PROJECT TITLE: Implementing American Eel Passage on Existing Dams

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2.0 Table of Contents

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3.0 Distribution List

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4.0 Project Task/Organization

Overall project management will be the responsibility of K. W. Able. Deployment of dam passage devices and monitoring of eel passage will be the responsibility of senior field technicians. These individuals and Able will provide guidance to Jacques Cousteau National Estuarine Research Reserve (JC NERR) volunteers. The Quality Assurance officer will be Roland Hagan, Laboratory Researcher III of Rutgers University. Able will prepare the final report for this project with assistance from senior field technicians.

5.0 Special Training Needs/Certification

None. There is no specific training required for the volunteers. Technicians will be handling passage device installation, measurement, and staging procedures and are already qualified to perform these duties. Volunteers will simply be assisting with setting and retrieving collectors under supervision of technicians and this task does not need any training.

6.0 Problem Definition/Background

6.1 Problem Definition

This project will evaluate restoration techniques for American eel passage to three waterways from which they have been denied access. The results of the monitoring program will allow for an evaluation of three low-cost passage devices that could be immediately retrofitted to existing dams and, thus, restore American eels to large components of three currently inaccessible watersheds (Lake Pohatcong drainage area of 12.3 square miles, Manahawkin Lake drainage area of 19.7 square miles, Kettle Creek/Lake Riviera, 9.5 square miles.); these are historic habitat from which they have been excluded. While renovation of the Lake Pohatcong and Manahawkin Lake dams identified in the project has been planned for a long time (U.S. Army Corps of Engineers 2000), construction is still under consideration and our proposed approach could provide passage in time for the next spring run. Eventually the other dams (at least 6, Zich 1977, 1978, NJDEP 2005) in the Barnegat Bay watershed could be included with this approach. The goal of the project is to provide immediate passage for American eel (glass eels and elvers) over dam spillways in Barnegat Bay utilizing low technology methods. Evaluation of the efficiency of the various techniques to be used will result in the selection of the optimal technique for use at other dams in the Barnegat Bay watershed and eventually elsewhere along the east coast of the U.S.

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). Of these, the last is most likely to have a positive impact if glass eels and elvers of American eels are provided passage to upstream areas that are now blocked by dams. Thus this project addresses the BBNEP strategic objectives on Habitat Loss and Habitat Restoration.

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) of the American eel are known to congregate at the base of dams/spillways in various Barnegat Bay watersheds (Lake Pohatcong, Manahawkin Lake, Kettle Creek) during their upstream migration during the winter – early spring, as our previous research has clearly shown for adjacent estuaries (Sullivan et al. 2006,

2009). These dam spillways present a barrier to the migration of this species to upstream freshwater habitat required to complete their catadromous life cycle. In order to increase the number of eels passing above these barriers we are proposing to test the efficiency of three types of low-technology, low cost eel passage devices at each dam spillway.

These approaches are based, in part, on prior attempts to provide passage for American eels associated with impoundments in the Delaware Bay watershed (Strait and Shotzberger 2002). In these successful evaluations, hundreds of glass eels and elvers were collected with a PVC pipe lined with discarded trawl mesh when spring temperatures were 13 - 39°C. It is anticipated that the devices will be placed on the dam spillways prior to the peak in eel in-migration in February and sampling will continue on a twice weekly basis until the end of the elver migration, which typically occurs in April (Able and Fahay 1998, 2010).

7.0 Project Task/Description

Field Sampling:

Eel Enumeration at Each Passage Device:

To increase the number of eels passing above the previously described barriers, we are proposing to test the efficiency of three types of low-technology, low cost eel passage devices at each dam spillway. The first device consists of burlap sacks sewn together and placed along the face of the dam spillway, reducing the velocity of water coming over that portion of the spillway and providing suitable textured substrate for the eels to move over the dam spillway and thus upstream to currently unoccupied portions of each watershed. The final two devices are variations on the same theme; both employ a medium diameter PVC pipe laid along the face of the dam spillway. One PVC pipe device is filled with woven mesh soil erosion matting while the other PVC pipe device is filled with aged trawl mesh. In both cases the filling in the tube serves to reduce water velocity and provide the textured surface needed by the glass eels and elvers to climb up the pipe and gain access to upstream habitat. On all eel passage devices a small mesh (1 mm) net collection system will be installed on the upstream end to allow for a count of the number of eels utilizing each passage device and, subsequently, the determination of size and pigmentation stage on a subsample of total eels collected. Locations of passage devices relative to other sites is not going to be taken into consideration.

