PROGRESS REPORT

State: **NEW HAMPSHIRE** **Grant**: **F-61-R-22/F19AF00061**

Grant Title: **NEW HAMPSHIRE'S MARINE FISHERIES INVESTIGATIONS**

Project I: **DIADROMOUS FISH INVESTIGATIONS**

Job 3: **AMERICAN EEL YOUNG-OF-THE-YEAR SURVEY**

Objective: To characterize trends in annual recruitment of young-of-the-year American Eel over time in New Hampshire waters.

Period Covered: January 1, 2019 - December 31, 2019

ABSTRACT

The annual American Eel *Anguilla rostrata* young-of-the-year survey was conducted on the Lamprey River in Newmarket, New Hampshire and on the Oyster River in Durham, New Hampshire, in 2019. A modified Irish elver ramp was installed under an overhang section of the fish ladder in the Lamprey River below the Macallen Dam at the head-of-tide. A box trap was set on the fish ladder at the Oyster River below the Mill Pond Dam at the head-of-tide. The survey was conducted for eleven weeks at both monitoring stations. A total of 755 young-of-the-year eels (717 glass and 38 brown) were caught in the Lamprey River; an increase from the 208 observed in 2018. The total number of young-of-the-year eels captured by the box trap at the Oyster River in 2019 has declined by 99% compared to the record high count in 2014. The peak catch per unit effort was 8.0 young-of-the-year eels/hours soak time on the Lamprey River and 0.3 young-of-the-year eels/hours soak time on the Oyster River. At the Lamprey River, the mean length for young-of-the-year glass eels was 62.7 mm (n=391) and brown eels averaged 94.1 mm (n=31). At the Oyster River, the mean length for young-of-the-year glass eels was 60.4 mm (n=29) and brown eels averaged 98.0 mm (n=8). High variability in annual counts make characterization of trends over time difficult and data show that migration timing and rate are affected by changes in water temperature, river discharge, and lunar phase.

INTRODUCTION

Worldwide declines of eels have been noted (Stone 2003) and a number of studies have drawn attention to a possible Atlantic coast decline in the American Eel *Anguilla rostrata* population. Castonguay et al. (1994) indicated that juvenile American Eel recruitment to the upper St. Lawrence River declined drastically between 1985 and 1992. Haro et al. (2000) also found evidence of a significant decline in the recruitment of American Eels over the same relative time period at various sites from Virginia to Nova Scotia. The lack of long-term American Eel abundance data led the Atlantic States Marine Fisheries Commission (ASMFC) to recommended an annual American Eel young-of-the-year survey be conducted by each state on the east coast to collect baseline population data (ASMFC 2000a). Data from these studies are expected to be used to characterize trends in the annual recruitment of the American Eel on the Atlantic coast of North America.

Due to the mating strategy of the American Eel, where adult eels reproduce in the Sargasso Sea and the offspring migrate to freshwater rivers on the northeast coast of North America, trends in recruitment abundance at individual rivers may reflect abundance trends for the entire eel population (Castonguay et al. 1994). The ASMFC American Eel Technical Committee prepared a standard procedures sampling protocol for the young-of-the-year survey in 2000, which stated an objective to sample two locations per state or jurisdiction, but later noted that the purpose and objective of the survey would not be compromised if only one location was sampled. In 2001, the State of New Hampshire (NH) established an annual survey of young-of-the-year eels in the Lamprey River in Newmarket, NH. A second monitoring station was established on the Oyster River in Durham in 2014. The goal of these surveys is to help distinguish natural variation in annual recruitment and facilitate an understanding of possible long-term trends in eel numbers. Natural variation may be caused by events such as annual changes in ocean currents, river flow, or water temperature, while an overall decline in eel recruitment may be the result of anthropological impacts such as pollution, commercial harvesting, and habitat modification (Haro et al. 2000).

