AMERICAN EEL IN EAST RIVER, CHESTER

NOVA SCOTIA

2018

Traps were placed in several locations throughout the East River, Chester watershed between August 30 to October 28, 2018. Three tagging sites were set upstream, while a single recapture site was located below. A total of 975 eel were caught at the tagging sites, of which 849 were tagged. The recapture site caught 937 eels, of which 38 were recaptured eels. The presence of A. crassus, the invasive swim bladder parasite, was found in 22 of the 26 sacrificed eels. Electrofishing was conducted at three sites within the watershed in late June, where many juvenile eel were observed.

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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, Chester in 2014, and has continued annually, although varying slightly from 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 eel 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 km^2. The headwaters of the watershed include Connaught and Timber Lakes, which are also the largest bodies of water in the system. American eel are the predominant species in the river system, while White sucker and Brook trout are also quite prevalent. The East River, Chester 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 several protected areas in and around the watershed, including the Long Lake Nature Reserve and the South Panuke Wilderness Area (Figure 2).

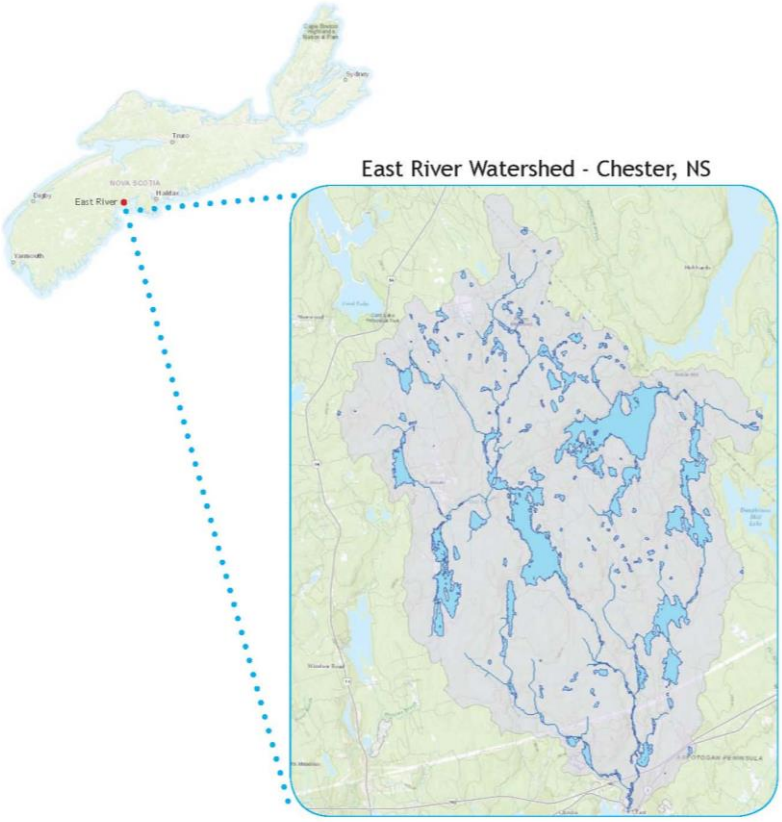

Figure 1 Map of Nova Scotia with emphasis on the East River, Chester watershed area.

