2018 ELVER ABUNDANCE STUDY

East River, Chester, NS

ABSTRACT

The American eel (Anguilla rostrata) annual abundance study was conducted on the East River, Chester, Nova Scotia beginning April 15 to July 5, 2018. As in past years, four Irish-style elver boxes were installed below the Hwy #3 bridge crossing the East River, Chester, just below the falls which act as a natural barrier. Before the boxes were operational, and until box catches were large enough, data was collected from the commercial catch, as commercial elver fishing occurs downstream. Elvers were estimated using a weight-based method by conducting elver counts of sub-sample weights consistently throughout the season. Juvenile eel were counted separately. In addition, biological sampling of individual elver length, weight, and pigment stage occurred throughout the entire season, including the commercial catch. The total catch from the boxes in 2018 was an estimated 3,479,777 elvers and 1118 juveniles.

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Introduction

A Joint Venture Project between Fisheries and Oceans Canada (DFO) and a group of commercial elver fishers began in the late 1990's to study elver abundance and harvesting in the Scotia-Fundy waters. In 2008, Bluenose Coastal Action Foundation (Coastal Action) was contracted to continue the previous research to further obtain data on basic life history information of migrating elvers entering East River, Chester, Nova Scotia. Coastal Action has continued the project for 11 consecutive years, which has contributed to estimating the run size of elvers, as well as provided an additional source of data on the biological characteristics of elvers entering the watershed. The Nova Scotia Department of Fisheries & Aquaculture (NS DFA) has contributed financially to the project most years (2009-2011, 2013, and 2015-2018).

The goal of the East River, Chester study is to: (1) estimate number of elvers migrating up the river on a daily and annual basis; (2) determine the pigment stage, size, and condition of elvers; (3) provide information sufficient for basic analysis of seasonal, regional, and annual patterns of elver migration to the elver license holders and DFO based on the results of this study; and (4) to identify juvenile eel caught with elvers by age class.

Study Area

The East River, Chester (Figures 1 and 2) drains into Mahone Bay, with its encompassing watershed located within the Municipality of the District of Chester, Lunenburg County, Nova Scotia. The watershed has an area of 134 km², of which 10.5% is lake surface. There are two main tributaries; the Canaan River, located 4 km upstream of the mouth of East River (drainage area 69.4 km²; 4.8% lake surface) and Barry's Brook, which is about 0.5 km from the mouth (drainage area 19.1 km²; 1.9% lake surface). The East Branch is the main stem and drains an area of 45.5 km² (22.8% lake surface). The mouth of the river has a small waterfall just above the high tide line, which is just above the Hwy#3 bridge.

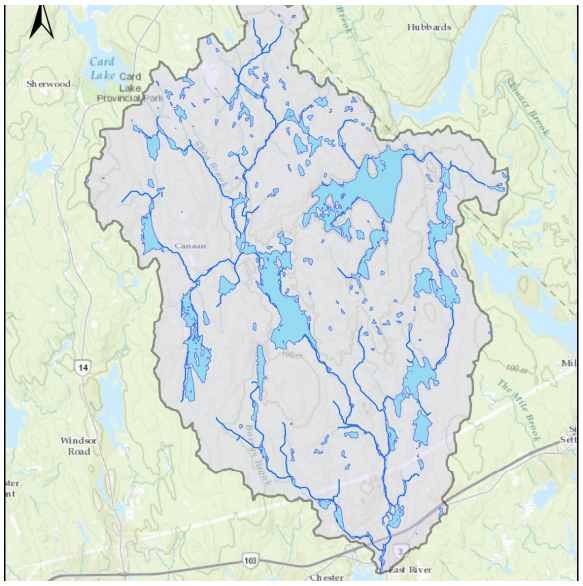

Figure 1 Map of East River, Chester watershed (GIS Coastal Action 2017).

Figure 2 Mouth of the East River, Chester, showing the falls just above the head of tide. Taken from the highway #3 bridge.

American eel are the most predominant species throughout the watershed, as found in a study conducted from 1983 to 1994, through electrofishing surveys on the river (Jessop, 2002). Electrofishing conducted at several sites between 1995 to 2000 further demonstrated American eel as the predominant species in the watershed. Additional electrofishing activities were initiated in September of 2017, and have continued in 2018, again demonstrating eel as the dominant species (personal observations).