PROCEDURES

The study was designed according to the ASMFC (2000b) procedures for the American Eel young-of-the-year survey. Sampling methods were updated in 2010 to be standardized with the ASMFC procedures. Each spring, since 2001, a modified Irish elver trap is installed in an enclosed protective overhang of the Lamprey River fish ladder where young-of-the-year eels have been observed below the head-of-tide Macallen Dam (approximately 21 miles from the mouth of the Piscataqua River). As of 2014, a box trap has been installed on the Oyster River fish ladder in a more public location where young-of-the-year eels are protected within a locked plywood box below the head-of-tide Mill Pond Dam, Durham, NH (approximately 15 miles from the mouth of the Piscataqua River). In both sampling locations, young-of-the-year eels are drawn to the freshwater flowing down the trap’s ramp. The young-of-the-year eels climb the trap’s ramp through Enkamat material, an erosion prevention mat constructed of monofilament, and drop into a sampling bucket at the end of the ramp.

Both sampling stations were monitored daily four times per week, generally Monday through Thursday, when American Eels were first observed arriving. Department biologists monitored the Lamprey River sampling station and a volunteer group monitored the Oyster River station. American Eels that were collecting in the sampling bucket over the weekend were passed upstream each Sunday to initiate the four-day sampling period each week. The sampling design requires a six-week minimum sampling period. To assure sampling occurs during peak young-of-the-year migration period additional weeks may be sampled.

For the trap to attract young-of-the-year American Eels there must be approximately 1 to 2 mm of consistent freshwater flow down the Enkamat mesh lining the ramp. A garden hose provided the gravity-fed water supply to the ramp by connecting a screen-covered funnel, submerged in freshwater above each dam, to a perforated PVC tube placed along the upper horizontal surface of the ramp. The perforated PVC tube and hose distributed an even stream of water down the ramp. A long-handled bristle brush was used to clean the PVC pipe if it became clogged with debris or algae.

Each day of sampling, a qualitative judgment was made on the ramp performance. Ramp performance at the time of the survey was rated as good, fair, poor, or void. The ratings were an attempt to account for the effect of ramp performance on the number of captured young-of-the-year American Eels. A rating of good indicated a steady, even flow of water down the ramp; fair indicated more than 50% of the holes were clogged and flow restricted to one side of the ramp; poor indicated that more than 90% of the holes were clogged and very little water reached the trap entrance; and void indicated all of the holes were clogged and no water reached the trap entrance or that the trap was knocked over for any reason (e.g., tide, floods, etc.). Before the end of each sampling day, every effort was made to return the trap, if necessary, to good performance by cleaning the tube, adjusting the flow, or repositioning the trap.

Young-of-the-year American Eels represent a single year class and are divided into two stages: glass eels and brown eels (elvers). Glass eels generally range from 45 to 70 mm long and elvers range from 65 to 100 mm long. The glass eel stage was classified further to one of seven pigmentation stages based on the methods of Haro and Krueger (1988). Each sampling day, the young-of-the-year eels were counted and a subsample of 60 eels (preferably glass eels) was measured and weighed twice per week. All eels were characterized as glass eels or elvers. All eels were then released above the head-of-tide dam into freshwater.

If the young-of-the-year American Eels in the bucket were too numerous to count, their numbers were estimated using a volumetric sampling technique recommended by the ASMFC (2000b) and similar methodology by Jessop (2000). Young-of-the-year eels were placed into a graduated cylinder until an eel volume of 25 mL was reached. The young-of-the-year eels in the graduated cylinder were counted and released to freshwater. This was repeated six times and the mean number of eels per milliliter was calculated. The remaining young-of-the-year eels were then placed into a graduated cylinder and the total remaining volume of young-of-the-year eels was recorded. The final estimated number of young-of-the-year eels equals the total remaining volume of eels (mL) multiplied by the calibrated average number of eels per milliliter plus the number of eels counted in each 25 mL calibration.

Additionally, during each site visit, lunar phase and water temperature was recorded and a note was made if the dam’s flood gates were open. Discharge flows, recorded in cubic feet per second, were downloaded from the United States Geological Survey Lamprey River station located upstream from the sampling location to provide daily mean discharge for each sampling day.

