



EAST RIVER, CHESTER AMERICAN EEL

2017

Traps were placed in several locations throughout the East River, Chester watershed between late August to November 2017. Three tagging sites were set upstream, while a single recapture site was located below. A total of 590 eel were caught at the tagging sites, of which 557 were tagged. The recapture site caught 409 eels, of which 13 were recaptured eels. The presence of *A. crassus*, the invasive swim bladder parasite, was found in 32 of 75 sacrificed eels.

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Contents

| | |
|-----------------------------------------------------------------|----|
| List of Figures | i |
| List of Tables | ii |
| Introduction | 1 |
| Bluenose Coastal Action Foundation | 1 |
| Study Area | 1 |
| Overview of Activities | 3 |
| Activities | 6 |
| Canaan River | 6 |
| Little Whitford Lake | 8 |
| Whistler Lake | 8 |
| Main Branch Recapture Site | 9 |
| Biological Sampling | 10 |
| Electrofishing | 13 |
| Discussion and Recommendations | 13 |
| Electrofishing | 16 |
| Biological Sampling | 16 |
| Industry Engagement & Public Education / Outreach Efforts | 17 |

List of Figures

| | |
|-------------------------------------------------------------------------------------------------------------------|---|
| Figure 1: East River, Chester watershed area | 2 |
| Figure 2: Nova Scotia protected areas in and surrounding the East River, Chester | 2 |
| Figure 3: Locations of 2017 silver eel tagging and recapture sites | 4 |
| Figure 4: Measuring silver eel length in trough | 5 |
| Figure 5: American silver phase eel, demonstrating silver colouring and black neuromasts along lateral line | 5 |
| Figure 6: American eel PIT tag injection site | 5 |
| Figure 7: Canaan A upper net (August 28 to September 28, 2017) | 6 |
| Figure 8: Canaan A lower nets (August 28 to September 28, 2017) | 6 |
| Figure 9: Canaan B net, upstream view (September 29 to October 19, 2017) | 7 |
| Figure 10: Canaan B net (September 29 to October 19, 2017) | 7 |
| Figure 11: Canaan C fyke net (October 20 to November 19, 2017) | 7 |
| Figure 12: Little Whitford wire trap with fyke net in front (November 16, 2017) | 8 |
| Figure 13: Whistler Lake Outflow (October 12, 2017). Net to the left is just out of view | 9 |

| | |
|----------------------------------------------------------------------------------------------------------------|----|
| Figure 14: One of the large females caught at Whistler Lake (November 17, 2017). Length measuring 980 mm. | 9 |
| Figure 15: Recapture A trap (August 28 to September 30, 2017). | 10 |
| Figure 16: Recapture net (September 30 to November 20, 2017). | 10 |
| Figure 17: Recapture net upstream view (September 30 to November 20, 2017). | 10 |
| Figure 18: Female silver eel. | 12 |
| Figure 19: Male silver eel. | 12 |
| Figure 20: Infected American eel swim bladder. | 12 |
| Figure 21: A. crassus from infected swim bladder. | 12 |
| Figure 22: Electrofishing the Canaan branch (site ID EstCh001) (September 14, 2017). | 13 |
| Figure 23: American eels caught at site EstCh001. | 13 |
| Figure 24: Run timing and catch per trap 2017. | 14 |

List of Tables

| | |
|----------------------------------------------------------------------|----|
| Table 1: Summary of site activities. | 14 |
| Table 2: Detailed summary of dates, trap sites, and activities. | 15 |
| Table 3: Detailed recapture data. | 15 |

