2013

American Eel Research Study: Year 5

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American Eel *Anguilla rostrata* research study in Oakland Lake and Oakland Stream 2013: Year 5

Mahone Bay, Nova Scotia

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ABSTRACT

Bluenose Coastal Action Foundation, in partnership with Fisheries and Oceans Canada (DFO) and the Commercial Atlantic Elver Fishery, has conducted a study over the past several years on the American eel in Oakland Lake, Mahone Bay, Nova Scotia. From 2009 to 2011, the objective of the study was to determine the habitat characteristics that American eel prefer based on a standardized habitat assessment form. However, 2012 and 2013 were focused on a mark-recapture study. The 2013 study began on June 26 with four weeks of baiting and potting. A one week break occurred at the midway point, before the study wrapped up on August 2, 2013. In addition to the mark-recapture study, a trap was placed in Oakland Stream August 16 until November 4, 2013 to observe eels exiting Oakland Lake into the Mahone Bay estuary, presumably on their way to spawn. The results of the study are specific to the Mahone Bay area; however, they will be viewed in a more general context and relate to the entire Scotia-Fundy area of the Atlantic region.

ACKNOWLEDGEMENTS

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Also, a very big thank you goes out to the project's 2013 funding partner – the Scotia-Fundy Elver Fishery, making it possible to complete all activities outlined in this report.

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INTRODUCTION

BLUENOSE COASTAL ACTION FOUNDATION

The Bluenose Coastal Action Foundation is a non-profit community based charitable organization that addresses the environmental concerns within Lunenburg County, Nova Scotia. The organization's goal is to promote the restoration, enhancement, and conservation of our ecosystem through research, education, and action. Bluenose Coastal Action Foundation'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.

Bluenose Coastal Action has successfully completed a number of projects within Lunenburg County, and along the South Shore region of the province, over the past 20 years, including the American Eel Project which has been ongoing since 2009.

AMERICAN EEL

Since April 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) had assessed the American eel as a species of special concern. After re-examination of the species in May 2012, COSEWIC has now designated the American eel as threatened.

The American eel has an elongated body with the most distinct feature being its long dorsal fin that runs along three quarters of its slender, snake like body (Figure 1). Its skin is extremely tough and is covered with a layer of mucus which it secretes for protection. The American eel is considered to be a catadromous fish species, meaning it lives the majority of its life in fresh water and then travels to salt water where it will spawn and, presumably, die. Spawning takes place in the Sargasso Sea, located in the Southwestern part of the North Atlantic Ocean. This fish is a carnivorous, opportunistic species and consumes many different types of fish and invertebrates. It occupies a wide variety of aquatic habitats that include estuarine, brackish, and freshwater areas. The eel is known to be an indicator of a healthy aquatic ecosystem. Distribution of the American eel ranges from Greenland along the east coast of North America to northern South America.

American eel are all part of a single breeding population and have complex life cycles consisting of a number of distinct stages. 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 their spawning grounds in the Sargasso Sea (Figure 2).

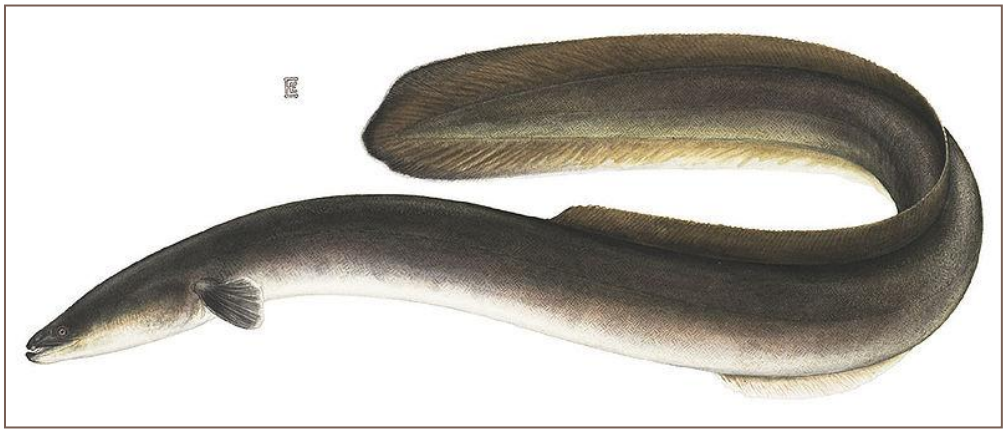

Figure 1: American eel adult by Ellen Edmonson and Hugh Chrisp. Retrieved from Wikipedia, 2013.

