

American Eel sampling at Conowingo Dam 2010

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Background

Eels are a catadromous species that ascend freshwater environments as juveniles then reside in riverine habitats until reaching maturity at which time they migrate to the Sargasso Sea where they spawn once and die. Larval eels are transported by ocean currents to rivers along the eastern seaboard of the continent. Unlike anadromous shad and herring, they have no particular homing instinct. Historically, American eels were abundant in East Coast streams, comprising more than 25 percent of the total fish biomass in many locations. However, Atlantic coast commercial landings have been declining since the 1970's.

The Atlantic States Marine Fishery Commission Fishery Management Plan for American Eel lists access to freshwater habitat as a priority for protecting the population. Although the Chesapeake Bay and tributaries support a large portion of the coastal eel population, eels have been essentially extirpated from the largest Chesapeake tributary, the Susquehanna River. The Susquehanna River basin comprises 43% of the Chesapeake Bay watershed. Construction of Conowingo Dam in 1928 effectively closed the river to upstream migration of elvers at river mile ten (Figure 1).

Mainstem Susquehanna fish passage facilities (lifts and ladder) were designed and sized to pass adult shad and herring and are not effective (due to attraction flow velocities and operating schedules) in passing juvenile eels (elvers) upriver. Specialized passages designed to accommodate elvers are needed to allow them access to the watershed above dams.

Survey methods and Equipment Placement

To determine the best method to reintroduce eels into the Susquehanna River above Conowingo Dam, we have collected baseline information on eel abundance, migration timing, catch efficiency, and attraction parameters at the base of the Conowingo Dam since the spring of 2005. Information from the study will assist in determining the potential for reintroducing eels into the Susquehanna watershed above Conowingo Dam.

The 2010 American eel sampling below Conowingo took place on the west side of the dam adjacent to the West Fish Lift. This sampling served as an attempt to further survey the population of juvenile eels (elvers) at the base of Conowingo Dam. In 2007, elvers were observed climbing up the rip rap where water was spilling over from pumps operated to supply water for the West fish lift operations. In 2008 we used this excess water as attraction flow for our elver trap, constructed from industrial cable tray with landscape fabric attached to the bottom (Figure 2). Elvers that found this attraction flow would crawl up the rip rap to the trap and then climb into the trap (control trap). In 2009 and 2010 we made an attempt to attract elvers directly from the Susquehanna River at the base of the riprap as well (experimental trap Figure

3). In 2010 we continued to use both the control and the experimental traps to sample for elvers. The top of the cable trays emptied into a fine mesh collection bag placed in collection tanks (Figure 4). Aerated water was supplied to the collection and holding tanks using a 1/8 HP Sweetwater™ Blower.

Elvers were sedated, measured for total length (TL), and individually counted. Large numbers of eels were counted volumetrically. The collection of substantial numbers of eels allowed for the experimental stocking of elvers into Buffalo Creek and Conowingo Creek. All of the elvers stocked were marked with a 6 hour immersion in buffered oxytetracycline (OTC) at a concentration of 550 ppm prior to release. A subsample of elvers captured was also sent to the Lamar Fish Health Center (Lamar, PA) for disease testing before any stocking occurred.

As in previous years, eel pots with a 6 mm square mesh were set around the base of the West Fish Lift to catch larger eels. In 2010 the goal was to tag new eels and recapture yellow eels that had been tagged with Passive Integrated Transponder (PIT) tags. Yellow eels captured in eel pots were sedated with a concentrated solution of MS-222 (450g/L), measured, fin clipped, and had a PIT tag inserted in the dorsal musculature and released.

In 2010, young-of-year (glass eels) were collected by Maryland Department of Natural Resources (Maryland DNR) in Turville Creek, MD. These eels were then transported to the United State Geological Survey lab in Wellsboro, Pennsylvania. The glass eels were held in the lab until June, and then released in Buffalo and Pine Creek (Table 2).

