Quality Assurance Project Plan

For

Assessing Larval Eel Ingress to Rivers and Streams in Barnegat Bay

v.1 March 26, 2012
v.2 January 2017
v.3 February 2019
v.4 January 2020

Dr. Jim Vasslides, BBP, Quality Assurance Officer

28 January 2020
date

BARNEGAT BAY PARTNERSHIP
RESEARCH · EDUCATE · RESTORE

2.0 Table of Contents

3.0 Distribution List

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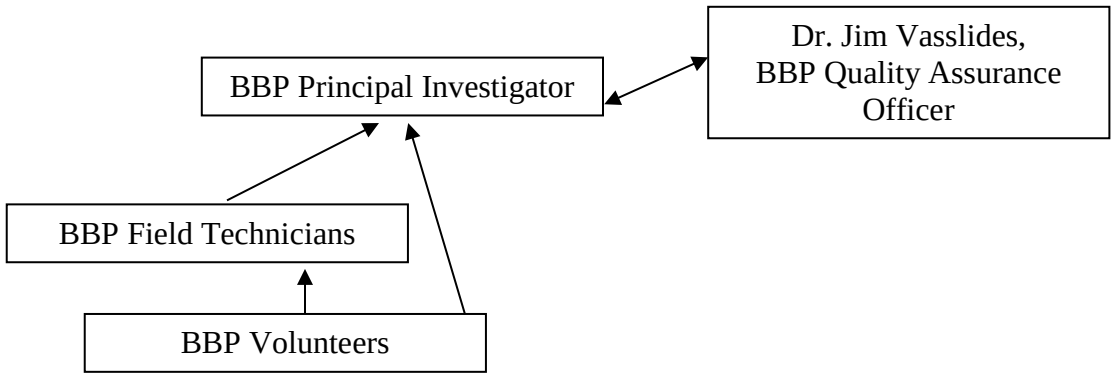
4.0 Project Task/Organization

Overall project management will be the responsibility of a senior field technician as identified by the BBP Program Scientist for each sampling year. The PI and field technicians will be responsible for deploying the eel collectors, collecting the eels and water quality parameters in the field, and measuring and staging the eels in the lab. Construction and maintenance of the collectors will be the responsibility of the field technicians and PI. Barnegat Bay Partnership (BBP) volunteers will assist with equipment maintenance and field collection with oversight from the technicians and PI. The Quality Assurance Officer, Dr. Jim Vasslides, Program Scientist of the BBP, will review the field and laboratory procedures to ensure compliance with the Standard Operating Procedures as outlined in this document. The PI will prepare the annual report for this project with assistance from field technicians.



5.0 Special Training Needs/Certification

None.

6.0 Problem Definition/Background

6.1 Problem Definition

The objective of this project is to better define the distribution of early life history of American eels (*Anguilla rostrata*) within the Barnegat Bay and provide us with an estimate of their relative abundance in the major waterways of the watershed. An understanding of the distribution and migration of early life history eels within the watershed will allow managers to consider the need for passage over or around obstructions (dams and culverts) during the design of construction or restoration projects.

6.2 Background

The recent decline of the American eel (*Anguilla rostrata*) in North America is a cause for immediate concern among fishermen, fishery scientists, and managers (Haro et al. 2000). These downward trends in abundance (both anecdotal and confirmed) appear to be occurring over large spatial scales (e.g. Lake Ontario, New Brunswick, Prince Edward Island, New York, Virginia; Richkus and Whalen 2000) and mirror declines in catadromous eel populations world-wide (*Anguilla anguilla, Anguilla japonica;* Dekker 2003, Tatsukawa 2003). A number of hypotheses have been suggested to explain these observed patterns: over-fishing of pre-spawning stages (i.e. estuarine residents; McCleave 1996), changes in the strength / position of major current systems (Castonguay et al. 1994a, b; Wirth and Bernatchez 2003), and habitat loss (Busch et al. 1998), including that due to dams both along the east coast (Busch et al. 1998, Greene et al. 2009) and in New Jersey (e.g. Durkas 1992). Data collected as part of this project will provide further insight into how habitat loss may be playing a role in population declines.

