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Proposing a Sustainable Future for the Muskoka Region

Prepared for: Stakeholders of the Muskoka
Region

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EXECUTIVE SUMMARY

The following report is from a summer research project conducted between May and August 2020 that was supported by Hamilton College's Emerson Collaborative Grants. The project's ultimate goal is to collect empirical survey data combined with expert interviews to propose pathways to a sustainable future for the Muskoka Region. The Muskoka Region is a gorgeous and unique area in Northern Canada that requires and deserves environmental stability and preservation. Over the past few years, Muskoka's environment has been increasingly degraded, and the causes and motivations of this degradation merit attention. This project consists of 3 reports, and aims to improve the Muskoka Region's sustainability. Report 1 and 2 consist of preliminary research through a combination of online empirical data, elite interviews, and participant surveys to set the stage for Report 3, where I propose a sustainable and equitable vision for the future of the very precious Muskoka Region. Specifically, I am interested in finding out what the biggest threats to Muskoka's natural environment are, what demographics may be causing these threats, and how the stakeholders within the region can better manage their individual and collective actions to reduce their ecological impacts. Below I present the goals and findings of each report and a conclusion that sums up the core findings of this proposal.

Sincerely,
Andrew Court

Report 1:

Goal: To outline the current and historical state of Muskoka's natural environment to understand the main threats to its sustainability and what demographics may have the most significant impact on the surrounding natural environment through analyzing content from elite interviews and online empirical data.

Findings:

- ⇒ The current state of Muskoka's environment is in better condition than it was historically, mainly due to the transition from a resource-based economy to a recreation/tourism-based economy.
- ⇒ New development may be the main threat to Muskoka's natural environment.
- ⇒ The values that short-term visitors or tourists hold may lead to the most environmental degradation, compared to the values of seasonal residents and permanent residents.

Report 2

Goal: To understand the general values each stakeholder group has towards Muskoka's natural environment to gauge what demographics may be the largest cause of environmental degradation in the Muskoka Region using a 2020 participant Summer Sustainability Survey.

Findings:

- ⇒ As a person's stake increases within the Muskoka Region, their relative impact on the natural environment decreases. Therefore, short-term visitors or tourists have the most significant negative impact on Muskoka's natural environment, followed by seasonal residents and permanent residents.
- ⇒ New development was reported to be the largest current perceived threat to Muskoka's natural environment.
- ⇒ All stakeholder groups agree that the Muskoka Region should have a combination of a tourist/recreational and resource-based economy, there should be no more access to chain

restaurants or stores than there is currently, and the Muskoka Region's economic make-up should remain the same.

⇒ Many stakeholders believe that climate change threatens Muskoka's natural environment.

Report 3

Goal: To propose a plan towards a sustainable future for all who inhabit the Muskoka Region through education and other unique suggestions tailored to each stakeholder group on what they can do to mitigate their personal and collective impact on Muskoka's natural environment.

Findings:

- ⇒ Permanent residents must take ownership for the environmental degradation they have caused and work with, not against, the other stakeholder groups.
- ⇒ Seasonal residents should buy a pre-existing cottage rather than constructing a new one. If seasonal residents already have a cottage, they should cut down as few trees as possible. When renting a cottage, seasonal residents should push for a cottage with natural vegetation, and when launching boats, they should clean them to avoid the spread of invasive species.
- ⇒ Short-term visitors or tourists must acknowledge that it is their duty to be a good steward of the environment, as they are the largest cause of environmental degradation in the Muskoka Region. Short-term visitors or tourists should also respect Muskoka's natural environment no matter how long they occupy it because future visitors deserve to have access to the same environment.
- ⇒ Short-term visitors or tourists should be encouraged to learn more about the environmental health of the region and understand that there should only be sustainable development, as long-term sustainability will provide every stakeholder group with relatively more utility. They should also learn that manicured lawns all the way down to the waterfront are not necessary to enjoy, have fun, or recreate within Muskoka.
- ⇒ Climate Change is increasingly becoming a significant threat to Muskoka's natural environment.

