

2018

American Eel in Oakland Stream, Mahone Bay, Nova Scotia



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SUMMARY

The Oakland Stream study took place from August 31 to November 1, 2018. A total of 31 eel were captured, including two (2) recaptured eel previously tagged during the Oakland Lake potting study (2009-14). The season was slow, with the highest number of eel caught in one day totaling eight (8) on October 28. The typical daily catch was less than three (3) eel, if any. Of the recaptured eel, both were silver and were sacrificed for further biological sampling. Two additional eel were sacrificed, as they were severely injured by mink. The invasive swim bladder parasite, *Anguillicoloides crassus*, was present in one of the four sacrificed eel.

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INTRODUCTION

COASTAL ACTION

Bluenose Coastal Action Foundation (Coastal Action) is a non-profit community based charitable organization that addresses the environmental concerns within the South Shore of Nova Scotia. Coastal Action's watershed boundaries include the coastline from East River Point to Vogler's Cove and inland to include the Petite Riviere, LaHave, Mushamush, Gold, and East River watersheds. The Towns of Mahone Bay, Lunenburg, Bridgewater, and the Village of Chester all fall within these boundaries as well as several other smaller communities.

Over the past 25 years, Coastal Action has successfully completed many projects within the South Shore region of the province, including the American eel and elver projects which have been ongoing since 2008.

BACKGROUND

Fisheries and Oceans Canada (DFO) conducted an annual American eel (*Anguilla rostrata*) elver abundance study on 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, 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). An additional silver eel study was initiated in East River, Chester in 2014, and has continued annually, although varying 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 eel in the system; as well as identify the prevalence and abundance of *Anguillicoloides crassus*, the invasive 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.

AMERICAN EEL

In April 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the American eel as a species of 'special concern'. After re-examination of the species in May 2012, COSEWIC designated the American eel as 'threatened'. The American eel is currently being considered for listing under the federal *Species at Risk Act (SARA)*.

The American eel has an elongated body with a long dorsal fin that runs along three quarters of its slender, snake like body (Figure 1). The skin is extremely tough and is covered with a layer of mucus which is

secreted for protection. The American eel is a catadromous fish species, meaning it lives most of its life in fresh water, then travels to saltwater where it will spawn and, presumably, die. Spawning occurs in the Sargasso Sea, located in the Southwestern part of the North Atlantic Ocean. American eel are carnivorous, opportunistic species and consume many different types of fish and invertebrates. American eel can be found in a wide variety of aquatic habitats that include estuarine, brackish, and freshwater areas, and are known to be an indicator of a healthy aquatic ecosystem. With one of the largest geographic ranges of any fish, distribution of the American eel ranges from Greenland along the east coast of North America to northern South America.



Figure 1. American Eel (*Anguilla rostrata*) by Ellen Edmunston. Retrieved from Wikipedia (2018).

American eel are thought to be panmictic, meaning they are all part of a single breeding population. They have a complex life cycle consisting of a number of distinct stages (Figure 2). When eggs hatch, they emerge as leptocephali and absorb nutrients from the currents upon which they float. They then metamorphose into unpigmented glass eel to pigmented elver and begin their migration from estuaries up rivers and streams in search of fresh water. They spend most of their lives in the yellow eel stage, the major growing phase, which can last from seven to twenty-four years or longer. When they eventually mature into sliver eel, they will begin their migration back to the spawning grounds in the Sargasso Sea.

American eel populations face many threats, both natural and anthropogenic. Dams and turbines pose migration barriers and may impede juvenile migration upstream. Turbines also pose a high mortality risk for mature downstream migrating eel, as they attempt to pass through them. Other threats include biological and chemical contaminants, and certain parasites such as the parasitic nematode *A. crassus*, that mainly affects the swim bladder. Potential threats may include changes in ocean conditions related to climate change that may affect eel ability to navigate to and from the spawning grounds, as well as the unknown effects of stocking programs which could cause changes to sex ratios (COSEWIC, 2012).