While previous research has documented the ingress of glass eels (earliest individuals to occur in estuaries, typically unpigmented, < 60 mm total length, Stage 1-2, as per Sullivan et al. 2009) and elvers (estuarine and freshwater, becoming pigmented, Stage 3-7) into adjacent estuaries during the winter – early spring (Sullivan et al. 2006, 2009), little is known regarding the timing and route of their migration into Barnegat Bay, nor the relative abundance and distribution in the rivers and streams of the watershed. This project is the continuation of a long-term sampling program by the Barnegat Bay Partnership in the South Branch Metedeconk River, Kettle Creek, Long Swamp Creek, and Forked River.

7.0 Project Task/Description

Field Sampling:
We will use eel collectors, passive structures constructed out of buoyant tufts of unraveled polyethylene rope fiber (Silberschneider et al. 2001, Sullivan et al. 2009), to collect eels below dams or other impediments to eel migration. Those individuals not retained as part of a subsample to be measured and staged will be returned to the water above the dam. The collection of the samples will be conducted by BBP staff members with participation from volunteers. A handheld water quality monitoring device will be used to collect water quality data per the BBP Laboratory SOP.

Sampling will occur 2 times per week at each of the five locations (Figure 1). The current schedule is to deploy the collectors on Monday mornings, sample Tuesday and Thursday mornings, and remove the collectors from the water and clean them following the Thursday sample event. In the case of hazardous weather conditions sampling will occur at the next available opportunity. The sampling methodology is detailed in the attached Sampling SOP (Attachment 1)

Measurement and Pigmentation Staging:
Eels collected will be measured in millimeters using standard measuring boards and the data will be recorded onto data sheets (Attachment 3). Length and pigmentation stage (Haro and Kruger 1988) determination on a subset of the sample will be conducted at the BBP. The subsample will be defined as the number of eels collected at each location up to a maximum quantity of 40. The subsample will be a random selection of individuals taken from each of the collectors (n=3) at a given location. The levels of pigmentation and stage of glass and elver eels will be determined with a microscope (see Measuring and Staging SOP; Attachment 2).

Timeline
The project is expected to commence upon final QAPP approval and will run for five years (2019-2024). Fieldwork will take place between the beginning of February and the end of April each year, weather dependent. Data entry and QA/QC will occur concurrent with sampling. A year-end report will be generated each November. The QAPP will be reviewed after the completion of the yearly report and updated if necessary.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fieldwork		**X**	**X**	**X**								
Data Entry		**X**	**X**	**X**								
Report Writing										**X**	**X**	
QAPP review	**X**											**X**

8.0 Criteria for Measurement Data

8.1 Precision

Precision of measurement and staging of the eels will be achieved by performing a replicate measurement and staging of the same eel by two different BBP personnel and comparing the measurement and staging of each. If the results do not agree, a third measurement and staging will be taken by the PI or Quality Assurance Officer. Replicate measurements will be conducted for the first 5 sampling events that contain eels in each season

All samples collected and analyzed by BBP staff shall be in accordance with NJAC 7:18 Regulations Governing The Certification Of Laboratories And Environmental Measurements, Standard Methods for the Examination of Water and Wastewater, and instrument manufacturer recommendations.

Precision of the Handheld Water Quality Meter will be ensured by following the BBP Laboratory's SOP. The same meter will be utilized for each days sampling when possible. Precision of the pH, DO, and specific conductivity samples will be checked daily when calibrated against know standards. Post calibration precision is as follows:
pH = +/- 0.05 su of the true value of a standard
DO = 0.0+/- 0.3mg/l in Zero DO solution
Specific Conductivity = +/- 1% of the true value of a standard

Precision will also be checked by taking a sample duplicate each day. Duplicate precision is as follows:
pH = +/- 0.1 su
DO = +/- 0.15 mg/L
Specific Conductivity = recording relative percent recovery of the duplicate

8.2 Bias

Bias may occur in the sampling protocol if the eel collectors were not consistently constructed. To minimize bias in collector construction a template will be created to ensure identical construction technique. Bias of the water quality instrument will be verified as part of a weekly/daily calibration, where they are compared to known, certified standards.

8.3 Representativeness

The chosen sites were determined based on the accessibility of impediments to migration as well as the relative locations of sites within northern and central Barnegat Bay.