RESULTS

In 2019, monitoring stations were installed April 30 on the Oyster River and May 7 on the Lamprey River. The elver traps were checked daily to note the presence of American Eels and the temperature of the water was recorded. The ramps and tubes were cleaned daily to assure good flow performance. Young-of-the-year eels were first observed on May 22, 2019, at the Oyster River and May 9, 2019, at the Lamprey River. The Oyster River sampling site was monitored until the second week of July and the Lamprey River was monitored until the third week of July; eleven weeks of monitoring for both sites (Tables 1.3-1 and 1.3-2). A total of 755 young-of-the-year eels (717 glass and 38 brown) were caught in the Lamprey River and 39 young-of-the-year eels (29 glass and 10 brown) were caught in the Oyster River. Peak young-of-the-year eel abundances at both sampling sites occurred near a new moon and declining river discharge flows (Figures 1.3-1 and 1.3-2). The Lamprey River had two peaks of eels on June 25 (134 eels) and July 1 (159 eels) (Table 1.3-1 and Figure 1.3-1). The Oyster River had one peak, which occurred on June 25, with 8 eels (Table 1.3-2 and Figure 1.3-2).

The peak CPUE was 8.0 young-of-the-year eels/hour soak time on the Lamprey River and 0.3 young-of-the-year eels/hour soak time on the Oyster River (Tables 1.3-3 and 1.3-4). The annual CPUE on the Lamprey was 0.7 young-of-the-year eels/hour soak time and the Oyster was <0.1 young-of-the-year eels/hour soak time. The daily mean river discharge ranged from 40 ft^3/s to 486 ft^3/s on the Lamprey River and from 4 ft^3/s to 84 ft^3/s on the Oyster River (Tables 1.3-1 and 1.3-2). Glass eels were first observed when fresh water temperatures reached above 14^{o}C on both the Lamprey and Oyster rivers. Freshwater temperature in the Lamprey and Oyster rivers ranged from 9^{o}C to 25°C during the sampling period that eels were monitored. Ramp performance was rated good or fair throughout all of the sampling period at both locations.

At the Lamprey River, the mean length for the young-of-the-year glass eels was 62.7 mm (n=391) and brown eels averaged 94.1 mm (n=31) (Table 1.3-5). Mean length for the young-of-the-year glass eels at the Oyster River was 60.4 mm (n=29) and brown eels averaged 98.0 mm (n=8) (Table 1.3-6). Glass eel pigmentation stages one through seven were observed at both rivers in 2019.

DISCUSSION

Young-of-the-year American Eel surveys typically have high variability in the number of American eels observed (Shepard 2014). The total number of young-of-the-year eels captured by the Irish elver ramp at the Lamprey River (755) in 2019 was higher than 2018 (208), but the third lowest in the time series (Table 1.3-3). The total number of young-of-the-year eels captured by the box trap at the Oyster River in 2019 was the lowest in the time series and has declined by 99% compared to the record high count in 2014 (Table 1.3-4). The annual totals of young-of-the-year eels have been variable and no significant trend (Mann-Kendall: Z = -32, P = 0.278) in recruitment is apparent in the Lamprey River; however, there is a declining trend (Mann-Kendall: Z = -13, P = 0.024) in the Oyster River.

It has been shown that temperature plays an important role on glass eel migration into freshwater. Glass eels are sensitive to water temperature and are capable of detecting 1°C changes in water temperature (Kim et al. 2002).

Sorensen and Bianchini (1986), Moriarty (1987), and Haro and Krueger (1988), reported the onset of eel migration into freshwater coinciding with an increase in water temperature. Other studies have also observed a correlation between peaks in eel migrations and increased water temperatures (Gascuel 1986; Tongiorgi et al. 1986; Tosi et al. 1990; Martin 1995; Edeline et al. 2006). However, Sorensen and Bianchini (1986) observed that once water temperature exceeded a threshold of 10–15°C it appeared to have minimal, if any, influence on migration. Elver migration into NH monitored rivers typically occurs when reaching a minimum water temperature threshold of 10–15°C, and observed in 2019 with the migration in the Lamprey and Oyster rivers (Tables 1.3-1 and 1.3-2).

River discharge and its effects on water velocity have been found to delay or prevent the upstream migration of elvers (Jessop 2000; Jessop and Harvie 2003). High levels of discharge could impede the upstream movement of glass eels in the Lamprey River. Overton and Rulifson (2009) observed higher numbers of eels when discharge was below 150 m^3/s and no eels when discharge went over 650 m^3/s in the Roanoke River, North Carolina. Although the discharge range on the Roanoke River is greater than both study sites in NH, the pattern of young-of-the-year eels decreasing at higher discharge rates is observed in both river systems. During 2019, in the Lamprey River, the highest number of eels (97.0%) were observed in the trap when discharge levels were below 250 ft^3/s (7.1 m^3/s), while at the Oyster River, 100% of eels were observed when discharge levels were below 27 ft^3/s (0.8 m^3/s) (Figures 1.3-1 and 1.3-2).