Eel Collectors:

We will also 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 the dam and compare these to the size and stage of those successfully passing over the dam for each device. Those individuals not retained as part of the subsample will be returned to the water above the dam. The collection of the samples will be conducted by volunteers of the Jacques Cousteau National Estuarine Research Reserve (JCNERR) with participation and

oversight by a staff member of RUMFS. Frequency of sampling will occur 2 times per week at each of the three dams in order to increase the sample size comparisons between passage devices. The collectors will only be placed in the day before sampling and not remain in place after collection has occurred.

Simultaneously, we will determine the timing and general availability of glass eels in lower Barnegat Bay (our experience is based on our long-term [20+ year] sampling program inside Little Egg Inlet (Witting et al. 1999, Sullivan et al. 2006; Fig. 1)) and glass eel and elver availability at the base of the dams with eel collectors. In the process, we will be able to evaluate whether eels are available to the estuary and whether passage over a dam spillway is related to the availability of eels downstream from the dam. The likelihood of success of this project is based on our prior experience sampling glass eels and elvers (Able and Fahay 1998, 2010; Sullivan et al. 2006, 2009) and knowledge of their behavior (Wuenschel and Able 2008), as well as familiarity with one of the dam sampling sites (O'Donnell et al. 2000).

Measurement and Pigmentation Staging:

Eels collected from passage devices and collectors will be measured in millimeters using standard measuring boards and the data will be recorded onto waterproof data sheets (see attached). Staging of a subset of eels (glass, elver) will occur at the Rutgers University Marine Field Station. Length and pigmentation stage (see Sullivan et al. 2009) determination on a subset of the sample will be conducted at the Rutgers University Marine Field Station (RUMFS) (see attached SOP). The subsample will be defined as ten eels or 10% of eels collected over the quantity of ten up to a maximum quantity of 40. The levels of pigmentation and stage of glass and elver eels will be determined with a microscope (see attached SOP).

8.0 Criteria for Measurement Data

8.1 Precision

More than one technician will not be required to stage a single eel; therefore precision can not be applied.

8.2 Bias

Bias will be minimized by maintaining consistent sampling methods and frequency of sampling as well as consistent construction of eel passage devices that will be employed.

8.3 Representativeness

The chosen sites were determined based on the accessibility of dams as well as the relative locations of sites within northern and southern Barnegat Bay.

8.4 Comparability

The sampling design will allow for comparability of collected data, specifically the successful use of passage devices at each of the three dam sites. The frequency of sampling (2 times per week) will allow for the collection of frequency and abundance data during peak eel migration/abundance and determine any variation that exists in environmental parameters and equipment that determine the ability of successful passage of eels.

8.5 Completeness

Completeness will be insured by sampling twice weekly at each of the three dams.

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.

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 investigate which methods most effectively pass eels over dams and will assess and compare the frequency and abundance of glass eels and elvers in three different devices during the peak in glass eel abundance. Three sample sites (Kettle Creek, Manahawkin Lake, and Lake Pohatcong) were selected based on accessibility and location in the Barnegat Bay watershed. Site latitudes and longitudes have been recorded on GPS. There are three eel passage devices that will be tested at each site in addition to the use of eel collectors and wire mesh traps, two methods with which we have had previous experience (Able & Fahay 2010). All eels collected will be measured and released, except for a subsample which will be used to determine pigmentation staging of eels (this will occur at RUMFS). This subsample for each site will consist of ten eels or 10% of the number of eels collected at the given site, with a max number of 40 eels.

10.2 Monitoring Methods

Eel passage devices will be placed on the face of each dam spillway and stabilized with anchored lines. Locations of passage devices relative to other sites is not going to be taken into consideration. There are three different design methods, each of which will be implemented separately. The first device will utilize sewn burlap bags to be laid across the dam face. The second device will utilize PVC piping filled with soil erosion matting. The third will utilize PVC piping filled with aged trawl mesh. Each device is intended to slow water flow to allow eels to pass over dam faces. All of these devices will be deployed simultaneously at each dam. Mesh traps and eel collectors will be placed below each dam to also help determine how many eels are collecting below the dams. Sampling at each site will occur two times per week with the assistance of JC NERR volunteers and overseen by a research technician from RUMFS. The collectors will only be placed in the day before sampling and not remain in place after collection has occurred.