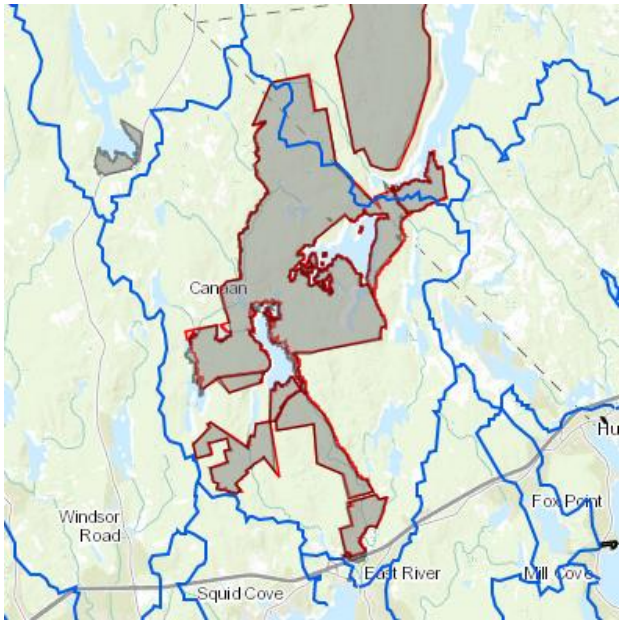

Figure 2 Protected areas in and around the East River, Chester watershed (NS Lands and Forestry 2017).

Overview of Activities

Mark-Recapture 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.

All sites remained the same as in 2017. The Canaan River site was just above the confluence of the Canaan River and the Whistler Lake outflow, where a hoop net with wings was placed. The East branch tagging sites included hoop and fyke nets at the Whistler Lake outflow and a wire trap at the Little Whitford Lake outflow. A hoop net was also used temporarily below the wire trap at Little Whitford.

To recapture tagged eel, 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, Chester watershed, and a predicted large number of migrating eel, this site was chosen assuming it would catch a reasonable percentage of migrating eel. A second hoop net was temporarily placed in the main branch, just above the fyke net, to increase catchability.

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. Water levels rose multiple times during the season, at times becoming unsafe for staff to undertake project activities. The traps were removed on October 16, and replaced October 21, due to safety concerns for staff and gear. The traps were removed for the season on October 28, due to increasing water levels and substantial forecasted rain.

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 eel[1]. 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. Eel were identified as silver with the presence of at least one black neuromast and a silver appearance 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 only one of the silvering criteria was present, the eel was recorded as silvering.

[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.