Introduction

Bluenose Coastal Action Foundation

Fisheries and Oceans Canada (DFO) conducted an annual elver abundance study on the East River, Chester, beginning in 1996, but due to lack of government resources the study ceased in 2002. In 2008, a joint venture project was formed between DFO, Bluenose Coastal Action Foundation (Coastal Action), and the Canadian Committee for a Sustainable Eel Fishery Inc. (CCSEF) to continue the elver study annually. In addition to the elver study, a yellow eel mark and recapture potting study occurred in Oakland Lake, Mahone Bay from 2008 to 2014. Oakland Lake has only one outlet, and an annual silver eel study has occurred in Oakland stream from 2009 to 2017 (excluding 2010). A second silver eel study was initiated in the East River in 2014, and has been continued annually, although has varied slightly year to year. The studies provide data to DFO which is used to: develop and maintain indices of eel and elver status; understand any effects of fishing on eel production; understand biological characteristic of elver and silver eel over run time; understand the age class structure of eels in the system; and identify the prevalence and abundance of *Anguillicoloides crassus*, otherwise known as the swim bladder parasite. Although these data are specific to the coast of Nova Scotia, the results may be reflected and applied elsewhere, as American eel are thought to be panmictic and have a wide geographical range.

Study Area

The East River, Chester drains into Mahone Bay, with its watershed located in the Municipality of the District of Chester (Figure 1). The watershed includes several lakes, marshes, and brooks and has a total drainage area of 134 km². The headwaters of the watershed include Connaught and Timber Lakes, which are also the largest bodies of water in the system. American eel are known to be the predominant species in the river system, while White suckers and Brook trout are quite prevalent. The East River was historically used by the Bowater-Mersey Co. Ltd for driving logs and had many dams and sluiceways removed over the years, although some structures and remnants remain. There are also several protected areas in and around the watershed, including the Long Lake Nature Reserve and the South Panuke Wilderness Area (Figure 2).

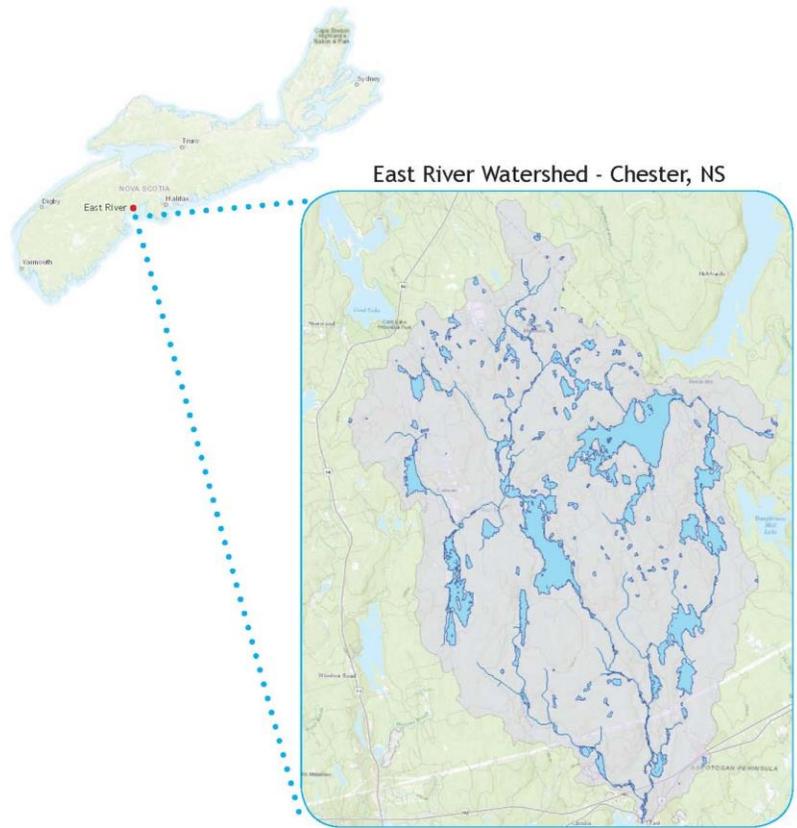


Figure 1: East River, Chester watershed area.

