CAWG North River Three Year Electrofishing Report

Prepared for the Cornwall and Area Watershed Group

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January 2024

Contents

1.0 Executive Summary

Prince Edward Island is home to three salmonid species: brook trout, rainbow trout, and Atlantic salmon. Of these three, Atlantic salmon are of particular concern. Atlantic salmon populations are declining globally and the species is classified “at risk” by the Atlantic Canada Conservation Data Center. In past decades North River, which is a historic salmon river, has been included in provincial electrofishing surveys. In 2021, the Cornwall and Area Watershed Group took over and expanded electrofishing surveys within the North River watershed.

The objective of this report is to compare salmonid densities across the first three years of electrofishing data collected by CAWG (2021, 2022, and 2023) to identify salmonid population trends in the North River system. Identifying such trends will help to quantify the success of conservation efforts, and aid in determining where such efforts should be targeted in the future.

Population sampling was conducted using a battery-powered backpack electrofishing unit. After the data was collected, population densities were calculated based on diminishing Catch Per Unit Effort and size of area sampled. Relative densities (densities as a percentage of total salmonid density) were also calculated to quantify salmonid community composition.

Based on the results, brook trout populations are on the rise throughout the North River system. Rainbow trout populations are rising at a slower rate, and Atlantic salmon populations are declining.

The decline of Atlantic salmon populations points to the importance of focusing conservation efforts on the restoration and increase of optimal Atlantic salmon habitat. Efforts that would aid toward this goal include the establishment of erosion control measures at upland sites, planting trees in the riparian buffer, and employing woody material management strategies within the stream. The results obtained by this report also highlight the usefulness of standardized yearly electrofishing surveys for the continued monitoring of salmonid populations.

2.0 Introduction

The rivers of Prince Edward Island, though often small compared to those of the Canadian mainland, are frequented by sport fishers targeting the island's abundant salmonid species. These consist of the native brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo salar*), as well as the non-native rainbow trout (*Oncorhynchus mykiss*).

Of the salmonid species present in PEI, the Atlantic salmon is considered endangered in the Bay of Fundy region (Canada. Department of Fisheries and Oceans, n.d.) and neighboring north-eastern states. The species is at risk in PEI, where it has been extirpated from many historic salmon rivers (AC CDC, 2023).

Conservation organizations often use freshwater population estimates to assess the status of Atlantic salmon and success of conservation efforts. These estimates are calculated using data gathered from electrofishing and redd surveys. Since 2021, CAWG has conducted yearly electrofishing surveys aimed at calculating the population densities of salmonids in the North River watershed. This report examines the population trends observed over the course of 2021, 2022, and 2023 to estimate the overall status of Atlantic Salmon in the river systems managed by CAWG and provide recommendations to further improve this status.

2.1 Salmonid species

Brook trout, sometimes referred to as speckled trout or "brookies," are the most abundant salmonid in PEI rivers. They are a relatively colorful fish, with yellow, worm-like patterns on an olive green back, red spots surrounded by blue halos along their sides, white-edged pectoral and abdominal fins, and a peach/orange wash of color on the ventral side. Though some brook trout migrate to sea in adulthood, the majority of the species remain in fresh water their entire lives.

With it's multitude of small, spring-fed streams, PEI rivers make for ideal brook trout habitat. These fish prefer cold waters of moderate velocity, a mix of shallow and deep pools and riffles, sand and gravel substrate, and plenty of overhead and in-stream cover (P. Adams et al., 2008; Maryland

Department of Natural Resources, n.d.). Brook trout, which are native to PEI and found in nearly all of PEI's rivers and streams, are ranked S5 (secure and abundant) in the province by the Atlantic Canada Conservation Data Center (2023).

Atlantic Salmon, the least abundant of PEI's salmonid species, go through a multi-stage life cycle and are referred to by many names which describe their life stage. Fisheries and Oceans Canada (2018) describes these life stages; newly hatched salmon are "alevins" with yolk sacks attached, become "fry" in their first year as the yolk sack is absorbed, and remain in freshwater for the next 2 to 3 years as "parr". At the parr stage, salmon develop grey bars on their sides, alternated with a row of red spots. The description continues with "smolts," at which stage salmon lose their parr marks and take on a silvery color, and finally make their way to the ocean where they will spend much of their adult life. Adult salmon are a silvery blue color, with a long thin body and small head, and are referred to as "grilse" or "multi-sea winters" depending on how many years they spend in the ocean before returning to fresh water to spawn (Fisheries and Oceans Canada, 2018).