Subsampled eels collected will be transported back to RUMFS in buckets filled with water. Once at RUMFS collected eels will be anesthetized using the drug Tricaine Methanesulfonate (MS-222), measured, and pigmentation stage will be determined via microscope. Comparison of eel abundance at each site and within each site will help determine which eel passage device is most effective in providing passage to upstream habitat above dams. See attached SOP for additional details in anesthetization and staging methods of eels.

10.3 Field Quality Control

Construction of eel passage devices will consist of the use of the same standard materials for each separate device type. Devices will be checked at each sampling period for any wear or damage. Eel collectors and mesh traps will also be checked at each sampling for any damage or wear. Materials to repair or replace any equipment issues will be brought to each sampling.

11.0 Analytical Requirements

11.1 Analytical Methods

Analysis of pigmentation staging will occur in a laboratory at the Rutgers Marine Field Station. 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 attached SOP). Statistical comparison of eel stage and size will follow the technique (Haro and Kruegar, 1988) outlined in our prior eel research (Sullivan et al., 2006, 2009).

11.2 Analytical Quality Control

Staging identification will follow a previous protocol developed to assess pigmentation of glass and elver eels (see attached SOP). Anesthetizing and staging of eels will be performed by a RUMFS technician.

12.0 Sample Handling and Custody Requirements

All eels will be measured, counted, and released at the location at which they were captured. Handlers of this data will be RUMFS research technicians who will be aided by JC NERR volunteers. Eels taken back to RUMFS for pigmentation staging will be handled by RUMFS research technicians.

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 RUMFS field technicians.

13.2 Instrument/Equipment Calibration and Frequency

See attached SOP for handling of microscopes and staging methods.

13.3 Inspection/Acceptance of Supplies and Consumables

Standard materials and supplies include PVC piping, trawl mesh, eel collectors, bins, buckets, and traps. PVC piping will be obtained through home improvement stores. Trawl net, mesh, collectors, and traps will be ordered from an approved Rutgers University vendor. All supplies will be provided by RUMFS 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-made on waterproof paper (see attached). Information on these sheets will be transferred to an electronic database (Hagan et al., 2002). Data will be entered by at least one person and will be double checked by at least one other person. Statistical analysis will use the SAS 9.2 program. Data files are maintained on networked computers that are backed-up daily at RUMFS. The data will remain in both hard copy and electronic file at the Rutgers University Marine Field Station indefinitely.

15.0 Assessments/Oversight

Not Applicable.

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 will check 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.

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 Rutgers University Marine Field Station in both electronic and hard copy form indefinitely, as we have done previously with all other projects (Hagan et al., 2002). A progress report and final report will be submitted by Dr. Ken Able to the Barnegat Bay Partnership per the grant requirements as well as to EPA Region 2.

Literature Cited:

Able, K. W., Fahay, M. P. 2010. Ecology of Estuarine Fishes: Temperate Waters of the Western North Atlantic. Johns Hopkins University Press, Baltimore, MD. 574 p.

Able, K.W, Fahay, M.P. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press. 342 p.

Busch, W.D.N., Lary, S.J., Castilione, C.M., McDonald, R.P. 1998. Distribution and availability of Atlantic coast freshwater habitats for American eel. Administrative Report #98-2. USFWS, Amherst, NY

Castonguay, M., Hodson, P.V., Couillard, C., Eckersley, M.J., Dutil, J.D., Verreault, G. 1994a. Why is recruitment of American eel declining in the St. Lawerence River, and Gulf? Canadian Journal of Fisheries and Aquatic Sciences. 51:479-488.

Castonguay, M., Hodson, P. V., Moriarity, C., Drinkwater, K. F., Jessop, B. M. 1994b. Is there a role of ocean environment in American and European eel decline? Fisheries Oceanography 3:197-203.