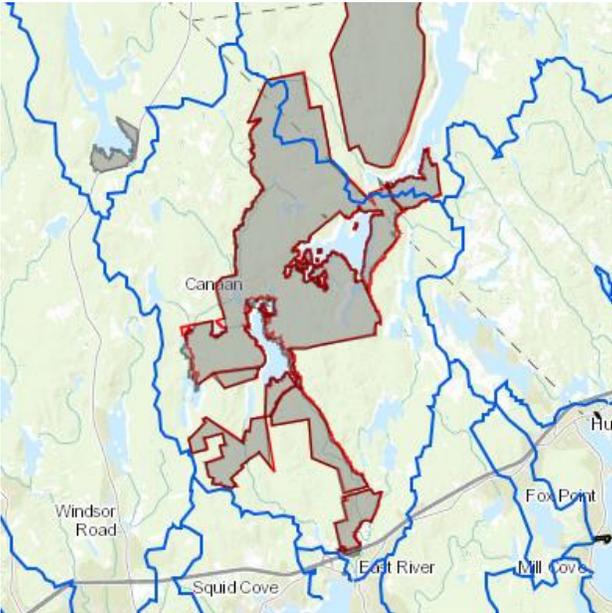


Figure 2: Nova Scotia protected areas in and surrounding the East River, Chester.

Overview of Activities

Three tagging sites and one recapture site were chosen within the watershed. The tagging sites were in each of the two branches flowing into the main river – one tagging site in the Canaan branch and two tagging sites in the East branch.

Due to the unavailability of a Rotary Screw Trap (RST), the previous year's Connaught Lake outflow site was moved farther downstream in the Canaan River; just above the confluence of the Canaan River and the Whistler Lake outflow. Several hoop nets with wings were staggered across the width of the river. The East branch tagging sites remained the same as in 2016, including hoop and fyke nets at the Whistler Lake outflow and a wire trap at the Little Whitford Lake outflow.

To recapture tagged eels, a fyke net was installed in a small channel of the main river branch, below the confluence of the Canaan and East branches into the main river. Due to the size of the East River watershed, and a predicted large number of migrating eel, this site was chosen assuming it would catch a reasonable percentage of migrating eels. Temporarily, a second hoop net was placed below the fyke net, to increase catchability and estimate escapement past the first net.

The trap sites were mapped (Figure 3), and the approximate distances between each trap site and the recapture site were estimated, using ArcGIS (Graphic Information Systems). The approximate distance between Canaan River, Little Whitford Lake, and Whistler Lake to the recapture site is 3.64 km, 4.22 km, and 3.34 km, respectively. The recapture site is approximately 0.88 km from the head of tide.

Traps were continuously maintained and modified as water levels fluctuated throughout the season.

Due to time restraints, the priority at all trap sites was to gather length measurements and phase (colouring) of each individual eel. Every eel captured was measured to length (in millimetres) using a measuring trough (Figure 4). Bycatch was recorded at all sites; however, no measurements of bycatch were taken. Phase, or colour, was determined using qualitative colouring criteria based on research for European eel¹. The lateral line of each eel was visually examined for two criteria: the formation of black neuromasts 1-2 cm apart along the lateral line; and the visual colour of the eel. To obtain silver criteria, the eel must have at least one black neuromast present and appear silver or shimmering in colour from the ventral surface to the lateral line (Figure 5). If no black neuromasts were present, or the colouring was yellow to green, and/or did not continue to the lateral line, the eel was recorded as yellow. If the eel had only one of the silvering criteria, the eel was recorded as in the process of silvering.

Electrofishing was anticipated to occur over 10 sites throughout the East River watershed. However, due to restraints with timing of training and warm water temperatures, only two sites were electrofished in 2017; the Canaan River, below Connaught Lake; and the Little Whitford Lake outflow, below the road crossing.

¹ Anthony Acou, Pauline Boury, Pascal Laffaille, Alain Jean Crivelli, Eric Feunteun. "Towards a standardized characterization of potentially migrating European silver eel (*Anguilla anguilla*, L.)." *Arch. Hydrobiol.* (2005): 237-255