The required habitat of Atlantic salmon varies according to their life stage (COSEWIC, 2010). In freshwater, they require well connected reaches with cool, well-oxygenated water, gravel and cobble stream beds, and deep pools (COSEWIC, 2010; Fisheries and Oceans Canada, 2018; NASCO, 2010). Water velocity required for good salmon spawning beds falls between 35-80 cm s^1 (Armstrong et al., 2003).

Atlantic salmon are considered an indicator species, in that the presence of salmon is a good indicator of a healthy river, and when a river is damaged they are among the first species to be affected (NOAA Fisheries, n.d.). Native Atlantic salmon were once abundant in PEI but have undergone severe population declines and are presently ranked S2S3 (imperiled/vulnerable) in the province (AC CDC, 2023).

Non-native rainbow trout are becoming increasingly abundant in PEI and are often considered an invasive species in the province (Harris, 2014). These salmonids are a silvery color with a distinct pink stripe along their sides. Like brook trout, most remain in freshwater throughout their lives, but some migrate to sea and return to the rivers to spawn. The habitat requirements of rainbow trout overlap considerably with those of Atlantic salmon, such that Atlantic salmon rarely reach significant densities in streams where rainbow trout are established (Guignion et al., 2010). The spawning habits of rainbow trout may also have a negative impact on Atlantic salmon populations. Unlike brook trout and Atlantic salmon, rainbow trout spawn during the spring (Raleigh et al., 1984). This can be damaging to Atlantic salmon eggs; the salmon redds which were previously created in the fall are vulnerable to destruction by rainbow trout which seek to create their own redds using the same gravel in which salmon eggs are still incubating.

2.2 Electrofishing as a conservation tool

The use of electrofishing to gather data about fish populations is a well-established practice conducted yearly among many watershed organizations in PEI. The method allows researchers to directly count fish populations, as well as obtain measurements that can reveal the age structure of those populations.

Electrofishing involves running a low electrical current through a small part of a water body. The current causes temporary immobilization of nearby fish, allowing personnel to net them easily. They are then placed in holding containers for identification, counting, and measurement, then allowed to recover before being released back into the stream from which they were collected. Many studies have been conducted on the safety and effectiveness of electrofishing, and operation of electrofishing equipment requires specialized training and certification (Bohlin' et al., 1989).

2.3 Population estimation

To assess the status of animal populations, counts and estimations of population size, density and structure are often used. A count is typically understood to mean the total number of individuals of a species that are present within a defined area at a specific time. In the natural world it is rarely possible to perform a total count of a wild population, thus estimates are made using various methods depending on the goal of the study, the species being counted, and the habitat in which they are found (Skalski et al., 2005).

The absolute size of a population is often only meaningful in relation to other factors such as the size of the area across which it is distributed, the total number of individuals that habitat can potentially support, or the historic population size for the area. For example, a population abundance of one hundred salmon could be considered a lot for a 30m stretch of a small river tributary but would be a dismally low abundance for the entirety of Prince Edward Island. For this reason, population estimates are often expressed in terms of density, expressed as the number of individuals per 100m2.

Another very useful measurement is relative population density. When we look at the wildlife in a given area, it is never comprised of only one species but instead of an entire community of different species. The proportion of this total that is made up by each species can provide insight into how species populations relate to one another, the carrying capacity of an area, the suitability of the habitat, and the resilience of individual species, among other factors. Relative population density (RD) is calculated as the percentage of the total population density (TD) that is made up by an individual species.

$$RD = \left(\frac{D}{TD}\right) x\ 100$$

3.0 Methods and Materials

3.1 Study area

The North River watershed comprises an area immediately west of Charlottetown which empties into Graham Rogers Lake and the North River estuary (Fig. 1). The dominant land use type in the area is agricultural. The mandated non-farming riparian buffer in the province is 15m, however a significant proportion of the non-farmed buffer lacks forest cover in the North River watershed. There are a number of old pond basins throughout the system which, though the associated mills have been removed, are still in a state of transition and are difficult to re-forest. All these factors have led to high levels of siltation in the North River and its associated tributaries.

