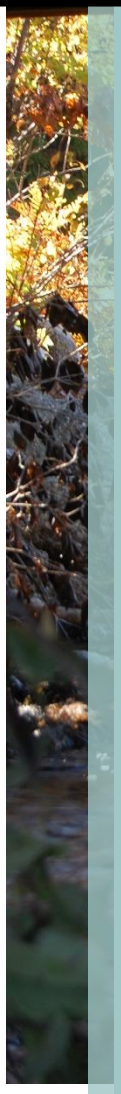
Fall 2016

American (Silver) Eel in East River, Chester



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Summary

2016 marked the third consecutive season of the East River, Chester American silver eel study. Traps were placed in several locations between late August and early November, with three upstream "tagging" locations and one "recapture" location below the confluence of the upstream sites. A total of 610 eel were tagged at the upstream sites, the majority of them being identified as silver or silvering (601 silver/silvering; 9 yellow). Only 62 eel were captured at the recapture site, due to unfavourable water conditions such as drought and significant rainfall, reducing the fishing efficiency of the trap. Of those 62 eel captured, all but one were silver and four were recaptures. Adverse weather conditions were also an issue at the upstream trap sites, reducing their ability to fish.

Background

Bluenose Coastal Action Foundation

Bluenose Coastal Action Foundation (Coastal Action), in partnership with Fisheries and Oceans Canada (DFO) and the Canadian Committee for a Sustainable Eel Fishery Inc. (CCSEF), has been studying annual elver recruitment on the East River, Chester since 2008. In addition to studying elver recruitment, a survey of adult silver eel seaward migration was initiated on the East River in 2014. Coastal Action has been monitoring silver eel migration from Oakland Lake since 2009, but 2014 was the first year to study silver eel migration on the East River. Both Oakland Lake and East River, Chester silver eel projects were continued in 2015 and 2016.

Study Area

The East River, Chester (ER-C) drains into Mahone Bay, with its watershed located in the Municipality of the District of Chester. 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. The Canaan Branch is acidified. American eel are known to be the predominant species in the river system. The East River was historically used by the Bowater-Mersey Co. Ltd for driving logs, and has had many dams and sluiceways removed over the years, although some structures and remnants remain (Figure 1). 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, NSDNR).