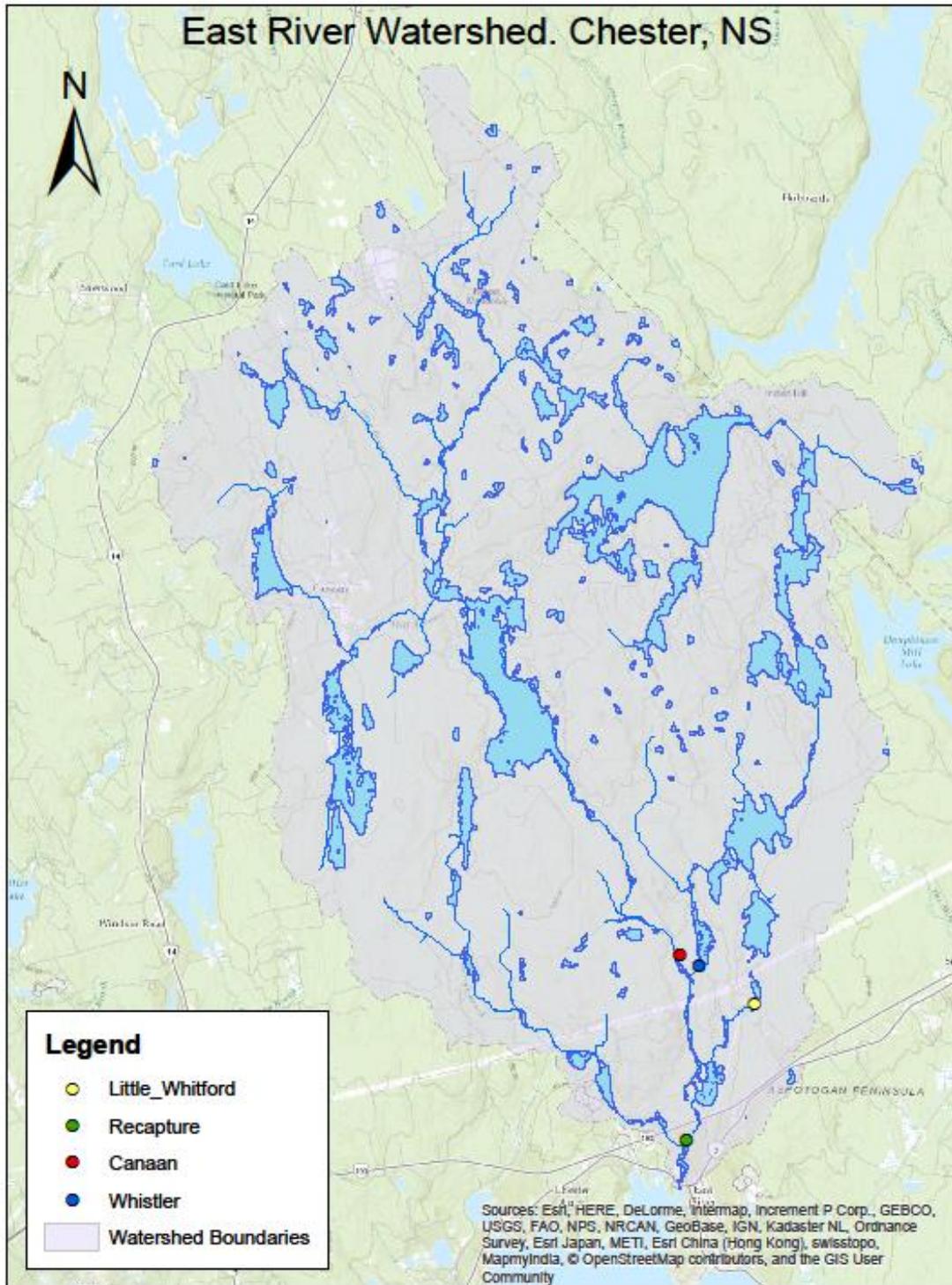


Figure 3: Locations of 2017 silver eel tagging and recapture sites.



Figure 4: Measuring silver eel length in trough.



Figure 5: American silver phase eel, demonstrating silver colouring and black neuromasts along lateral line.

American eel captured at the three upstream sites were marked with a Passive Integrated Transponder (PIT) tag. Each individual eel was scanned to ensure there was not an existing PIT tag, as occasionally eel find their way into a trap more than once. The PIT tag was placed in front of the dorsal fin, midway between the lateral line and dorsal surface (Figure 6). Every eel caught at the recapture site was scanned to determine if it was recaptured from upstream tagging sites.



Figure 6: American eel PIT tag injection site.