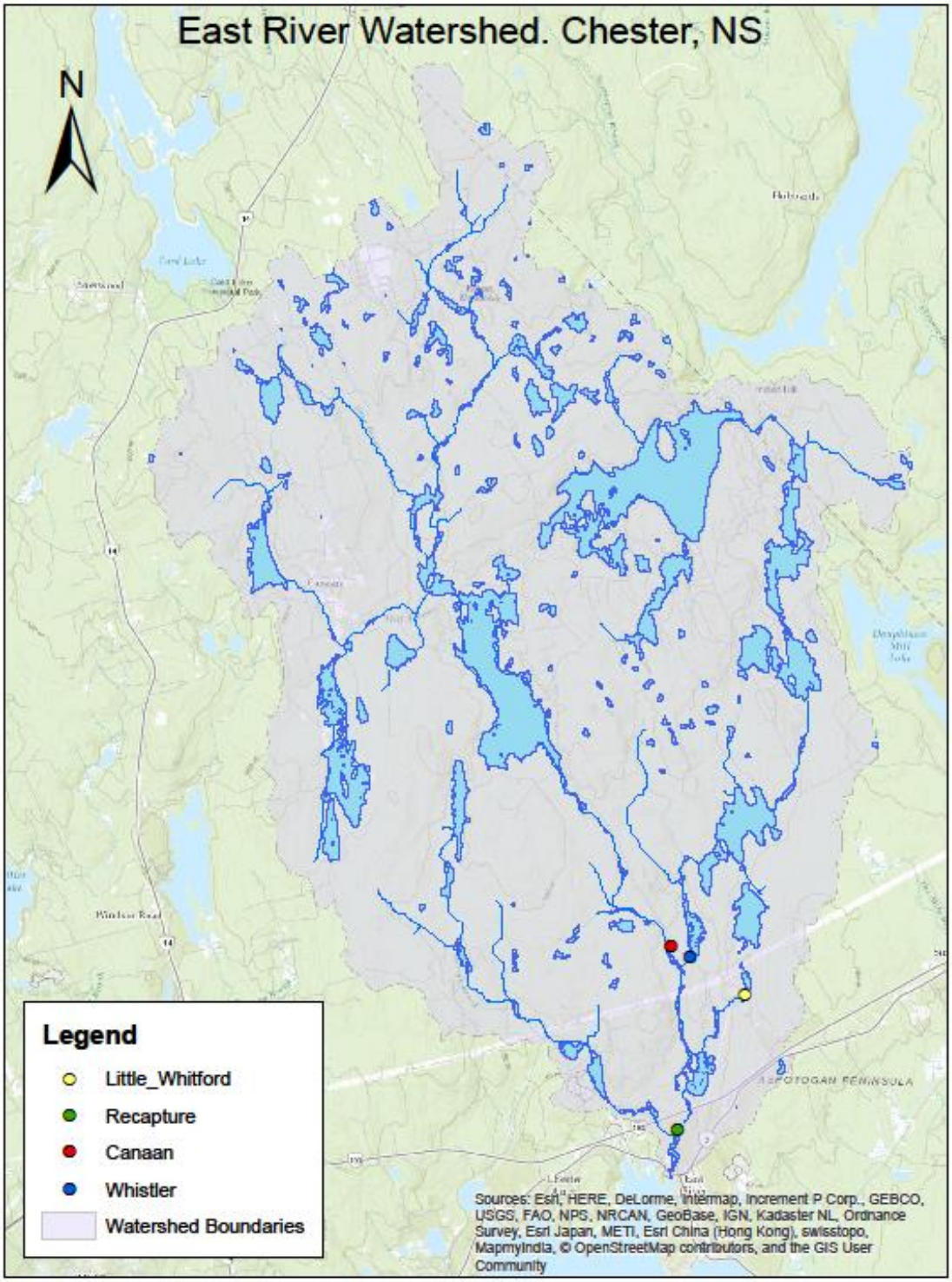

Figure 3 Map of East River, Chester watershed showing trap locations.

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 had been tagged upstream.

Figure 6 PIT tagging a silver eel (2017 photo).

Biological Sampling

American eel caught in the main branch recapture site were randomly selected to be collected and sacrificed for additional biological sampling. Every third eel caught was collected and euthanized in a bed of ice before being frozen. A random sample was expected to be representative of the length frequency distribution of the run. In addition, any eel visibly injured, by mink or otherwise, were collected as additional sacrifice samples. A small sample of 26 eel was collected, due to the nature of the run and numbers of daily catches dropping quickly.

Electrofishing

Electrofishing was anticipated to occur over six sites throughout the East River, Chester watershed. However, the ability to electrofish was hindered due to the hot and humid weather throughout the summer, and the timing of when electrofishing is permitted. Three sites were electrofished in 2018; one site in the Canaan River, one site in the East Brach, and one site in the main branch of the East River.

Activities and Results

Canaan River

A hoop net was placed near the bank of the river, with a long wing extending half the width of the river (Figure 7 and 8). The trap was placed on August 30, and was operation until October 3, when heavy rain and high-water levels forced the trap to be removed. The Canaan branch is particularly susceptible to quickly increasing water levels. The trap was replaced October 21, once the water level receded. No eel were captured after October 3, and the trap was removed for the season on October 29. A total of 223 eel were caught at the Canaan site; 218 were tagged.

Figure 7 Side view of Canaan hoop net and wing (September 5, 2018).

Figure 8 Upstream view of Canaan hoop net and wing (September 5, 2018).

Little Whitford Lake

A wire trap was placed in the outflow of Little Whitford Lake (Figure 9) on August 30, and removed on October 28, due to high water (Figure 10). The trap consisted of a large, rectangular frame with a ramp and extended funnel to catch and retain eel in the holding area. A piece of material 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 eel into the trap. Eel were scooped out with a net and sampled on the riverbank. An additional hoop net was placed below the wire trap on September 26, when water levels were low, to determine if eel were bypassing the wire trap. The number of eel bypassing was very low and the net was removed on September 28. A total of 62 eel were captured in Little Whitford; 51 were tagged.