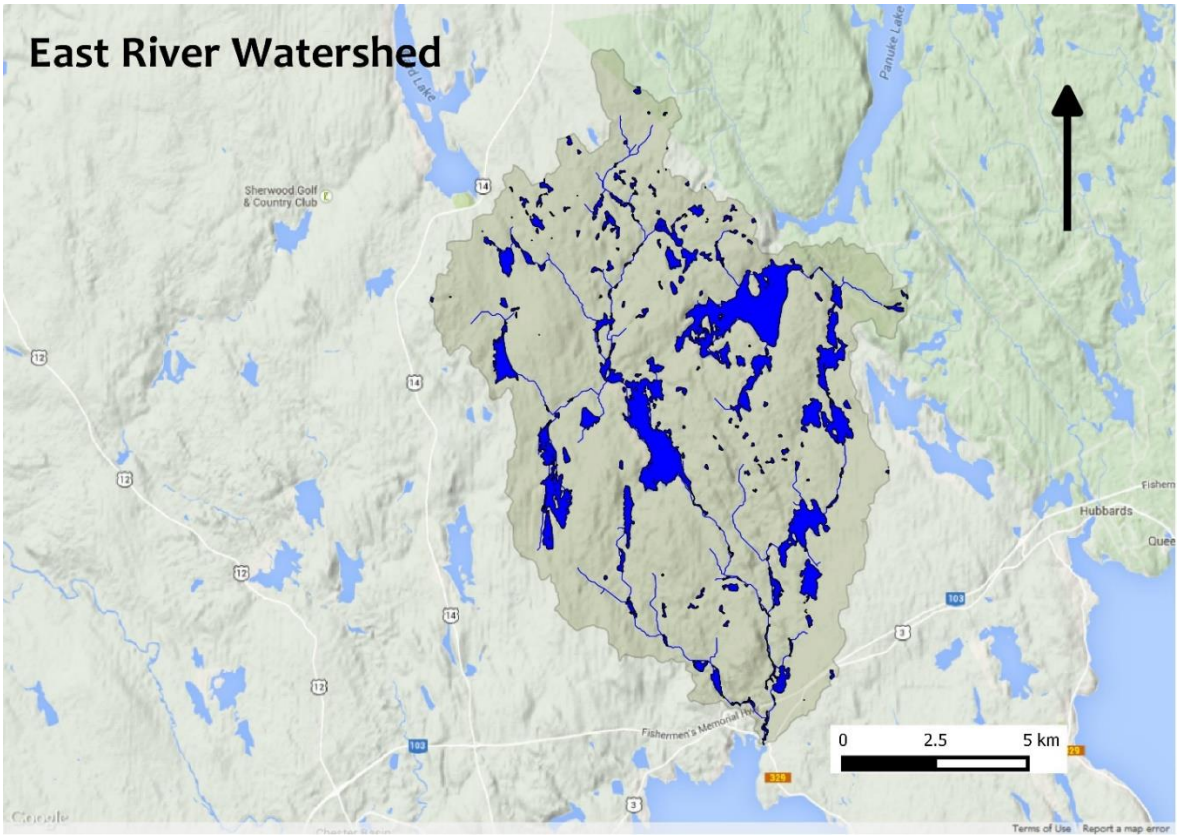

Figure 1: Drainage basin of the East River, Chester, Nova Scotia (GIS, Coastal Action 2015).

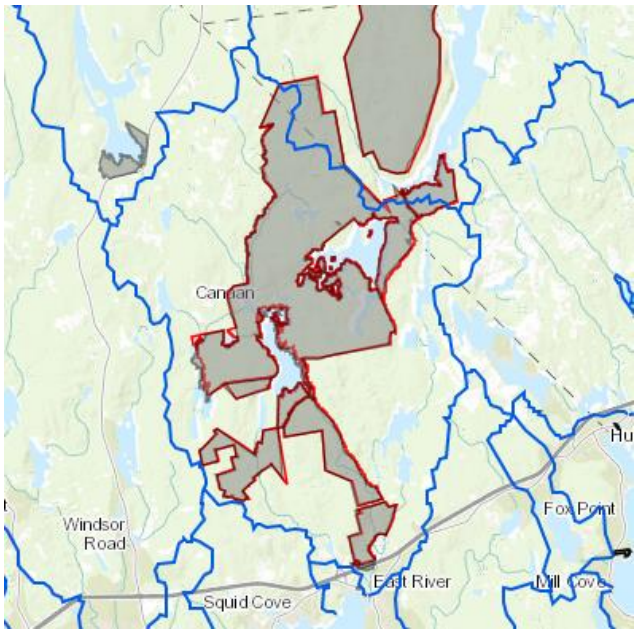

Figure 2: Protected areas within and around the East River, Chester watershed (NS DNR, Dec 2016).

Materials & Methodology

Similar to 2015, three tagging locations were used within the watershed. Locations and traps were the same as the previous year, except for the trap net at Officer Camp Lake (2015) which was replaced by a fyke net at Whistler Lake (2016). Whistler Lake is located much lower in the watershed than Officer Camp, but is located on the same branch, the east branch of the river. The change in location saved significant driving time and increased eel catches. Trap types used in 2016 included a rotary screw trap (RST) at the outflow of Connaught Lake, a fyke net at the outflow of Whistler Lake, and a wire trap at the outflow of Little Whitford Lake. Data loggers were placed at all three locations to record water temperature.

A recapture net was installed in a small channel of the main branch of the river, below the confluences of the tagging sites. Due to the size of the ER-C watershed, and therefore a predicted large eel population, this site was chosen based on the assumption that it would catch a reasonable fraction of eel migrating downstream.