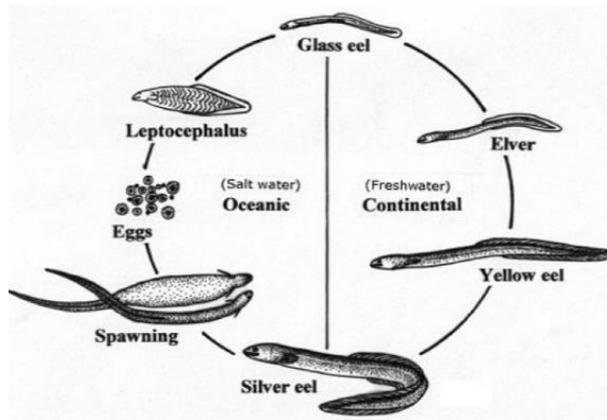


Figure 2. American Eel (*Anguilla rostrata*) lifecycle by Rob Slapkauskas. Retrieved from Ontario Ministry of Natural Resources (2018).

OAKLAND WATERSHED

Oakland Lake (Figure 3) is located approximately 1 km northeast of the Town of Mahone Bay, at UTM 20T E391480.3335 N4924067.847. The surface area of the lake is roughly 0.65 km², with depths up to 15 m. The surrounding watershed is approximately 4.05 km². The lake serves as the drinking water supply for the Town of Mahone Bay and has been designated as a protected watershed where human activity in the area is regulated and restricted to protect the water quality of the lake. The lake's protected status makes it ideal for the American eel study. Potential human disturbances in the area include a walking trail along one side of the lake, along with the Town of Mahone Bay's water treatment intake pipe, pump house, and storage buildings.

An American eel yellow potting study was conducted on Oakland Lake from 2008 to 2014. Eel pots were set, baited, and checked regularly over the spring and summer months. Eel captured were measured and injected with a PIT (Passive Integrated Transponder) tag. Tagged eel were caught many times over the duration of the study. The only outflow from Oakland Lake is Oakland Stream, which drains into the Mahone Bay estuary. The stream runs through two culverts; the furthest upstream runs under Sleepy Hollow Road and the other, downstream under Oakland Road and into Mahone Bay estuary. American eel are monitored in the stream during the fall, when silver eel migrate downstream to the ocean.

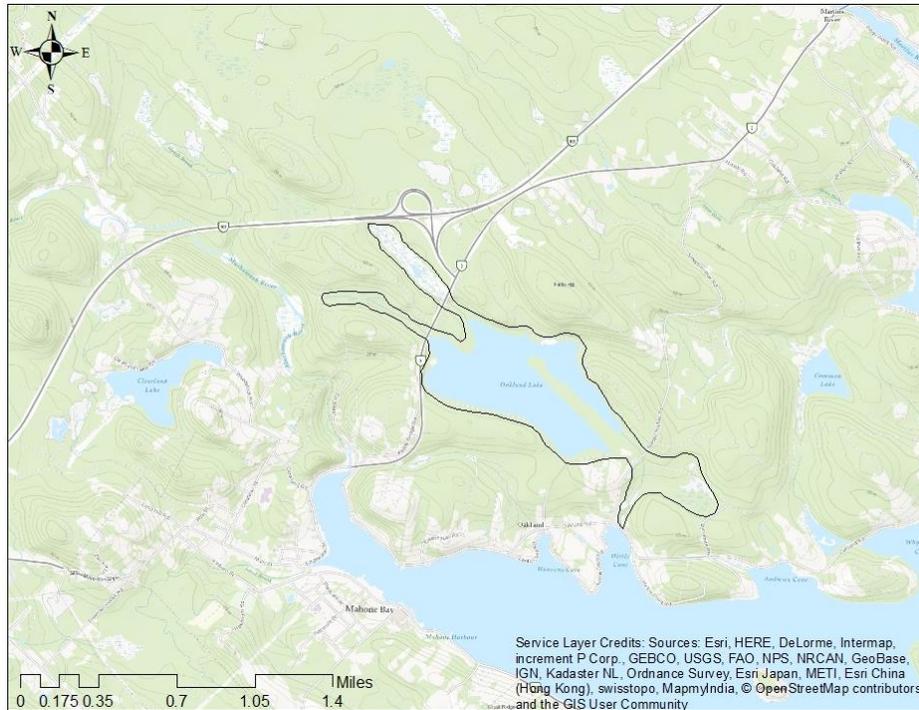


Figure 3. Oakland Lake and surrounding watershed (Slaunwhite, ArcGIS 2017).