Figure 9 Upstream view of Little Whitford wire trap and wings (September 5, 2018).

Figure 10 Little Whitford wire trap in high water, just before it was removed for the season (October 28, 2018).

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 and 2017, a small rectangular fyke net was placed below the beaver dam in the outflow of Whistler Lake from August 30 to October 28, 2018 (Figure 11 and 12). 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 obtained the highest catches, with a total of 689 eel captured; 580 were tagged. A noticeable run occurred on October 2, where the remaining PIT tags were applied. After October 2, eel captured were counted, measured, and released without PIT tags.

Figure 11 Whistler Lake Outflow (September 5, 2018). Hoop net to the left, fyke net on the right.

Figure 12 Whistler Lake Outflow following heavy rain and flooding (October 29, 2018). Nets removed October 28.

Main Branch Recapture Site

The recapture trap was set up in the same location as in previous years, in a small channel of the main river below the confluence of the East and Canaan branches (Figure 13 and 14). The fyke net was in place from August 30 to October 28, 2018. The additional hoop net remained in place from August 30 to October 3, when water levels increased.

A total of 933 eel were caught at the recapture site, including 38 tagged eel. Most of the eel came during a run on October 3 (fishing the night of October 2), after substantial rain. During this event, 673 eel were captured (255 eel were caught in the hoop net and 418 were caught in the fyke net); 27 eel were recaptured. Traps were checked again the night of October 3, where 37 eel were caught, including three recaptures. Of the three recaptured eel, two had been tagged earlier that same day, both at Whistler. An additional six eel were caught in the recapture net the following morning, including another recapture that was tagged at Canaan the day before. Numbers tapered off quickly and never picked up again following this rain event.

Due to high and rising water levels (Figures 15 and 16), traps were removed for the season on October 28.

Figure 13 Right: Fyke net at the end of the penstock channel. Left: Hoop net in main flow (August 30, 2018).

Figure 14 View upstream of fyke net (August 30, 2018).

Figure 15 High water levels at the recapture site (October 4, 2018).

Figure 16 Continued high water at the recapture site. Traps were temporarily removed (October 16, 2018).

Electrofishing

Three sites throughout the watershed were electrofished in June. The sites were chosen based on past DFO electrofishing survey sites, location in the watershed, and accessibility. The Canaan site (EstCh015) was 100 m long, while the two other sites were shorter due to physical impediments such as water falls or depth. The main branch (EstCh014) site was 72 m long, while the East branch site (EstCh009) was only 30 m.