Water quality measurements will be taken near the bottom, upstream of the collectors. This depth is representative of the overall water quality characteristics encountered by the eels in the vicinity of the collectors.

8.4 Comparability

The sampling design will allow for comparability of collected data, specifically the relative abundance of glass eels and elvers at each of the five sampling sites. The frequency of sampling (Tuesday and Thursday mornings) will allow for the collection of frequency and abundance data during peak eel migration/abundance and determine any variation that exists in environmental parameters. Furthermore, this sampling methodology is similar to that conducted by the NJDEP in other watersheds, allowing for comparisons at a larger spatial scale.

8.5 Completeness

Completeness will be insured by sampling twice weekly at each of the five locations from February through April, encompassing the known migration period of this species. At least one collection per week will be necessary to confirm peak migration timing. A missed sampling event(s) will not disqualify the data from further analysis.

8.6 Sensitivity

Length measurements will be taken to the nearest millimeter using standard measuring boards for all eels. Pigmentation staging of eels will occur under microscope with a minimum 10x lens and maximum 100x lens.

In regard to the handheld water quality monitoring device, the minimum instrument detection limit for temperature (-5 C), DO (0 mg/l and 0%), pH (0 units), and conductivity (0 mS/cm) are all below the expected values to be found at our sampling sites.

9.0 Non Direct Measurement (Secondary Data)

Non-direct measurement will not be used in this project.

10.0 Field Monitoring Requirements

10.1 Monitoring Process Design

This study is designed to assess the relative abundance and distribution of glass eels and elvers at four different locations in northern and central Barnegat Bay. The four sample sites (Lake Shenandoah on South Branch Metedeconk River, Kettle Creek, Long Swamp Creek, and Forked River) were selected based on accessibility, location in the Barnegat Bay watershed, and location relative to prior eel sampling efforts conducted by the BBP and others. Site latitudes and longitudes will be recorded on GPS at the start of each sampling season, or if collector locations need to be changed during a season. All eels will be enumerated in the field when possible, while a subsample will be measured for length and used to determine pigmentation staging of eels (this will occur at BBP). This subsample for each site will consist of a maximum of 40 eels, with no more than 20 from any single collector.

10.2 Monitoring Methods

Eel collectors will be placed within 150 meters of a dam or other impediment to migration at each location when feasible. Sampling at each site will occur two times per week, led by the PI and a research technician(s) with the assistance of BBP volunteers. Three collectors are deployed at each site with collector one the furthest upstream, and collector three the most downstream. The required equipment and methodology for removing the eels from the collector is described in the Sampling SOP (Attachment 1). Eels from each collector will be placed in individually labeled containers filled with ambient water and transported back to the BBP. Once at the BBP, collected eels will be anesthetized using the drug Tricaine Methanesulfonate (MS-222), measured, and pigmentation stage will be determined via microscope. See the Measurement and Staging SOP (Attachment 2) for additional details on anesthetization and staging methods. While there is no maximum exposure time for the eels in MS-222, all reasonable speed will be exercised to return the animals to recovery water. A total of up to 40 eels per site will be measured and staged, with all efforts made to select from each collector in relation to the total number for the site. No more than 20 eels will be measured and staged from an individual collector.

In addition to recording the biota collected, water quality measurements will be recorded using a handheld water quality meter. Temperature, conductivity/salinity, dissolved oxygen, and pH will be measured *in situ* and recorded prior to the start of sampling at each location, preferably slightly upstream of collector 1.

10.3 Field Quality Control

Construction of eel collectors will consist of the use of the same standard materials for each location, and will be identical to that of the other eel collectors deployed in the watershed. Devices will be checked at each sampling period for any wear or damage. Materials to repair or replace any equipment issues will be brought to each sampling.

As mentioned in Section 10.2, field measurements of salinity, pH, dissolved oxygen, and temperature will be recorded utilizing a handheld water quality instrument. This instrument is maintained and calibrated in accordance with an NJDEP approved Laboratory Certification #15036 (Attachment 4).