Conclusions

The higher the stake a person has in the Muskoka Region, the more they care and are willing to change their behaviors to reduce their impact on Muskoka's natural environment. Report 1 provides evidence from online empirical data and content from elite interviews that points toward the fact that new development and the values that tourists hold are the leading causes of ecological degradation and land alteration in the Muskoka Region. This idea was supported in Report 2, where responses from a participant survey displayed numerous occasions where permanent residents seemed to care the most about Muskoka's environment, followed by seasonal residents and short-term visitors or tourists. This idea allowed me to correlate the impacts associated with each stakeholder to the current state of Muskoka's natural environment that I discussed in Report 1. In Report 3, suggestions were given for each stakeholder group on how to mitigate the associated impacts that were discovered in Report 2. If internalized by each stakeholder group, these suggestions present the Muskoka Region with the ability to achieve sustainability, as each suggestion is tailored to the unique impacts that each stakeholder group is expected to have. This full report will be shared with multiple platforms around the Muskoka Region, as I believe the contents of these reports are vital for each stakeholder group to understand moving forward.

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REPORT 1: CURRENT AND HISTORICAL THREATS AND THE CHANGING ENVIRONMENT OF MUSKOKA

Introduction

Muskoka is a 2,500-square mile, scenic, natural environment in Northern Ontario that has 8,700 miles of shoreline, pristine lakes, waterfalls, rivers, and forests (Baytides Management, 2003). The area's natural beauty has been attracting tourists to the region since the early 19th century (Shifflett, 2012). In 2011, National Geographic ranked Muskoka #1 globally for the best place to visit in the summer (National Geographic, 2011). However, with ever-increasing recreational demand, Muskoka's natural environment is being rapidly degraded.

The continued prosperity of the Muskoka Region depends upon maintaining its natural environment. Although it can be hard for the District of Muskoka to control the effects of climate change on the region, the citizens within the area can reduce their direct impact on Muskoka's natural environment, increasing the chances of maintaining and even amplifying it.

Though Muskoka's citizens and visitors can reduce their environmental impacts, there is an increasing conflict between the values that different demographics hold, as some fight for economic development and others for environmental conservation, pitting the two as incompatible (Macgregor, 2015). Development and the ecological degradation that comes with it is increasing at high rates in Muskoka (Forester, 2017). Despite this increase in development, conservation efforts, and the ecological restoration that accompanies it has also increased (Ontario, 2019). This difference in opinion on development and ecological restoration shows a stark contrast in opinions on what the Muskoka Region is best suited for, a divide which merits closer attention. At one end of the spectrum, there are stakeholders within Muskoka who see the benefits that Muskoka's ecosystem services provide, such as fresh air and pristine aquatic and terrestrial environments. At the other end of the spectrum, there are stakeholders within the region who push for increased development of cottages and infrastructure, as they see the benefits of increased economic activity. The difference in stakeholders' values between economic and environmental motives is an issue that can be seen globally (Gallagher, 2009) and leads to planning issues for the District of Muskoka (District of Muskoka, 2020). The Region's top economists and environmentalists have worked together for years to increase the region's sustainability and economy, but have largely failed to do so because of a lack of understanding of values between stakeholder groups (Muskoka Watershed Council, 2008). It is more feasible to balance the different values of demographics within a region

if they all have a better understanding of each other's values (Mayo, 2015). Therefore, it is my goal to enhance the knowledge and understanding of each unique demographic within the Muskoka Region for the District of Muskoka to more effectively plan for a sustainable and economically prosperous future. To do this, I must understand the current and historical state of Muskoka's environment and the values, perceptions and beliefs that each stakeholder group has. By synthesizing these two streams of evidence, I can then work to help propose a sustainable and equitable future for the Muskoka Region.

Report 1 describes the available empirical data about the current and historical state of Muskoka's natural environment. This report also presents results from the interviews with local scientific experts, giving insight into their specific area of expertise that may or may not support the existing online data on the current state of Muskoka's various environmental components. Specifically, this report outlines the current and then the historical state of Muskoka's biodiversity, water quality, air quality, erosion, and flooding. It is imperative to understand the current threats to Muskoka's natural environment to start to grasp the values that people may hold within the region that lead to ecological degradation. It is also essential to understand the historical threats to Muskoka's natural environment and what demographics may have caused it to start making sense of how people's values may have changed and what this meant for the natural environment of Muskoka. These two analyses of the current and historical state of Muskoka's environment are vital to understand as it is important to know the current and historical anthropogenic impacts on Muskoka's natural environment before understanding what demographics tend to cause it. Therefore, Report 1 aims to understand the current and historical threats to Muskoka's natural environment to set the stage for a more in-depth analysis in Report 2, where I understand and report the perceptions of Muskoka's stakeholder groups.