Results

Eels were sampled between 31 May and 2 August 2010 and elvers were collected throughout the sampling timeframe (table 1). A total of 24,000 elvers were collected during 2010 (table1). Maryland DNR conducts an American eel young of year (glass eel) survey to characterize trends in American eel recruitment over time (ASMFC 2000). Sampling takes place at Turville Creek, MD using a modified Irish elver ramp. We compared estimated recruitment of glass eels from Turville Creek to captures of elvers below Conowingo dam one year later. Based on three years of data it appears that the glass eel recruitment index at Turville Creek does predict elver abundance the following year at Conowingo Dam (Figure 5).

In 2010, a majority of the elvers were collected in June and July which was similar to 2008. During 2009 the run was later and more protracted with the majority of elvers being collected in the end of July through August. In 2008 and 2010, we saw multiple waves of elvers throughout our sampling efforts; where as in 2009 there did not appear to be spikes in collections, but more of a steady level of migration through the sampling period (Figure 6).

Juvenile eel lengths ranged from 95 to 195 mm TL (Figure 7), comparable to the results from previous years sampling. In 2010 seventy-five percent of elvers measured were between 110 and 139 mm, and from 2005-2009 seventy percent of elvers measured were between 110 and 139 mm.

Yellow and silver eel collections in eel pots have taken place from 2007 - 2010. In 2010, we caught a total of 25 yellow and silver eels, with 11 new captures, 9 recaptures, and 5 we were not able to scan due to equipment malfunctions. This was significantly less than in previous years. The fewest numbers of yellow and silver eels previously caught was in 2008, when we had 32 new captures, and our greatest number of new captures was in 2009 with 68 (Table 3). The addition of the 11 new captures brings the total number of PIT-tagged yellow eels in the study to 161 (Table 3). We have had 27 single or multiple recaptures of PIT tagged eels. We are tracking annual growth rates of yellow eels using these recaptures. Yellow eels collected in eel pots ranged from 335 to 696 mm TL.

A total of four stockings from elvers captured at Conowingo Dam were conducted, with an estimated total of 17,500 elvers being stocked in Buffalo and Pine Creek (Table 2).

To evaluate stocking success at Buffalo and Pine Creek, we conducted electrofishing surveys using 3 backpack shockers in September 2010. Methods used by the Maryland Biological Stream Survey (2007) were used to quantify the catch per unit effort (CPUE) and the biomass of eels. Two sites, bracketing the eel release sites, in each creek were surveyed (Table 1). At each site, 75 meters of stream were blocked off using ¼" mesh block net. In order to quantify the fauna in the stream, two passes with the electrofishing units were conducted and all species of fish collected were enumerated. Captured eels were measured to assess growth and a subsample of the eels collected was brought back to confirm previous marking of otoliths by OTC. In September of 2010, 81 elvers were recaptured in Buffalo Creek during electrofishing surveys. Of the eels captured, 70 were found at the Strawbridge Rd. bridge site where over 20,000 elvers and glass eels were stocked in June. The other 11 were found at the foot bridge on Rte. 1003 where 4,500 glass eels were stocked. The lengths of the recaptured eels suggest that a large majority were stocked as elvers from below Conowingo Dam (Figure 1). Two of the recaptured eels measured less than 100 mm in length suggesting that they may have been stocked glass eels since most elvers exceeded that size at stocking. The average TL of stocked elvers from Conowingo was 124 mm while the average TL of recaptured eels was 143 mm (Figure 8). The 81 recaptured eels had a total weight of 830 g which results in an average of 10.2 g per eel. Only 1 eel was recaptured in Pine Creek during electrofishing surveys. The captured eel was an older yellow eel (approximately 500 mm in length) likely released in June 2010 by the USGS. Although the eel lacked an external tag, there was a scar in the location at which tags were placed. In addition to eels, 1,447 individuals of 26 fish species were collected in Buffalo Creek and 1,060 individuals of 20 fish species were collected in Pine Creek during electrofishing surveys. (Minkinen et al. 2011)

Discussion

Throughout the project we have compared elver captures to several environmental factors. We have not been able to determine what environmental factors control the timing of the elver migration below Conowingo Dam. Typically elvers reach the dam between the first week of May through the end of June and peak captures usually occur in June and July.