The trap sites were mapped (Figure 3) and the approximate distances between each trap site and the recapture site were estimate using ArcGIS (Graphic Information Systems). The estimated distance between Connaught Lake, Little Whitford Lake, and Whistler Lake to the recapture trap are 8.43 km, 4.22 km, and 3.34 km respectively.

Figure 3: Map of ER-C watershed area showing trap locations.

Due to severe drought conditions throughout most of the season, traps were continuously maintained and modified to work during changing water levels and conditions.

The priority at all trap sites was to gather length measurements and colouring, or phase, of each individual fish. Every eel captured was measured to length in millimetres, using an eel trough (Figure 4).

Figure 4: Eel measuring trough.

Colour, or phase, was determined using qualitative colouring criteria based on research criteria for European eel[1]. The lateral line of each eel was visually examined to determine differentiation; i.e., the formation of black corpuscles along the lateral line, 1-2 cm apart. If at least one black corpuscle was present, the eel was given a score of 1, indicating differentiation of the lateral line; if there were no black corpuscles present, the eel scored a zero. The colour of each eel was also used to determine the phase of each fish. If the eel was silver or shimmery in colour from the ventral surface to the lateral line, the eel scored 1. If the colouring was more yellow, and did not continue to the lateral line, the eel scored zero. If the total score of the eel was zero, the eel was recorded as yellow. If the eel scored in both the lateral line and colouring criteria, for a score of 2, the eel was recorded as silver (Figure 5). If the total score of the eel was only 1, meaning the eel only had one of the silvering criteria, the eel was recorded as in the process of 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 5: Photo showing black corpuscles along lateral line, and silver colouring along ventral surface and up to the lateral line, indicating a silver phase eel.

American eel captured at any of the three upstream sites were marked with a Passive Integrated Transponder (PIT) tag (Figure 6), each having an individual number, making the eel identifiable. The PIT tags were placed just ahead of the dorsal fin, halfway to the lateral line (Figure 7). Each eel was scanned to ensure there was not an already existing PIT tag, as occasionally eel find their way into the same trap more than once. Every eel caught at the recapture site was scanned to determine if it was recaptured from upstream.

Figure 6: PIT (Passive Integrated Transponder) tag and injector.

Figure 7: Injecting an eel with a PIT tag.

Signs were posted at each of the trap locations, explaining the background of the project and providing contact information.

Connaught Lake

A Rotary Screw Trap (RST) was installed in the outflow of Connaught Lake from September 22 until November 3 (Figure 8). The RST was assembled and installed by Coastal Action staff, and securely tied to the shore in such a way that it would catch most of the current flowing from Connaught Lake. The holding box was emptied with a dip net, and any fish other than eel that were caught were recorded in the field notes and released immediately. The RST used in the previous year was a slightly different smaller model, with a 5' diameter drum, whereas this year was larger with an 8' drum.

Figure 8: Rotary Screw Trap (RST) at Connaught Lake outflow in 2016 (Coastal Action photo: October 24, 2016).

Due to low water levels at the beginning of the season, fyke nets (Figures 9 and 10) were placed below the RST site from August 29 to October 10, at which point the RST began fishing when water levels had risen enough to rotate the drum. After October 22, heavy rains fell and flooded the Connaught site for several days (Figure 11), resulting in no catches.

Figure 9: The large fyke net installed early in the season, when water levels were too low to turn the RST (Coastal Action photo: September 16, 2016).

Figure 10: Smaller fyke net placed downstream in a stronger current, after finding the larger fyke net was inefficient (Coastal Action photo: October 6, 2016).

Figure 11: Flooded RST after heavy rainfall (Coastal Action photo: October 22, 2016).