	Sensor Type	Range	Accuracy	Resolution	Units	Calibration
Dissolved Oxygen (%) (temp comp range - 5 to 45°C)	Polarographic	0 to 500%	0 to 200% (± 2% of reading or 2% air saturation, whichever is greater) 200% – 500% (± 6% of reading)	1% or 0.1% air saturation (user selectable)	%	1 or 2-points with zero
Dissolved Oxygen (mg/L) (temp comp range - 5 to 45°C)	Polarographic	0 to 50 mg/L	0 to 20 mg/L (± 2% of reading or 0.2 mg/L, whichever is greater) 20 – 50 mg/L (± 6% of reading)	0.1 or 0.01 mg/L (user selectable); 0.1% air saturation	mg/L, ppm	1 or 2-points with zero

Temperature (Lab-grade)		0 to 40°C	±0.35°C	0.1°C	°C, °F,	
Conductivity**	Four electrode cell	0 to 200 mS/cm (auto range)	±0.5% of reading or 0.001 mS/cm, whichever is greater	0 to 0.500 mS/cm = 0.001 0.501 to 50.00 mS/cm = 0.01 50.01 to 200 mS/cm = 0.1 (range dependent)	µS, mS	1 point
Salinity	Calculated from conductivity and temperature	0 to 70 ppt	±1.0% of reading or 0.1 ppt, whichever is greater	0.01 ppt	ppt, PSU	1 point
pH	Glass Combination Electrode	0 to 14 units	±0.2 units	0.01 units	mV, pH units	3 point; US Buffers
** Derived parameters can include salinity, specific c conductance						

11.0 Analytical Requirements

11.1 Analytical Methods

Analysis of pigmentation staging will occur in a laboratory at the Barnegat Bay Partnership. Microscopes will be used with lens at a minimum of 10x and maximum of 100x magnification. Eels will be anesthetized using MS-222 before pigmentation staging occurs. See the Measuring and Staging SOP for details (Attachment 2).

11.2 Analytical Quality Control

Staging identification will follow a previous protocol developed to assess pigmentation of glass and elver eels (Haro and Krueger 1988; see SOP in Attachment 2**).** Anesthetizing and staging of eels will be performed by BBP technicians and trained volunteers. Precision of measurement and staging of the eels will be achieved by performing a replicate measurement and staging of the same eel by two different technicians and evaluating the measurement and staging of each technician's results. If the results do not agree, a third measurement and staging will be taken by the PI or Quality Assurance Officer.

12.0 Sample Handling and Custody Requirements

Eels will be placed into a separate 1-liter container for each collector at each location. The containers will be pre-labeled with the site name and collector number. A separate liter container with ambient "recovery water" from each location will also be collected in an appropriately labeled container.

Upon return to the BBP lab, the eels will be measured, staged, and then placed in the appropriate recovery container as described in the SOP(Attachment 2). After all samples have been measured and staged, the eels will be returned to their native waterways. The same personnel will be with the samples from collection through release.

13.0 Testing, Inspection, Maintenance and Calibration Requirements

13.1 Instrument/Equipment Testing, Inspection, and Maintenance

All devices and equipment will be checked for wear or damage and functionality at each field sampling and materials for repair or replacement will be on hand for each sampling. Assessment of damage and wear will be the responsibility of BBP technicians.

The water quality handheld device is inspected, cleaned, and tested per the manufacturer's recommendations and the BBP Water Quality Laboratory SOP.

13.2 Instrument/Equipment Calibration and Frequency

Per the BBP's Laboratory Certification and SOP, the water quality measuring device is calibrated for DO and specific conductivity on a daily basis, and for pH daily (with a check every 3 hours).

13.3 Inspection/Acceptance of Supplies and Consumables

Standard materials for the eel collectors consist of polypropylene rope, clay plant saucers, and plastic plant saucers. All materials are available through home improvement stores. All supplies will be provided by BBP and additional parts for repair and maintenance will be stocked. All materials are standard and do not require special inspections.

14.0 Data Management

Field data sheets will be pre-printed on waterproof paper (see attached). Information on these sheets will be transferred to an MS Access electronic database. Data will be entered by at least one person and will be double checked by at least one other person. Statistical analysis will be conducted using the R-software program. Data files are maintained on networked computers that are backed-up daily at Ocean County College. The data will remain in both hard copy and electronic file at the Barnegat Bay Partnership for a minimum of 3 years after the end of the project.