Interruptions in power supply to our pumps have reduced elver catch on several occasions. We have been working on several sampling design changes in an attempt to ensure that we would

have an uninterrupted supply of water throughout the sample period. We have also increased the size of our collection and holding tanks in an effort to increase survival and decrease stress while holding the elvers for stocking. These measures have improved our ability to capture and hold larger numbers of elvers for stocking above the dam.

We expected to have a greater number of silver and yellow eel captures and recaptures in 2010, but due to constant trap failures, the effort was not equal to the effort in years past. In 2011 we will attempt to collect more silver and yellow eels to continue to collect recapture information on PIT tagged eels.

In 2011 we will attempt to collect 60,000 elvers and we propose to release the first 15,000 elvers in Pine Creek. The remaining elvers will be evenly stocked into Conowingo Creek in Maryland and Buffalo and Pine Creek in Pennsylvania. Elvers will be marked with OTC before being released. The Maryland Biological Stream Survey plans on conducting surveys in Conowingo Creek to evaluate the stocking effort. The Maryland Fishery Resources Office will survey elvers released in the Pennsylvania tributaries using methods identical to those used in 2010.

Figure 1. Map of the Maryland Biological Stream Survey (MBSS) sampling sites of tributaries to the Susquehanna River in Maryland. The numbers in boxes indicates eel counts at each sampling site. Note the difference in densities of eels in tributaries below Conowingo Dam compared to above the Dam.

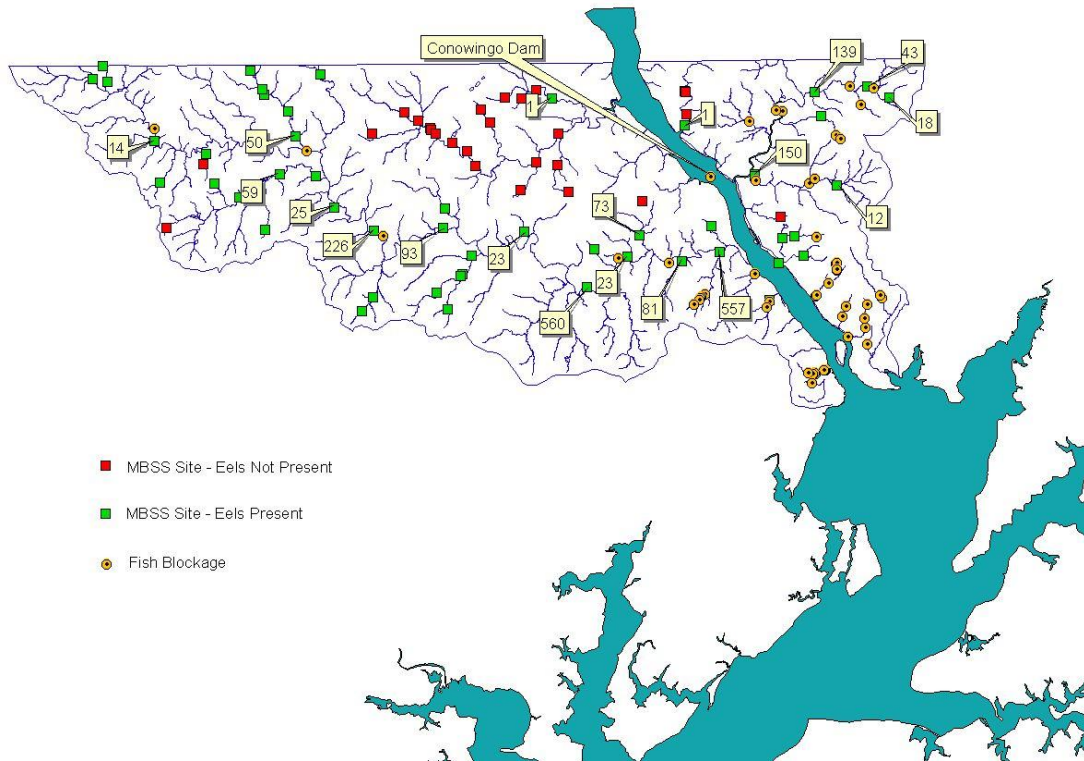


Figure 2. Eel trap constructed of industrial cable tray and landscape fabric.