Little Whitford Lake

A wire trap was placed in the outflow of Little Whitford Lake on August 30, and removed on November 5. The wire trap was the same used in 2015 and consisted of a large, rectangular frame with a ramp and extended funnel to catch and retain eel in the holding area (Figure 12). The funnel was 6" x 6" and extended into the holding area, to make it harder for eel to find their way out. In addition, a sock was added to the funnel to decrease the chances of eel escapement. The stream has a slow flow, even during significant rainfall events. A wing was installed on either side of the funnel to direct more eel into the trap. A dip net was used to fish eel from the trap and daily efforts were made to clear any debris build up from the entrance.

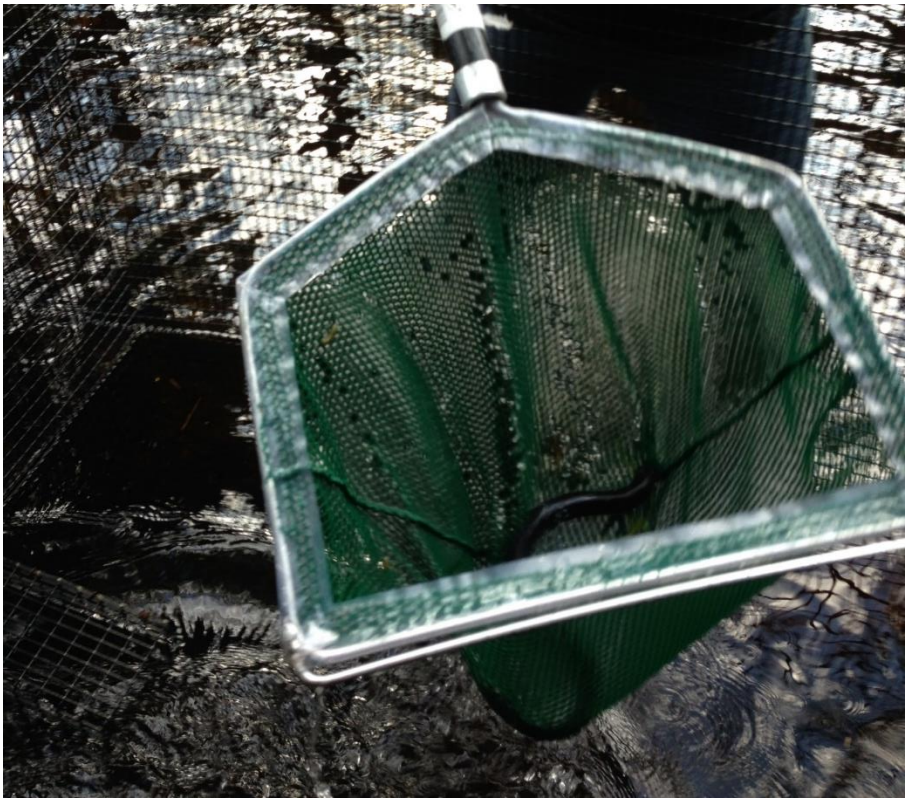

Figure 12: Scooping eel out of the Little Whitford trap.

Whistler Lake

A fyke net was placed in the outflow of Whistler Lake from August 29 to November 4. The outflow of the lake is wide, tapering to a funnel beneath a bridge before opening into a pool. The fyke net was originally set directly below the bridge (Figure 13), but as water levels rose, the trap was moved around the outflow several times throughout the season attempting to increase catches and avoid trap blow out. The fyke net consisted of two small wings, an apron, and a funnel to help guide fish into the trap.

Late in the season, another wing was added in an attempt to capture more water flow and deflect eel into the trap (Figure 14).

Figure 13: Whistler Lake outflow fyke net at the first site beneath the bridge during low water level (Coastal Action photo: September 15, 2016).

Figure 14: Whistler Lake outflow trap site later in the season, with a wing on the right, after water levels rose (Coastal Action photo: October 17, 2016).