15.0 Assessments/Oversight

Within the first three weeks of sampling in each year the Quality Assurance Officer will observe the field sampling and laboratory staging to ensure that the QAPP and SOPs are being followed. Documentation of this assessment will be included in the project file.

16.0 Data Review, Verification, Validation, and Usability

16.1 Data Review, Verification, and Validation

Datasheets will be transcribed from spreadsheets into an electronic database. Original data sheets will have the responsible technician's name on it so if any questions arise they can be addressed by the data taker. The data sheets will also be labeled as to who enters the data into the electronic database and who checked the data in the database, again so if any questions arise they can be directed to the appropriate individuals. Irresolvable errors

in data will result in the removal of this data from analysis. If data removal is necessary it will be noted in data reports.

16.2 Reconciliation with User Requirements

During statistical analysis, the data will be examined for outliers and for deviations from assumptions of statistical tests (e.g., homogeneity of variances). Outliers will be removed from analyses and data not conforming to assumptions of statistical test will be transformed appropriately. The limitations of the data will be noted and discussed in any written document (e.g., annual report, manuscript) in which they are incorporated.

17.0 Reporting, Documents, and Records

All data will reside at the Barnegat Bay Partnership in both electronic and hard copy form for a minimum of three years. It is anticipated that this data will be used in a collaborative manner with the NJ Department of Environmental Protection to describe the distribution and relative abundance of glass eels and elvers in Barnegat Bay. Any reports or publications generated as a result of this effort will be made available on the Barnegat Bay Partnership website. All reports will include any limitations associated with the data.

Literature Cited:

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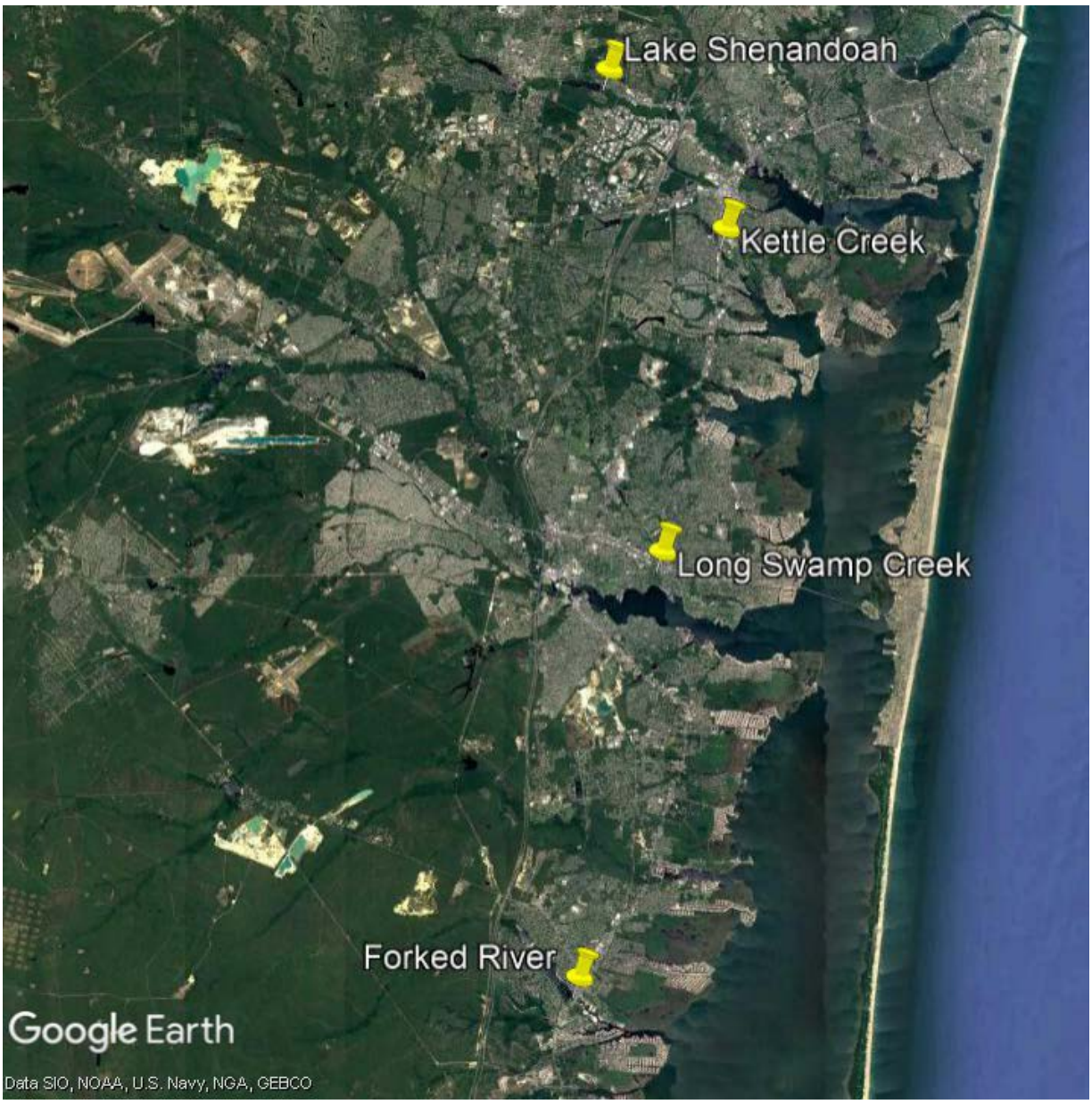
Wirth, T., Bernatchez, L. 2003. Decline of North Atlantic eels: a fatal synergy? Proceedings of the Royal Society of London 270:681-688.