MATERIALS AND METHODOLOGY

OAKLAND STREAM

A wire trap was placed in Oakland Stream August 31, 2018 but was only in operation from October 13 to November 1, 2018. The trap consists of a large plastic funnel, 12" diameter plastic tube, and large 8'x4' holding cage (Figure 4). The funnel encompasses the entire stream width, while rocks and moss are built up around it. Fish traveling downstream must enter the funnel, pass through the plastic tube, and into the holding cage, which is submerged part way into the stream. A small hoop net (Figure 5) was set 10 m downstream from the wire trap, from September 26 to October 29, 2018, and later moved to 1.5 m downstream from the wire trap from October 29 to November 1, 2018 when water levels rose. This was in place to ensure any eel that may have bypassed the wire trap were captured.



Figure 4. Oakland Stream wire trap (October 27, 2018).

Each eel caught in the trap was scooped out with a large dip net and transferred into a holding bag, awaiting to be sampled. Any bycatch was removed from the trap, recorded in the field notes, and released downstream of both traps. The weight of the eels was taken as a batch (in kg) in the holding bag. Each eel was identified as silver, yellow, or silvering (an eel transitioning between phases). The phase was determined by the colour and contrast above and below the lateral line, and if there was a differentiated lateral line with clear neuromasts present. Each eel caught was measured for length (in mm) and scanned for a PIT tag. After the sampling process, each eel was released downstream of the traps. Any silver eel caught with a PIT tag identification number were sacrificed for further sampling.



Figure 5. Oakland Stream hoop net (October 27, 2018).



Figure 6. Silver eel vs. yellow eel. Top: Silver eel with clear silver colouring and contrast above and below the lateral line. Bottom: Yellow eel with yellow underside and no clear contrast at lateral line.

RESULTS

The Oakland in-stream wire trap was in operation from October 13 to November 1, 2018; totaling 19 days, while the downstream hoop net was in operation from September 26 to November 1, 2018; totaling 36 days. The wire trap was not fishing from August 31 to October 12, due to extremely low water levels at the beginning of the season, despite multiple rain events. Figure 7 shows rainfall and number of eel caught in both the wire trap and hoop net in 2018.

A total of 31 eel were caught, all in which were silver phased eel. Two (2) of the eel caught in the trap were previously tagged in the Oakland Lake potting study; one (1) from 2011 and one (1) from 2012. Four (4) eel in total were sacrificed for further sampling; two (2) previously tagged eel and two (2) additional eel that would have died if released due to mink predation. Out of the total 31 eel captures in Oakland Stream, six (6) were caught in the hoop net downstream. Only two eel were caught after the wire trap began fishing, demonstrating the efficiency of the wire trap when working properly. Table 1 summarizes the annual days fishing and eel caught and recaptured since 2008.

