Jennifer McKinnon photo

# 2017 EAST RIVER, CHESTER ELVER ABUNDANCE STUDY

Bluenose Coastal Action Foundation - Year 10


## ABSTRACT

The American eel (Anguilla rostrata) annual abundance study was conducted on the East River, Chester, Nova Scotia beginning April 13 to June 30, 2017. 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. The boxes were installed on April 21, and operational until June 30, when they were removed. 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 and juvenile eels captured in boxes were estimated using a weight-based method by conducting elver counts of sub-sample weights consistently throughout the season. In addition, biological sampling of individual elver length, weight, and pigment occurred throughout the entire season, including the commercial catch. The total catch from the boxes was an estimated 801,396 elvers and 592 juveniles. Of the juveniles captured, 73 were sacrificed for identifying age class. This year was the tenth consecutive annual study conducted by Bluenose Coastal Action Foundation.



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## Introduction

A Joint Venture Project between Fisheries and Oceans Canada (DFO) and a group of 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 10 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 varying amounts to the project most years (2009-2011, 2013, and 2015-2017).

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; and (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. During the 2017 field season, an additional objective was added; (4) to identify juvenile eel caught with elvers by age class.

### Study Area

The East River, Chester (Figure 1) 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 4km upstream of the mouth of East River (drainage area 69.4 km²; 4.8% lake surface) and Barry's Brook, which is about 0.5km from the mouth (drainage area 19.1km²; 1.9% lake surface). The East Branch is the main stem and drains an area of 45.5km² (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.

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 will be continued more extensively in 2018.

## Materials and Methods

Using the same methodology as in 2016, 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 (Figure 2). 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 metres 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 had mesh screens on the walls to allow a constant flow of water to pass

over the elvers to prevent mortality. Holding boxes were placed on two pieces of rebar, allowing them to float without drifting during very high tides or in the event of excessive rainfall (Figure 4). 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.

The four traps were operational from April 21 to June 30, 2017. Consistent with past years, Trap numbers 1 and 2 were located on the true right side of the river (Chester side), 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), with Trap 3 being downstream from Trap 4. Due to typically larger catches on the Halifax side, the holding boxes are larger than on the Chester 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.

Padlocks were placed on each of the holding boxes, and three trail cameras were set up overlooking the boxes on either side of the river.

### 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 counts exceeded holding box capacity.

Holding boxes were emptied using small fish nets to transfer elvers into five-gallon buckets filled with river water (Figure 4). To avoid suffocation and mortality, only about one full, and another half, scoop of the net, which coincidentally is about 1.5 kilograms 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. 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 5).

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 holding box were counted independently to obtain four counts, which were then added together for a total daily and annual estimate.

### Weight Estimates

Volumetric estimates were used to count elvers in past years (2008-2015); however, a new method was introduced in 2016 to estimate elver numbers by weight rather than volume. Weight estimates are more consistent with the way elvers are estimated commercially. After some trial and error attempting to find a reliable field method, a new protocol was developed and implemented, and used again in 2017.

Elver weigh bins were created using small plastic bins with mesh bottoms to allow water to drain from the elvers (Figure 6). On advice from commercial fishers who use a similar method, it was established that placing 1-1.5 kilograms 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, placed onto the scale, and the weight of the elvers recorded. 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 0.050kg, the elvers were hand counted.

### Weight Calibrations

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 100g was quickly taken from the bin before the rest of elvers are released. 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 7). Blind counting results in more accurate estimates of elvers. These calibrations were used to find an average number of elvers per gram, which was 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.

### Biological Data

Biological sampling began on April 13, continuing until June 30, 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 400ml 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 8). 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=±0.005g accuracy. An Epson digital scanner was used to scan elvers in four groups of 25 per sample day; using the thumbnail 3200dpi 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.

### 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.

### Juvenile Sampling

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

Sacrificing needs were based on length frequency distribution of the juveniles, to determine the number of sacrifices per length interval. At least three to five juveniles were sacrificed per 5mm length interval. Juvenile eels were sacrificed based on their length, where three to five sacrifices were taken for every 5mm length interval between 60mm 124.90mm.