Figure 1 – 2020 juvenile eel sampling sites within the Barnegat Bay



Attachment 1: Field Sampling SOP

STANDARD OPERATING PROCEDURE: EEL COLLECTOR DEPLOYMENT AND RECOVERY

Equipment

Initial Deployment

- Eel collectors (3 per site)
- Eel project datasheet (1 per site)
- Pencils

Retrieval

- Handheld water quality monitoring instrument
  - To include – Field case, C-batteries, screwdriver, guard and field guard cover
- Water quality "Calibration and Sampling Log(s)" (original plus extra)
- Distilled water to rinse Handheld Water Quality Meter
- Cooler containing:
  - pH 4 buffer
  - pH 7 buffer
  - pH 10 buffer
  - 3 plastic 250ml beakers
- Eel project datasheets from initial deployment (1 per site)
- Eel project datasheets for second deployment, if applicable (1 per site)
- Pencils
- 1-liter containers (3 per site; pre-labeled "Site X Collector X")
- Grey tote/bin
- 5-gallon bucket with short length of line (for gathering water)
- Mesh strainer (#16; 12 inch diameter, 1.18 mm mesh)

Methodology

Deployment

1. At each site there will be three collectors put out, with collector #1 being the furthest upstream, then in descending order downstream.
2. Eel collectors should be placed within 150 meters of a dam or other impediment to migration at each location, when feasible.
3. Collectors should be deployed with the base resting against the substrate, and as much of the collector submerged as possible.
4. Record the time when the last collector for a site was placed in the water as the "Set Time."

Retrieval

1. Prior to leaving the office, calibrate the handheld water quality meter per BBP Lab SOP, and record all calibration data on BBP's "Calibration and Sampling Log."
2. Once in the field, collect and record water quality data upstream of collector #1 on the "Calibration and Sampling Log."

3. Rinse meter with distilled water and place field guard cover over guard. Return to field case.
4. Start at collector #1, slowly pulling it out of the water and placing it in the grey bin, frayed rope facing down. The bin should be as close to you as possible to minimize any potential loss of eels. Record this as the "Retrieval Time".
5. Bring the eel collector and the bin to a level area with the least amount of ground cover feasible. Lay out the tarp and conduct the remaining activities on it.
6. Fill the 5-gallon bucket to about 3/4 full of ambient stream water and pour into the bin.
7. Keeping the collector plate in the water, vigorously move the collector forward 3 times, right 3 times, back 3 times, and left 3 times, trying not to splash water out of the bin. Then lift the plate and the ropes just out of the water and quickly rotate clockwise and counterclockwise twice. See the video at https://youtu.be/V18cA04kDKs (1:10 - 1:30) for a demonstration.
8. Remove the collector from the bin and place on the tarp, frayed-side up.
9. Place the mesh strainer on top of the 5-gallon bucket and pour the water in the bin through it. Eels, debris, and aquatic invertebrates (scuds, larval insects, etc) will be captured on top of the strainer.
10. Remove any eels and place them in the appropriately labeled 1-liter container (1/2 filled with ambient water), and carefully sort through debris in the strainer for additional eels.
11. Repeat steps #5-10, utilizing the same rinse water, until no eels are present for 2 cycles.
12. Sort through any debris remaining in the grey bin; eels like to hide out in the corners. Also check the tarp.
13. Repeat steps #2-10 for collectors #2 and #3.
14. Return the collectors to the water following the deployment methodology. If the final collection day for the week, bring the collectors back to the office to rinse with freshwater and dry.