Main Branch Recapture Site

The recapture trap net, also used in 2015, was set up in the same location as in past years, in a side branch of the main river below the confluence of the East and Canaan Branches. The trap was in place from August 29 to October 24, and was held in place with one-inch rebar driven into the stream bed and tied perpendicular to create a frame. To make it easier to fish and set the trap, durable rope was used to create a pulley system, allowing the bottom of the net to be lifted and lowered (Figure 15). The wings were long, stretched to either side of the channel, essentially catching the width of the stream. A modification to the trap in 2016 included a plastic funnel at the opening of the trap, to make it more difficult for eel to swim back out. Three leaf catchers were added upstream to try to deflect and relieve some of the pressure from leaf buildup (Figure 16). The leaf catchers were made of half-inch plastic hardware cloth and three-inch wire mesh held in place with rebar.

American eel captured at this location were measured for length, observed for colouring, and scanned for PIT tags. Every third eel was sacrificed for biological sampling and euthanized on ice to be sampled at a later date.

Figure 15: Recapture net being set (Coastal Action photo: August 29, 2016).

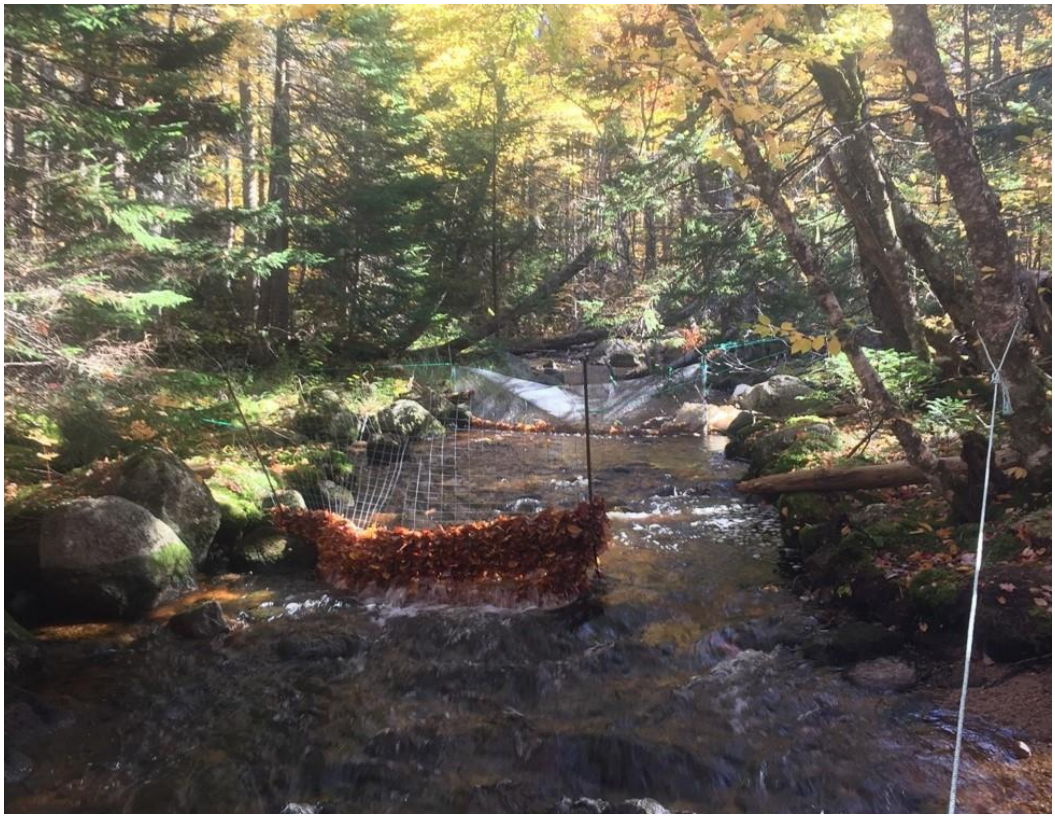

Figure 16: Three leaf catchers set above the recapture trap (Coastal Action photo: October 18, 2016).