Materials and Methods

Four elver traps were placed on the upstream side of the Nova Scotia Trunk 3 East River bridge, between the bridge and the small falls. The falls act as a natural barrier to slow the movement of elvers upstream. The lower portion of the river is influenced by tides; however, above the falls there is little to no impact, as there is an elevation decrease of about 1.1 m from the top of the falls to the mouth of the river (Jessop, 2002). Traps used were Irish-style elver traps, each of which consist of a ramp and a holding box (Figure 3). Holding boxes have mesh screens on the walls to allow a constant flow of water to pass over the elvers to prevent mortality (Figure 4). Holding boxes were placed on pieces of rebar, preventing them from drifting during very high tides or in the event of excessive rainfall. Rocks were placed on top of the ramps and holding boxes to maintain their position. All the ramps and holding boxes were repaired and repainted over the winter. Traps were in place from April 15 to July 5, 2018. Consistent with past years, Trap numbers 1 and 2 were located on the true right side of the river (Chester side; Figure 5), with Trap 1 located downstream and Trap 2 located about two metres upstream from Trap 1. Traps 3 and 4 were located on the true left side (Halifax side; Figure 3), with Trap 3 being downstream from Trap 4. Due to typically larger catches on the left side, the holding boxes are larger than on the right side. Gravity fed hoses in the holding boxes provided a

constant water flow from above the falls to the ramps creating a small current. Drawn to the water running down the ramp of the Irish-style traps, the elvers climb the ramp and are flushed into the holding boxes where they are later collected. Enkamat and moss were also secured to the ramps to ensure there were no gaps between the water level and the ramps to aid in elver movement. Insulating foam was sprayed around the ramps and boxes to block elvers.

Figure 3 View looking upstream towards the falls, Traps 3 (lower) and 4 (upper) pictured. Ramp is visible with hose leading into holding box, constituing Trap 3 (2018).

Figure 4 Holding box of Trap 4, showing elvers. Mesh screen visible on sides of box (2018).

An additional experimental elver trap with a new design was added in an effort to alleviate pressure of high catches in other boxes, as well as to test the modified design (Figure 6).

Figure 5 View looking upstream, showing Traps 1 (lower), Trap 2 (middle), and Trap E (upper) (2018).

Figure 6 View overlooking ramps for Trap 2 (green) and Trap E (wood) (2018).

The experimental trap differed in that the ramp itself was smaller, and the drain was on the bottom of the ramp rather than on the side. On May 14, Trap "E" was placed on the true right side of the river, upstream of Trap 2, and remained in place until May 31.

Padlocks were placed on each of the holding boxes to deter any unwanted intervention.

During a period of heavy elver recruitment, traps were checked and emptied twice a day, and scientific dipping was initiated below the bridge to relieve pressure on traps. During the incoming to high tide at night, commercial fishers aided in dipping of elvers, while Coastal Action transported and counted the elvers at the release site following study protocols. The dipped weight was kept separate from the trap weights.

Elver Processing

The traps were monitored daily once elvers were first observed arriving at the river. Additional collection occurred during peak migration periods to avoid mortality, when elver catches exceeded holding box capacity.

Holding boxes were emptied using small fish nets to transfer elvers into five-gallon buckets filled with river water (Figure 7). To avoid suffocation and mortality, only about one-and-a-half scoops of the net, which coincidentally is about 1.5 kg of elvers, were placed in a bucket at a time. This amount was chosen to minimize stress on the fish as well as the time taken to empty the traps and transport the buckets to the release site to be processed. As soon as buckets were full, they were immediately transported to the release site, and poured through a grading net into a holding bag (Figure 8). The grading net separated the juveniles from the elvers, and the number of juveniles were recorded per trap and placed into a separate bucket to be

processed. The holding bags safely held the elvers until they could be counted, while the rest of the holding boxes were emptied and graded.

Figure 7 Trap 4 being emptied into a bucket (2018).

Figure 8 Pouring buckets of elvers collected from traps through the grading net into holding bags (2017).

A scrub brush was used to clean the mesh screens daily to rid the holding boxes of residue buildup from the river. The gravity fed hoses were shaken as needed to clear any algae accumulation and the intakes were checked to ensure they remained fully submersed.

