

# Chain Pickerel Mercury Accumulation Project

## 2020 Progress Report

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## Introduction

### Coastal Action

Coastal Action is a charitable organization that addresses environmental concerns throughout the south shore region of Nova Scotia. Our goal is to promote the restoration, enhancement, and conservation of our ecosystem through research, education, and action. Our vision is a healthy environment for future generations. Coastal Action has been an established member of the Lunenburg County community and the greater conservation community in Nova Scotia since its inception in 1993.

Over the past 25 plus years, Coastal Action has successfully managed a wide variety of environmental projects in Nova Scotia, including river restoration and habitat surveys on the Mushamush, Gold, LaHave, and Petite Riviere systems; water quality monitoring in multiple watersheds; species at risk research projects addressing the Roseate tern, Atlantic whitefish, Atlantic salmon, and American eel; aquatic invasive species research and monitoring programs; climate change, pollution prevention, and stormwater management initiatives; environmental education programs; and clean boating.

### The Problem

Mercury (Hg) concentrations in sportfish pose human-health concerns for the consumers, especially if the levels are higher than acceptable consumption levels for Hg in fish tissue. Chain pickerel (*Esox niger*) are an aquatic invasive species that has been introduced to the LaHave River Watershed and, in recent years, has been promoted as a sportfish in Nova Scotia. However, these fish are at greater risk of mercury bioaccumulation due to their piscivorous nature and high trophic level, as Hg biomagnifies within food webs.

### Chain Pickerel (*Esox niger*)

Chain pickerel are freshwater fish in the pike family (*Esocidae*) that prefer warmer waters of slow-moving streams or heavily vegetated lakes (Coffe, 1998; Hoyle & Lake, 2011). Pickerel have diverse feeding habits. Larger fish tend to be more piscivorous in nature, while smaller bodied individuals tend to feed more on invertebrates (Hunter & Rankin, 1939; Warner, 1973). A variety of food are consumed by pickerel including fish, invertebrates, amphibians, algae, and plants.

Although the native range of chain pickerel is from Maine to Florida along the eastern seaboard (Coffe, 1998; Hoyle & Lake, 2011), their distribution has expanded in the last century. Chain pickerel were first introduced to Nova Scotia in Digby County in the 1940's and have since spread to more than 95 known waterbodies across the province (Mitchell et al., 2010). Their spread has been facilitated through the illegal movement of live fish and subsequent dispersal within adjoining watersheds (Mitchell et al., 2010). These top predators may impact the native fish communities of Nova Scotia through predation and resource competition. The presence of chain pickerel can cause lower species richness and diversity, reduce overall fish abundance, and truncate fish size (i.e., an absence of fish <15cm in pickerel lakes) (Mitchell et al., 2010).

### Mercury

Mercury exists as elemental, inorganic, and organic compounds. This compound is not required in biological functioning and many forms of it can be highly toxic, such as methylmercury (LeBlanc et al., 2020). In aquatic systems the combination of anaerobic conditions, high microbial activity, and abundances of organic carbon (such as wetland conditions) can allow inorganic Hg to undergo methylation

and produce organic Hg compounds such as methylmercury (MeHg) (O’Driscoll et al., 2005). Methylmercury is a highly toxic and bioaccumulates within ecosystems.

Mercury concentrations are correlated with trophic position; being highest in piscivorous species and increasing in concentrations with age and size (Depew et al., 2013a; Wyn et al., 2009). Top predators, such as chain pickerel, are more susceptible to elevated Hg concentrations. Sportfish, which are generally top predators such as chain pickerel or smallmouth bass (*Micropterus dolomieu*), are likely to have elevated concentrations of the toxin which is concerning for human health. Hg levels in sportfish can warrant a notice for fishers as it can be dangerous for human consumption.

Nova Scotia, particularly southwest Nova Scotia, is known as a biological hotspot for mercury concentrations. This also pertains to bioaccumulation in freshwater fish. Southwest Nova Scotia was found to have some of the highest levels of Hg in fish in North America (Kamman et al., 2005). Elevated Hg in fish pose a concern to other wildlife and humans, as Hg biomagnifies consistently in food webs across the globe (Lavoie et al., 2013).

## Goals and Objectives

The goals and objectives for the 2020 field season included the first portion of a two-year research project and focused on project planning and initial sampling. The field season focused on capturing chain pickerel for preliminary analysis. Stomach content removal can provide an overview of diet and food web structure, especially when paired with stable isotope analysis (SIA). Fish stomach contents were identified to the lowest taxonomic level possible. Fillets from the fish were prepared and dried for mercury and SIA. Indicators of success for the 2020 field season consisted of the following:

1. Number of chain pickerel captured for mercury and stable isotope analysis.
2. Number of stomach contents extracted.
3. Number of samples dried and sent to lab for analysis.