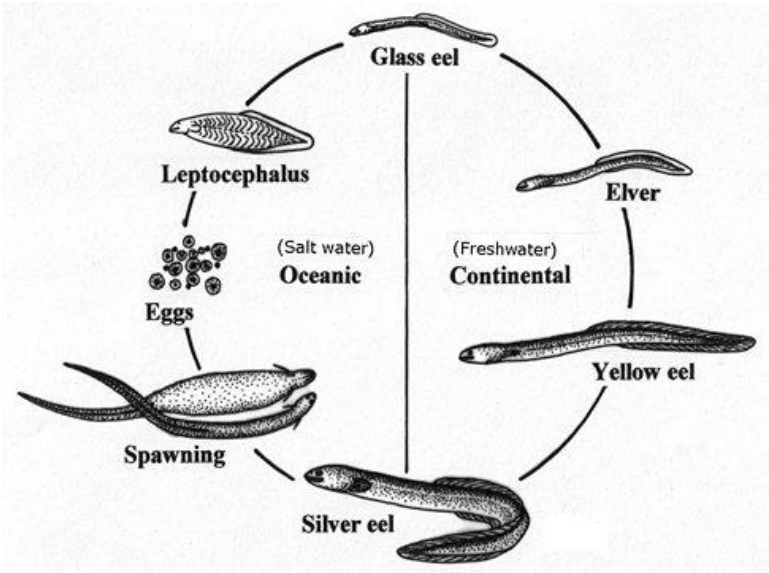

Figure 11: American eel lifecycle (created by Rob Slapkauskas). Retrieved from Ontario Ministry of Natural Resources (2007).

American eel populations face a number of threats, both natural and anthropogenic. Dams and turbines are migration barriers and may impede juvenile migration upstream, as well as mature eel migration downstream. Turbines also pose a high mortality risk for mature migrating eels, as they attempt to pass through them. Other threats include biological and chemical contaminants, and certain parasites such as the parasitic nematode *Anguillicolides 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).

STUDY AREA

OAKLAND LAKE

Oakland Lake is located approximately one kilometre northeast of the Town of Mahone Bay, at UTM 20T E391480.3335 N4924067.847. The surface area of the lake is roughly 0.65km^2, with depths up to 15m. The surrounding watershed is approximately 4.05km^2. 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 in an effort 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 (which is slated for expansion in the near future), pump house, and storage buildings.