Heavy flows in April and May that may occur as a result of open flood gates at the dam on the Lamprey River, likely hinder eels from moving upstream in the beginning of their migration. These high flows could impede eels from approaching the entrance to the traps or may cause them to burrow into sediment and halt their upstream migration. However, the flood gates at the Lamprey River were only open between 5/7 to 5/9 during the monitoring period, likely having little impact on elver migration this year. During this period, only one eel was observed; suggesting that increased river discharge negatively impacts the upstream migration of young-of-the-year eels.

Lunar phase has been shown to impact elver migration. Deelder (1958), in a study of European Eels *Anguilla anguilla*, suggested that phases of the moon act upon the migration of European Eels in an indirect way when higher tides during the full or new moon carry them further upstream. The peaks in young-of-the-year American Eel density occurred near the new moon on both the Oyster and Lamprey rivers (Figure 1.3-1 and 1.3-2). Typically, higher tides associated with a full moon are related to increased densities of young-of-the-year

American Eels, but an increase in river discharge before the full moon could prohibit elvers from upstream migration. In May and July of 2019, the observed increases in river discharge before the full moon could have slowed migration and explain the low American Eel densities in both rivers.

While the density of migrating young-of-the-year American Eels has been highly variable from year to year, mean lengths of young-of-the-year eels are consistent. Mean length of glass eels varies by latitude, with smaller glass eels in the southern portions of the range (Cairns et al. 2014). According to Cairns et al. (2014), the latitude for NH should have a mean length for glass eels around 60 mm. Mean lengths of glass eels on the Lamprey River were consistent with these findings between 2014 and 2019, ranging from 60.0 to 63.1 mm (Table 1.3-5). The mean lengths of glass eels at the Oyster River have also been consistent with Cairns et al. (2014), ranging from 59.2 to 62.4 mm between 2014 and 2019 (Table 1.3-6). The constancy of glass eel lengths from year to year can be attributed to latitude and the migration time from spawning grounds in the Sargasso Sea.

In summary, numbers of young-of-the-year American Eels returning were relatively low at both the Lamprey and Oyster rivers in 2019. The high inter-annual variability of observed American eels makes characterization of trends difficult; however, there is a declining trend in the Oyster River. Environmental factors may influence the timing and abundance of young-of-the-year eel migration. Temperature plays a role in the timing of migration into freshwater, with movement beginning above a threshold level. River discharge can also affect the number of migrating glass eels observed at sampling stations, with high discharge rates decreasing glass eel densities and peak passage being associated with low flow rates. The increases in river discharge at both sites in May and June may explain the decrease in eels. While many environmental factors influence the abundance of migrating young-of-the-year eels, mean length is associated with latitude. Further annual surveys in NH, combined with other states along the east coast of the U.S., will likely characterize trends in the young-of-the-year eel recruitment over time. The combination of these studies should allow the ASMFC to establish a qualitative appraisal of the annual recruitment of American Eel to the U.S. Atlantic coast.

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Table 1.3-1. Data collected from the American Eel young-of-the-year survey using a modified Irish elver trap in the Lamprey River, Newmarket, New Hampshire, 2019.