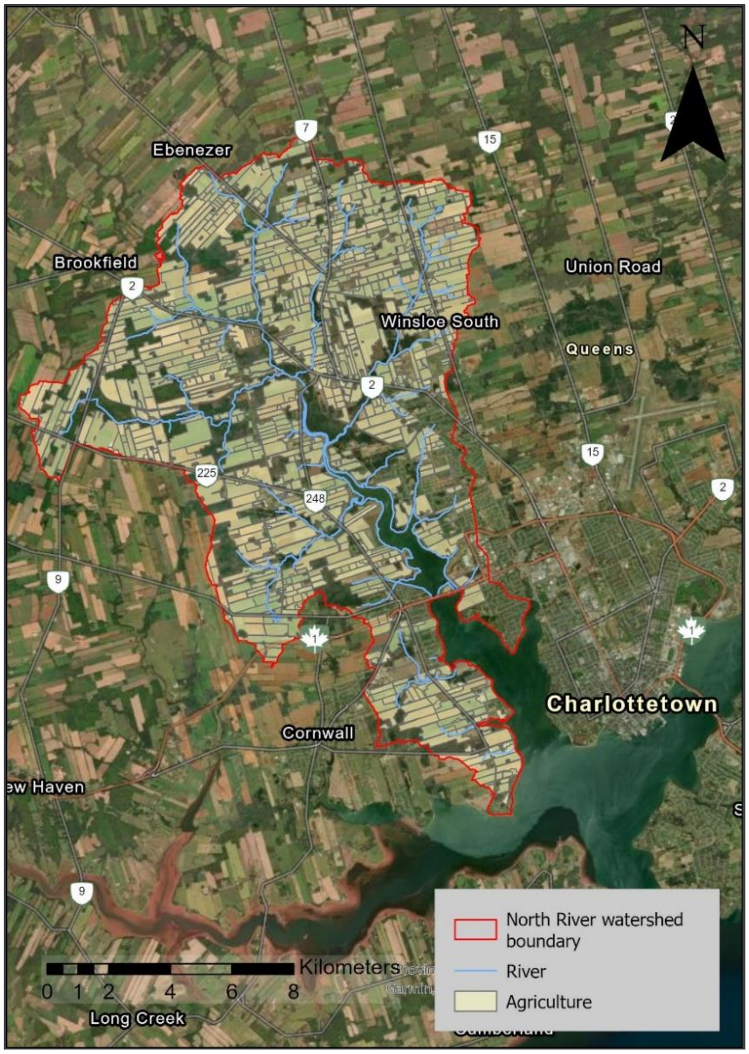

Figure 1
Map of the North River watershed showing the dominant land use type.

Surveys were conducted by CAWG in August of 2021, July of 2022, and August of 2023. A total of 17 index sites were surveyed in both 2021 and 2022, spanning the main and north branches of North River, as well as two of its tributaries: Watts Creek and Milton Brook. In 2023 changes to crew size and equipment availability necessitated a significant reduction of electrofishing sites. Priority sites were selected with input from the Forests, Fish, and Wildlife division of the Prince Edward Island Department of Environment and Climate Action. This resulted in five index sites retained and three new spot check sites established, giving a total of eight sites surveyed in the 2023 season.

3.2 Survey Method

Electrofishing surveys were conducted using a Smiths LR-24 battery-operated backpack unit. At each site selected for index survey, a reach 30m in length was established using barrier nets at both the upstream and downstream ends of the reach, and a total of three shock passes were completed. At sites selected for spot checks, a single timed pass was completed and no blocker nets were used. Shocking began at the waypoint and continued upstream for a timed period of 15 minutes. All collected data was recorded on field data sheets.

3.3 Data Analysis

For each index site, population densities of Atlantic Salmon (*Salmo salar*), Brook Trout (*Salvelinus fontinalis*), and Rainbow Trout (*Oncorhynchus mykiss*) were estimated by establishing a regression equation based on diminishing Catch per Unit Effort (CUE) and dividing the resulting population estimate by the area of the reach. Population density trends were identified and relative population densities were compared by tributary as well as the entire North River system as a whole, across all years for which data had been collected.