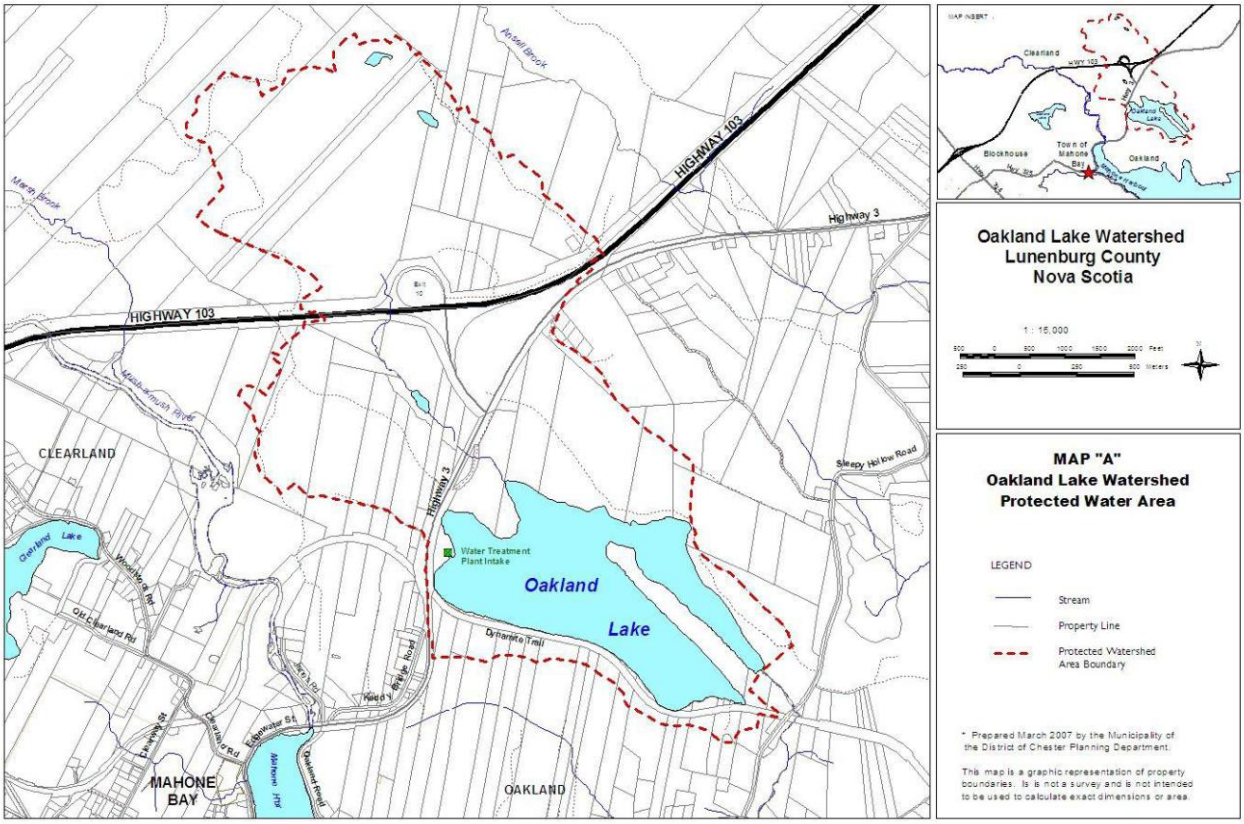

Figure 12: Oakland Lake watershed area, Mahone Bay, NS.

OAKLAND STREAM

The only outgoing water flow 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 Hallow Road and the other downstream under Oakland Road and into Mahone Bay estuary.

MATERIALS AND METHODOLOGY

OAKLAND LAKE

A total of 30 traps were placed around the perimeter of Oakland Lake from June 26 to August 2, 2013. Trap placement was determined based on the previous years' study which used a standardized habitat assessment form that took into account slope, distance from shore, amount and type of vegetation, lake bottom composition, and depth. Traps were placed at specific UTMs around the lake (Figure 4). On account of Oakland Lake being a municipal drinking water supply and a protected watershed, a 12-foot aluminum boat with an electric motor powered by a marine battery was used to navigate the lake.