The contents of each trap were counted independently to obtain counts per trap, which were then added together for a total daily and annual estimate. Numbers obtained from scientific dipping were kept separate from the trap counts.

Weight Estimates

Volumetric estimates were used to count elvers in past years (2008-2015); however, a weight-based method was introduced in 2016, and has been continued. Weight estimates are more consistent with commercial elver counts. After some trial and error attempting to find a reliable field method, a new protocol was developed and implemented, and has been used since 2016.

Elver weigh bins were created using small plastic bins with mesh bottoms to allow water to drain from the elvers (Figure 9).

On advice from commercial fishers who use a similar method, it was established that placing 1-1.5 kg of elvers in the weigh bin at one time was ideal for water drainage, without too much slime accumulating. The weigh bin was placed on the drain table, and allowed to drain for up to two minutes, or until water stopped dripping and slime bubbles appeared. The weigh bin

was then quickly given a swirl and a shake to release excess water, and placed onto the scale where the weight of the elvers was recorded (Figure 10). Elvers were then either released or used for sub-samples to calibrate the number of elvers in a given weight throughout the season.

If the number of elvers per trap was less than 0.050 kg, the elvers were hand counted.

Figure 9 Elvers being poured from holding bag into weigh bin with mesh bottom to be weighed (2018).

Figure 10 Recording the weight of the elvers (2018).

As elver size changes over the course of their migration, weight calibrations were conducted three times a week (typically Monday, Wednesday, and Friday) throughout the season as numbers allowed. Ideally, five sub-samples were taken, using one of two methods, depending on the number of fish. Method one involved taking one sub-sample per weigh bin, five times. Following the weight estimates, after elvers were weighed in the bin, a sub-sample of near 100 g was quickly taken from the bin before the rest of elvers are released (Figure 11). This was repeated five times, taking one sample per each bin. Method two, where all sub-samples were taken from one weigh bin was necessary when the elver catch was lower. After elvers were weighed in a bin, working as quickly as possible, the first sub-sample was collected. The weigh bin was then swirled to gently mix and redistribute the accumulating slime before the next sub-sample was taken, for up to five sub-samples as numbers allowed.

In both methods, immediately after sub-samples were collected, they were poured into a bucket of river water with a corresponding sub-sample number. In the bucket, the elvers rested to reduce stress before being blind counted by each field person (Figure 12). Blind counting results in more accurate estimates of elvers. These calibrations were used to find an average number of elvers per gram, which was then used to estimate the number of elver

present in a given weight. Depending on the dates when sub-samples were conducted, the average number of elvers per gram would change every two or three days.

Figure 11 Collecting a sub-sample of elvers near 100 g (2018).

Figure 12 Counting elvers per sub-sample, with the help of a mesh strainer to gently rinse elvers, and a step counter (2018).

Biological Data

Biological sampling began on April 3, continuing until July 3, and was conducted Monday, Wednesday, and Friday of each week throughout the season. One-hundred (100) individual elvers were taken from either the commercial catch (before traps were functional) or from the elver boxes. Working in batches of 25, elvers were euthanized using a solution of approximately 0.05% clove oil and water (about three drops of clove oil per 400 ml of water). Elvers were laid out on paper towel and lengths were taken with digital calipers to one hundredth of a millimetre. Each elver was classified as one of seven pigment stages based on the methods of Haro and Krueger (1988) (Figure 13). After blotting the elvers dry with a paper towel, the weight of each elver was taken using a digital balance with a capacity of d=±0.005 g accuracy. An Epson digital scanner was used to scan elvers in four groups of 25 per sample day; using the thumbnail 3200 dpi 24-bit colour setting. Elvers were arranged in order on the scanner with an identifying tag indicating the date and numbers of elver (i.e., 1-25, 26-50, 51-75, 76-100). The scanner provides a high quality digital image and could potentially be used as a tool to create consistency in defining pigment stage.

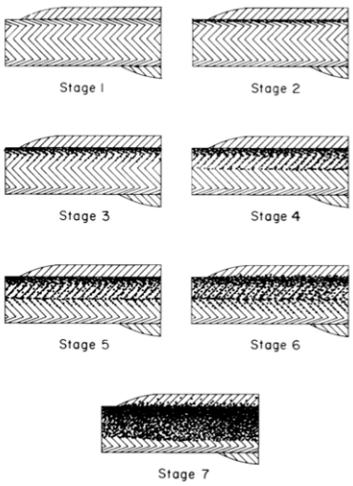

Figure 13 Pigment stages defined by Haro and Krueger, 1988.