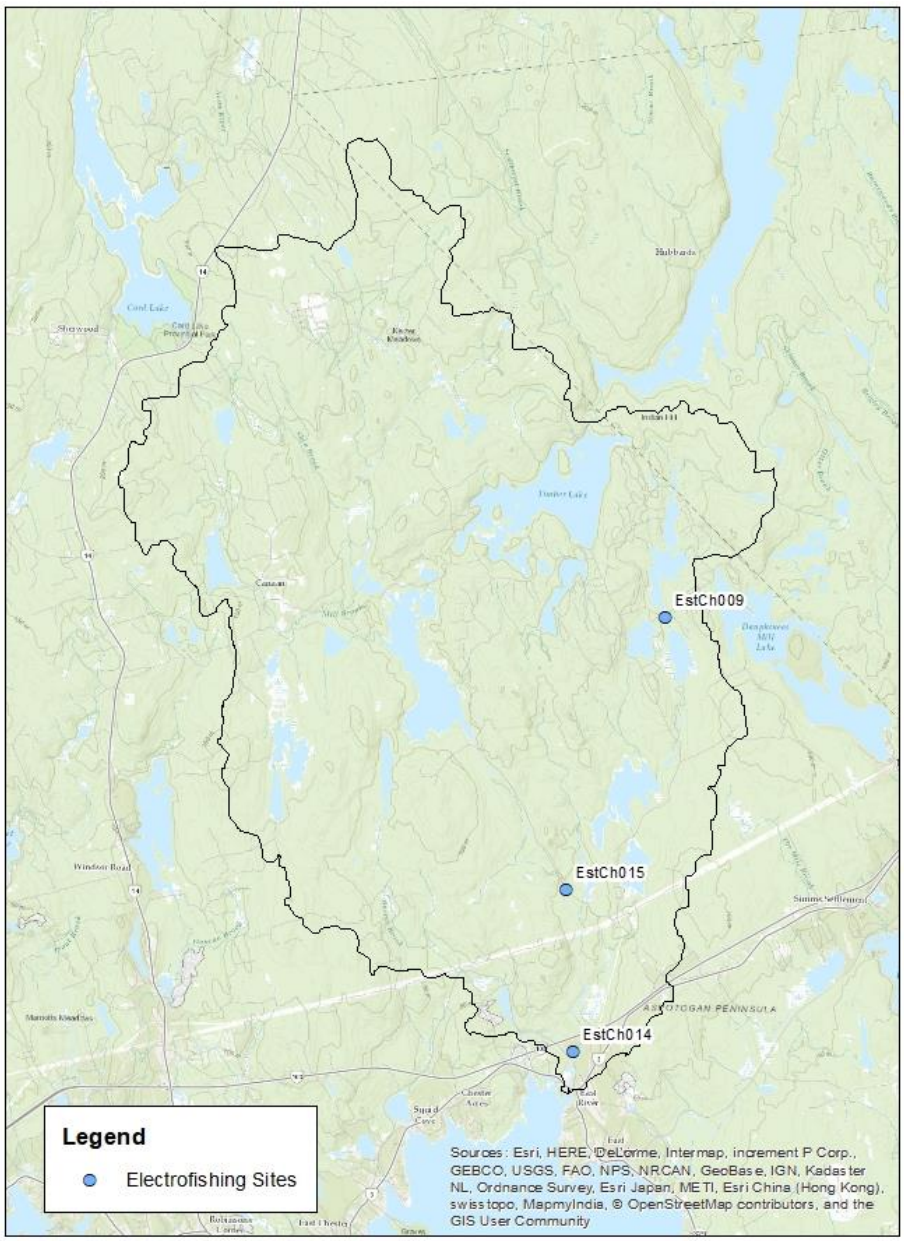

Figure 17 East River, Chester electrofishing sites (Slaunwhite, GIS 2018).

A multiple pass method was used, which included three repeated passes through the area, following the timeframe of the first pass. Fish captured were held in buckets or holding bags until all passes were complete, and then sampled and released.

Fish species observed include American eel, White sucker, Mummichog, Chub sp., and Brook trout. Hundreds of elvers were observed in the main branch site during the electrofishing passes.

Each site was anticipated to be electrofished several times throughout the season; however, weather and water conditions did not cooperate. As hot and humid conditions persisted throughout the summer, water temperatures rose to a point where it was no longer safe to conduct electrofishing activities for various fish species.

Biological Sampling

Of the 26 sacrificed eel, sizes ranged from 310 mm to 545 mm. Each sample was measured again for length and weighed. Additional measurements such as eye diameter and fin length were taken before the body cavity was opened (Figure 18). Internally, the gonads were collected and weighed, and the eel were determined as male or female. The majority, 17, were male, while eight were female. One was not sexed but presumed male based on length. The swim bladders were examined for parasite presence and prevalence (Figure 19). All but four eel were found to have at least one parasite present, but often more. In several cases, the parasite presence exceeded 10 parasites. Otoliths were collected from all samples and will be processed for aging.

Figure 18 Dissection of a female silver eel 2018.

Figure 19 Swim bladder infected with A. crassus (2017 photo).

Results & Discussion

The 2018 field season was successful, tagging a total of 849 eel, surpassing the target of 500. Most of the tagging was conducted at Whistler Lake, but many eel were tagged at both Canaan and Little Whitford as well. Occasionally eel escaped and were simply recorded as such (**E**). Once PIT tags ran out, eel were counted and released (**CR**) (Table 1).