Activities

Canaan River

Several hoop nets were staggered across the width of the river, in triangle form; one above and two approximately 20 metres below, a few metres apart (Figures 7 and 8). Small wings were added to the nets. These nets captured 78 eels and remained in place from August 28 to September 28, 2017, until a heavy rain brought the water level up and the traps were not able to withstand the pressure.

On September 29, following the rise in water level, a small fyke net with a square frame was placed about 50 metres farther downstream at a bend in the river (Figures 9 and 10). A long wing was extended diagonally upstream from the net, stretching about two-thirds across the river. After capturing no eels, the net was moved downstream a few more metres; where again, no eels were caught. Finally, a single fyke net with a long wing stretching two-thirds across the river on an upstream diagonal was set roughly 100 metres upstream on October 20 (Figure 11). The net remained in this location for the duration of the season until November 19, capturing 34 eels.

Eels were emptied into holding bags and sampled on the riverbank. A total of 112 eels were captured at all Canaan traps; 109 eels were tagged.



Figure 7: Canaan A upper net (August 28 to September 28, 2017).



Figure 8: Canaan A lower nets (August 28 to September 28, 2017).



Figure 9: Canaan B net, upstream view (September 29 to October 19, 2017).



Figure 10: Canaan B net (September 29 to October 19, 2017).



Figure 11: Canaan C fyke net (October 20 to November 19, 2017).

Little Whitford Lake

A wire trap was placed in the outflow of Little Whitford Lake on August 28 and removed on November 19. The trap consisted of a large, rectangular frame with a ramp and extended funnel to catch and retain eels in the holding area. A sock was added to the funnel to decrease the chances of eel escapement. A wing was installed on either side of the trap entrance to guide more eels into the trap. Eels were scooped out with a net and sampled on the riverbank. On November 16, near the end of the season, a fyke net was placed directly in front of the wire trap (Figure 12) but caught no eels. A total of 29 eel were captured in Little Whitford; 28 were tagged. All 29 eels were captured before October 16.



Figure 12: Little Whitford wire trap with fyke net in front (November 16, 2017).

Whistler Lake

The outflow of Whistler Lake is wide with a small braid in the middle of the outflow, tapering to a funnel beneath a bridge and opening into a pool. In the same location as 2016, a small rectangular fyke net was placed below the beaver dam in the outflow of Whistler Lake from August 28 to November 19, 2017 (Figure 13). An additional hoop net with wings was added to the far-left side of the outflow (river right). Traps were emptied into holding bags and brought to the riverbank to be sampled.

This site drains most of the East branch of the East River and, as expected, obtained the highest catches. A total of 449 eel were captured in the Whistler Lake outflow; 420 were tagged. The last three eels were captured here on November 17 and were the largest eels of the season with lengths estimated at 940 mm, 960 mm, and 980 mm (Figure 14).



Figure 13: Whistler Lake Outflow (October 12, 2017). Net to the left is just out of view.



Figure 14: One of the large females caught at Whistler Lake (November 17, 2017). Length measuring 980 mm.

Main Branch Recapture Site

The recapture trap was set up in the same location as in past years, in a small channel of the main river below the confluence of the East and Canaan branches (Figure 15). The fyke net was in place from August 28 to November 20 but was moved just downstream (Figures 16 and 17) on September 30, when water levels rose and made the current site unworkable. The recapture trap remained in that location for the duration of the season, where changes in water level posed less of a problem. A wing was extended from the net and a wire leaf catcher was placed above the net and cleared daily to reduce pressure from leaves and litterfall.

A second hoop net was temporarily set up in the main river, about 15 metres below the recapture net, to estimate the number of eel being missed. Any eels captured in the upper trap were tagged with a streamer tag before being released. Unfortunately, the streamer tags had a poor retention rate, and due to a heavy rainfall, the hoop net was only in place from September 18 to September 30, before being washed out.

American eel caught in the recapture net were emptied into a holding bag and brought to the riverbank to sample. Each eel was measured for length, observed for silvering criteria, and scanned for PIT tags. In total, 409 eels were captured at the recapture site; 13 were recaptured from upstream. Nine (9) of the recaptured eels were tagged at Whistler Lake and four (4) were tagged in the Canaan River. No eels that were tagged at the Little Whitford Lake outflow were recaptured.