Juvenile Sampling

Juvenile sampling was implemented during the 2017 field season and continued through 2018. After juveniles were separated from elvers and the number of juveniles per trap recorded, they were placed into a bucket to be sampled individually (Figure 14). Each juvenile was laid out on paper towel without the use of clove oil, as clove oil appears to have damaging effects on juvenile eels, and length was measured (0.01 mm) using a digital caliper (Figure 15). A weight measurement followed (0.005 g).

Figure 14 Bucket of juvenile eels separated from elvers (2018).

Figure 15 Measuring the length of a juvenile eel (2017).

Environmental Data

Thermographs were set above the falls at the Louisiana Pacific pumping facility and at the mouth of the East River on a private wharf. Thermographs remain in place continuously throughout the year, monitoring the water height and temperature at hourly intervals. Tidal heights and moon phase were noted in the field book to compare with run abundance. Water depth readings were also recorded throughout the season.

Results

The elver traps were operational from April 15 to July 5, 2018. The holding boxes were checked daily to record the presence and abundance of elvers and juveniles, as well as to monitor trap performance. Traps were checked more or less often as capacity was reached or as elver numbers dropped.

A total of **3,479,777 elvers** (834.444 kg, plus hand counted elvers) were estimated throughout the season, along with **1,118** juveniles.

The season started slow and consistent, and the run substantially increased beginning May 8 and reached the highest count on May 13, estimated at 121.190 kg (521,117 elvers). The counts gradually dropped back down to around 6 kg (30,000 elvers) on May 20 (Figure 16). During the peak period, traps were emptied at least twice a day, in addition to scientific dipping as well as the installation of experimental Trap E. Despite checking traps often, some mortality occurred, estimated at 18.386 kg over four separate incidents. A total of 97.040 kg was dipped over four nights during the peak of the run.

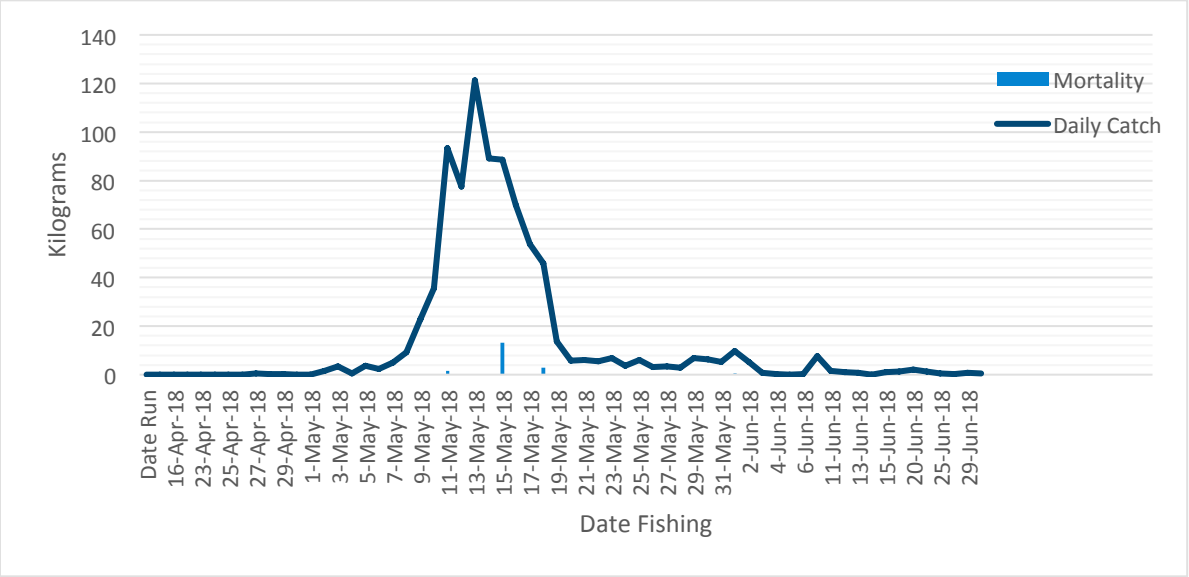

Figure 16 East River, Chester 2018 elver run, by weight (kg).