Attachment 2: Measuring and Staging SOP

STANDARD OPERATING PROCEDURE: EEL MEASURING AND STAGING

MEASURING:

Eels will be anesthetized with Tricaine Methanesulfonate (MS-222). This is a drug that allows for the temporary immobilization of fish and reptile species. Aquatic animals readily absorb it across the gill tissue, the degree of sedation or anesthesia is easily varied for a wide variety of applications, and animals recover rapidly after exposure and resume normal physiological and behavioral functions. For the purposes of this study, < 1 gram of powder (or the equivalent of a spatula tip) is needed per ¼ liter of seawater to successfully anesthetize glass eels. Once eels are immobilized, measurements will be taken to the nearest millimeter on a standard measuring board and then pigmentation staging determined.

Once measurement and pigmentation stage is recorded eels will be placed in fresh sea water to be revived and released.

PIGMENTATION STAGING (Haro and Krueger, 1988):

Use of a microscope set to a minimum 10x lens and maximum 100x lens will be used to determine pigmentation staging of eels. Determination and visualization of stages are outlined below.

STAGE 1: No pigment on any part of body between dorsal and anal fin origins

STAGE 2: Pigment along base of dorsal fin, but not extending below apices of dorsal posterior cone myosepta

STAGE 3: Pigment extends ventrally along myosepta ca. halfway to lateral line; intermyoseptal pigment present or absent.

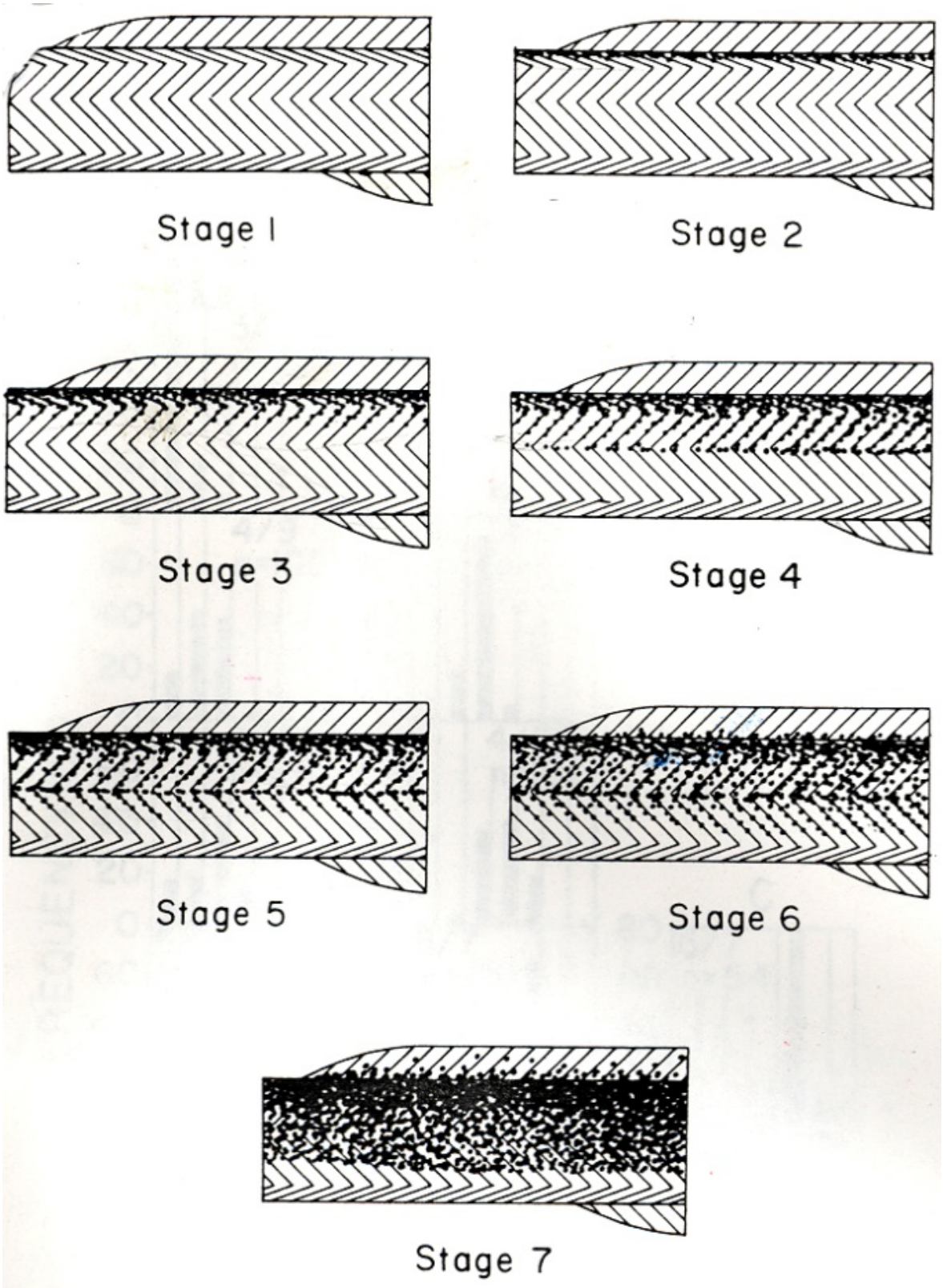
STAGE 4: Pigment extends to lateral line, which is now distinctly pigmented; intermyoseptal pigment usually present dorsolaterally.