Each sacrificed eel was euthanized on ice, and frozen in water, to preserve the condition of the fish. An identification tag was included in the bag with the date captured, sacrifice number, and fresh length and weight.

## Results

The elver traps were operational from April 21 to June 30, 2017. Typically, the traps remain in place until mid-July; however, due to consistently low catches the season ended early.

The holding boxes were checked daily to record the presence and abundance of elvers as well as trap performance.

Traps were checked seven days a week between April 22 and June 30, but less often, usually on Mondays, Wednesdays, and Fridays, when catches were low (≥ 2000 individual elvers). The number of elvers and juveniles were estimated and counted daily. Trap performance remained

generally good throughout the season, with daily efforts made to return the trap to good performance.

A total of **801,396** elvers and **592** juveniles were estimated in the four boxes during the 2017 season.

The peak of the run occurred over May 22, catching a total of 37.430kg (163,435 elvers). Other than a few days prior to the peak, catches remained relatively consistent throughout the season (Figure 9). The peak of the run occurred quickly and unexpectedly, which unfortunately resulted in an estimated 4kg of mortality, due to too many fish in a single box (23.064kg in trap 4). A number of juveniles were released without counting in an effort to separate the live elvers quickly and reduce any further mortality, thus missing an unknown number of juveniles in the total count.

### Weight Estimates

The total weight of elvers was 176.555kg, 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. The average number of elvers per gram obtained through sub-samples varied throughout the season (Figure 10) and the average per day was used to estimate the total number of elvers in daily weights.

### Biological Data

Biological sampling began prior to trap placement. The commercial catch was utilized to gather samples from April 13, until the set traps were yielding enough fish to gather samples on April 21. For the month of April, the average elver length, weight, and pigment stage was 63.48mm, 0.203g, and 1, respectively; for the month of May, 62.32mm, 0.180g, and 3; and for the month of June, 60.27mm, 0.152g, and 5, respectively. Consistent with previous years, elver length and weight decreased, while pigmentation increased, as the field season progressed (Figure 11). The digital scans provided a clear image of each sampled elver (Figure 12). Most of the elvers were Stage 6 and 7 pigmented by the end of the season.

### Environmental Data

Elvers were first observed in small numbers in the river when the water temperature above the falls reached 5.72°C. The water temperature was 9.43°C at the peak of the elver run on May 21, catching 27.43kg of elvers.

### Juvenile Sampling

A total of 551 juvenile eels were measured for length and weight. The majority of the juveniles measured between 100 to 140mm. The largest juveniles captured were 177.70mm and 197.84mm; the smallest was 57.14mm. Of the juveniles captured, 73 were sacrificed and collected to be classified by age. Not all juveniles were sampled, as some escaped, particularly small juveniles which slipped through the grading net with the elvers.

## Discussion

The East River, Chester is commercially fished for elvers below the NS Trunk 3 East River bridge – the estimated number of elver recruited in the elver abundance study, exclude the commercial catch removed from the river. The commercial fishing begins before elver boxes are operational, as high river velocities typical in early spring prevent the elvers from reaching the traps upstream.

East River, Chester had increasing elver recruitment from 2011 to 2014, a drop in 2015, and a record high in 2016 (2,377,902 elvers). The 2017 field season was one of the lowest observed elver recruitment years on the East River, Chester. The annual elver recruitment (1996-2002; 2008-2017) on the East River is shown in Figure 13.

Several environmental elements have a significant impact on the movement of elvers into the East River and include: (1) temperature, which influences the start time of the runs; (2) water level and velocity, which affect the elvers ability to maneuver over barriers upstream; and (3) tides, which bring elvers into the estuary and river mouth (Jessop 2002).

Elver migration to the East River, Chester is challenged by the falls, which act as a barrier. Particularly during heavy rainfall and rising water, elvers are unable to swim upstream. Elvers cannot swim in velocities over 35 $cm \cdot sec^{-1}$, and usually choose not to swim at even lower velocities (Jessop 2002). Rainfall throughout the spring did influence elver migration, as higher water prevented elvers from reaching the traps. Following heavy rain, as water levels rose, there was a drop in elver recruitment (Figure 14).