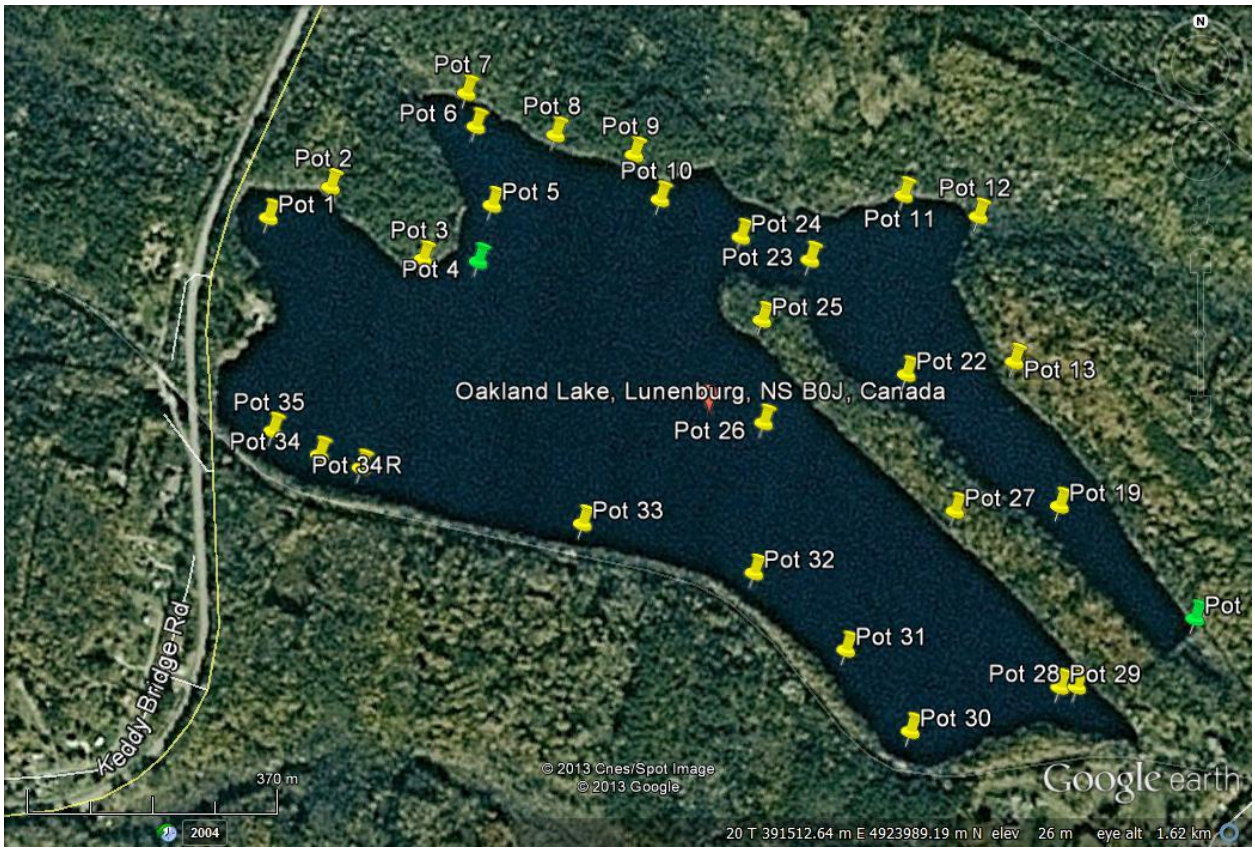

Figure 13: Eel trap placement in Oakland Lake, 2013.

Frozen herring supplied by Lunenburg Fish Company was used to bait the traps. Traps were baited on average twice per week, and checked the following day. Eel and by-catch data were recorded in a waterproof field book and later transferred to a Microsoft Excel spreadsheet. Captured eel were separated by trap number and temporarily contained in holding bags, then either processed onboard the boat or transported to shore. Cotton gloves were used to handle eel during processing so as to provide a grip while minimizing any possible damage to the eel. Eel length was measured in centimeters using an eel trough (Figure 5), and a digital scale was used to weigh eel to the nearest gram. Eel were scanned for Passive Integrated Transponder (PIT) tags to determine if and when the eel had been captured before. If previously tagged, the number was recorded. If no tag was found, a new tag was injected approximately two centimeters in front of the dorsal fin on either side of the spine (Figure 6), and the number was recorded as a new tag. In past years, clove oil had been used to anesthetize eel for processing; however, it was deemed an unnecessary step in 2013. Rather than using the clove oil, it was discovered that covering the eel's head calmed them enough to process and obtain the required information.

Once captured eel were measured, weighed, PIT tagged, and recorded. They were released back into the water after processing. All by-catch species were recorded and immediately released back into the water as well.