Dekker, W. 2003. Status of the European eel stock and fisheries. Pp. 237-254 in Aida, K, Tsukamoto K, Yamauchi K (eds) Eeel Biology. Springer-Verlag, Tokyo.

Durkas, S. J. 1992. Impediments to the spawning success of anadromous fish in tributaries of the NY/NJ harbor watershed. Report prepared for the American Littoral Society, Sandy Hook, NJ

Greene, K. E., Zimmerman, J. L., Laney, R. W., Thomas-Blate, J. C. 2009. Atlantic coast diadromous fish habitat: a review of utilization, threats, recommendations for conservation and research needs. Atlantic State Marine Fisheries Commission. Habitat Management Series #9, Washington, DC.

Hagan, S.M., Able, K.W., Witting, A.M., Muzeni, and McLellan, J. 2002. Long-term Fish and Associated Environmental Data Management at the Rutgers University Marine Field Station. Rutgers University Institute of Marine and Coastal Sciences Technical Report:100-20.

Haro, A.J., Krueger W.H. 1988. Pigmentation, size, and mirgration of elvers (Anguilla rostrata (Lesueur)) in a coastal Rhode Island stream. Canadian Journal of Zoology 66: 2528-2533.

Haro, A., Richkus, W., Whalen, K., Hoar, A., Busch, W.D., Lary, S., Brush, T., Dixon, W. 2000. Population decline of the American eel: implications for research and management. Fisheries 25:7-16

McCleave, J.D. 1996. Life history aspects of management of the American eel. P. 107 in Abstracts: 52nd Annual Northeast Fish and Wildlife Conference. Farmington, Connecticut. Marsh 31-April 3, 1996.

New Jersey Department of Environmental Protection. 2005. Locations of anadromous American shad and river herring during their spawning period in New Jersey's freshwaters including known migratory impediments and fish ladders. Division of Fish and Wildlife unpublished report, Sicklerville, NJ.

O'Donnell, S., Hoden, R., Able, K. W. 2000. River herring restoration in the Jacques Cousteau National Estuarine Research Reserve: Data loggers as a tool supporting the reestablishment of

river herring runs. Annual meeting National Estuarine Research Reserve System/NERRA, Restoration Science Workshop, Williamsburg, VA.

Rickhaus, W.A., Whalen, K. 2000. Evidence for a decline in the abundance of the American eel, *Anguilla rostrata*, in North America since the early 1980s. Dana 12:83-97.

Silberschneider, V., Pease, B. C., Booth, D. J. 2001. A novel artificial habitat collection device for studying resettlement patterns in anguillid glass eels. Journal of Fish Biology 58: 1359-1370.

Strait, K. A., Shotzberger, S. L. 2002. Successful migration of juvenile American eels (*Anguilla rostrata*) at two experimental eel ladders on small Delaware impoundments. 132nd Annual Meeting of the American Fisheries Society, Baltimore, MD. August 2002.

Sullivan, M.C., Able, K.W., Hare, J.A., Walsh, H.J. 2006. *Anguilla rostrata* glass eel ingress into two U.S. east coast estuaries: patterns, processes and implications for adult abundance. Journal of Fish Biology 69:1081-1101.

Sullivan, M. C., Wuenschel, M. J., Able, K. W. 2009. Inter- and intra-estuary variability in ingress, condition, and settlement of the American eel *Anguilla rostrata*: implications for estimating and understanding recruitment. Journal of Fish Biology 74:1949-1969

Tatsukawa, K. 2003. Eel resources in East Asia. Pp. 293-300 in Aida, K, Tsukamoto K, Yamauchi K (eds) Eeel Biology. Springer-Verlag, Tokyo.

United States Army Corps of Engineers. 2000. Barnegat Bay Feasibility Study – Draft Early Action Report: Fish Ladders at Lake Pohatcong and Manahawkin Lake. Contract DACW 61-99-D-0001, Task Order No. 0002. Prepared by Moffatt and Nichol Engineers, Baltimore, MD in association with Versar, Inc., Columbia, MD.
Wirth, T., Bernatchez, L. 2003. Decline of North Atlantic eels: a fatal synergy? Proceedings of the Royal Society of London 270:681-688.

Witting, D.A., Able, K.W., Fahay, M.P. 1999. Larvale fishes of a Middle Atlantic Bight estuary: Assemblage structure and temporal stability. Canadian Journal of Fisheries and Aquatic Sciences 56(2):222-230.