The traps used during this study do not have a 100% efficiency rate, and elvers were observed pooling around rocks above the ramps and holding boxes. This was observed particularly when water levels dropped (personal observations May 24), enabling elvers to travel further upstream. Tides heavily influence elver migration, typically bringing the largest numbers with the spring tides after dark. Very high tides, corresponding with a new moon, may have decreased the number of elvers in boxes as the ramps were fully submerged and the high tide may have carried elvers farther upstream, above the boxes (personal observations). This level of escapement is considered to be low compared to the total number of elvers migrating through the site. However, elvers were also observed migrating in small numbers during daylight hours.

### Biological Characteristics

As in past years, elvers migrating up the East River, Chester, underwent a seasonal variability in length, weight, and pigment. Early during the season, elvers were larger (average 63.48mm; 0.203g for the month of April) and clearer in pigment (stage 1). Elver size decreases as metabolism uses body energy reserves prior to feeding initiation, which is in turn linked to the pigmentation stage (Stages 3-4 typically have begun feeding) (Dutil *et al*, 1989). The digital scan provides a high-quality image of elvers, such that food was visible in stomachs of elvers which were at least at Stage 3 pigment (Figure 15).

## Acknowledgment

Bluenose Coastal Action Foundation would like to thank all those who were involved in the 2017 East River, Chester elver study. Thank you to Wayne, Yvonne, and Genna Carey and their team at Atlantic Elver Fishery Inc. for much assistance and guidance; Dr. Rod Bradford, of Fisheries and Oceans Canada, for providing scientific guidance and field supplies; financial support from the Canadian Committee for a Sustainable Eel Fishery Inc (CCSEF); Louisiana Pacific for allowing the use of their property along the river for a field station; and finally to the Coastal Action staff and volunteers who contributed their time to the study: Jennifer McKinnon, Sam Reeves, Ben Wentzell, and Liz Murphy.

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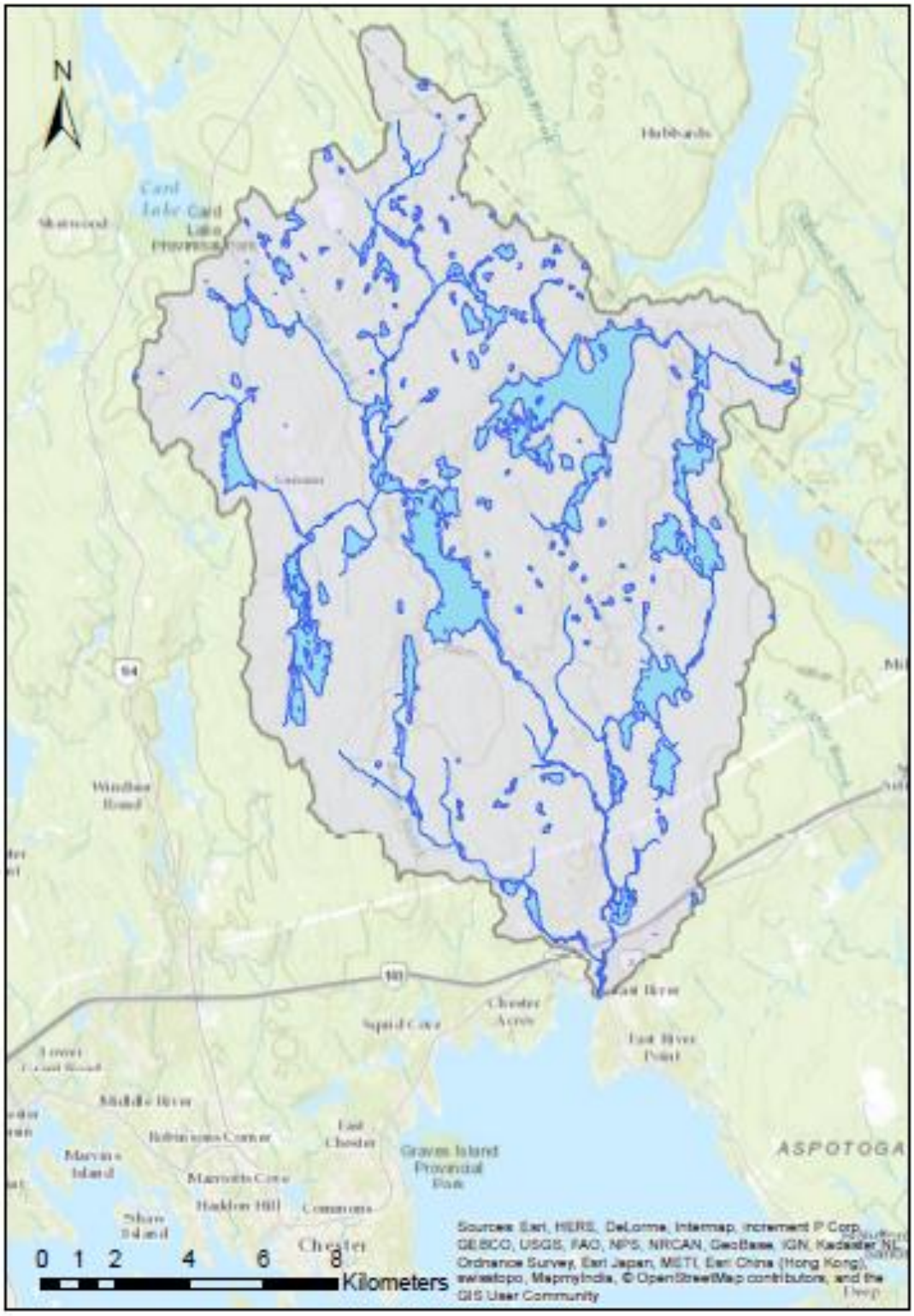