4.0 Results

Across all tributaries of the North River watershed, total salmonid density has increased over the three years (Fig. 2). This was comprised of an increase in both brook trout density and rainbow trout density (Fig. 3). However, the relative density of the non-native rainbow trout alone has increased over

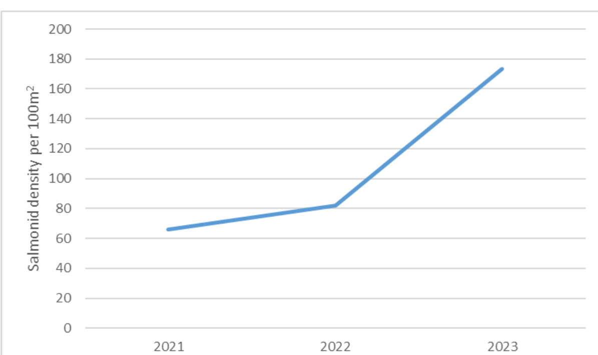

Figure 2

Salmonid population density trend across all sections of the North River system from 2021 to 2023.

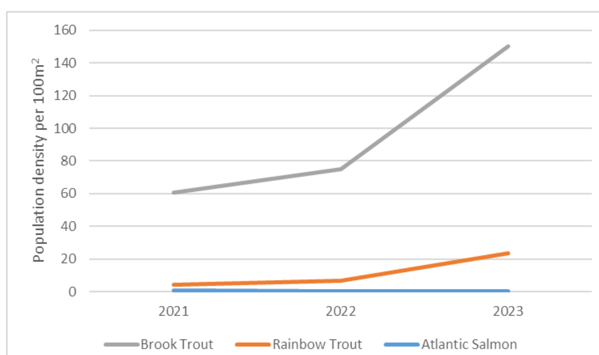

Figure 3

Population density trends of individual salmonid species across all sections of the North River system from 2021 to 2023.

the three years, while the relative densities of the native brook trout and Atlantic salmon have decreased (Fig. 4).

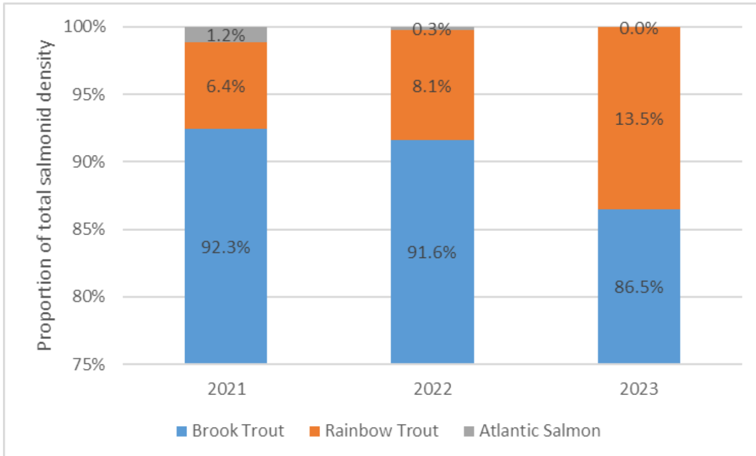

Figure 4

Relative population densities of individual salmonid species across all sections of the North River system from 2021 to 2023.

By individual section and/or tributary, the results of the North River main branch most closely resembled those of the system as a whole. In the North River main branch, salmonid densities have also risen over the 3 years (Fig. 5), with increases in brook trout and rainbow trout densities (Fig. 6). This section, like all others, also saw a fall in Atlantic salmon density. As with the whole system, rainbow trout made up an increasing proportion of the total salmonid density (Fig. 7). Relative density of rainbow trout jumped to 26.7% in 2023, surpassing the species' 2023 relative density for the North River system as a whole.

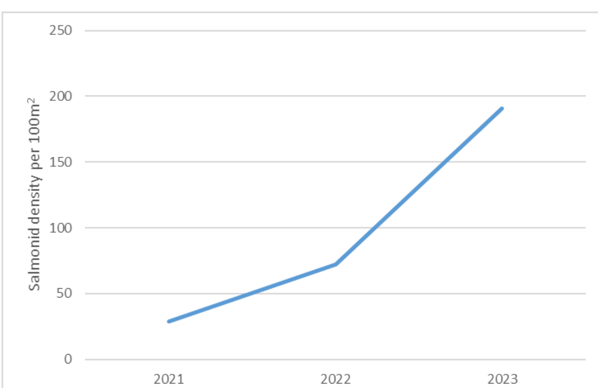

Figure 5

Salmonid population density trend in the main branch of North River from 2021 to 2023.