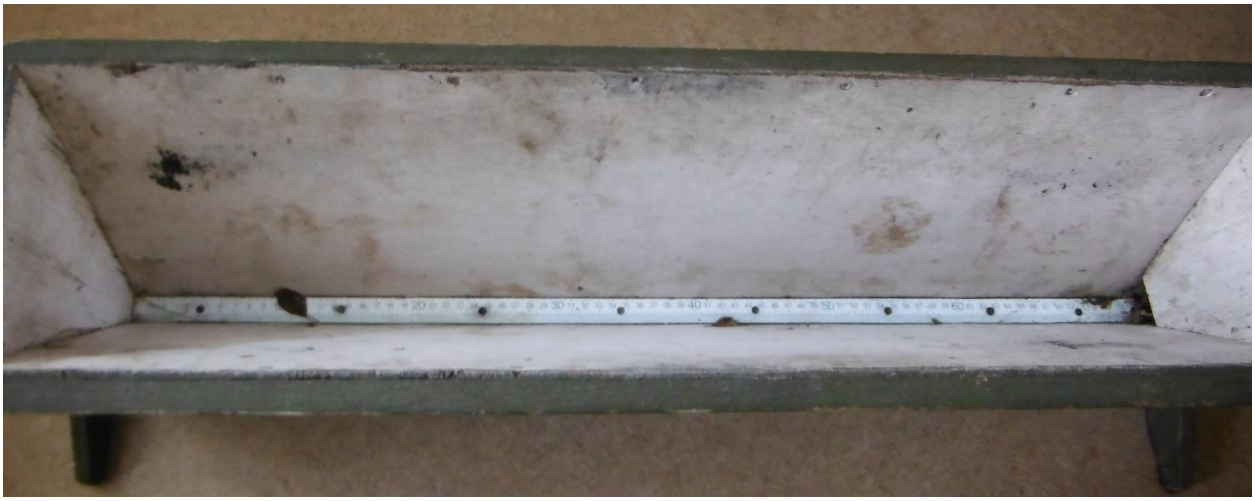

Figure 14: Eel measuring trough.

Figure 15: PIT tag insertion by field technicians.

OAKLAND STREAM

A trap was placed in Oakland Stream, which runs from Oakland Lake into Mahone Bay estuary off of Sleepy Hallow Road, from August 16 to November 4, 2013. The trap, which was also used in 2012, was designed by Wayne Carey and consists of a large plastic funnel, plastic tube, and large square cage (Figure 7). The funnel encompasses the entire stream width, while rocks and moss are built up around it. Therefore, everything traveling downstream must enter the funnel, pass through the plastic tube, and into the large square holding cage, which is submerged halfway in the stream. The trap was checked every three days until August 30, at which point the eel began to exit the lake on a more regular basis and in larger numbers. The trap was then checked seven days a week until November 4. Anything caught in the trap was scooped out with a large net, and a viewfinder was used to look underwater to ensure everything was collected from the trap. The same sampling procedures were used to process these eel as in the Oakland Lake study, with the addition of measuring the vertical and horizontal eye diameter of each eel with digital calipers (Figure 8). The eye diameter was measured to aid in the identification of silver eel that were leaving the lake, since at the silver eel stage the eyes becomes enlarged for enhanced vision during ocean migration.

Figure 16: Oakland stream trap 2013.

Figure 17: Measuring eye diameter of a silver eel at Oakland Stream 2013.

A thermograph was also placed beside the trap to monitor and record stream temperatures throughout the duration of the study.

RESULTS

OAKLAND LAKE

The 2013 Oakland Lake study season began on June 26 and ended August 2, 2013. A total number of 126 eel were captured; 45 were marked (PIT tagged), 59 were recaptures, and 22 were released without any mark due to some being half eaten as well as an unavailability of PIT tags (Figure 9). The average length and weight of eel captured was 185.165cm and 42.76g, respectively. Compared to previous years, 2013 was the lowest catch since the study began with 156 in 2012, 374 in 2011, 176 in 2010, and 145 in 2009 (Figure 10).