Date	Soak time (h)	Freshwater temperature (°C)	Moon phase[a]	Daily mean discharge (ft^3/s)[b]	Ramp performance	Number of eels		CPUE (# eels/hr soak time)
						Glass	Brown	
5/7/2019	24.00	11	New	486	good	0	0	0.0
5/8/2019	24.00	12	New	413	good	0	0	0.0
5/9/2019	24.00	13	New	358	good	0	1	0.0
5/10/2019	23.50	14	First	328	good	1	0	0.0
5/13/2019	22.50	14	First	289	good	13	4	0.8
5/14/2019	21.50	13	First	388	good	0	0	0.0
5/15/2019	28.25	11	First	430	good	2	2	0.1
5/16/2019	23.75	11	First	418	good	0	0	0.0
5/20/2019	24.00	14	Full	277	good	0	0	0.0
5/21/2019	24.00	14	Full	244	good	1	0	0.0
5/22/2019	24.50	16	Full	213	good	1	1	0.1
5/23/2019	27.50	16	Full	184	good	0	0	0.0
5/28/2019	18.50	16	Last	143	good	14	14	1.5
5/29/2019	20.50	16	Last	203	good	3	1	0.2
5/30/2019	29.00	15	Last	224	good	0	0	0.0
5/31/2019	22.00	15	New	222	good	0	1	0.0
6/3/2019	26.00	16	**New**	174	good	1	0	0.0
6/4/2019	27.00	16	New	164	good	0	0	0.0
6/5/2019	21.50	15	New	149	good	1	0	0.0
6/6/2019	26.50	17	New	381	good	0	0	0.0
6/10/2019	21.50	20	First	268	good	0	0	0.0
6/12/2019	24.00	19	First	239	good	11	0	0.5
6/13/2019	25.00	18	First	225	good	3	2	0.2
6/14/2019	23.00	17	First	236	good	4	0	0.2
6/17/2019	18.75	18	First	191	good	4	0	0.2
6/18/2019	25.00	18	Full	173	good	14	1	0.6
6/19/2019	22.00	19	Full	155	good	19	0	0.9
6/20/2019	25.00	19	Full	145	good	22	1	0.9
6/24/2019	21.25	20	Last	131	good	48	4	2.4
6/25/2019	26.75	21	**Last**	110	good	134	0	5.0
6/26/2019	25.50	22	Last	123	good	47	1	1.9
6/27/2019	21.00	22	Last	122	good	67	0	3.2
7/1/2019	20.00	21	New	148	good	156	3	8.0
7/2/2019	22.25	21	**New**	145	good	79	1	3.6
7/3/2019	25.25	20	**New**	122	good	23	1	1.0
7/4/2019	24.00	21	New	97	good	12	0	0.5
7/9/2019	24.00	24	**First**	56	good	9	0	0.4
7/10/2019	24.00	24	First	48	good	9	0	0.4
7/11/2019	26.00	25	First	46	good	7	0	0.3
7/12/2019	20.50	25	Full	79	good	7	0	0.3
7/16/2019	21.00	24	**Full**	61	good	2	0	0.1
7/17/2019	24.00	24	Full	50	good	2	0	0.1
7/18/2019	24.00	24	Full	44	good	1	0	0.0
7/19/2019	24.00	24	Full	40	good	0	0	0.0

[a] Moon phase in bold is the actual day of that moon phase.
[b] Provisional data subject to revision (http://waterdata.usgs.gov/nh/nwis/current/?type=flow).

Table 1.3-2. Data collected from the American Eel young-of-the-year survey using a box trap in the Oyster River, Durham, New Hampshire, 2019.