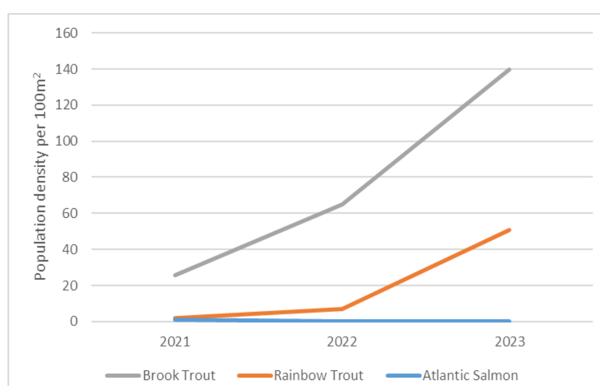

Figure 6

Population density trends of individual salmonid species in the main branch of North river from 2021 to 2023.

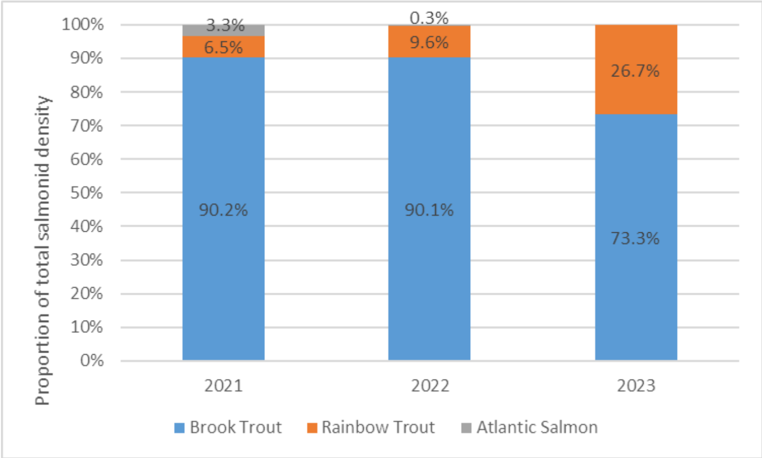

Figure 7

Relative population densities of individual salmonid species in the main branch of North River from 2021 to 2023.

In the north branch of North River salmonid densities have increased over the 3 years (Fig. 8), but this increase has consisted entirely of an increase in brook trout density (Fig. 9). Rainbow trout density fell over the three years as did Atlantic salmon density. Brook trout are occupying an increasing proportion of the salmonid community in the north branch, as seen by the rise in brook trout relative density and corresponding fall in rainbow trout and Atlantic salmon relative densities (Fig. 10).

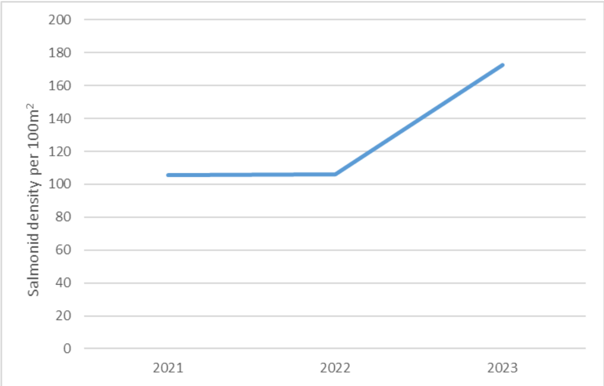

Figure 8

Salmonid population density trend in the north branch of North River from 2021 to 2023.

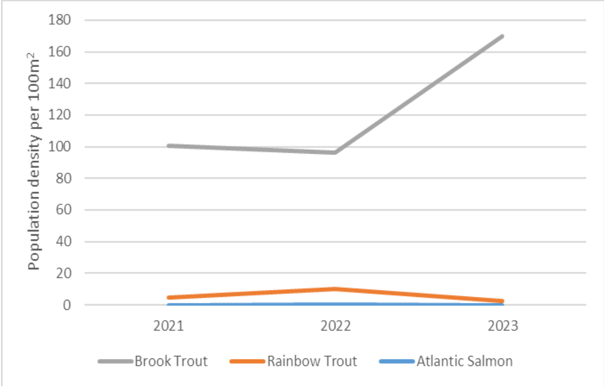

Figure 9

Population density trends of individual salmonid species in the north branch of North River from 2021 to 2023.