*Figure 1. East River, Chester watershed area.*


*Figure 2. Elver trap placement in the East River, Chester.*

*Figure 3. Irish-style elver trap, featuring a ramp (left) and holding box (right) (2015).*

*Figure 4. Scooping elvers from the boxes into buckets to be transported to release site (2017).*

*Figure 5. Holding bags used to hold elvers while sampling (2017).*

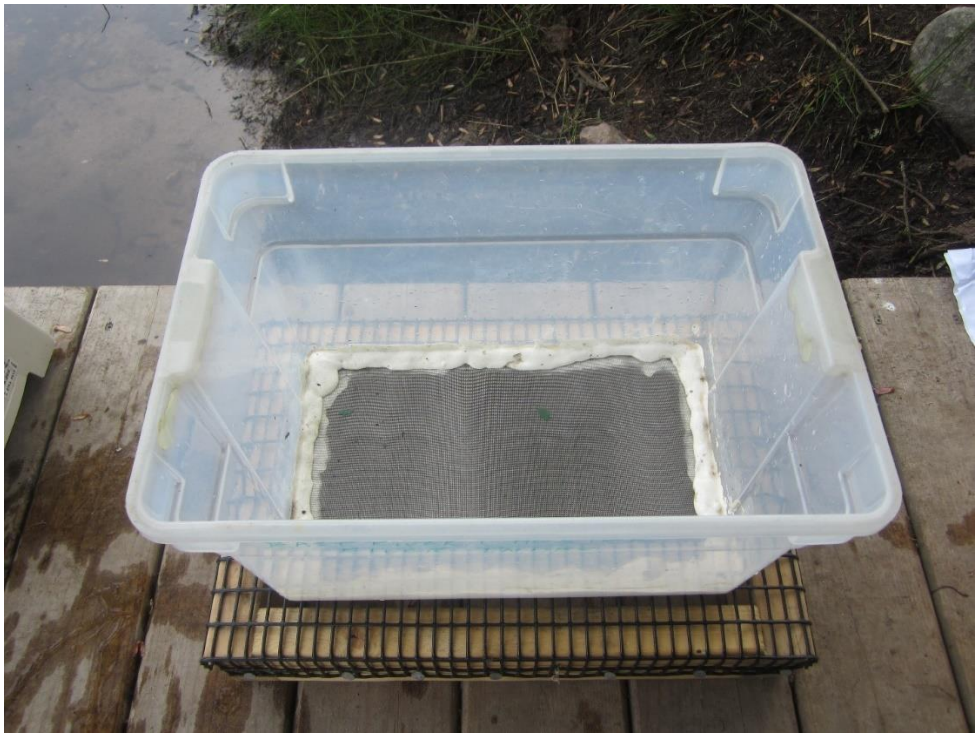

*Figure 6. Elver weigh bin and drain table, used to weigh elvers.*

*Figure 7. Counting weight sub-samples into buckets, labelled with sample number (2017).*