Date	Soak time (h)	Freshwater temperature (ºC)	Moon phase[a]	Daily mean discharge (ft3/s)[b]	Ramp performance	Number of eels		CPUE (# eels/hr soak time)
						Glass	Brown	
4/30/2019	26.00	10	Last	46	good	0	0	0.0
5/1/2019	24.00	10	Last	39	good	0	0	0.0
5/2/2019	24.00	10	New	45	good	0	0	0.0
5/3/2019	24.00	10	New	42	good	0	0	0.0
5/7/2019	24.00	11	New	28	good	0	0	0.0
5/8/2019	24.00	11	First	25	good	0	0	0.0
5/9/2019	24.00	12	First	21	good	0	0	0.0
5/10/2019	23.25	13	First	21	good	0	0	0.0
5/14/2019	24.75	9	First	37	good	0	0	0.0
5/15/2019	23.25	10	First	31	good	0	0	0.0
5/16/2019	25.75	10	Full	24	good	0	0	0.0
5/17/2019	22.50	10	Full	24	good	0	0	0.0
5/21/2019	23.75	14	Full	14	good	0	0	0.0
5/22/2019	24.00	14	Full	12	good	1	0	0.0
5/23/2019	24.25	14	First	10	good	2	1	0.1
5/24/2019	27.50	14	First	13	good	0	0	0.0
5/28/2019	22.50	16	First	11	good	0	0	0.0
5/29/2019	25.00	14	First	25	good	0	0	0.0
5/30/2019	24.50	12	New	16	good	1	0	0.0
5/31/2019	24.00	12	New	14	good	1	0	0.0
6/4/2019	23.50	14	New	9	good	0	1	0.0
6/5/2019	23.50	15	New	7	good	0	0	0.0
6/6/2019	25.00	15	New	84	good	0	0	0.0
6/7/2019	23.50	15	First	46	good	0	0	0.0
6/11/2019	24.50	18	First	26	good	0	1	0.0
6/12/2019	23.50	18	First	21	good	0	1	0.0
6/13/2019	24.50	17	First	18	good	0	1	0.0
6/14/2019	22.25	14	Full	22	good	0	0	0.0
6/18/2019	24.75	18	Full	11	good	1	1	0.1
6/19/2019	23.25	18	Full	9	good	1	0	0.0
6/20/2019	24.00	18	Full	9	good	0	1	0.0
6/21/2019	24.00	16	Full	12	good	0	1	0.0
6/25/2019	23.75	18	Last	5	good	7	1	0.3
6/26/2019	24.00	18	Last	7	good	6	0	0.3
6/27/2019	26.00	17	Last	6	good	3	0	0.1
6/28/2019	22.75	20	Last	5	good	4	1	0.2
7/2/2019	24.00	18	New	7	good	0	0	0.0
7/3/2019	24.50	18	New	6	fair	2	0	0.1
7/4/2019	26.50	20	New	5	good	0	0	0.0
7/5/2019	21.00	20	New	4	good	0	0	0.0
7/9/2019	24.25	20	First	5	good	0	0	0.0
7/10/2019	24.00	20	First	7	good	0	0	0.0
7/11/2019	24.00	20	First	7	good	0	0	0.0
7/12/2019	24.00	20	First	21	good	0	0	0.0

[a] Moon phase in bold is the actual day of that moon phase.
[b] Provisional data subject to revision (http://waterdata.usgs.gov/nh/nwis/current/?type=flow).

Table 1.3-3. Annual summary of the American Eel young-of-the-year survey in the Lamprey River, Newmarket, New Hampshire, 2001–2019.

Year	Monitoring period	Date (count) first observed in trap	Peak CPUE (# eels/ hour soak time)	Date of peak CPUE	Total number observed during peak	Mean annual CPUE	Total number of eels observed during year
2001	May 1-June 7	May 1 (4)	111.8	May 7	2,655[a]	11.1	6,356[a]
2002	April 19-May 23	April 19 (15)	391.8	April 20	9,600[a]	31.0	17,798[a]
2003	April 22-July 31[b]	April 30 (5)	65.6	July 7	1,559[a]	4.3	6,165[a]
2004	April 13-July 30	April 20 (1)	20.0	July 8,9	490/525	3.5	5,252
2005	April 18-July 28[c]	April 21 (1)	12.7	July 14	314	1.5	2,095
2006	April 11-May 11[d]	April 14 (50)	26.3	April 25	571	5.2	2,637
2007	April 26–July 26	May 8 (6)	18.9	July 26	515[a]	0.9	1,240[a]
2008	April 22–August 1	May 22 (2)	14.4	July 10	231	0.9	1,361
2009	April 21-June 18	April 27 (1)	100.4	June 9	2,559	8.4	6,385
2010	April 26-July 8	April 26 (12)	1.3	May 26	25	0.2	208
2011	May 3-July 29	May 3 (3)	14.4	July 13	285	1.3	1,491
2012	April 3-July 26	April 23 (998)	50.5	April 23	998	2.7	4,213
2013	April 16-June 14	April 19 (1)	244.1	May 9	6,407	41.1	35,036
2014	April 22-June 23	May 5 (3)	65.1	June 11	1,806	9.9	8,449
2015	April 21–June 24	May 5 (4)	13.8	May 15	339	2.2	1,959
2016	April 19-June 23	April 20 (1)	261.8	May 17	7,396	16.7	15,621
2017	April 18-June 23	April 26 (2)	151.7	May 22	3,185	4.5	4,354
2018	April 24-June 8	April 25 (1)	1.0	May 17	24	0.3	208
2019	May 7-July 19	May 9 (1)	8.0	July 1	159	0.7	755

[a] Values estimated.
[b] Two of the weeks were checked only once per week.
[c] Irish elver ramp was removed on May 25 and 26 due to high tides and high precipitation.
[d] Irish elver ramp was destroyed due to floods.