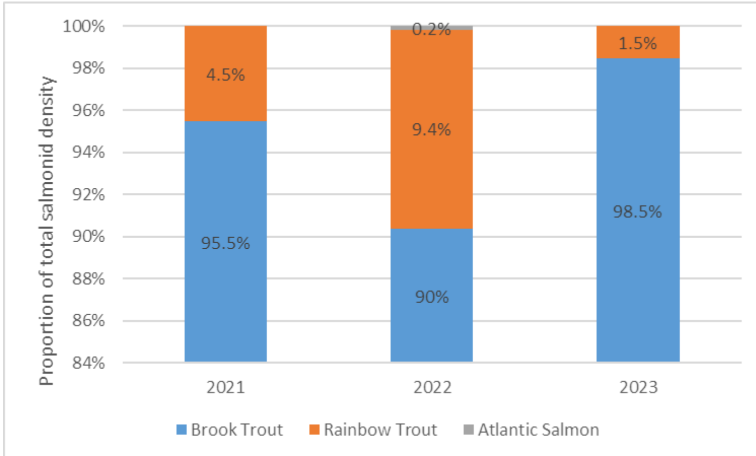

Figure 10
Relative population densities of individual salmonids in the north branch of North River from 2021 to 2023.

Watts Creek, which has historically held the largest number of salmon redds in the system, saw an overall decrease in salmonid density, though this decrease was not steady (Fig. 11). Densities of brook trout in Watts creek closely matched the trend of total salmonid density, while density of rainbow trout

appeared to rise and fall inversely to that of brook trout (Fig. 12). The decreasing density of Atlantic salmon in Watts Creek was steady across the three years. The changes to relative densities of salmonids in Watts Creek closely reflected population density trends, with rainbow trout quickly increasing to a large portion of the total salmonid community in 2022 and falling sharply to make up only 0.5% of the same community in 2023 (Fig. 13).

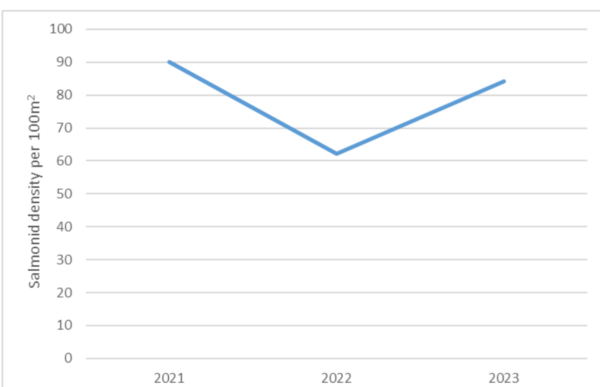

Figure 11
Salmonid population density trend in Watts Creek from 2021 to 2023.

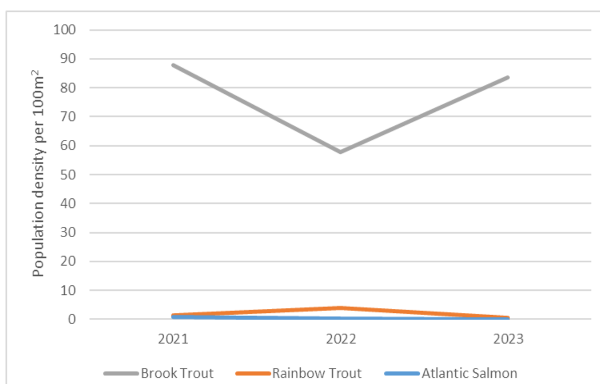

Figure 12
Population density trends of individual salmonid species in Watts Creek from 2021 to 2023.