Weight Estimates

The total weight of elvers was **834.444 kg**, excluding elvers that were hand counted on days when the catch was very low. The sub-samples collected three times a week allowed for the daily weight estimates to be converted into an estimated number of elvers. A total of 23 sub-samples were taken over the season. The number of elvers per gram obtained through sub-samples varied and increased throughout the season (Figure 17), and the average per day was used to estimate the total number of elvers in daily weights (Figure 18).

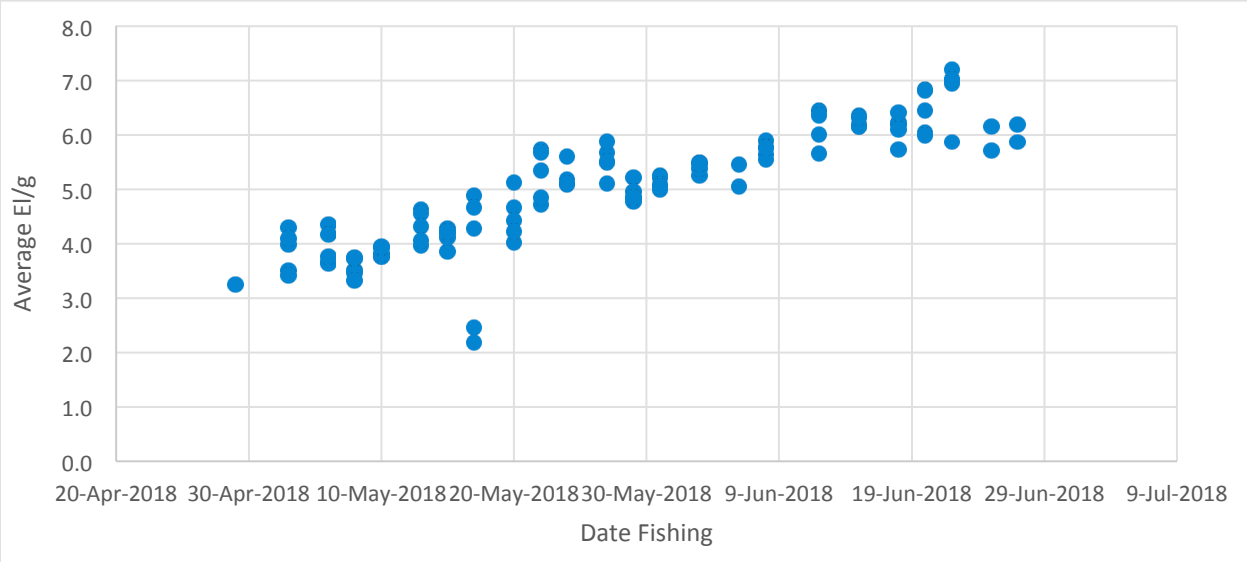

Figure 17 Elvers per gram over the 2018 season.