## Methods

### Chain Pickerel Extraction

Scientific angling is a cost effective and time efficient method for fish extraction, especially for predators such as chain pickerel. This method was used throughout the duration of the 2020 field season. At the time of fish extraction, several variables were measured including forked and total length (cm), weight (g), parasite presence, sex, maturity, and stomach contents. Volunteers from the LaHave River Salmon Association provided full, frozen chain pickerel and their stomach contents from angling throughout the 2020 field season. Angling was completed from the shorelines of the LaHave River as well as Wentzells Lake between July 7, 2020 and August 21, 2020.

### Fish Drying

Frozen fish were thawed and then filleted to be dried for mercury and stable isotope analyses. Fillets were approximately 10 cm<sup>2</sup> of skin-free muscle tissue and weighed for wet weights before drying. Samples were dried at approximately 55°C for 24-48 hours, after which dry weights were obtained. Samples were placed in labelled vials for analysis.

## Sample Analysis

Mercury analysis will be completed at Saint Mary's University in Halifax, Nova Scotia while stable isotope analysis will be conducted at the University of New Brunswick, Fredericton, New Brunswick. A sample of dried tissue from each fish will be sent to the Stable Isotopes in Nature Laboratory (SINlab).

## Area of Study

Samples collected during 2020 were from Wentzells Lake; a fluvial lake located outside of Bridgewater, Nova Scotia in the LaHave River watershed (Figure 1). The lake supports a population of chain pickerel, which is the focus for the mercury analysis. The lake also has two boat launches allowing for easy access, as well as various access points from the shoreline.



Figure 1. Aerial view of Wentzells Lake.

## Results & Discussion

A total of 41 chain pickerel samples were collected during the 2020 field season. The mean total length was 34.0 cm (sd = 8.9), while most fish were between 20-30 cm in length (Figure 2).

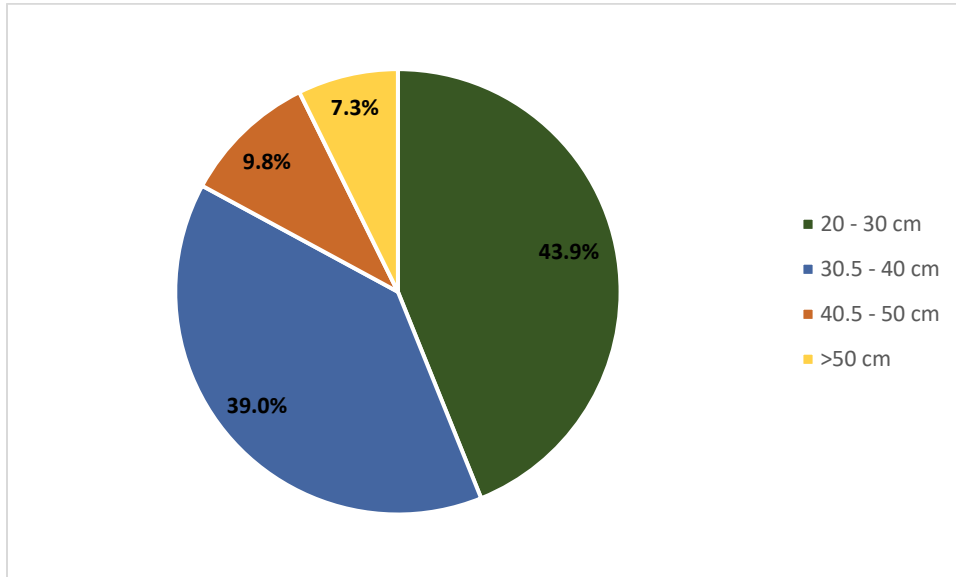


Figure 2. Size classes of total length (in cm) of chain pickerel caught during the 2020 field season. N = 41.

Approximately 17% of the chain pickerel caught were over 40 cm in length. It is likely that these larger fish will have elevated levels of mercury due to bioaccumulation.

Due to the COVID-19 global pandemic, many field season activities were unable to be completed. Fishing derbies were expected to be the main sampling method to obtain chain pickerel; however, due to gathering limits, these derbies were unable to take place. Despite this limitation, 41 fish were captured this season. Considering these restrictions, one of the main outcomes of this field season was an extensive literature review that focused on chain pickerel, invasive ecology, mercury, and stable isotope analysis.

Drying and analyzing samples was delayed due to the global pandemic as access to Saint Mary's University and the Dynamic Environment and Ecosystem Health Research (DEEHR) Lab was restricted. A socially distanced, makeshift lab was established in Lunenburg County to process samples. We are awaiting results from the mercury analysis as well as the SINlab stable isotope analysis.

## 2021 Field Season

### Goals and Objectives

The 2021 field season will focus on catching chain pickerel of various size classes for mercury analysis. Native fish species such as White Perch (*Morone americana*), Yellow Perch (*Perca flavescens*), Brown Bullhead (*Ameiurus nebulosus*), and White Sucker (*Catostomus commersonii*) will also be captured for mercury and stable isotope analysis. Another non-native fish, smallmouth bass (*Micropterus dolomieu*)



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will be included in the 2021 analysis as well. A comprehensive food web analysis, as well as mercury biomagnification rates, will be assessed for the LaHave River watershed, based out of Wentzells and Sherbrooke Lakes.

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