Biological Sampling

A random sample of eel were sacrificed; collecting every third eel randomly selected from a holding bag. The eels collected were euthanized on ice, and frozen in water until they were thawed for sampling. In addition to the fresh length taken before the eel were sacrificed, once thawed, another length was taken along with weight, eye diameter, and head and fin lengths. Gonads were extracted and weighed and each eel was sexed as male, female, or undifferentiated if gonads appeared underdeveloped. 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*.

Outcomes & Discussion

Connaught Lake

The total catch at Connaught was 270 eel. Of those, 261 were tagged, six were recaptured, and three escaped.

Little Whitford Lake

The total catch at Little Whitford was 136, including two recaptures. 124 were tagged throughout the season, six were retained as sacrifices late in the season, and four escaped.

Whistler Lake

Total catch at Whistler Lake was 230 eel. A total of 225 of the eel were tagged; however, 131 were tagged early in the season during a single day on September 27. None of these eel were recaptured, as water levels remained low until mid October and eel were likely deflected around the recapture trap. A total of five escaped without tags at Whistler Lake.

Recapture Site

The recapture site caught a total of only 62 eel, with four recaptures. The recaptures all appeared during the same day on October 20, when a total of 12 eel were caught. Three of the recaptures were from Connaught; two had been tagged on October 11, and the third was tagged on October 14. The other recapture was tagged at Little Whitford on October 11. The largest catch occurred on October 11, where 26 eel were captured; however, there were no recaptures on that day.

Towards the end of the season, leaves quickly became a problem (Figure 17), along with high water levels (Figures 18 and 19). The trap became overflowing with water, even without leaves, forcing the season to come to an abrupt end at the recapture site on October 24.

Figure 17: Recapture net showing leaf build up (October 19, 2016).

Figure 18: High water levels overflowing recapture trap (Coastal Action photo: October 22, 2016).

Figure 19: Recapture site after significant rainfall (Coastal Action photo: October 24, 2016).

Biological Sampling

A total of 24 eel were collected and sacrificed from the East River; 18 were taken from the recapture site and six more were collected from Little Whitford at the end of the season. In addition, two recaptured eel were collected from Oakland Lake. *A. crassus* was found in two of the 26 sacrificed eel; one female in Oakland Lake had two parasites and one male from the recapture site at East River had one parasite present. Most the eel sacrificed were male (18), while the other eight were female, including the two sacrifices from Oakland Lake.

Comments & Recommendations

Low water levels and drought conditions were one of the biggest problems during the 2016 field season. The traps were not designed to be fishing under such low water levels and were, therefore, not properly functioning during the beginning of the season.

Just a couple hundred metres upstream from the recapture site, a waterfall exists where the river splits into several directions before rejoining below the recapture site. The recapture site is in one of the branches leading from this split in the river. During low water conditions, it was observed that almost all the water was being channeled down another branch, with only a very small fraction flowing down to the recapture site (Figures 20 and 21). This means that until water levels came up significantly on October 10, most, if not all, of the eel moving downstream were likely channeled away from the trap as they move with the current. Once the water levels came up, the pressure on the recapture net was so strong that the bottom of the net was lifted off the stream bed, allowing eel to pass under the net rather than become captured. In addition to high water levels, leaves were once again an issue at the recapture site, increasing pressure on the net. Although the installation of three leaf catchers upstream helped to relieve some pressure from the net, the site was visited between one to three times a day just to empty leaves. As the site is about a one kilometre hike in, extra hands helping with leaves was much appreciated and necessary.