Figure 3. Cable tray on the West Shore below Conowingo Dam, tray on the left is the experimental, and the tray on the right is the control location from 2008.



Figure 4. The cable tray emptying into a collection bag in a holding tank.



Figure 5. Yearly catch rates of glass eels from Turville Creek and elvers from Conowingo Dam

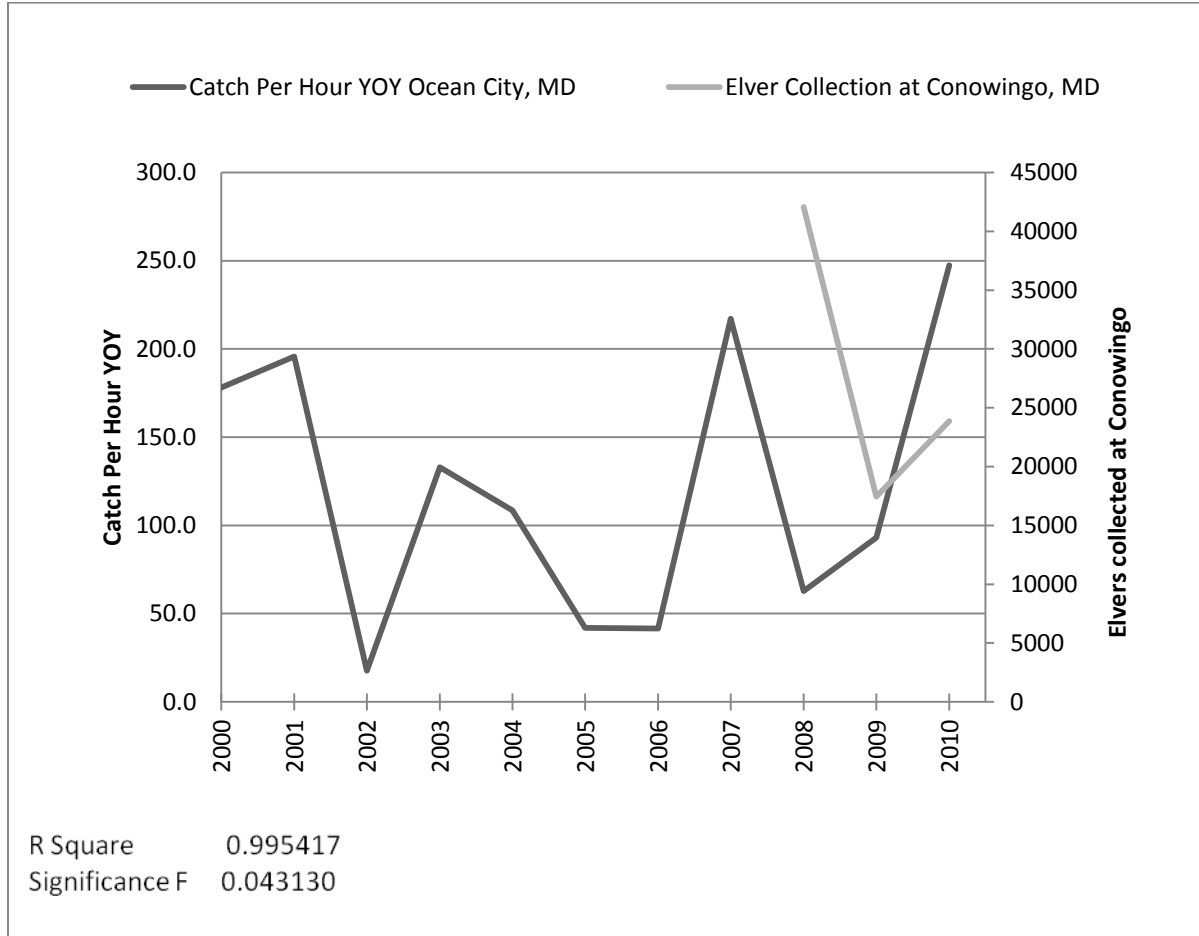


Figure 6 Elver capture in relation to date for 2008, 2009, and 2010

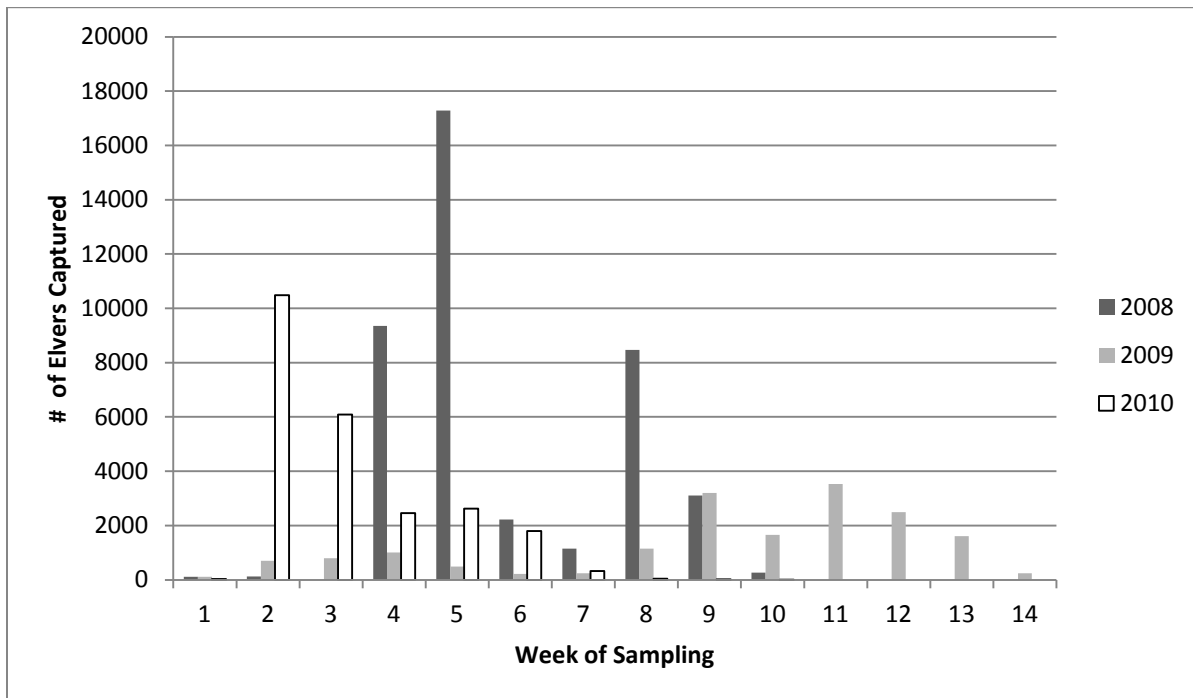


Figure 7 Length frequency of elvers captured below Conowingo Dam 2005-2010.