Figure 15: Recapture A trap (August 28 to September 30, 2017).



Figure 16: Recapture net (September 30 to November 20, 2017).



Figure 17: Recapture net upstream view (September 30 to November 20, 2017).

Biological Sampling

A total of 75 silver eels were randomly selected, based on length frequency from 200 mm to 1000 mm, and euthanized on ice. Sacrificed eel were frozen in water until they were thawed for sampling. Lengths were measured before and after freezing. Other measurements such as weight, eye diameter, and head

and fin lengths were recorded. Gonads were extracted and weighed, and each eel was sexed as female (Figure 18) or male (Figure 19). Otoliths were collected and stored in vials with a corresponding identifying number and swim bladders were examined for the presence of the invasive parasite, *Anguillicoloides crassus* (Figures 20 and 21). Of the 75 eels sacrificed, 23 were female and 52 were male. Thirty-two (32) of the silver eels sacrificed were infected with the *A. crassus*; of those, 13 were female. The highest prevalence of parasites was found in a female measuring 488 mm in length, where 20 swim bladder parasites were observed.



Figure 18: Female silver eel.



Figure 19: Male silver eel.



Figure 20: Infected American eel swim bladder.



Figure 21: *A. crassus* from infected swim bladder.

Electrofishing

Electrofishing was conducted at two sites in the East River; the Canaan branch, below Connaught Lake, (site ID EstCh001) (Figures 22 and 23) and the East branch, below Little Whitford Lake (site ID EstCh008). Electrofishing was conducted using the same methodology as used by DFO-Science, Maritimes Region.



Figure 22: Electrofishing the Canaan branch (site ID EstCh001) (September 14, 2017).



Figure 23: American eels caught at site EstCh001.

At site EstCh001, fished September 14, a total of 22 eels were captured. The majority were yellow eels, two were silver, and one was silvering. Other fish captured at the site included Brook trout, Chub sp., Dace sp., and White sucker.

At site EstCh008, fished September 19, six (6) eels were captured, of which five (5) were yellow and one was silver. A high prevalence of Brook trout and White sucker were also found at the site.

Discussion and Recommendations

Overall, the 2017 field season was successful. The target of tagging 500 eels was reached and even exceeded; however, ideally would have been spread out amongst all tagging sites. Most of the tagging was conducted at Whistler Lake (Table 1).

Table 1: Summary of site activities.

| Location | Tagged | Total Captured |
|-----------------|--------|----------------|
| Canaan | 109 | 112 |
| Little Whitford | 28 | 29 |
| Whistler | 420 | 449 |
| Recapture | 13 R | 409 |

No significant run events occurred; the catch was quite dispersed over the season. The largest run event occurred on September 20, catching 105 eels in the recapture trap, and lower numbers at the tagging sites (Figure 24). The run corresponded with a new moon, as well as 13.8 mm of rain. Air temperatures were quite warm, averaging 19.85°C (weather data retrieved from Canada.ca). Catches varied greatly per site over the season, in part likely due to weather and also due to moving traps around (Table 2).