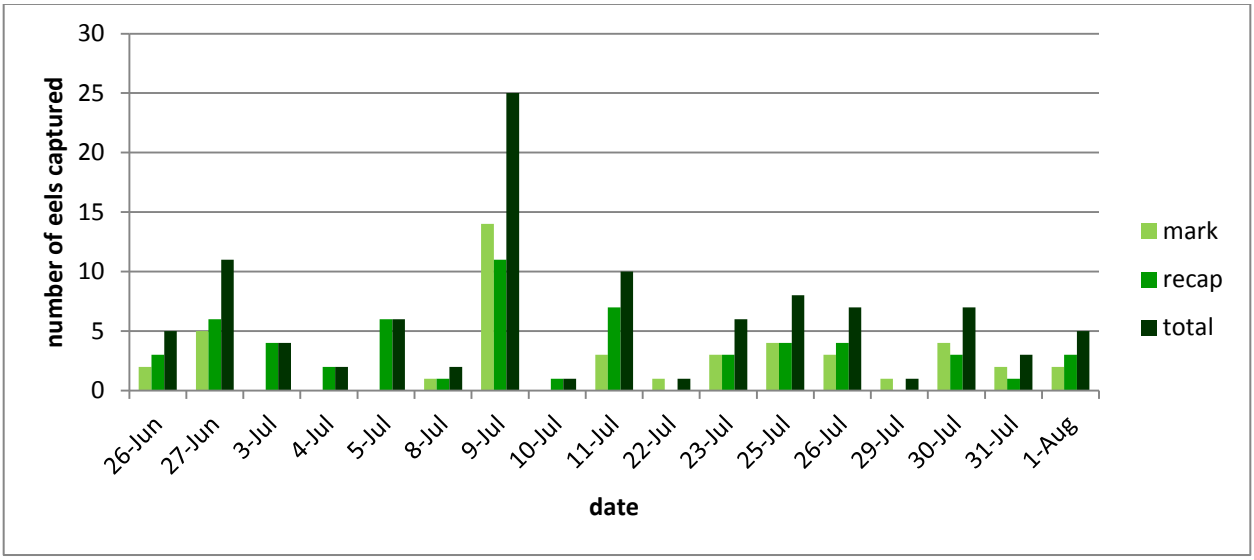

Figure 18: Eel captured and marked in Oakland Lake throughout the 2013 field season.

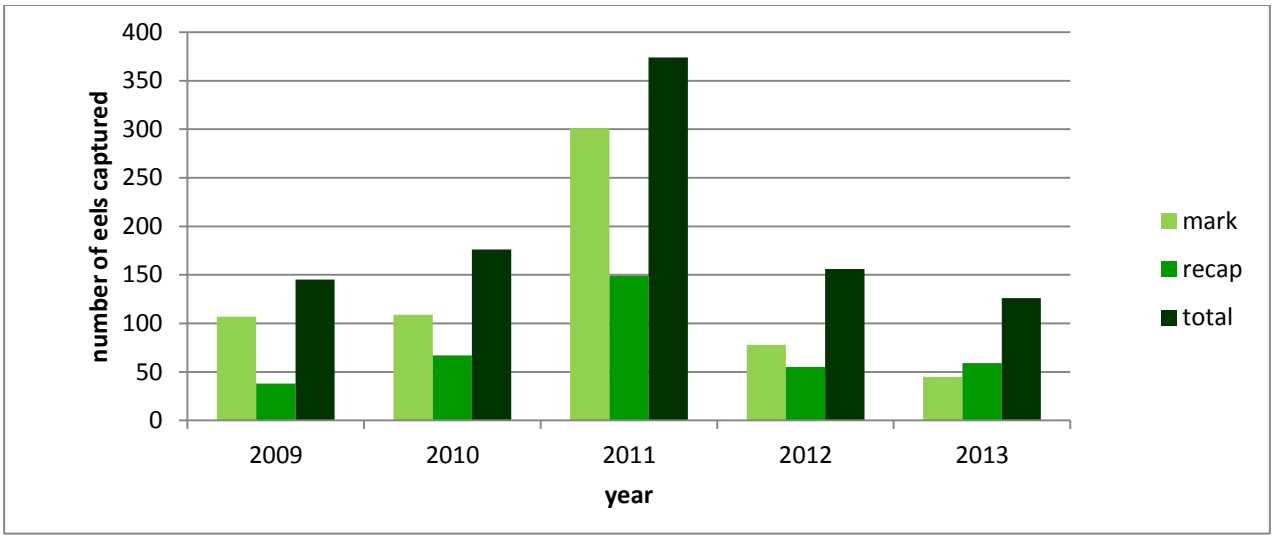

Figure 19: Eel captured and marked annually since the study began 2009-2013.

The trap with the highest catch rate was Trap nine, catching a total of 17 eel (Figure 11). Trap eight caught the second highest number of eel with 14. Most of the captured eel were yellow; few appeared to be turning to the silver eel stage.