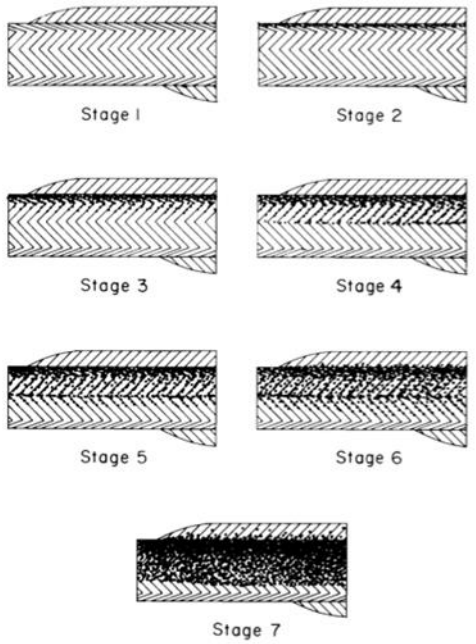


*Figure 8. Haro and Kruger (1988) pigmentation stages, used to identify pigment stage of elvers.*

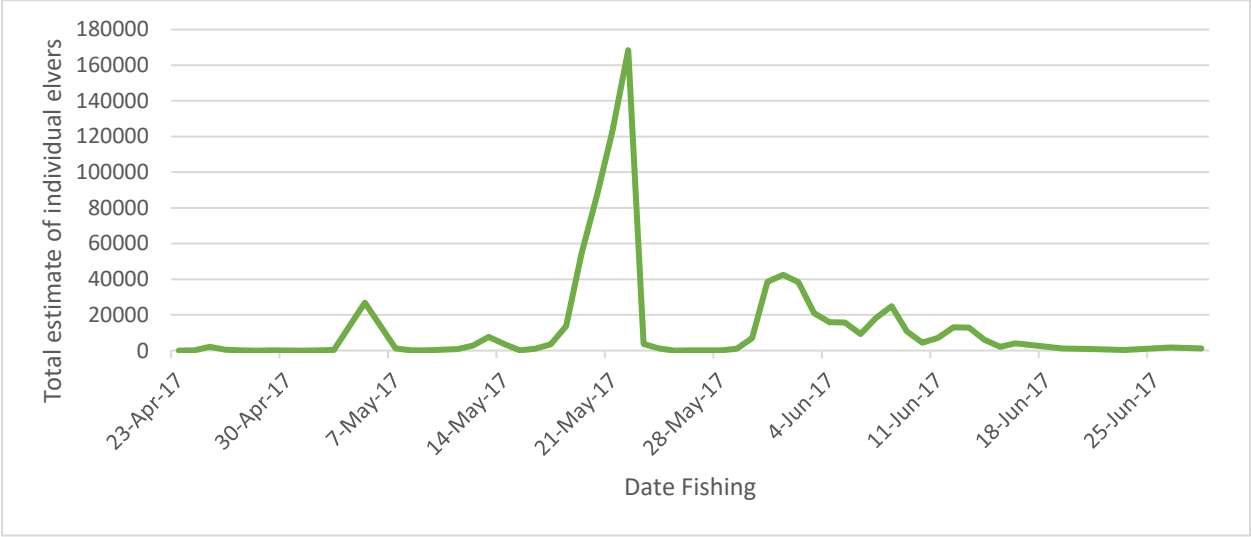