Methods

To assess the current challenges to ecological sustainability in Muskoka, I first used online empirical evidence to outline the anthropogenic threats to Muskoka's natural environment. Online data was also used for outlining the motivations for these threats. Next, I conducted semi-structured elite interviews with environmental experts in the region. These interviews were conducted from Monday, May 25th to Wednesday, June 3rd, 2020. Five people were interviewed who were experts across various environmental and historical fields. All interviews were

conducted remotely following an interview protocol approved by the Hamilton College Institutional Review Board. To assess the historical state of Muskoka's environment, I used a similar method, as online empirical evidence and the contents from the five elite interviews were used to outline the historical state of Muskoka's environment.

Results

Below I discuss the current challenges affecting Muskoka's biodiversity, water quality, air quality, erosion, and flooding as identified in the review of available online ecological data and through elite interviews. I also discuss the historical state of challenges that affected Muskoka's natural environmental components. The results were largely successful in mapping out the current and historical state of Muskoka's environment as the combination of online data and creating my own through interviews proved to be effective.

Biodiversity

According to Muskoka Water Web, a conservation organization that aims to preserve Muskoka's watershed, 48 species in the region are identified to be at risk (Muskoka Water Web, 2020). This decline is mainly due to industrial-scale factories' development and the rapid conversion of land into buildings and other facilities (Council, 2020). The threat to biodiversity is also a result of climate change, pollution, and invasive species. Although biodiversity decline from human activities is happening more severely elsewhere because the good quality of Muskoka's natural environment buffers the region from high levels of species extinction (Hernandez, 2020), there is still a decline in species diversity, which merits closer attention. Here is a list of a few species in the Region that are at risk, along with a short description of why they are at risk:

1. The *Blanding's turtle* is threatened due to habitat loss or fragmentation and road mortality (Brownlee, 2019).
2. The *Butternut tree*, according to the ministry, was threatened by hybridization, canker disease, and development (Brownlee, 2019).
3. Lake *Sturgeon fish* are threatened due to harvesting, damnum, other river barriers, habitat loss, and poor water quality. (Brownlee, 2019).

4. The *Barn swallow* is threatened due to accidental trapping, destruction of nests in urban areas, and collisions with electrical lines (Muskoka Water Web, 2020).
5. The *Eastern wolf* is threatened by habitat loss and degradation (Muskoka Water Web, 2020).

After reviewing the reasons why these above species are threatened in the Muskoka Region, human activities such as land conversion and trapping may exacerbate biodiversity loss in the Muskoka Region. Humans also tend to accidentally introduce invasive species such as Zebra and Quagga Mussels by launching their uncleaned boat into new waters, degrading the aquatic food chain and ecosystems in large Muskoka lakes such as Georgian Bay and Lake Roseau (GBGLF, 2019). Therefore, future analysis should be conducted to determine what demographics in the region may be impacting Muskoka's biodiversity, causing a decline in the overall number of species in Muskoka. However, as one local environmental expert stated, "Muskoka's current state of biodiversity is still intact despite this decline in biodiversity." This interviewee also highlighted the fact that the current state of Muskoka's terrestrial and aquatic ecosystem is in "near pristine" condition:

Although there is insufficient data about the trends in biodiversity in aquatic ecosystems of the lakes that were measured, there were no significant changes in ecosystem diversity and health. There were also no significant changes in water quality in those observed areas. Despite the seemingly healthy biodiversity in aquatic ecosystems, I cannot fully conclude their current state as there is not yet enough widespread and legitimate data on the current state of all of Muskoka's aquatic ecosystems. Regarding terrestrial ecosystems, I believe they are in excellent health as Muskoka's forests are in great condition as they have been becoming healthier and denser ever since the historic logging that occurred and then was halted, supporting much species diversity within the region. However, there has been an increase in the number of species that are considered endangered or near extirpation. Despite this, as a whole, the species diversity of terrestrial and aquatic plants and animals is intact but are most affected by the impacts of climate change and new development.