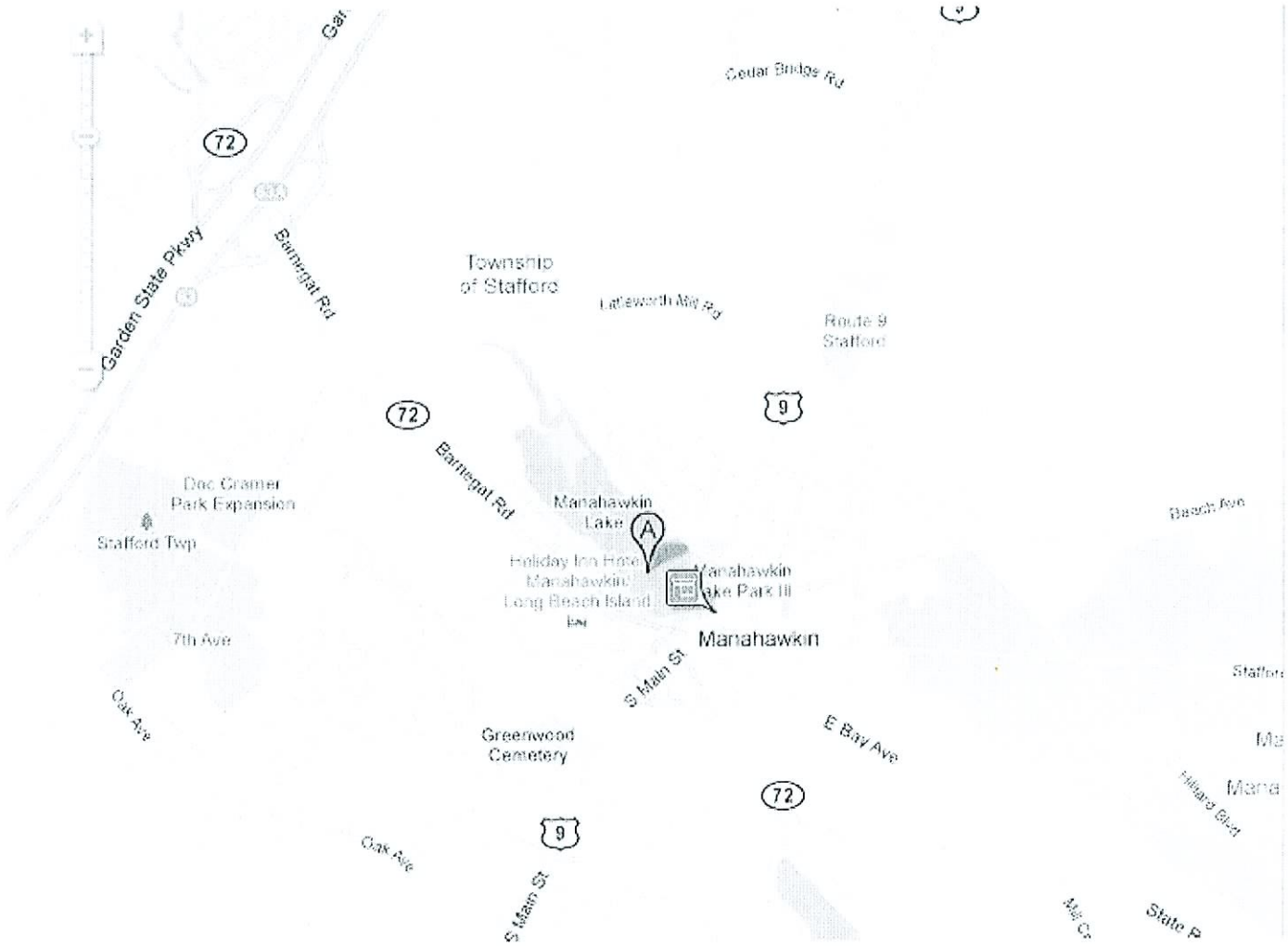
Wuenschel, M. J., Able, K. W. 2008. Swimming ability of estuarine-dependent eels (*Anguilla rostrata, Conger oceanicus*) at ingress: contrasting patterns of cross-shelf transport? Marine Biology 154:775-786.