*Figure 9. Elver run throughout the 2017 season.*

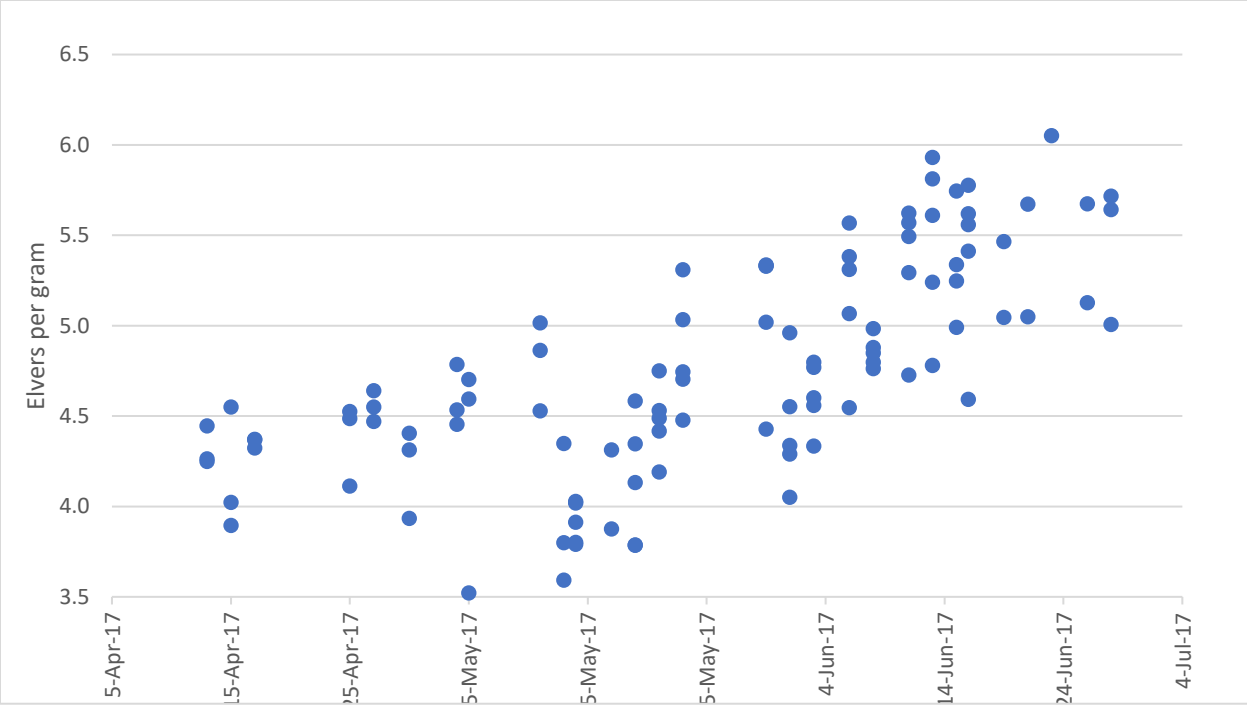


*Figure 10. Average elvers per gram, based on sub-samples counted throughout the 2017 season.*