After analyzing the available scientific data and talking with elite interviewee #1, the general understanding is that Muskoka's biodiversity has remained "intact", although it continues to be threatened. Future work should be conducted to find out the leading causes of new development within the Muskoka Region. Most importantly for charting a sustainable future, discussions with local experts made clear that biodiversity in Muskoka is most affected by **climate**

change and **new development**, of which only the latter of the two can be fully mitigated by local action.

Water Quality

The District Municipality of Muskoka (DMM), in conjunction with the Canadian Ministry of the Environment and Climate Change (MOECC), has been testing water quality in Muskoka for almost 40 years and has produced quality-controlled data for 193 sites on 164 lakes in the region (Muskoka, 2019). Based on their analysis of long-term data acquired to date, the water quality at most sampling locations remains **good to excellent** (MLA, 2020). To better understand the data, the DMM and MOECC used area summary sheets to summarize the sampling results using traffic light zymology. In this case, a green light indicates the water quality remains consistently good. A yellow light indicates that further investigation is recommended to maintain good water quality. A red light means that remedial action may be necessary to improve water quality (MLA, 2020). Of the 55 areas tested, there were 42 areas with a green light, 9 areas with yellow light, and 2 areas with a red light (MLA, 2020). This year, six areas changed from green to yellow, and five areas changed from yellow light to green light, showing little net change in water quality from 2019 to 2020 (MLA, 2020).

The water quality parameters sampled in 2020 consisted of secchi depth (water clarity), total phosphorus (nutrients phosphorus is a limiting nutrient in many lakes, and excess phosphorus can lead to harmful algal blooms), water temperature, and total coliform bacteria count. The secchi depths recorded in 2019 remained consistent with the depths reported historically, generally supporting the oligotrophic (as opposed to the degraded eutrophic) classification (MLA, 2020). Conversely, spring phosphorus concentrations recorded were highest to date (MLA, 2020). Harmful algae blooms (HAB) also increased from 2 HABs in 2019 to 4 in 2020, showing a 50% increase (MLA, 2020). An increase in total phosphorus increases the probability that a HAB will occur (Muskoka Watershed Council, 2020), showing a positive correlation between phosphorus and HAB abundance in Muskoka. Increased temperatures resulting from climate change can also exacerbate HAB's abundance and spread, posing future worries to environmental scientists within the region (Muskoka Watershed Council, 2020).

Although there has been a slight increase in phosphorus loading and other harmful chemicals such as road salts into water bodies (Muskoka Water Web, 2020), Muskoka's water

quality holistically remains good. This idea that Muskoka's water quality is in good condition can be supported by the discussion from my second elite interview (Table 1):

Of the 160 lakes that the Muskoka Watershed Committee tested, maybe 7 of them have experienced slightly increased phosphorus loads. This yearly fluctuation is normal and does not worry me. I also don't worry much about the impacts of seasonal residents and homeowners in the region, as many of their attitudes have changed around environmental stewardship. Ever since the legacy issues with tanneries where harmful chemicals leaked into the soil, people who have a significant stake within the region have realized what activities degrade Muskoka's water quality and have done a much better job in mitigating those specific activities that impact Muskoka's watershed, letting it restore itself. The shift of Muskoka's Industries from large companies such as Algonquin automotive to smaller businesses such as breweries is another reason why Muskoka has experienced an alleviated impact of pollution on its watershed. The gradual transition of boaters using a 2-stroke engine to a 4-stroke engine and the small number of farming practices in the region also has limited point and non-point source pollution into the watershed. However, I do worry a bit about the increase in both tourists and HAB in this region. Tourists tend to prefer manicured lawns all the way down to the water. This preference is precisely what many resorts in Muskoka's offer and tourists visit, contributing to non-point source runoff of harmful chemicals into Muskoka's waterbodies. Muskoka Tourism also promotes excessive use of its watershed through marketing videos, blog posts, magazines, etc. Although this generates revenue for Muskoka's economy, it can harm water quality within its lakes, rivers, and ponds. Regarding HAB, I am aware that the increase in HAB experienced in 2019 may be a result of Muskoka's residents being more apt to report them. However, I believe this increase in HAB reports was a combination of people reporting them more, and there actually being a higher amount of HAB cases. This increase in HAB makes sense because as lake water temperatures rise, the conditions for HAB formation become more favorable. Although I think Muskoka's Watershed is in good condition, as a whole, I believe Muskoka's water quality is most threatened by climate change and the tourists, as both are negatively impacting it in one way or another.