Zich, H.E. 1977. The collection of existing information and field investigation of anadromous clupeid spawning in New Jersey. NJDEP Div. of Fish, Game, and Shellfishes. Tech. Rep. 2-39.

Zich, H. E. 1978. Information on anadromous clupeid spawning in New Jersey. Department of Environmental Protection, Division of Fish and Wildlife, Miscellaneous Report No. 41. 28 p.

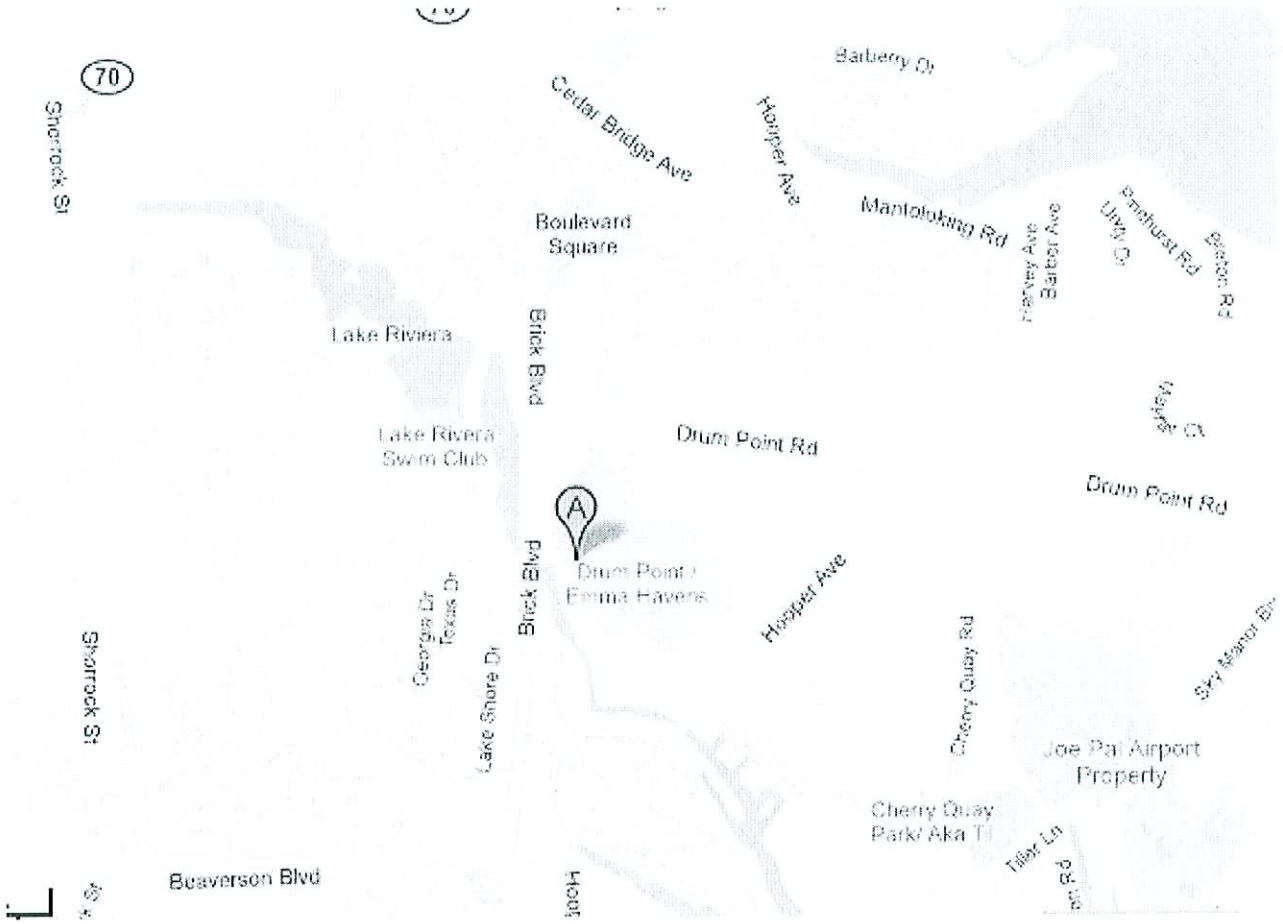
MAPS:

Location – Manahawkin Lake, Manahawkin NJ 08050

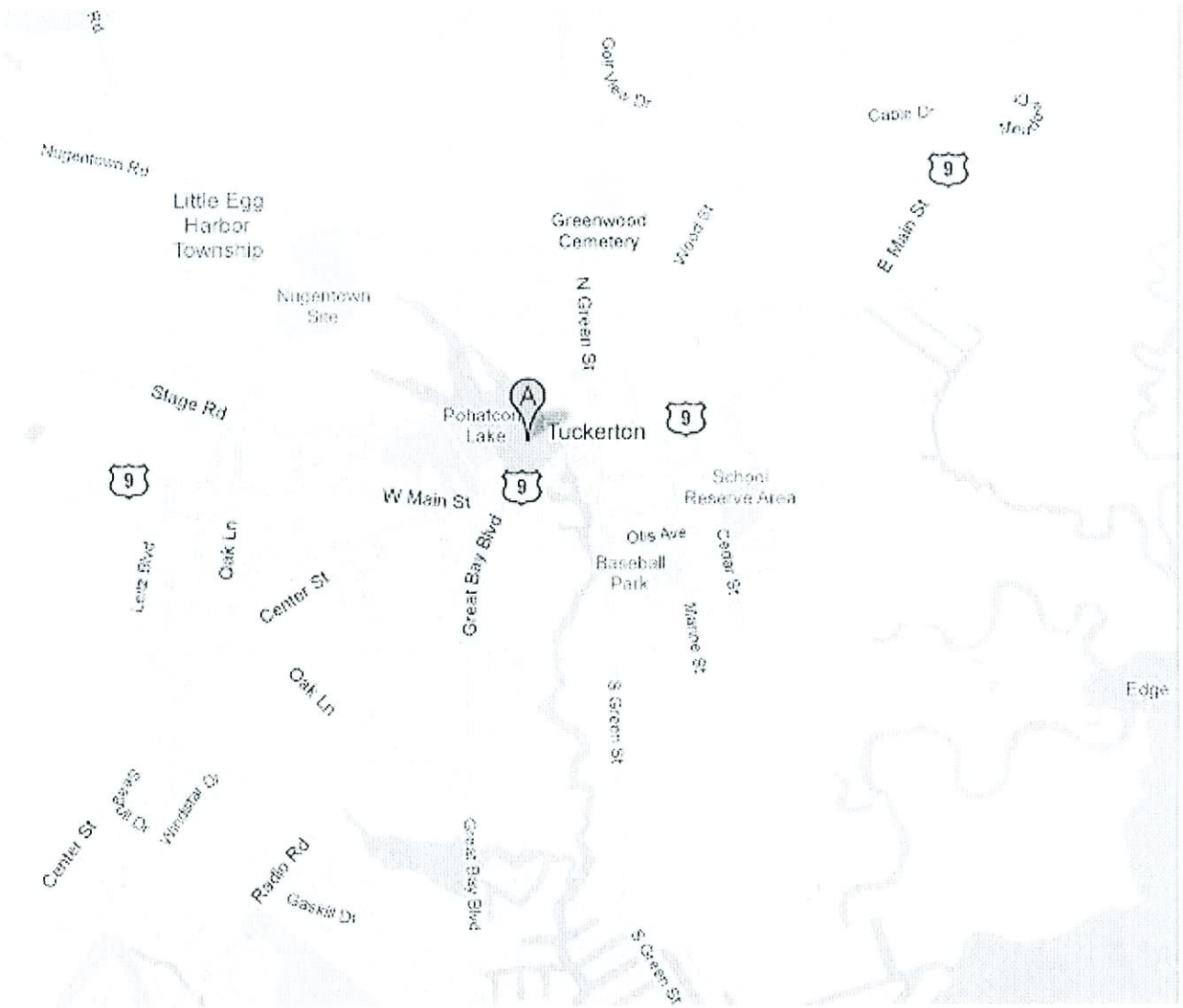


MAPS:

Location – Kettle Creek, Brick, NJ 08724



MAPS: Lake Pohatcong, Tuckerton, NJ 08087



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.