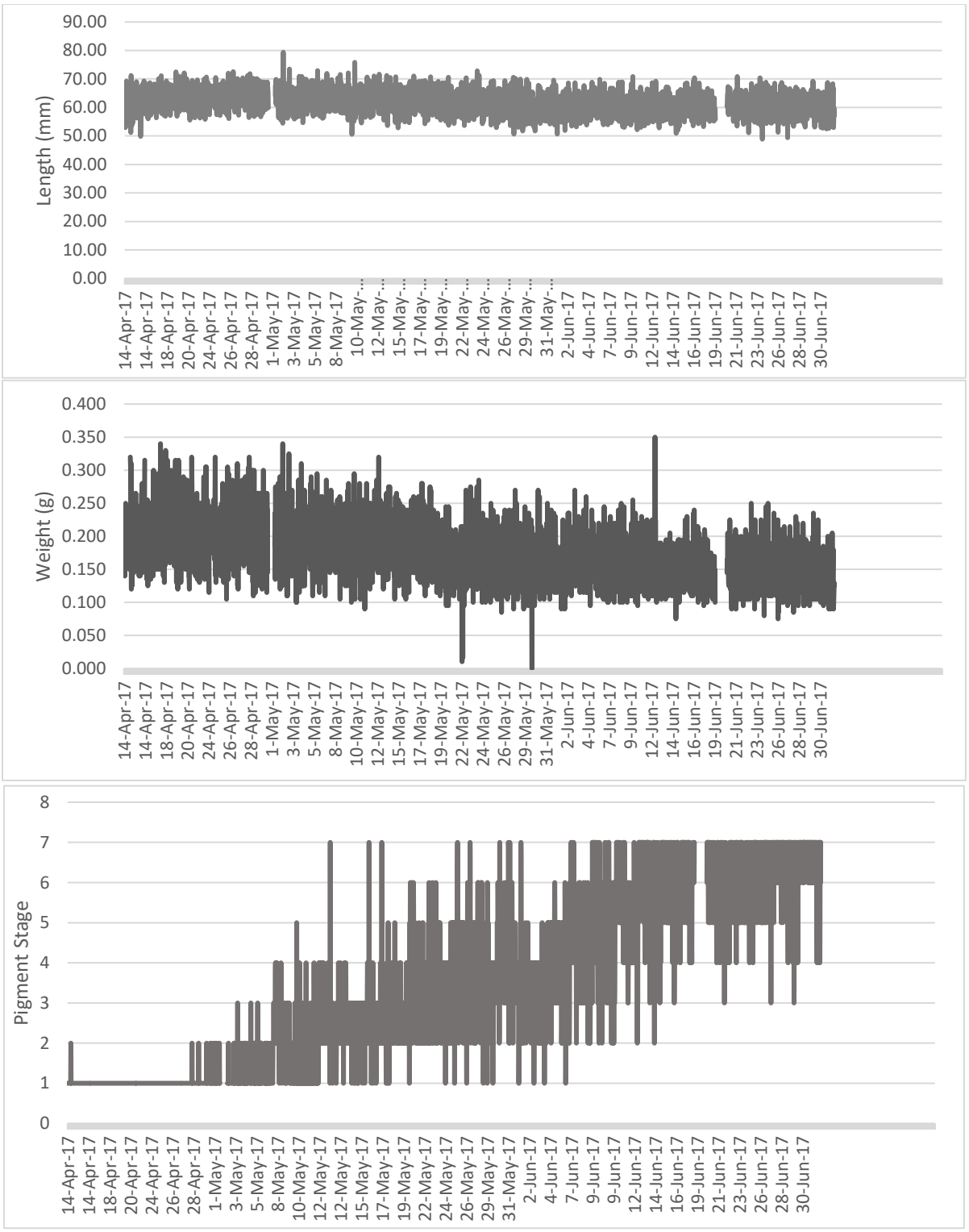


*Figure 11. Elver length, weight, and pigment stage gathered from biological sampling throughout the 2017 season.*