Table 1 Summary of 2018 catch. CR = count, release; E = escape; M = tagged; R = recaptured; and S = sacrificed.

Location	CR	E	M	R	S	Total
Canaan	2	3	218			223
Little Whitford	10	1	51			62
Whistler	99	10	580	1		690
Recapture	854	19		38	26	937
Total	965	33	849	39	26	1912

The daily catches were slow and steady until temperatures cooled off and significant rain events began in early October. A run occurred on October 2 and 3, catching a total of 970 eel. Numbers dropped quickly following the run, and did not pick up significantly, although significant rain events continued (Figure 20).

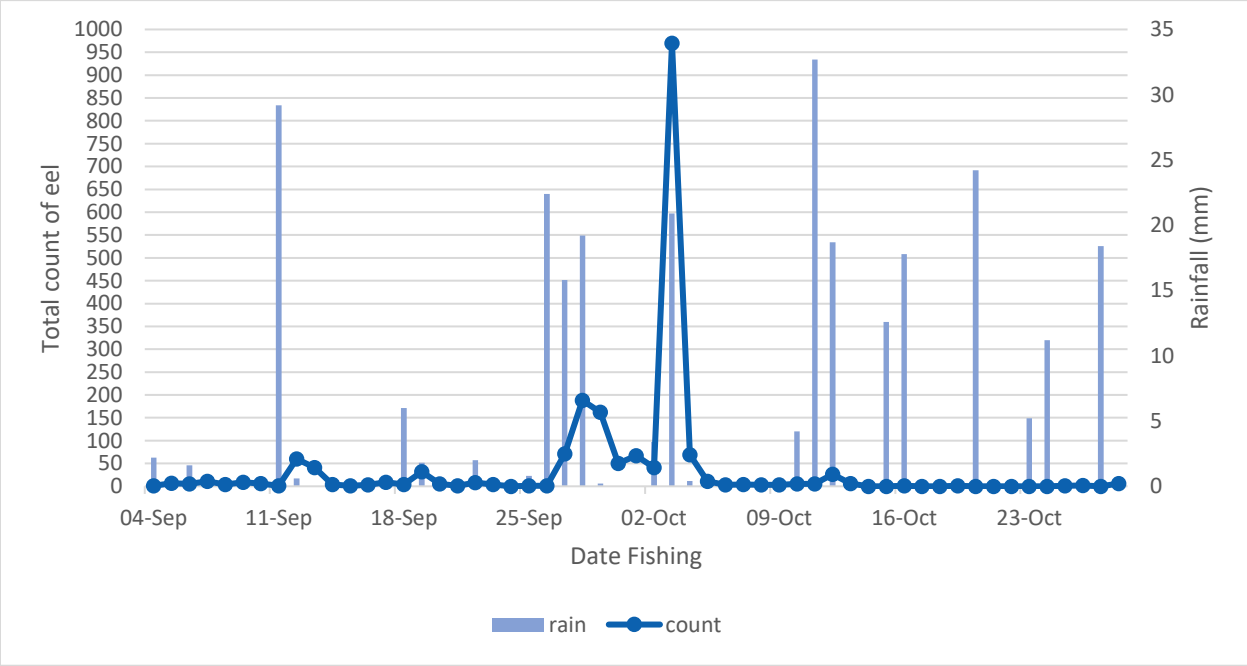

Figure 20 2018 Silver eel run of all East River, Chester sites combined and rainfall events. Rainfall data retrieved from ECCC.

The largest numbers of eel were caught at Whistler and the recapture site. The smallest number of eel was captured at Little Whitford (Figure 21).