STAGE 5: Pigment extends ventrally to midway between lateral line and apices of ventral posterior cone myosepta; intermyoseptal pigment always present dorsolaterally, but pigment more intense along myosepta.

STAGE 6: Pigment extends further ventrally along myosepta, forming irregular ventral margin; dorsolateral surfaces uniformly pigmented; intermyoseptal pigment usually present below lateral line, but myosepta more distinctly pigmented; pigment on base of dorsal fin present or absent.

STAGE 7: Previously pigmented areas now uniformly pigmented, obscuring myoseptal pigmentation; ventral margin or pigment a distinct line; base of dorsal fin usually pigmented, base of anal fin pigmented or not.

Fig. 1: Pigmentation Stages



Attachment 3: Eel project datasheet

Collection ID _____

Entry Date _____

Checked Date _____

Eel collector sampling datasheet

FIELD

Dam Site:_____ Collector #'s out:_____ Draw collector locations on reverse →

	Set	Retrieval
Date……..		
Time…….		
Personnel……..		
Depth……		

Notes:

Temp:

Salinity:

DO %:

DO mg/L:

pH:

LAB

Measured by:_____

Tow ID

_____ Collector #: 1 # of eels:_____ Other species:_____

_____ Collector #: 2 # of eels:_____ Other species:_____

_____ Collector #: 3 # of eels:_____ Other species:_____

	TL*	Stage	Pres.		TL*	Stage	Pres.
1				21			
2				22			
3				23			
4				24			
5				25			
6				26			
7				27			
8				28			
9				29			
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16				36			
17				37			
18				38			
19				39			
20				40			

Notes:

* Measurements live unless noted otherwise

Attachment 4: NJDEP Laboratory Certification

State of New Jersey
Department of Environmental Protection
Certifies That

BARNEGAT BAY PATNERSHIP

Laboratory Certification ID # 15036

having duly met the requirements of the

Regulations Governing the Certification of
Laboratories and Environmental Measurements N.J.A.C. 7:18 et. seq.

is hereby approved as a

State Certified Environmental Laboratory

to perform the analyses as indicated on the Annual Certified Parameter List which must accompany this certificate to be valid

Expires June 30, 2020

Michele M. Potter
Manager

THIS CERTIFICATE IS TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST IN A LOCATION ON THE PREMISES VISIBLE TO THE PUBLIC