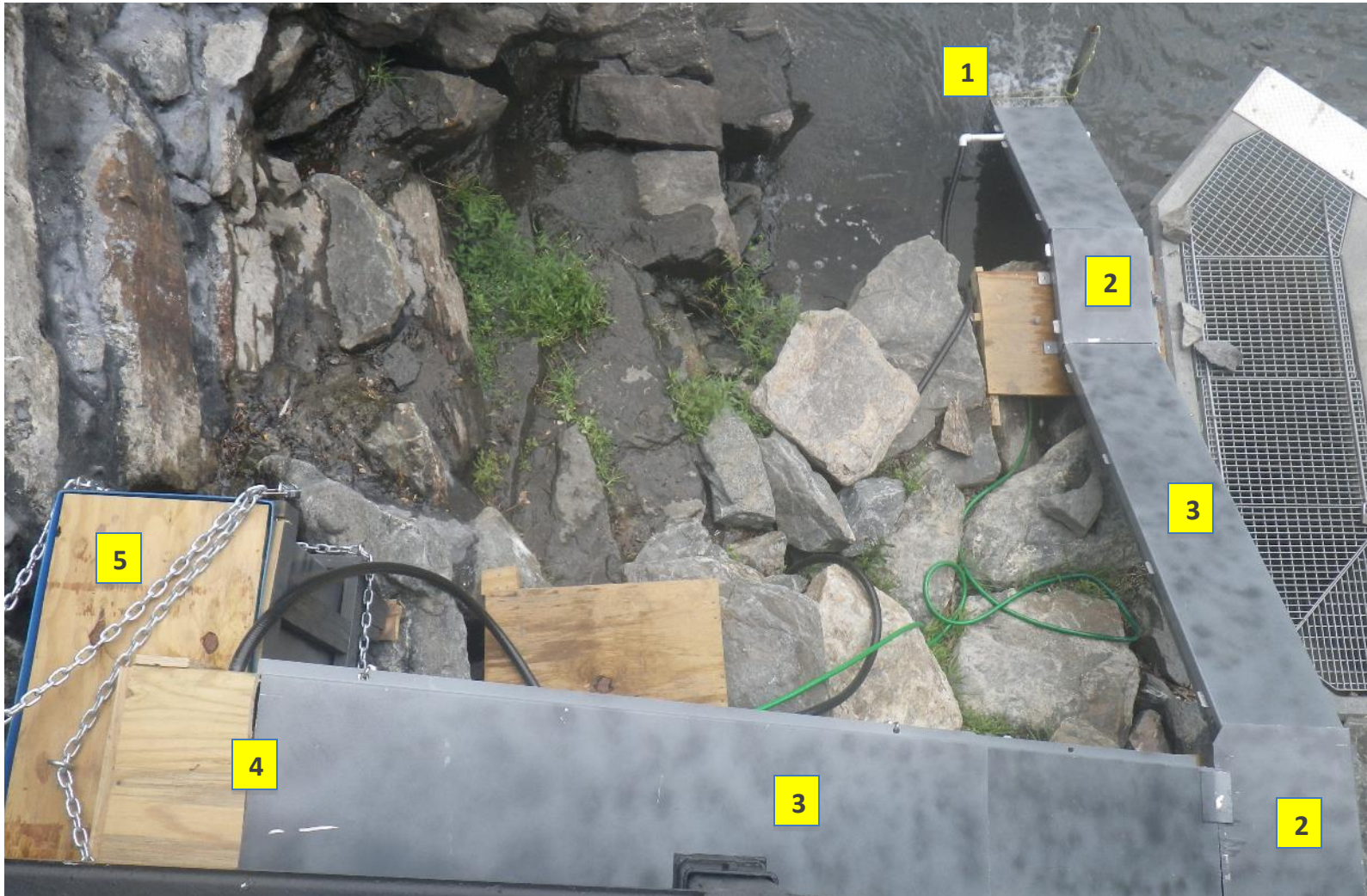


Photo 20: American eel passage (aerial view); (1) entrance to eel passage and location of lower spray bar; (2) resting area for eels; (3) sloped ramps for eels to climb up; (4) upper spray bar and entrance to holding tank; and (5) holding tank



Photos 21-26: Views of the eel passage, monitoring equipment, and PVC water system



Photo 21: Holding tank with screen attached and location of the upper spray bar



Photo 24: The knife valve is open to allow the water to flow out of the holding tank