After reviewing the available scientific data about current state of Muskoka's watershed and speaking with a local expert on the dynamic water quality of the region, we can conclude that presently, Muskoka's water quality is in good condition. The scientific evidence shows a majority of the lakes and rivers are placed into a "green light" category, indicating the water quality remains consistently good. In the interview, the local expert on Muskoka's watershed expressed that the water quality has "improved since earlier times" and that seasonal residents and tourists tend to "increasingly adopt a low impact cottage infrastructure." Therefore, based off the online empirical evidence and content from elite interviewee #2, I infer that the current demographics who live in and visit the Muskoka Region have not impacted the water quality enough to cause any significant

changes. However, future research will be necessary to determine which threats may affect water quality more directly. Elite interviewee #2 especially highlighted different ways in which permanent residents, seasonal residents, and short-term visitors or tourists, affect water quality.

Air Quality

The Muskoka District Municipality has been able to record regular measurements of air quality since 2015. The district's current measurement to gauge the relative air quality in an area is called an air quality index (AQI). Suppose a region has an AQI of 50 or lower. In that case, the air quality is good, and air pollution poses little to no risk to the biotic components of the areas terrestrial and aquatic ecosystems. If an area has an AQI of 51-100, the air quality is acceptable, but there may be a risk to some people's health, particularly those who are unusually sensitive to air pollution (Air Now, 2020). As a region AQI score increases, the associated health risks also increase while the relative air quality decreases until 300, where the air quality is hazardous (Air Now, 2020). Currently, the average AQI of Muskoka is around 26, resulting in the region having good air quality (Air Quality, 2020). Also, the District of Muskoka uses the air quality health index (AQHI). This index has a built-in scale designed to help people understand what the air quality in their region means for their health. If an area has a score of 1, there is little to no risk of the air quality impacting people's physical and mental health. If a region has a score of 10, there is a very high risk of people getting health issues associated with their experienced air quality (Government of Ontario, 2020). Currently, the average AQHI in Muskoka is 2 (Ontario, 2020), showing a low risk to the permanent residents, seasonal residents, and short-term visitors or tourists in the region.

The idea that Muskoka's air quality is good is also supported by my interview with elite interview #3 (Table 1):

I think the air quality here is pretty darn good. Fantastic really. I have been coming here as a cottager since I was very young, and I now live up here full time for 20 years, and I love the air quality here. I think the environment is in excellent condition. The air that I breathe seems to be clean and safe, and Muskoka's air quality reports support that. I also have not heard of or seen any health-related problems that correlate to Muskoka's air quality. However, there are times where there are certain places you can sit around popular lakes like Lake Muskoka and Joseph and observe the build-up of exhaust rising off highway 400 and highway 11 (the major highways that run through Muskoka). That's because it is bumper to bumper traffic and is moving slowly for hours. This traffic creates

a smog-like setting and is not normal. It only happens on the busiest weekends of the year, such as the notorious Canada Day in July. Still, it is a relatively new issue that may pose potential future air quality problems.

After reviewing the available empirical scientific data and talking with a local air quality expert, I can conclude that Muskoka's air quality is **good**. Elite interviewee #3 posited information saying that the air quality is "fantastic" and "safe" to breathe, supporting the scientific evidence that suggests that the Muskoka Region has good air quality. However, future research should be conducted to estimate what types of demographics who live in or visit Muskoka may be degrading the region's air quality the most. Elite interviewee #3 posited a relatively new issue regarding air quality, expressing that on certain weekends there is a build-up of smog just off Muskoka's major highways due to an influx of people. Therefore, future research should be conducted to determine what types of people are coming up to Muskoka's on these weekends and why they may have the desire and ability to do so to find out who is causing this cloud of smog with reduced air quality and vision.