On September 27, about 15 mm of rain fell (Environment Canada). When traps were checked that night, two eel were captured at Connaught (in a fyke net), four eel were captured at Little Whitford, 134 eel were captured at Whistler Lake – but nothing was caught in the recapture trap. This could have been the migration run for several reasons:

- There was a new moon was on September 30, therefore, skies were dark
- Although the rain was not significant, due to the extremely low water levels, it may have been enough to signal the eel run
- Whistler caught a large amount of eel, but likely missed even more, as the trap was only fishing about two-thirds of the waterway making it possible that many eel swam past
- The fyke net at Connaught was not in an ideal location as a gravel bar during low water separated the river and the leader did not stretch across the entire river, possibly allowing many eel to swim by
- The low water deflected any eel heading toward the recapture trap in the opposite direction (personal observations and comments).

The weather was carefully observed, and extra help was on standby should it have been needed. On several occasions when heavy rainfall was expected, extra help was called in to ensure all traps could be emptied to prevent any mortalities. Typically, this involved checking the traps before 11:00 PM (AST) and having a team at the recapture site to work at keeping the trap fishing while the other upstream sites were checked.

Figure 20: East River, Chester falls above the recapture site (October 4, 2016). Most of the water is redirected to the left channel, while the recapture site is to the right, downstream. Less water flow to the trap means less eel moving towards the trap.

Figure 21: East River, Chester falls above recapture site showing most of the water at low flow is redirected down the channel to the left, away from the recapture site which is to the right (October 4, 2016).

Comparisons to 2015

Although there were many obstacles faced in 2016, more eel and data were collected from the upstream tagging sites during 2016 than in previous years (Table 1). Had the water levels been steadier throughout the season, a larger portion of eel would have been captured; there is no doubt that many eel were missed in 2016. The main issue was the recapture site, which caught hardly a fraction of the eel due to extreme low waters followed by extreme high water levels.

Table 1: 2015 and 2016 East River, Chester comparisons.

	2015		2016	
Site	**Tagged**	**Total Catch**	**Tagged**	**Total Catch**
Connaught Lake	215	249	261	270
Little Whitford Lake	63	99	124	136
Officer Camp Lake	16	16	225	230
Recapture Site	5 recaptures	987	4 recaptures	62

Industry Engagement & Public Outreach Activities

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

- CBC interviewed the project team in October, creating public awareness via several radio broadcastings, a web video, and a story on CBC News at Six.
- Project staff met with project partners from both DFO and the Canadian Committee for a Sustainable Eel Fishery Inc. three times over the duration of the season. 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 extra hands when help was needed checking traps.
- Several public events were attended where project information was highlighted, including: Bayview Camp Mushamush; YMCA Healthy Kids Day; Michelin Health and Safety Fair; Bridgewater Children's Fair; Bridgewater Growing Green Sustainability Festival; and Coastal Action's Annual Rum & Chowder Social. A youth naturalists camp (Indian Point Young Naturalists Club) was attended on three separate occasions where project staff were on hand to talk about American eel and direct related activities. A presentation was delivered at the Fishermen's and Scientists Research Society Annual General Meeting and 24th Annual Conference highlighting the American eel project.
- Many people were involved in the project, including local residents, students, and commercial eel fishers. At least 14 local residents volunteered their time to help with traps and learn about the American eel. Posters with information about Coastal Action and the lifecycle of the American eel were put up next to the traps to inform people passing through of the project taking place.
- 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 100,000 reaches and at least two people contacted Coastal Action about the swim bladder parasites found.

Conclusion

Challenges are expected when working within a large watershed. Heavy rains are usually the biggest challenge to overcome, but very low water levels were also an unforeseen challenge in 2016, as traps were not able to fish under such low flow. Replacing the Officer Camp Lake trap with the Whistler Lake trap saved significant commuting time and increased catches, which is a positive takeaway from the 2016 season. In addition, PIT tagging was very successful, tagging nearly every eel captured. No mortalities occurred and length and colouring data from over 600 individual eels was obtained. Aside from the recapture trap, more eels were captured at all sites than in 2015. Keeping a close eye on the forecast, and having extra hands nearby to help, alleviated extra pressure on the field staff. Bringing in extra help from industry was also useful in helping staff to determine the best course of action when traps blew out or were not fishing properly.