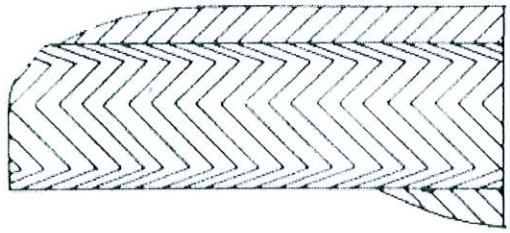
STAGE 4: Pigment extends to lateral line, which is now distinctly pigmented; intermyoseptal pigment usually present dorsolaterally.

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.

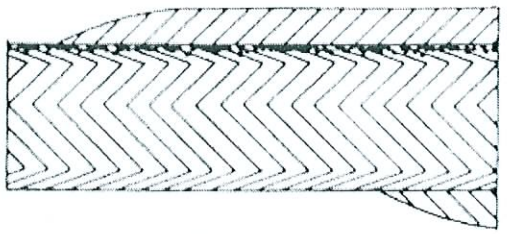
STAGE 6: Pigment extends further ventrally along myosepta, forming irregular ventral margin; dorsolateral surfaces uniformly pigmented; intermyoseptal pigment usually present below lateral line, but myosepta more distinctly pigmented; pigment on base of dorsal fin present or absent.

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



Stage I



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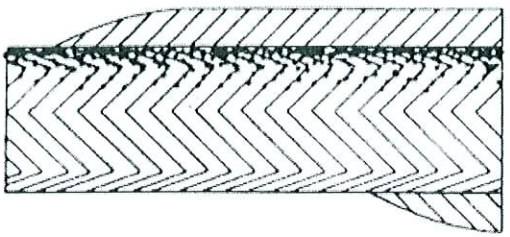

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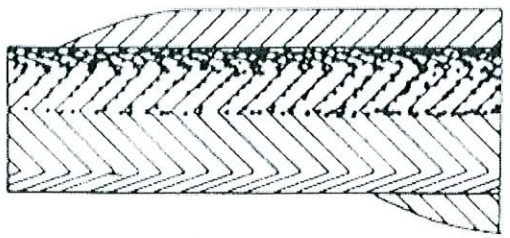

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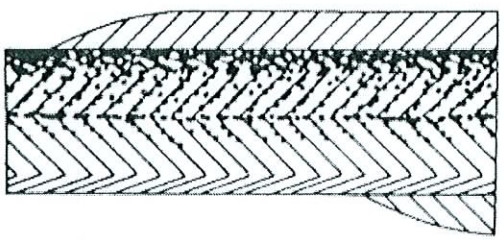

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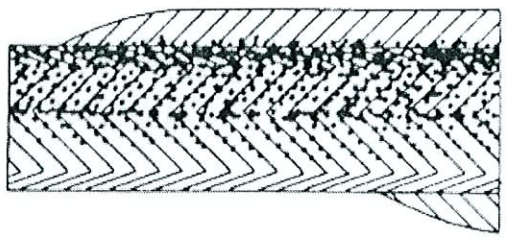
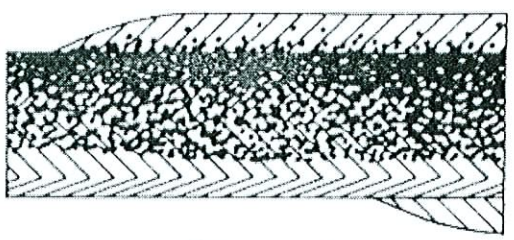


Stage 6



Stage 7

Eel passage device sampling datasheet

FIELD

Dam Site:_____ Draw passage device location on reverse →

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

Notes:_____

LAB

Measured by:_____

Device #:_____# of eels:_____Other species:_____

Device #:_____# of eels:_____Other species:_____

Device #:_____# 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			
10				30			
11				31			
12				32			
13				33			
14				34			
15				35			
16				36			
17				37			
18				38			
19				39			
20				40			

Notes:_____

* Measurements live unless noted otherwise

Eel collector sampling datasheet

FIELD

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

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

Notes:_____

LAB

Measured by:_____

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

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

Collector #:_____ # 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			
10				30			
11				31			
12				32			
13				33			
14				34			
15				35			
16				36			
17				37			
18				38			
19				39			
20				40			

Notes:_____

* Measurements live unless noted otherwise