*Figure 12. Elver digital scans. April 13 (top) and June 26 (bottom) 2017.*

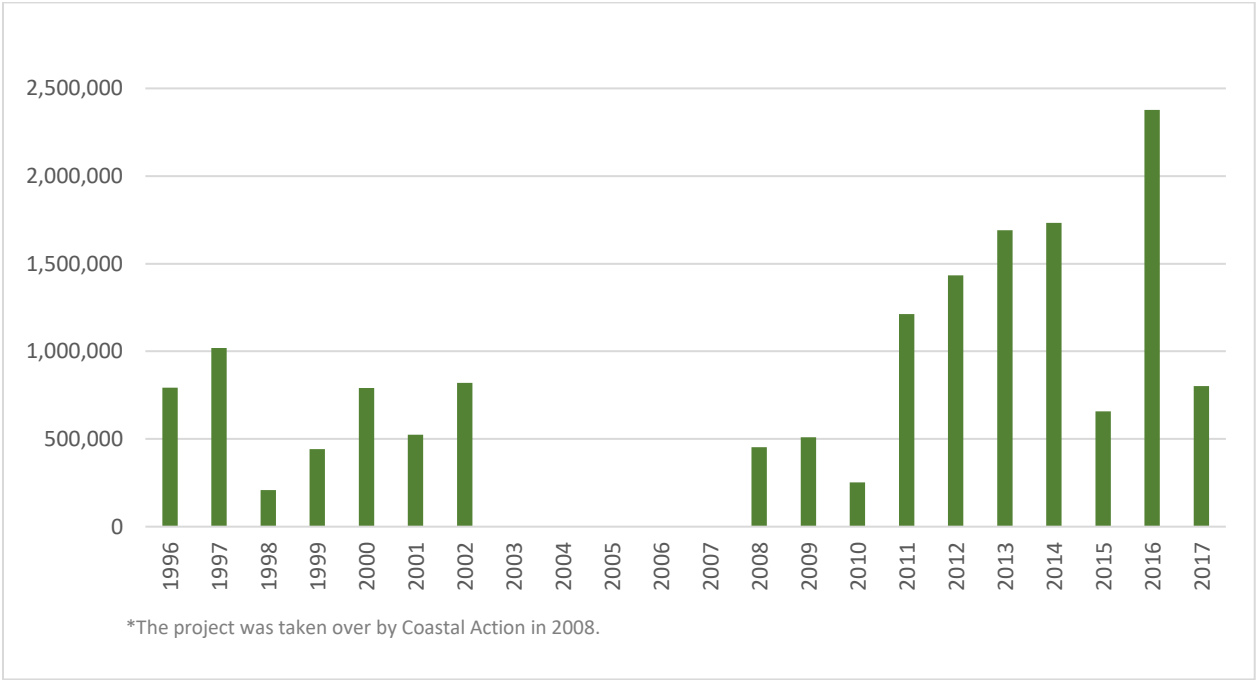


*Figure 133. Annual elver recruitment to East River, Chester (excluding commercial catch).*

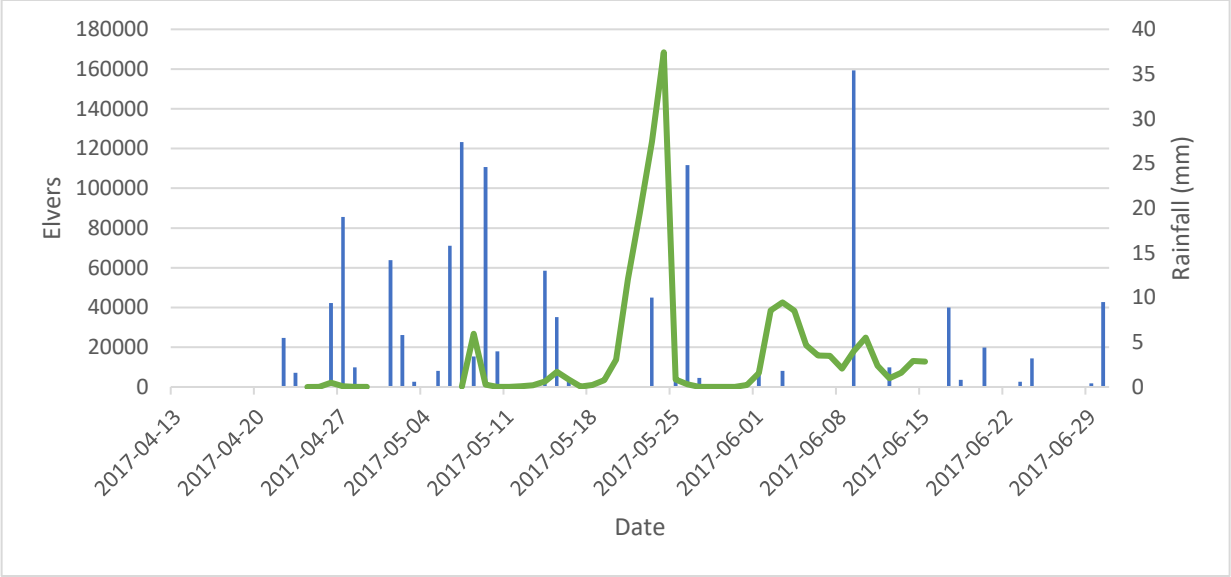


*Figure 144. Elver run and rainfall 2017 (rainfall data retrieved from Environment Canada).*

*Figure 155. Digital scan showing food in elver stomachs.*