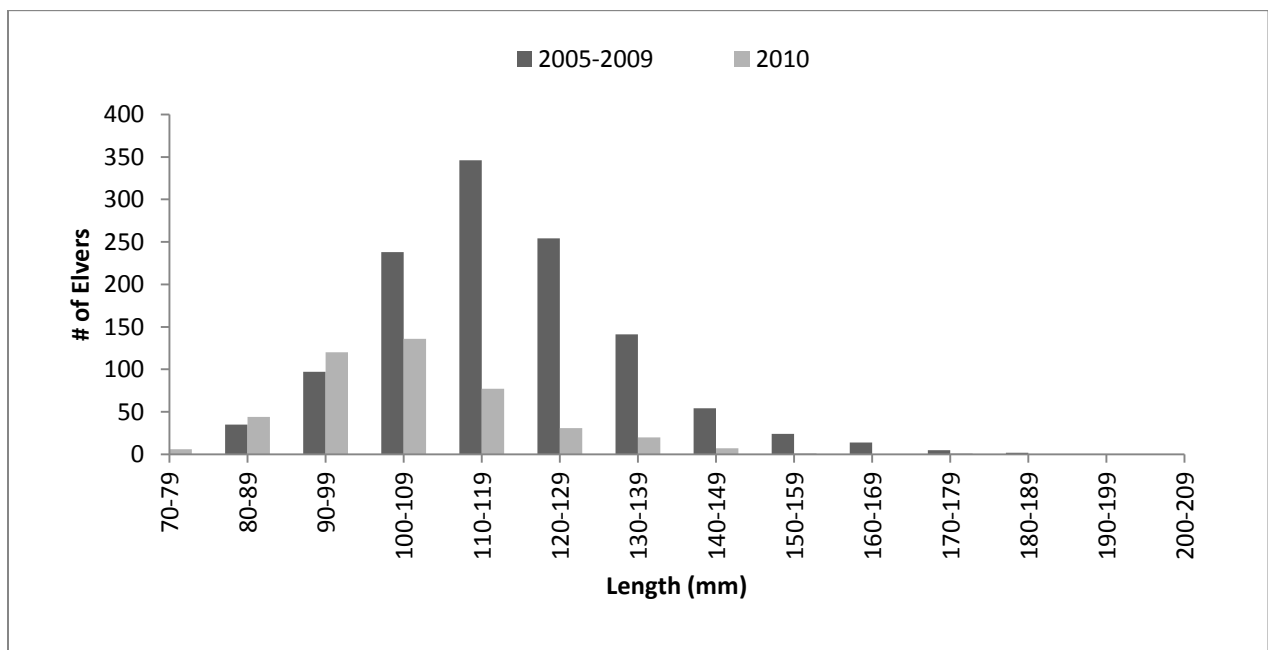


Figure 8 Length frequency of elvers recaptured in Buffalo Creek

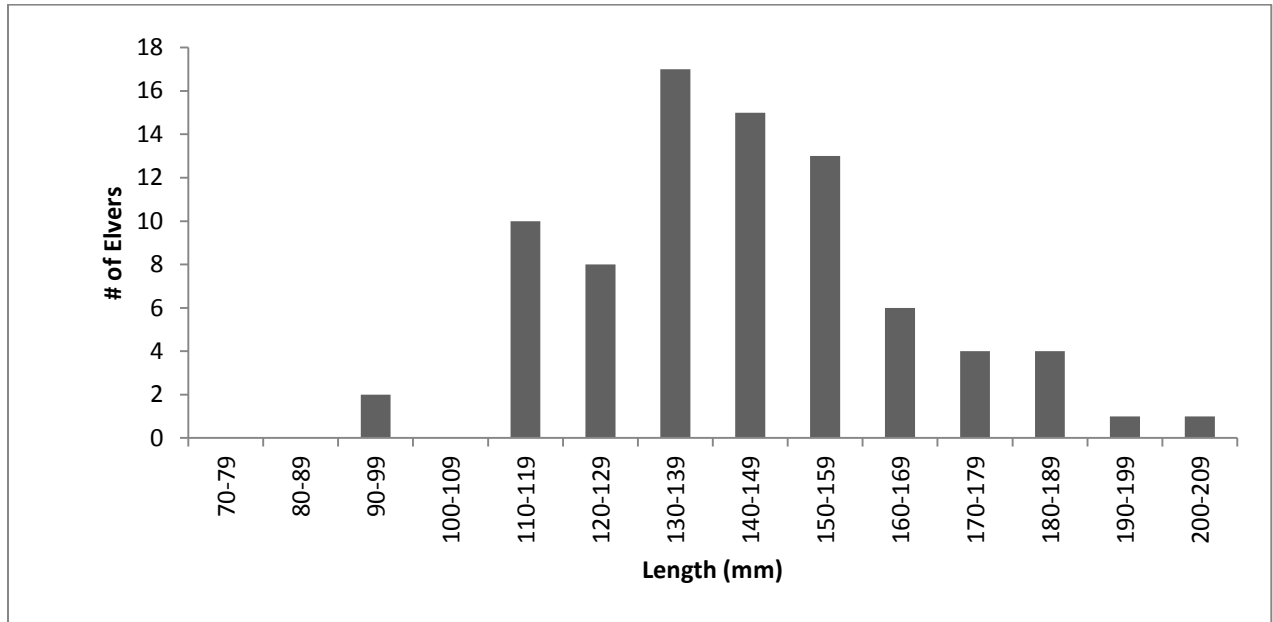


Table 1. Date, Location, and number of elvers collected and stocked in 2010

Date	# Stocked	Creek	Latitude	Longitude	Origin
6/9/2010	3000	Pine	41.74368	-77.43394	Turville Creek
6/9/2010	3000	Pine	41.73671	-77.43036	Turville Creek
6/9/2010	3000	Pine	41.72098	-77.41300	Turville Creek
6/10/2010	8084	Buffalo	40.98560	-76.93237	Conowingo Dam
6/10/2010	4500	Buffalo	40.98560	-76.93237	Turville Creek
6/10/2010	4500	Buffalo	40.98105	-76.95134	Turville Creek
6/21/2010	7790	Buffalo	40.98560	-76.93237	Conowingo Dam
6/30/2010	1311	Conowingo	39.7308	-76.17841	Conowingo Dam
8/2/2010	340	Conowingo	39.7308	-76.17841	Conowingo Dam

Table 2. Number of eels caught at the base of Conowingo Dam by eel traps on the West side of the dam during 2010.

Date	Control Total #	Experimental Total #
5/31/2010	7	8
6/2/2010	24	12
6/4/2010	305	0
6/7/2010	3504	0
6/9/2010	3334	0
6/10/2010	3344	0
6/11/2010	1012	0
6/14/2010	3672	0
6/16/2010	1400	0
6/18/2010	448	0
6/21/2010	1900	0
6/23/2010	106	0
6/25/2010	315	0
6/28/2010	765	0
6/30/2010	539	17
7/2/2010	999	3
7/5/2010	935	0
7/6/2010	105	0
7/9/2010	759	0
7/12/2010	47	0
7/14/2010	245	0
7/16/2010	27	0
7/19/2010	27	0
7/21/2010	3	0
7/23/2010	16	0