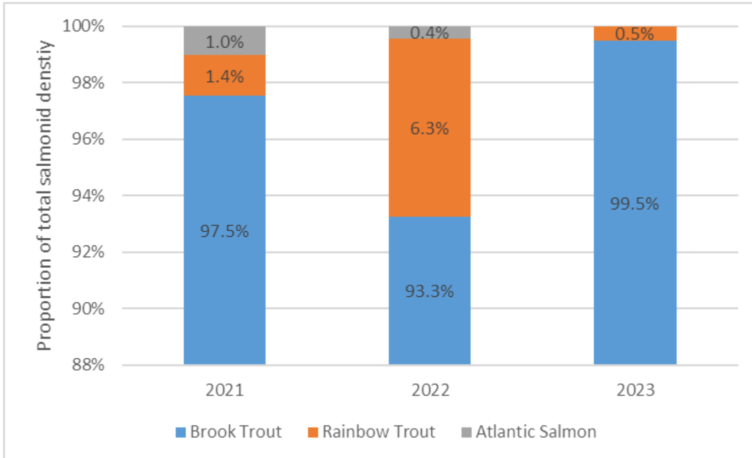

Figure 13

Relative population densities of individual salmonid species in Watts Creek from 2021 to 2023.

Finally, Milton Brook, which has not hosted salmon in any of the three electrofishing years, also saw an increase in salmonid density (Fig. 14) which is attributed entirely to a rise in brook trout density (Fig. 15). Rainbow trout density fell consistently across the three years. In 2021 Milton brook had the highest relative density of rainbow trout across the entire system and across all three years, making up 35.1% of the total salmonid community in the tributary (Fig. 16). Over the course of 2022 and 2023 this was steadily replaced by a growing relative density of brook trout.

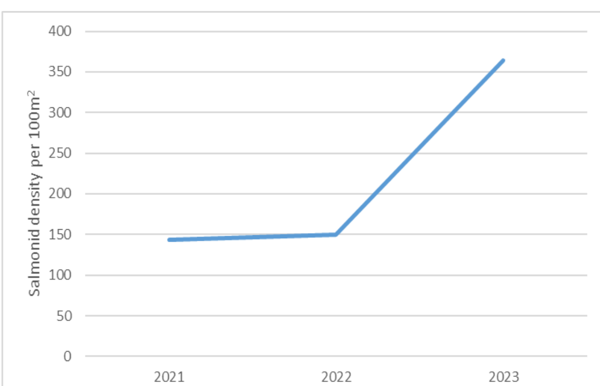

Figure 14

Salmonid population density trend in Milton Brook from 2021 to 2023.

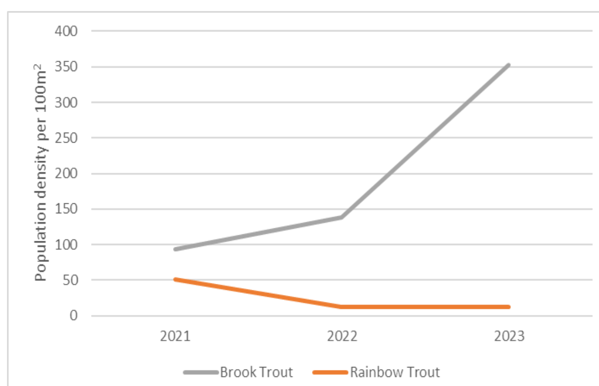

Figure 15

Population density trends of individual salmonid species in Milton Brook from 2021 to 2023.

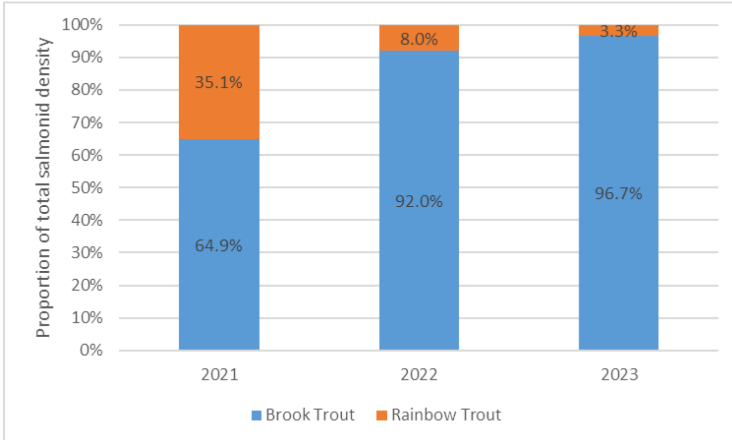

Figure 16

Relative population densities of individual salmonid species in Milton Brook from 2021 to 2023.

Throughout the entire North River system as well as in individual sections and tributaries, Atlantic salmon densities were at their highest of the three years in 2021 and have since steadily declined. Despite this general decline, in 2022 Atlantic salmon parr were found at two sites where they had not previously been found. In 2023 no Atlantic salmon were found at any of the surveyed sites.