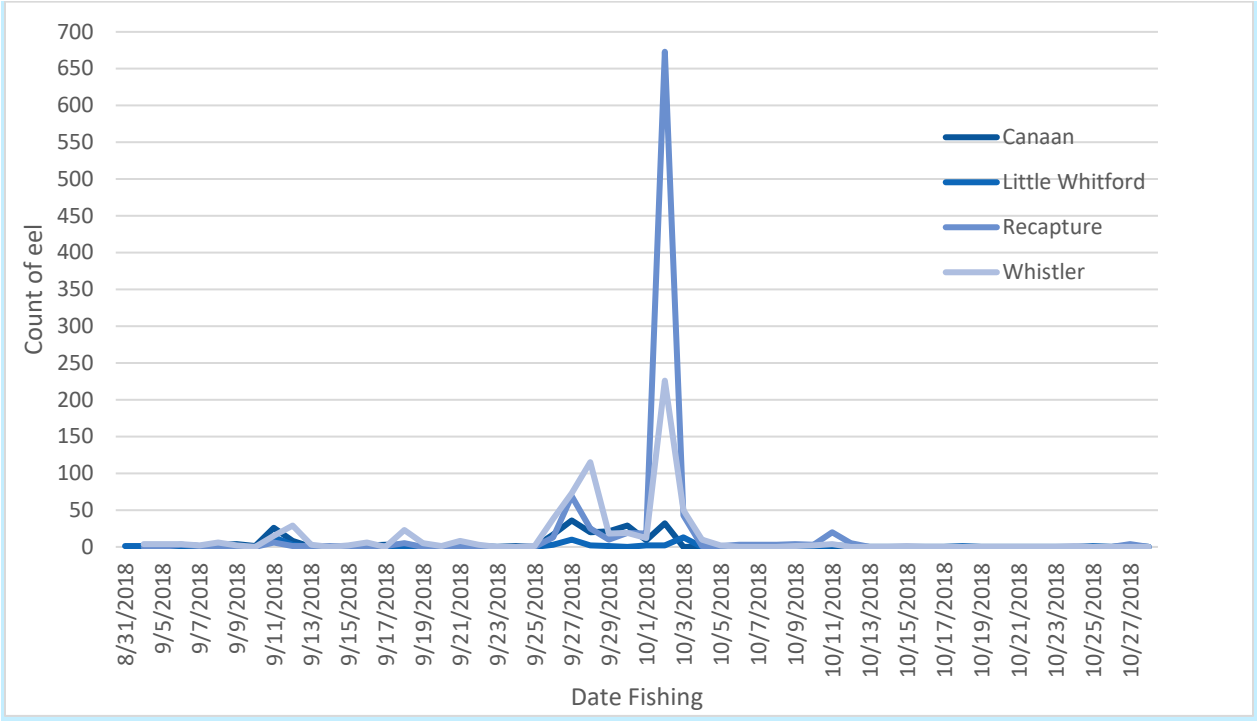

Figure 21 2018 Silver eel run per site.

Migration time between sites varied greatly for individual eel, with as little as a few hours and as much as weeks between tagging and recapturing. A total of 19 eel that were tagged at Whistler were recaptured in the main branch; 17 were recaptured from the Canaan. Only two were recaptured from Little Whitford (Table 2).

Using the same sites and gear from previous years allowed for knowledge gained over previous years to be used and allowed the team to be more proactive in preventing any issues. The field team used their judgement to determine when water levels became unsafe in which to work, gear was removed and replaced when conditions were deemed safe again.

Based on personal observations, the swim bladder parasite may be becoming more prevalent in the East River, Chester system.

Table 2 Summary of 2018 recaptures eel.