Table 1.3-4. Annual summary of the American Eel young-of-the-year survey in the Oyster River, Durham, New Hampshire, 2014–2019.

Year	Monitoring period	Date (count) first observed in trap	Peak CPUE (# eels/ hour soak time)	Date of peak CPUE	Total number observed during peak	Mean annual CPUE	Total number of eels observed during year
2014	April 22-June 24	April 23 (47)	159.7	May 13	4,151	20.10	17,447
2015	April 21-June 25	May 4 (7)	42.6	May 13	1,034	5.19	4,765
2016	April 19-June 23	April 19 (2)	31.9	April 21	814	3.82	3,608
2017	April 18-June 23	April 18 (15)	9.0	May 3	205	0.64	621
2018	April 24-June 14	May 4 (21)	32.1	May 8	754	2.94	2,190
2019	April 30-July 12	May 22 (1)	0.3	June 25	8	0.04	39

Table 1.3-5. Mean lengths of sampled young-of-the-year American Eels by life stage in the Lamprey River, Newmarket, New Hampshire, 2014–2019.

		Year											
		2014		2015		2016		2017		2018		2019	
Life stage	Pigmentation stage	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length
Glass	1	63.1	18	59.0	3	57.9	96	62.4	16	63.0	1	60.0	13
	2	61.4	88	59.9	68	60.3	326	62.1	39	61.0	24	62.0	7
	3	61.2	77	60.6	93	61.0	170	62.9	36	62.7	29	64.0	3
	4	61.4	154	60.9	77	59.9	90	63.7	37	61.1	20	60.8	35
	5	60.0	144	59.8	76	58.9	145	63.3	50	63.3	12	61.7	56
	6	61.6	185	60.9	116	59.4	237	63.1	18	64.6	7	62.0	160
	7	63.5	116	63.7	84	62.2	115	65.8	9	68.5	2	65.2	117
	Combined	61.5	782	61.0	517	60.0	1,179	63.1	205	62.3	95	62.7	391
Brown	-	84.5	25	97.9	86	92.3	14	95.8	17	95.5	93	94.1	31
Annual average (all stages)		62.2	807	66.3	603	60.4	1,193	65.6	222	78.7	188	65.0	422

Table 1.3-6. Mean lengths of sampled young-of-the-year American Eels by life stage in the Oyster River, Durham, New Hampshire, 2014–2019.

		Year											
		2014		2015		2016		2017		2018		2019	
Life stage	Pigmentation stage	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length	Mean length (mm)	Count of length
Glass	1	62.1	181	57.9	32	58.3	79	61.2	88	57.4	15	58.0	1
	2	60.8	168	89.5	74	59.5	245	62.8	165	59.3	101	63.5	2
	3	60.4	200	59.4	111	59.3	199	62.6	74	60.7	78	56.6	5
	4	60.4	183	58.8	79	58.6	158	63.3	38	61.3	59	59.6	7
	5	60.0	188	59.6	87	58.4	98	62.1	13	61.2	40	60.6	8
	6	60.3	170	59.5	57	59.3	50	61.9	8	63.2	26	61.5	2
	7	61.8	94.0	62.2	25	63.9	26	61.0	7	65.8	9	64.8	4
	Combined	60.8	1,184	59.4	465	59.2	855	62.4	393	60.6	328	60.4	29
Brown	-	98.4	8	94.0	90	97.2	105	97.4	8	98.2	36	98.0	8
Annual average (all stages)		61	1,192	65.0	555	63.3	960	63.1	401	64.3	364	68.5	37