7/26/2010	14	0
8/2/2010	4	0

Table 3. Number of Passive Integrated Transponder Tags (PIT) applied to yellow eels by year.

2007 Tags Applied	2008 Tags Applied	2009 Tags Applied	2010 Tags Applied	Total
51	32	68	11	162

Table 4. Growth of yellow eels caught and recaptured in pots at the base of Conowingo dam by year.

ID	<i>Average Length (mm)</i>				<i>Average Annual Growth Increase (mm)</i>
	2007	2008	2009	2010	
257C63E092	594	617	*	*	23
257C6534CA	733	770	*	*	37
257C6526C0	463	474	*	*	11
257C65EB48	404	510	521	*	58.5
257C655F24	426	445	*	*	19
257C65F2F2	338	390	505	*	83.5
257C63E581	551	589	*	*	38
257C65F8B0	475	511	*	*	36
257C65E87B	405	471	510	*	55
257C65FBAB	377	405	440	*	31.5
257C652B3A	466	490	*	*	24
257C63C580	391	520	*	557	55.3
257C660193	386	428	*	*	21
257C63CE9A	458	*	565	*	53.5
257C63CF54	484	*	624	*	70
257C652735	457	*	590	*	66.5
257C6534A4	386	*	478	*	46
257C66192F	447	*	580	*	66.5
257C63D36E	*	419	433	*	14
257C652BF4	*	364	383	395	15.5
257C65342C	*	393	516	*	123
257C65B1E0	*	479	543	*	64
257C660279	*	497	575	*	78
257C65E54F	*	454	*	550	48
1C2D05239A	*	*	612	626	14
1C2D0529B9	*	*	495	578	83
257C63D39B	*	*	432	462	30

REFERENCES

ASMFC (Atlantic States Marine Fisheries Commission). 2000. Standard procedures for American eel young of the year survey.

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