Recapture	Date (Checked) Tagged	Location Tagged	Date (Fishing) Recaptured	Tag Number
1	13-Sep-2018	Canaan	26-Sep-2018	982 411 171 583
2	12-Sep-2018	Canaan	26-Sep-2018	982 411 171 453
3	9-Sep-2018	Whistler	28-Sep-2018	982 411 171 440
4	27-Sep-2018	Canaan	28-Sep-2018	982 411 171 661
5	19-Sep-2018	Canaan	28-Sep-2018	982 411 171 571
6	22-Sep-2018	Whistler	1-Oct-2018	982 411 171 517
7	19-Sep-2018	Whistler	2-Oct-2018	982 411 171 598
8	28-Sep-2018	Canaan	2-Oct-2018	982 411 171 771
9	19-Sep-2018	Canaan	2-Oct-2018	982 411 171 520
10	22-Sep-2018	Whistler	2-Oct-2018	982 411 171 538
11	1-Oct-2018	Canaan	2-Oct-2018	982 126 051 256 722
12	12-Sep-2018	Little Whitford	2-Oct-2018	982 411 171 471
13	28-Sep-2018	Canaan	2-Oct-2018	982 411 171 735
14	10-Sep-2018	Whistler	2-Oct-2018	982 411 171 416
15	27-Sep-2018	Whistler	2-Oct-2018	982 411 171 606
16	29-Sep-2018	Canaan	2-Oct-2018	982 126 051 256 751
17	28-Sep-2018	Canaan	2-Oct-2018	982 411 171 760
18	9-Sep-2018	Whistler	2-Oct-2018	982 411 171 504
19	28-Sep-2018	Whistler	2-Oct-2018	982 411 171 630
20	29-Sep-2018	Canaan	2-Oct-2018	982 126 051 256 738
21	14-Sep-2018	Whistler	2-Oct-2018	982 411 171 590
22	12-Sep-2018	Canaan	2-Oct-2018	982 411 171 425
23	28-Sep-2018	Whistler	2-Oct-2018	982 411 171 737
24	14-Sep-2018	Whistler	2-Oct-2018	982 411 171 526
25	12-Sep-2018	Whistler	2-Oct-2018	982 411 171 448
26	27-Sep-2018	Whistler	2-Oct-2018	982 411 171 667
27	29-Sep-2018	Whistler	2-Oct-2018	982 126 051 256 579
28	29-Sep-2018	Whistler	2-Oct-2018	982 126 051 256 617
29	1-Oct-2018	Canaan	2-Oct-2018	982 126 051 256 668
30	27-Sep-2018	Little Whitford	2-Oct-2018	982 411 171 694
31	29-Sep-2018	Whistler	2-Oct-2018	982 126 051 256 625
32	12-Sep-2018	Canaan	2-Oct-2018	982 411 171 474
33	19-Sep-2018	Whistler	2-Oct-2018	982 411 171 555
34	30-Sep-2018	Canaan	3-Oct-2018	982 126 051 256 689
35	3-Oct-2018	Whistler	3-Oct-2018	982 126 051 256 759
36	3-Oct-2018	Whistler	3-Oct-2018	982 126 051 256 757
37	3-Oct-2018	Canaan	3-Oct-2018	982 126 051 256 995
38	3-Oct-2018	Canaan	12-Oct-2018	982 126 051 256 940

Industry Engagement, Public Education & Outreach Efforts

The following engagement and outreach activities took place as part of the project.

- A meeting was held prior to the start of the field season to discuss project objectives. DFO-Science provided instruction on data collection and methodology. 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 a person from their team to assist with and maintain traps on a regular basis.
- A presentation was delivered at the World Ocean's Day event in Lunenburg, in partnership with former Canadian Senator, Wilfred Moore, at the Lunenburg School of Arts. Additional events attended where project information was shared included: Shubenacadie Wildlife Park Kids Biodiversity Day; Michelin Seniors Expo; Michelin Health and Safety Fair; and Liverpool Privateer Days.
- Social media posts specifically about the project field work reached over 400 people – the Bluenose Coastal Action Foundation Facebook page received over 40,000 reaches, and hundreds of views. Coastal Action's website had over 138,000 hits in 2018, with over 6,200 visitors and over 1,100 visits to American eel project information.
- Posters with information about the project and the lifecycle of the American eel were placed next to all five trap sites to inform passers by.

Acknowledgements

Coastal Action would like to acknowledge and thank everyone who contributed to the study in 2018. Wayne, Genna, and Yvonne Carey and their team at Atlantic Elver Fishery along with Dr. Rod Bradford with DFO Science, Maritimes Region.