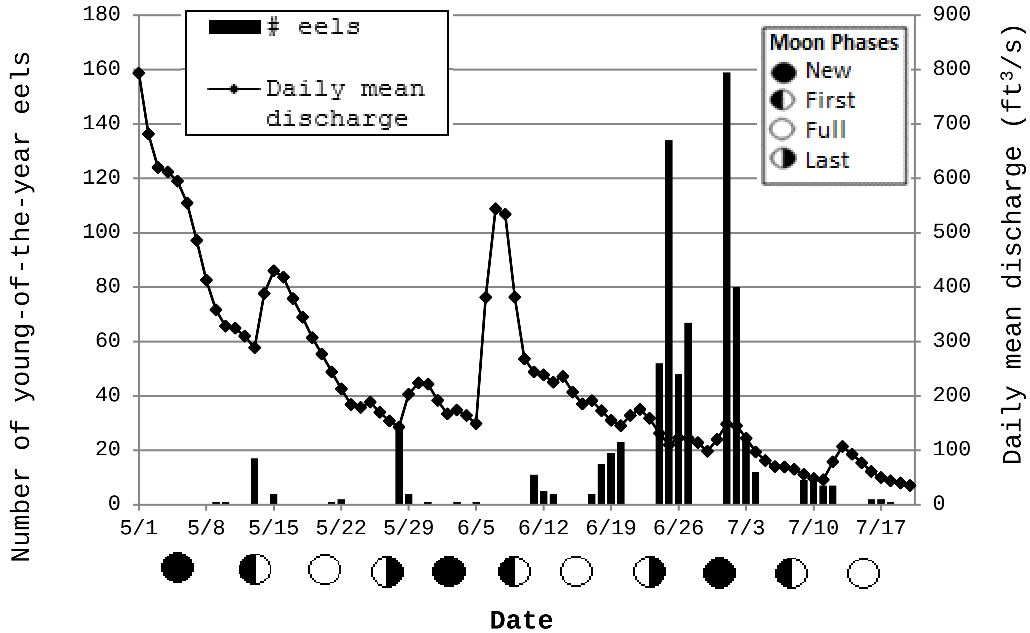

Figure 1.3-1. Daily mean discharge (ft³/s) in the Lamprey River with the total number of American Eel young-of-the-year observed each sampling day, 2019.

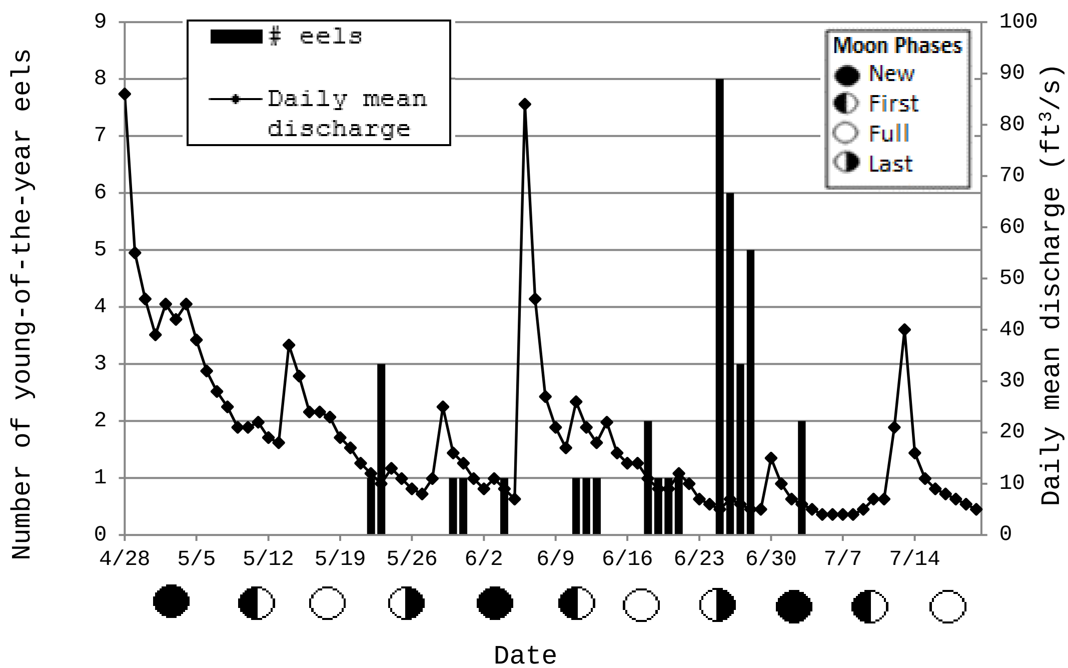

Figure 1.3-2. Daily mean discharge (ft³/s) in the Oyster River with the total number of American Eel young-of-the-year observed each sampling day, 2019.