5.0 Discussion

Based on the results, we can conclude that both brook trout populations and rainbow trout populations are on the rise in the North River system, with brook trout population growth outpacing that of rainbow trout. Atlantic salmon populations, on the other hand, appear to have declined to critical levels. This indicates that restoration projects within the North River watershed in recent years have not been sufficient to reverse or even stall the threats to Atlantic salmon in the system.

The observed increase in rainbow trout populations has occurred primarily in the main branch of the North River. Although rainbow trout densities have increased in some of the tributaries, they have been outpaced by the increase in brook trout density and are being displaced in their share of the total salmonid community. This may be related to changes in habitat availability caused by sedimentation and blockages in the North River system. The habitat requirements for rainbow trout and Atlantic salmon are extremely similar. In areas where the two species cohabit, the more aggressive rainbow trout tends outcompete the Atlantic salmon for control of the most optimal habitats (Gormley, 2003; S. Houde et al., 2016). This type of habitat is disappearing in PEI; trenching of surface run-off, siltation of springs and first order tributaries, and reduction of the forested buffer have all contributed, among other factors, to high levels of siltation in many PEI rivers. While the habitat requirements of brook trout are similar to those of other salmonids, brook trout tend to spawn in gravel substrate as opposed to the coarser cobble substrate preferred by Atlantic salmon and rainbow trout. Brook trout are also able to tolerate lower flow regimes than Atlantic Salmon. Due to the high rate of sedimentation and low flow regimes in the North River system relative to other salmon rivers in PEI, reinvigorating the Atlantic salmon population in this watershed will require more than damage mitigation; it will require the restoration of appropriate habitat to support the species, and any management plan for Atlantic salmon in North River should prioritize this. However, since the non-native rainbow trout share those same habitat requirements and are known to be detrimental to Atlantic salmon populations in PEI, it is important that their expansion throughout the North River system be avoided. This could be addressed by including strategies for management, or even removal, of invasive rainbow trout as part of the watershed's Atlantic salmon management plan.

It is important to note that there was a major decrease of surveyed sites in 2023. This was the result of scheduling limitations with rented equipment and operating with a reduced field crew. Attempts were made to choose a representative sampling of survey sites for retention, nonetheless the reduction in surveyed sites meant a smaller collection of data available for 2023. Population density estimations at the tributary and watershed scale were likely skewed by the reduced sample size. It is possible that this led to underestimation of Atlantic salmon densities for that year. In light of this, it is recommended that CAWG electrofishing surveys for 2024 be expanded to include as many of the 2021 and 2022 sites as possible.

Other potential causes for the lack of Atlantic salmon detected in 2023 include the landfall of post-tropical storm Fiona in September of 2022, which made record as one of the strongest storms to ever reach Atlantic Canada (Government of Prince Edward Island, 2024; Pasch et al., 2023) and caused the most costly amount of storm damage to the region in recorded history (Gambrill, 2023; Insurance Bureau of Canada, 2023). In addition to the unprecedented damage to PEI forests, there was an extensive amount of stream blockages and bank upheaval. Atlantic salmon are highly sensitive to habitat disturbance (COSEWIC, 2010). Fiona created a significant natural disturbance, and while it is not possible to attribute any part the Atlantic salmon decline to the storm with absolute certainty, it is reasonable to assume that the stream blockages, course alteration, and sedimentation it caused would have reduced access to valuable spawning and foraging habitat. Salmon are capable of adapting to adverse conditions in a stable system, so it is possible that as the North River watershed stabilizes post-Fiona, we may see a return of Atlantic salmon to the river system. Removal of stream blockages and erosion mitigation and prevention strategies will be of utmost importance over the next several years to stabilize the system.

Overall, it is clear that Atlantic salmon are on the decline in the North River system, and that the damage to Atlantic salmon stocks in the system in recent years has outpaced the effects of conservation efforts. Members of the Cornwall and Area Watershed Group have observed that this damage comes primarily from the combination of high sediment loading and reduced flow regimes in the upper reaches, which allows fine sediments to settle over spawning areas and reduces the quality of forage and in-stream cover. Projects aimed at reducing sediment loading, removing excess silt, and improving flow regimes are recommended and are predicted to have the highest impact in restoring Atlantic salmon population in the North River system.

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