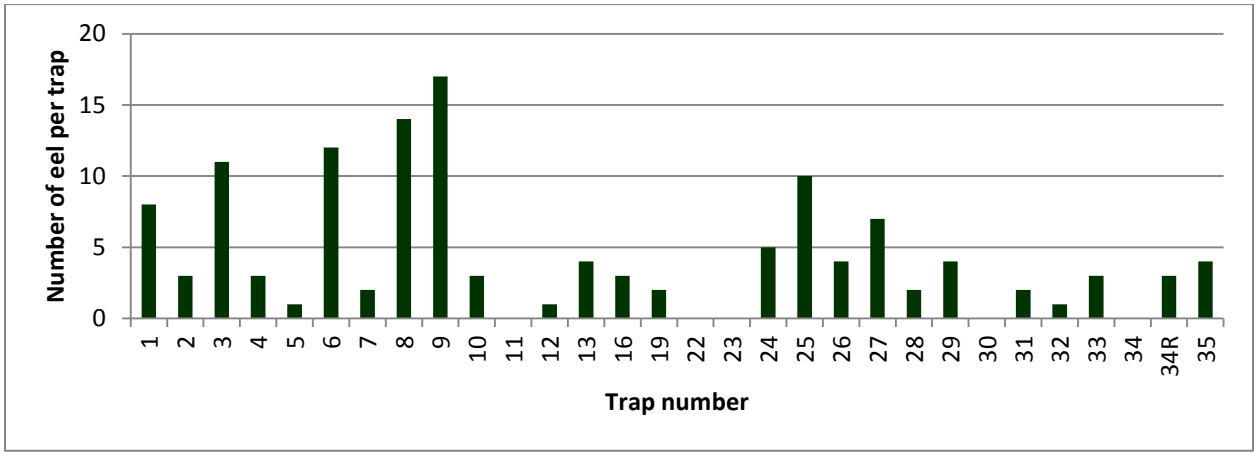

Figure 20: Eel catch per trap number during 2013.

OAKLAND IN-STREAM TRAP

The Oakland in-stream trap was operational from August 16 to November 4, 2013. The trap was installed about a month earlier than usual, in hopes of catching a larger number of migrating eel. The trap was in place for a total of 81 days, compared to only 45 days in 2012. The longer time frame accounted for catching more eel than the 405 caught in 2012. A total of 559 migrating eel were captured in 2013, 17 of which had previously been PIT tagged in the lake; one from 2013, one from 2012, six from 2011, eight from 2010, and one from 2009. The total number of eel caught and recaptured in 2013 was higher than during previous study years (Table 1). Assuming silver eel larger than 45 centimeters are female, 146 female and 380 male silver eel were captured in 2013. The remaining 33 eel were still considered to be in the yellow eel phase.

American eel migrating from Oakland Lake came in several larger runs, with few migrating in between. The first eels were captured on August 17, and a small number of eel were caught in the days following up until August 30th. Following the last quarter moon and accompanying rainfall, August 30th marked the first run, and a total of 40 migrating eel were captured. The largest run occurred on October 2, also following a last quarter moon and heavy rainfall, and 57 migrating eel were captured. During clear or full moon nights, there were low to zero migrating eel in the stream (Figure 12).

Table 2: Annual eel captures in Oakland in-stream trap 2009-2013.

	2009	2011	2012	2013
Days trap was in place	29	26	45	81
Total eels captured	221	283	405	559
Recaptures	2	1	13	17