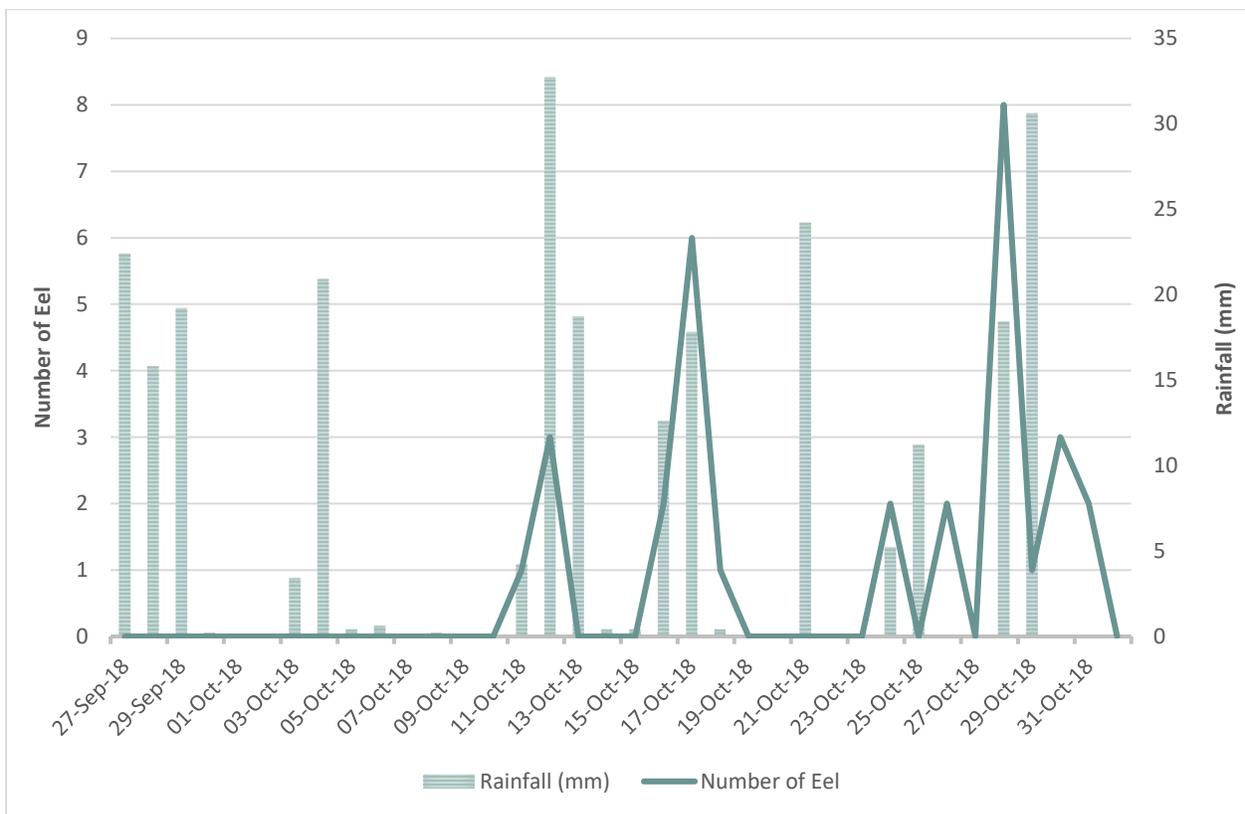


Figure 7. Rainfall and silver eel run, Oakland Lake, September to October 2018.

Table 1. Annual catches and days fishing at Oakland Stream (*2016 not representative of catch).

	2009	2011	2012	2013	2014	2015	*2016	2017	2018	Total
Days Fishing	29	26	45	81	70	70	*73	85	36	
Total Catch	221	283	405	559	513	555	*153	378	31	3098
Recaptures	2	1	13	17	10	9	2	4	2	60

Sacrificed eel were biologically sampled, where various measurements such as length and weight, eye diameter, head length, and fin length were taken. The eel were dissected and gonads examined to determine the sex and weight of gonads. Swim bladders were examined for presence and abundance of the invasive swim bladder parasite *Anguillicoloides crassus*. All sacrificed eel were female and *A. crassus* was found to be present in only one of them.

DISCUSSION

The 2018 Oakland Stream silver eel study showed no significant run of eel throughout the duration of the season. This could be due to the wire trap not fishing for the first 42 days of the season. The largest run of eight (8) eel came with one of the smaller rainfall events around 18 mm on October 28. After the wire trap began fishing, there were several rain events over 15 mm, and two over 30 mm causing the water levels in the trap to increase significantly over a short period of time. This led to the funnel of the wire trap washing out on October 31. The wire trap was removed on November 1, as the velocity of the water was too high to set the trap properly and a high volume of rain was forecasted.

The 2018 season was not as successful as in previous years, likely due to low water levels early in the season. The hoop net downstream was installed September 26, and some eel may have been missed before that date. No small mammals or bycatch were harmed this season, likely due to the increased holding area of the wire trap and wooden ladder placed inside the trap for animals to climb out. However, the large size of the trap increased the difficulty of collecting fish.

The main issues faced during the 2018 season seemed to be mostly weather related – extremely low water levels that quickly changed to extremely high water levels. When the water level was low it is possible that eel may have slipped under the funnel, whereas extremely high water levels could have allowed eel to swim up and around the sides of the funnel, which may contribute to the low number of eel this season.

ACKNOWLEDGEMENTS

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