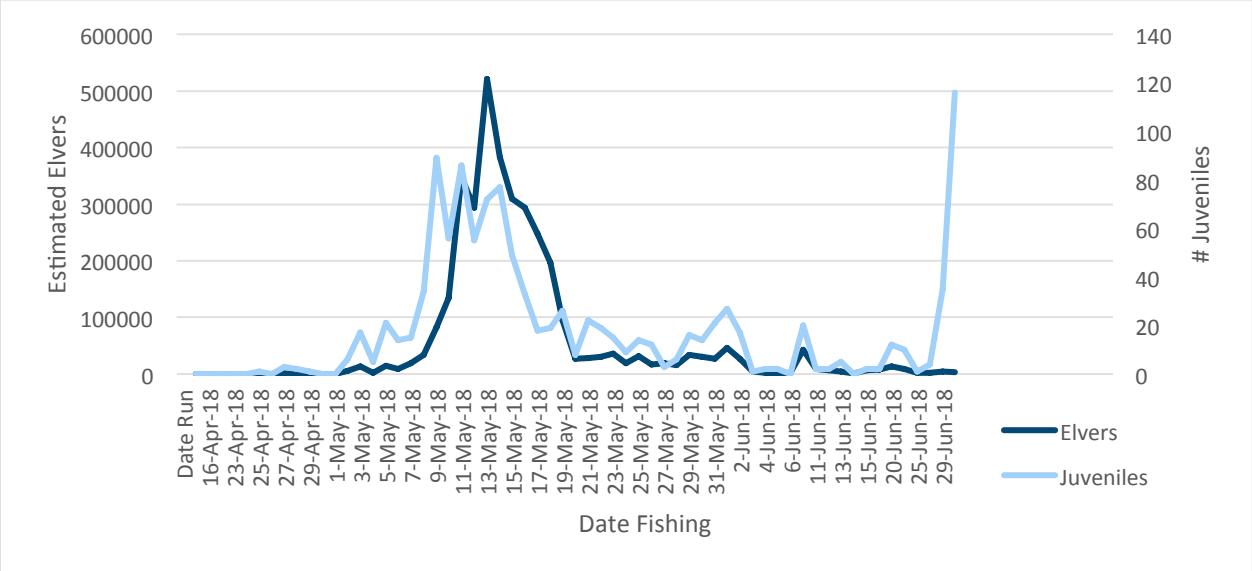

Figure 18 Estimated number of elvers using numbers estimated from sub-sample counts.

Biological Data

Biological sampling began prior to trap placement. The commercial catch was utilized to gather samples from April 3, until the set traps were yielding enough fish to gather samples on April 27. For the month of April, the average elver length, weight, and pigment stage (n=840 elvers) was 62.97 mm, 0.198 g, and 1 respectively; for the month of May, 61.80 mm, 0.170 g, and 4 (n=1373 elvers); and for the month of June, 59.95 mm, 0.134 g, and 6 (n=1272 elvers). Consistent with previous years, elver length and weight decreased, while pigmentation increased, as the field season progressed. The digital scans provided a clear image of each sampled elver (Figure 19). Most of the elvers were Stage 6 and 7 pigmented by the end of the season.

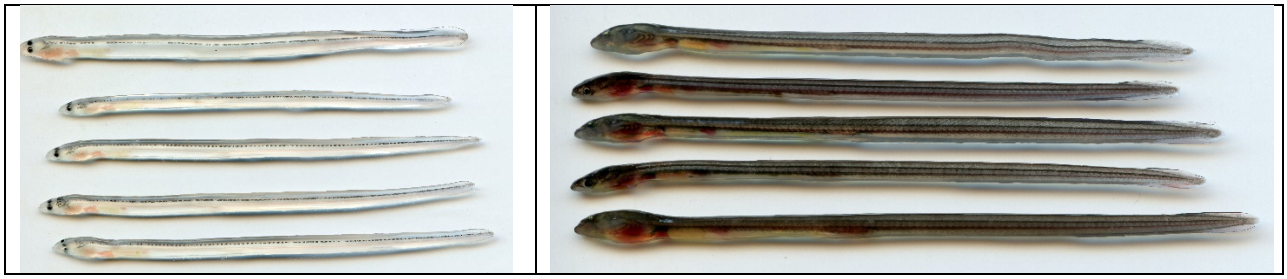

Figure 19 Scanned images of elvers biologically sampled in 2018 (April 8 and June 8).

Environmental Data

Elvers were first observed in small numbers in the river on April 27, when the water temperature above the falls reached 6.05°C. The water temperature was 8.39°C at the peak of the elver run on May 13. By the end of the season, the water temperature reached 17.6°C on July 5.

Juvenile Sampling

A total of 1,118 juveniles were caught over the 2018 season. All juveniles, other than a few escapees, were measured for length and weight. Figures 20 and 21 show the distribution of length and weight of juveniles over the season. The largest number of juveniles was captured at the end of season on July 5, with 116 juveniles.