Photo 22: Location to stand adjacent to the holding tank

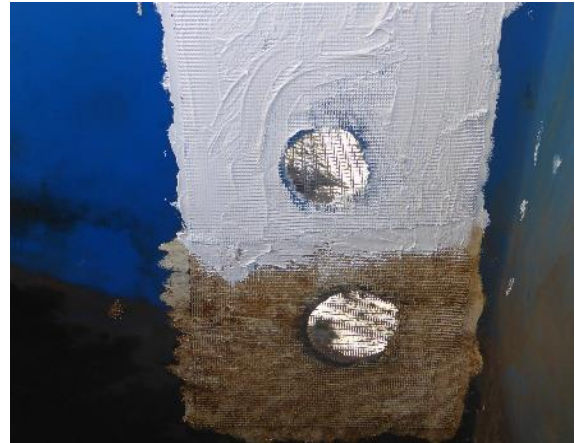


Photo 25: Two overflow holes located inside of the holding tank

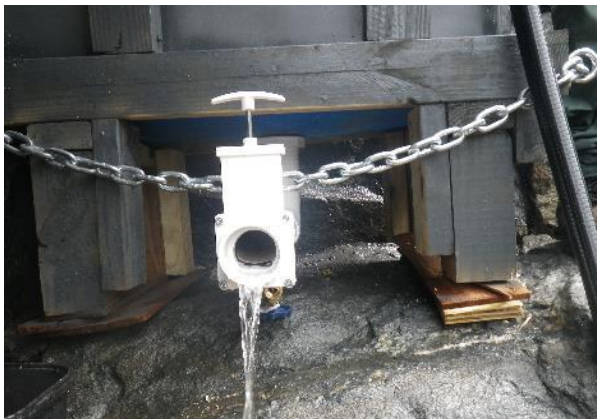


Photo 23: The knife valve is open to allow the water to flow out of the holding tank



Photo 26: The upper spray bar's water pressure should be high enough to supply water to the passage and holding tank while still allowing eels to safely and efficiently climb up the ramps (yellow circle)

Photos 27-29: Examples of American eels inside a fish bucket, location of releasing the eels, and location of the water pump that supplies water to the entire eel passage



Photo 27: There are 63 American eels in this fish bucket



Photo 29: Water pump (inside yellow circle) that supplies water to the eel passage; located inside the fish ladder near the exitway



Photo 28: Release eels in the area within the yellow circle



## Appendix C: American Eel Life Stages and Sizes



Photo 30: American eel life stage: Glass eel transitioning into an elver (approximately 5cm)



Photo 32: American eel life stage: Elver (approximately 20cm)



Photo 31: American eel life stage: Elver (approximately 6-8cm)

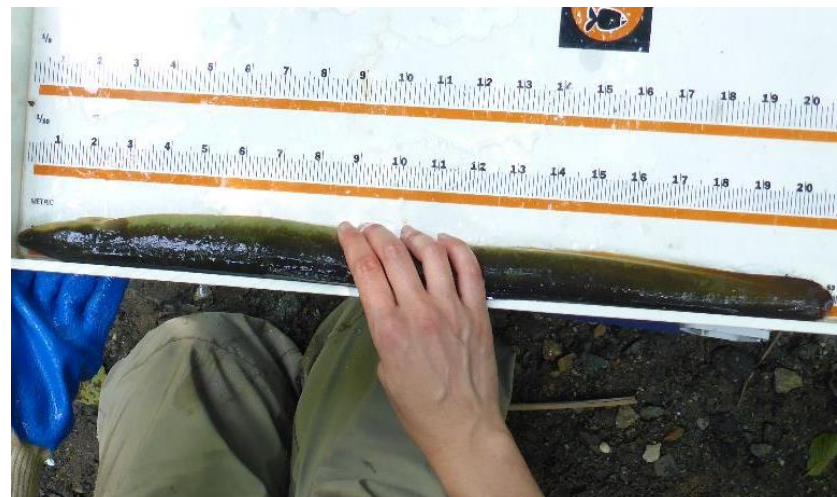


Photo 33: American eel life stage: Yellow (approximately 53cm)

## Appendix D: Fish Ladder Datasheet

| River Park Fish Passage Datasheet                                     |        |                                 |     |  |     |  |
|---|--------|---------------------------------|-----|--|-----|--|
| Date:   |        |                                 |     |  |     |  |
| Time (start and end):   |        |                                 |     |  |     |  |
| Weather:  |        |                                 |     |  |     |  |
| Crew (first and last name):   |        |                                 |     |  |     |  |
| Debris Build-up / Blockage  |        |                                 |     |  |     |  |
|   | YES/NO | Comment (description of debris) |     |  |     |  |
| Top of Dam  |        |                                 |     |  |     |  |
| Monitoring Box  |        |                                 |     |  |     |  |
| Entrance  |        |                                 |     |  |     |  |
| Exitway   |        |                                 |     |  |     |  |
| Steeppasses   |        |                                 |     |  |     |  |
| Water Temperature:  |        |                                 |     |  |     |  |
| Exit:   | 1st    |                                 | 2nd |  | 3rd |  |
| Entrance:   | 1st    |                                 | 2nd |  | 3rd |  |
| Fish Count:   |        |                                 |     |  |     |  |
| Upstream:   |        |                                 |     |  |     |  |
| Downstream:   |        |                                 |     |  |     |  |
| Were fish observed in the video footage (Yes/No)?                     |        |                                 |     |  |     |  |
| If so, what video file(s) were fish observed in?                      |        |                                 |     |  |     |  |
| Notes (include observations, activities performed, and photos taken): |        |                                 |     |  |     |  |
|   |        |                                 |     |  |     |  |
|   |        |                                 |     |  |     |  |
|   |        |                                 |     |  |     |  |
|   |        |                                 |     |  |     |  |
|   |        |                                 |     |  |     |  |