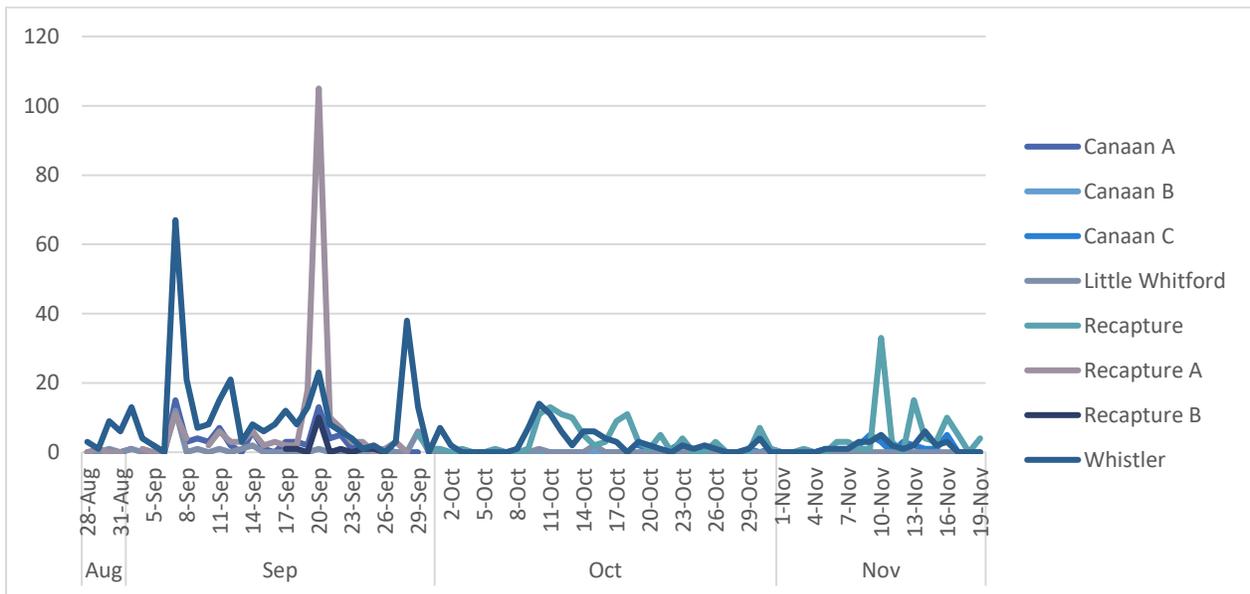


Figure 24: Run timing and catch per trap 2017.

Table 2: Detailed summary of dates, trap sites, and activities.

| Site | Dates in place | Total eels captured | Tagged | Recaptured |
|-----------------|-----------------------------|---------------------|--------|------------|
| Canaan A | August 28 – September 28 | 78 | 76 | |
| Canaan B | September 29 – October 20 | 0 | | |
| Canaan C | October 20 – November 19 | 34 | 33 | |
| Little Whitford | August 28 – November 19 | 29 | 28 | |
| Recapture A | August 28 – September 30 | 197 | | 2 |
| Recapture B | September 18 – September 30 | 17 | | |
| Recapture | September 30 – November 20 | 195 | | 11 |
| Whistler | August 28 – November 19 | 449 | 420 | 6 |

Migration time between sites varied greatly for individual eels, with as little as four days and as much as two months, between tagging and recapturing (Table 3).

Table 3: Detailed recapture data.

| PIT TAG | Date Tagged | Location Tagged | Date Recaptured |
|-----------------|-------------|-----------------|-----------------|
| 982 406 270 138 | 8-Sep-2017 | Whistler | 12-Sep-2017 |
| 982 406 270 244 | 15-Sep-2017 | Canaan | 21-Sep-2017 |
| 982 406 270 030 | 4-Sep-2017 | Whistler | 30-Sep-2017 |
| 982 406 270 332 | 21-Sep-2017 | Canaan | 4-Oct-2017 |
| 982 406 269 947 | 8-Sep-2017 | Whistler | 14-Oct-2017 |
| 982 406 270 338 | 29-Sep-2017 | Whistler | 18-Oct-2017 |
| 982 406 270 172 | 12-Sep-2017 | Whistler | 18-Oct-2017 |
| 982 411 171 384 | 15-Oct-2017 | Whistler | 27-Oct-2017 |
| 982 411 171 374 | 6-Nov-2017 | Canaan | 11-Nov-2017 |
| 982 406 270 176 | 13-Sep-2017 | Whistler | 11-Nov-2017 |
| 982 411 171 399 | 31-Oct-2017 | Whistler | 17-Nov-2017 |
| 982 411 171 391 | 11-Nov-2017 | Whistler | 17-Nov-2017 |
| 982 411 171 369 | 11-Nov-2017 | Canaan | 18-Nov-2017 |

Due to the weather and water conditions, traps remained in place later than in the past. Typically, the season ends early November, rather than mid-late November. Moving forward, it is recommended for the traps to remain in place until the end of November. Three of the largest eels observed since the study began in 2014, were captured November 17. Leaving the traps in later in the season ensures fewer eel are missed, in particular any large females which typically run late in the season.