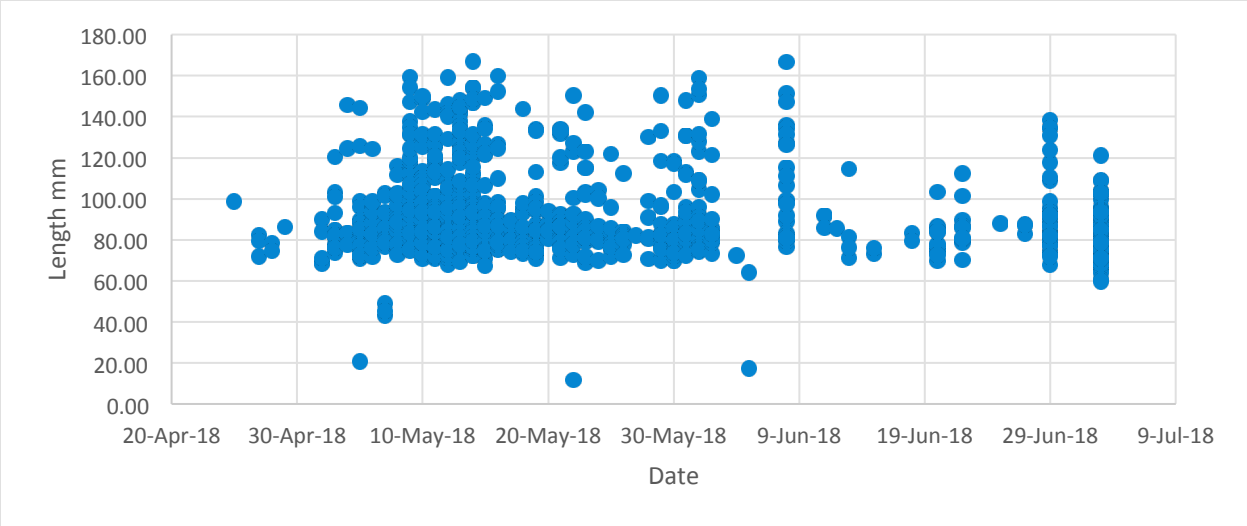

Figure 20 Length distribution of juvenile eels caught in 2018.

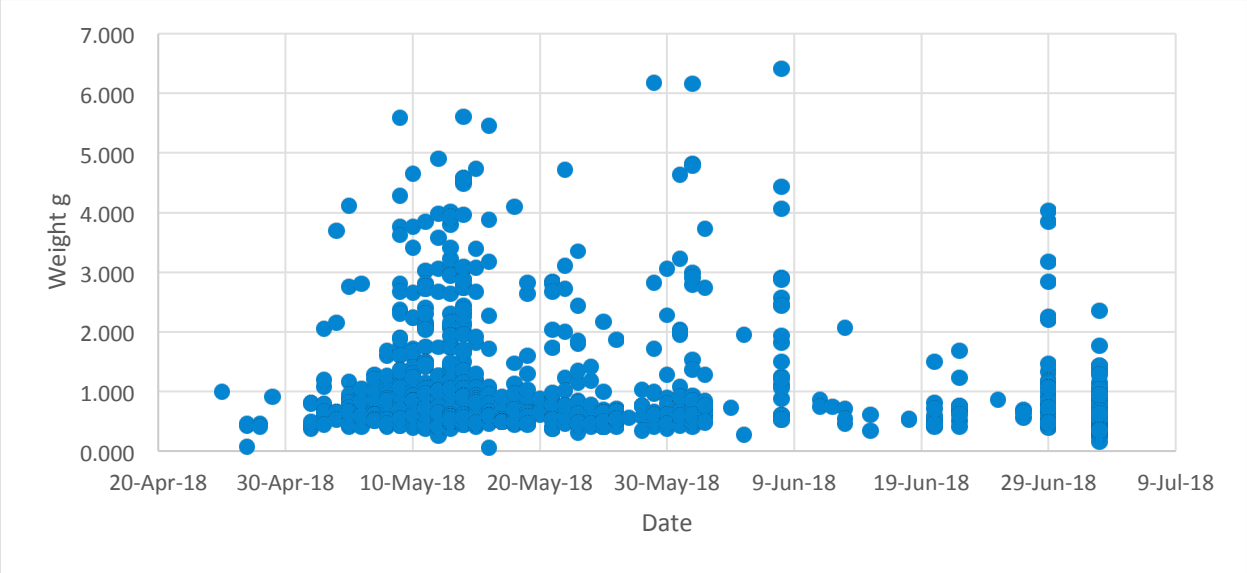

Figure 21 Weight distribution of juvenile eels caught in 2018.