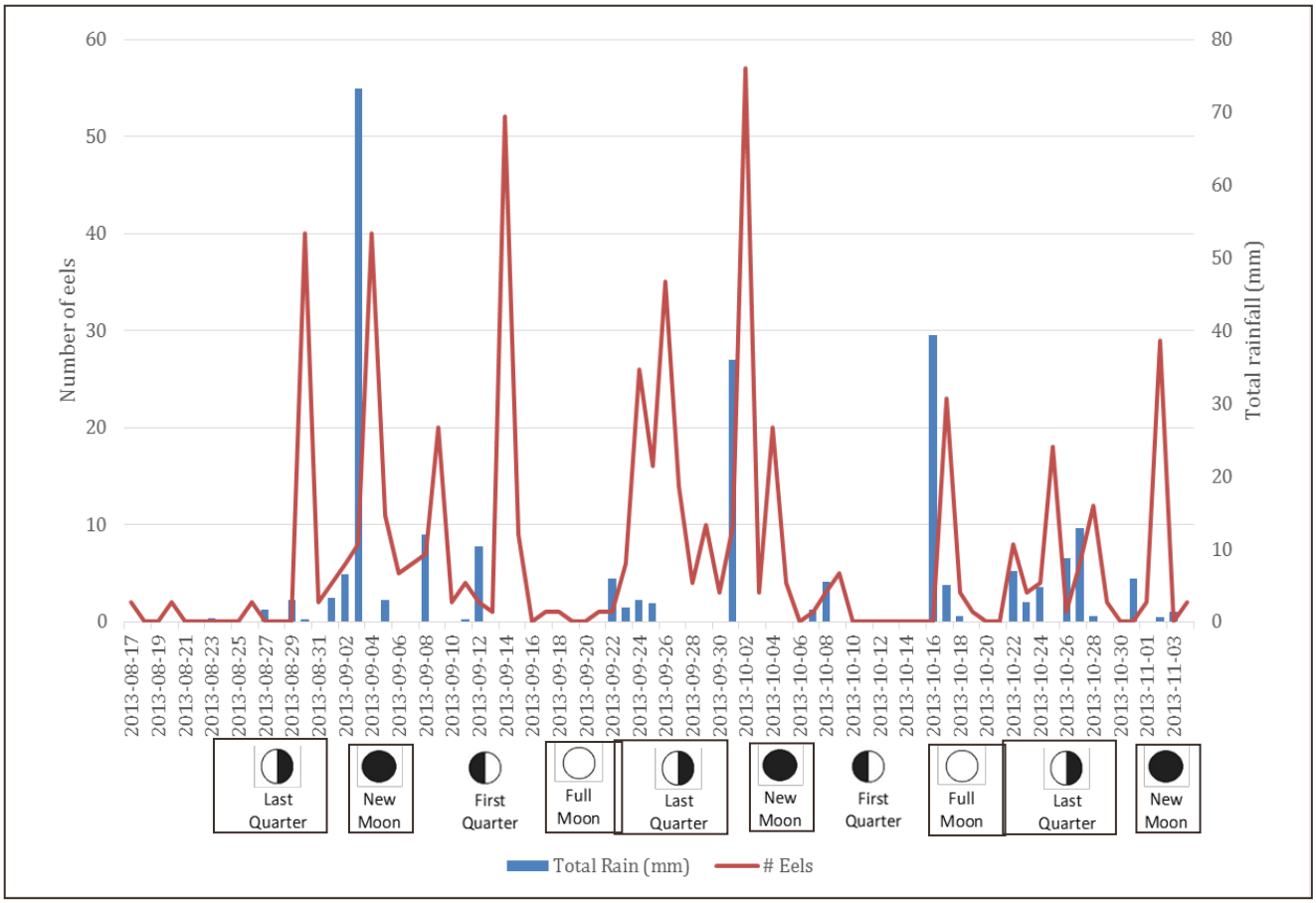

Figure 12: Silver eel escapement relative to rainfall and moon phase in Oakland in-stream trap 2013.

DISCUSSION

OAKLAND LAKE

The traps were typically checked the day following baiting, in order to minimize the possibility of eel escaping or being captured by predators. On many occasions when traps were checked the day after baiting, the entire bait fish was gone (except sometimes for the head) and the trap was empty.

On several occasions, eel that appeared to be half eaten were found in the traps. In all cases, about half of the tail end had disappeared. This seemed to occur during the few times the traps were not checked the day after baiting, but rather two days later. Often when eel are captured and trapped in the pots, smaller eel became stuck within the wire of the trap as a consequence of attempting to escape through the holes. As the half-eaten eel were not large (<50cm), they may have been preyed upon if they were sticking out of the trap.

In the past, traps have sometimes disappeared on the public trail side of the lake. Similar to 2012, pots on this part of the lake only had long floatable ropes rather than buoys, to make them less visible to the public. However, traps 34 and 34R disappeared in 2013. This section of the lake has a deep embankment according to a topographical map of the lake, so it is possible that the missing traps rolled down the bank. An effort will be made to retrieve them in the near future.

OAKLAND STREAM

The 2013 Oakland in-stream trap study accounted for the largest number of migrating eel being captured since the study began in 2009. This may be influenced by the improved trap design and the longer time frame in which the trap was operational in 2013.

The largest run in 2013 was relatively small compared to 2012, where there were 168 eel in one day following the last quarter moon and a heavy rain. This may be partially due to the water level in the lake and amount of rainfall, as water levels were lower in 2012 and substantial rainfall caused the water level to rise, signaling the eels to migrate. During 2013, the water level of the lake was more consistent, so eels may have migrated more consistently rather than in larger runs (personal observations).

One of the issues faced by the 2013 Oakland in-stream trap was by-catch. On several occasions, drowned beavers and muskrats were found in the trap, despite checking the trap daily. Next year, the trap location will be visited early to try and discourage beavers and muskrats from the area. As well, a grate will be placed in front of the funnel large enough to let eel through but small enough so as to deter beavers from the trap.

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