Moving the Connaught Lake outflow trap further downstream saved significant travel time each day. However, a lesser number of eels were captured than in previous years. As well, moving traps around so much throughout the season decreases consistency in the study as well as the validity of the science. It is recommended that trap locations and types remain as consistent as possible throughout the season and from year to year. The Canaan B trap was inefficient and is considered a factor in the low catch of eels in

the Canaan branch. If the Canaan C site is to be continued in the future, a leaf catcher and larger holding area in the net are necessary.

The Whistler Lake site and traps have been very efficient, receiving the largest catches. The site is also easily accessible even during heavy rainfall and rising water levels. The leaf catcher was not particularly useful for leaves, as leaves tend to drop in the lake before reaching the net. However, the leaf catcher was effective in preventing feeding ducks from drifting into the net!

The Little Whitford outflow caught fewer eels than in past years, for reasons unknown. All conditions remained the same, and the trap was in the exact place as previous years. The site has very low velocity, increasing the chance of eels finding their way past the trap.

The use of a rectangular fyke net as the recapture net was much easier to set, check, and move if needed. Moving the net to the end of the channel greatly increased the ease of checking the trap. Particularly, when water was high, the site was still accessible and safe to check. The rectangular fyke nets used at both the recapture site and Whistler Lake were durable, efficient, easy to set and check, and safely held many eels at a time. While the black nets fished well, a longer cod end would make it easier to check and empty the traps, as well as hold more eel in the event of a large run. Keeping loops on the hoop nets so they are able to slide up and down the rebar which holds them in place, also greatly increased the ease of checking and emptying the traps.

Streamer tags are difficult to push through tough eel skin, and a larger needle must first be used to create a hole for the tag, increasing handling time and stress on the fish. As well, the streamer tags did not have a good retention rate; however, it is thought that tying a knot will increase retention. More efficient types of tags could be investigated for the purposes of estimating the number of eels bypassing a net.

Mink and holes from mink activity have continued to be a problem, particularly at the recapture trap site, despite many efforts to deter mink from the traps. Efforts have included hanging aluminium plates and hanging strong scented soap around the net.

Electrofishing

Electrofishing certification was not obtained until late August, due to conflicting availability of staff and course dates. Due to time constraints and license conditions, electrofishing activities were restricted, and only two sites were able to be fished. With electrofishing certification now completed, moving forward, electrofishing activities will be aimed to begin in June, and sites will be fished at least twice over the season.

Biological Sampling

The highest prevalence of parasites per sample size was found in 2017. Specimens collected, both at the recapture site and from electrofishing, indicate that the parasite is present in the Canaan branch; however, the parasite has not yet been confirmed in the East branch. The majority of the sacrificed samples were collected randomly at the recapture site, but the area of origin within the watershed is

unknown. Additional sampling may be required specifically within the branches of the river to determine the prevalence of the parasite.

Industry Engagement & Public Education / Outreach Efforts

The following communications / outreach activities took place as part of the project.

- Project staff met with project partners from both DFO and the CCSEF four times over the duration of the season. DFO-Science provided instruction on data collection, as well as data management. Commercial elver fishers were involved in the set-up, construction, and maintenance of field gear and participated in the periodic checking of traps throughout the field season. In addition, commercial elver fishers provided an extra person for help and maintenance of traps when needed.
- Several public events were attended where project information was highlighted, including: Bridgewater Children's Fair; White Point Beach Resort's March Break Program; Coastal Action's Annual Rum & Chowder Social; Mahone Bay's Heritage Boat Yard Co-op Festival.
- A presentation was delivered at the first Bi-national American Eel Symposium in Cornwall, Ontario on December 13, 2017.
- Many people were involved in the project, including local residents, students, and commercial eel fishers. At least five (5) local residents were directly engaged in the project, volunteering their time to check traps and learn about the American eel. Posters with information about Coastal Action and the lifecycle of the American eel were placed next to trap sites to inform passers by.
- Social media posts about the project's field work reached a large number of people – the Bluenose Coastal Action Foundation Facebook page received well over 40,000 reaches. Coastal Action's website had over 206,000 hits in 2017, with over 77,000 visitors.