Discussion

The 2018 season was the highest elver catch ever recorded on the East River, Chester (Figure 22). The previous highest catch was in 2016 with an estimated catch of 2,377,902 elvers and 991 juveniles.

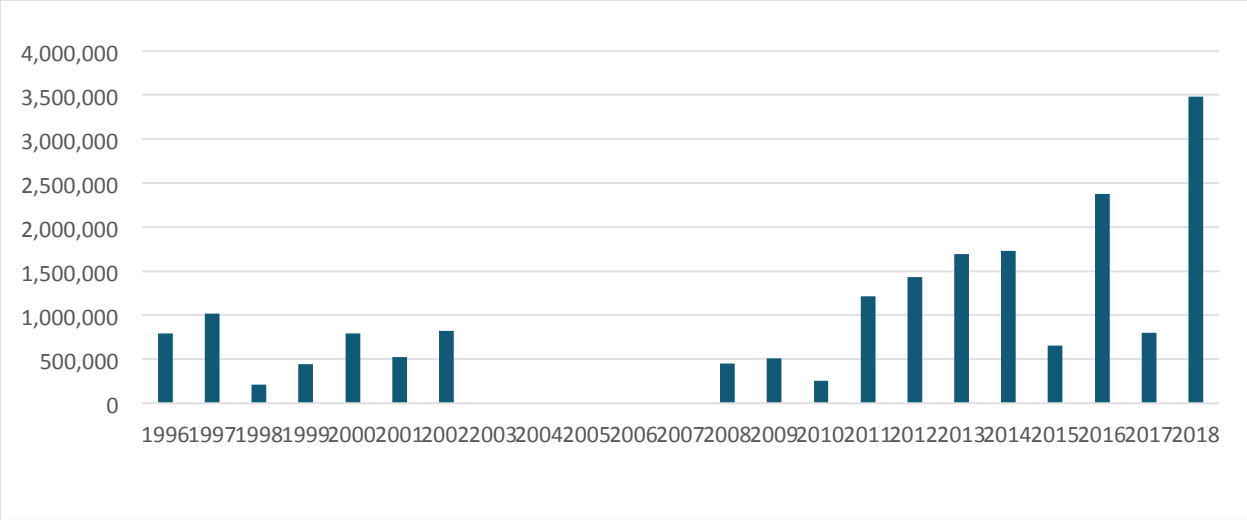

Figure 22 Annual elver recruitment East River, Chester (1996-2002; 2008-2018).

Environmental factors such as water temperature, water level (velocity), and tide height and time have been shown to impact the movement of elvers into the East River (Jessop 2002). Typically, elvers are not observed in the river until the water temperature reaches at least five degrees Celsius, and the water level drops to a certain point. Elvers cannot swim in velocities over 35 $cm \cdot sec^{-1}$, and usually choose not to swim at even lower velocities (Jessop 2002). Elvers typically enter the river with a high tide after dark, but also occasionally during the day.

The traps used during this study do not have a 100% efficiency rate, and some elvers were observed pooling around rocks above the ramps and holding boxes. In an effort to block elvers from bypassing traps, expanding foam was sprayed around the traps and rocks.

The mortality likely occurred due to overcrowding and/or lack of water flow. Although the hoses provide constant water flow over the elvers in the holding boxes, during high tide the boxes are completely submerged, which fills the boxes with water preventing adequate water flow when there is a high catch. Checking traps more often than twice a day during very heavy runs appears to prevent this from occurring.

As in past years, elvers migrating up the East River, Chester, underwent a seasonal variability in length, weight, and pigment stage. Early during the season, elvers were larger (average 63.48 mm; 0.203 g for the month of April) and clearer in pigment (stage 1). Elver size decreases as the season continues, with the average length, weight and pigment being 59.95 mm, 0.134 g, and 6, respectively during the month of June. It was also observed at the end of the season, that elvers appeared to be “wetter”, as it was more difficult to shake excess water from the bin of elvers (personal observations).

Juveniles appeared to run fairly consistently with the elvers, until the end of the season, when 116 juveniles were counted with only 0.586 kg of elvers. This provides insight to the possibility that juveniles may migrate up river all summer.

The East River highway #3 bridge is forecasted to be reconstructed in 2019. Potentially, the bridge and road will be realigned, and could cause significant changes to the elver field season.

Acknowledgements

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