Erosion

After conducting extensive online research and talking with elite interviewee #4 (Table 1), I have concluded that there is little information about the current state of erosion in Muskoka. However, online data presents information about human activities that exacerbate erosion and gives reference to specific cases of bad erosion in Muskoka. For example, in a report by ecologist Kimberly Laframboise, she explained that residents on lakes tend to replace their native flora and fauna with grass, leaving their property vulnerable to surface erosion such as sheet erosion, wind erosion, and wave action (Laframboise, 2017). A news report online posted by Alison Brownlee states that there is "devastating" erosion on Cedar Lane in Bracebridge, where fluvial erosion such as rill, gully and tunnel erosion "is going to turn [this area] into a sinkhole," costing at least 350,000 dollars to repair and also poses public health and transportation risks (Brownlee, 2019). There is another case of bad erosion in Bracebridge, where a home was deemed "unlivable," forcing its longtime homeowner to abandon their seasonal residence (Higgins, 2019). Despite this empirical data, there is few online data that presents other information about what activities exacerbate erosion and specific cases of erosion in Muskoka.

The idea that there is little online data that presents information about erosion can be supported by Elite Interviewee #4 (Table 1), where it was stated that: “To the best of my knowledge, erosion information isn't collected by anyone, so I don't think there is a data source that would provide this information.” However, elite interviewee #4 briefly raised some new points about the current state of erosion in Muskoka and its main types and causes:

From doing the Love Your Lake Shoreline Assessment program, there are very few areas of severe erosion on the lakes we have surveyed. The impacts associated with the current state of erosion in Muskoka so far seem to be manageable for the Muskoka District and its citizens. However, the main types of erosion seen on shoreline properties tend to be undercut banks from wave action and some surface erosion patches in areas with fragile soils and little vegetation. These types of erosion are definitely exacerbated by human-caused effects such as wake boats and people who have cleared out most of the vegetation on their property. These types of erosion also are often more severe in construction areas where cottages are being built.

After reviewing the online data and talking with Elite Interviewee #4 about erosion in Muskoka, I can conclude that humans may exacerbate Muskoka's erosion. The effects of erosion can also start to be understood. Even though there is little data on the current state of erosion in Muskoka, Elite Interviewee #4 raised some points that could be further analyzed to better understand who is causing erosion in Muskoka and why. Specifically, points were raised regarding the activities that can exacerbate erosion, such as wave action, getting rid of the plant diversity and vegetation near a shoreline, and constructing a new cottage. Therefore, to better understand Muskoka's erosion and how to mitigate it, the demographic category that tends to participate in these erosions exacerbating activities merits further attention and analysis.

Flooding

Currently, Muskoka's water levels remain within the "normal range" (Brownlee, 2020). The Muskoka River Water Management Plant (MRWMP) can manipulate water levels to a certain extent through dams. The plan "allows for initially higher spring water levels resulting from melting snow, with a gradual release of water throughout the late spring and summer (Muskoka Water Web, 2020). Specifically, the MRWMP objective in the summer is to “maintain waterways at levels which allow for continued recreational use of lakes and rivers while at the same time maintaining water levels in sensitive aquatic environments” (Muskoka Water Web, 2020).

However, the Ministry of Natural Resources and forestry admits that Muskoka's dams are not able to control flood, as that function was not considered back when the dams were constructed (Muskoka Water Web, 2020). Here is what was explained in a news article geared towards the general public with regards to Muskoka's dams ability to mitigate floods:

Muskoka's Dams are not flooding controlled structures and have minimal capacity to store or hold back floodwaters, as they have little to no lake or reservoir capacity. As a result, in a large volume, rapid runoff flood, the dams have limited capacity to reduce peak water levels. The higher the flood event, the less ability the MNRF, MRWMP, and dam operators have to mitigate the associated impacts (Huddleston, 2020).

After analyzing the available online data, it is clear that Muskoka's current water management system is inadequate to manage the excessive water quantity that comes with a flood. Despite dam's inability to manage an excessive amount of water, Muskoka has suffered its second 100-year flood in six years (Macgregor, 2019). These floods have resulted in docks being torn away, boats left in boathouses crushed, debris flowing down the Muskoka River, and the closure of several local businesses (Macgregor, 2019). These floods occurred as a direct result of global to regional scale climate conditions (NRDC, 2019), and this is supported elite interviewee #2 and #4 (Table 1) as they stated that "from what I learned, read and understand, these floods are climate change related" and "climate change is the reason these floods were so intense," respectively. The District of Muskoka has also unveiled their predicted flood plain maps, warning its citizens that there could be a massive flood coming due to the anticipated regional climate conditions (Heatlie, 2020).

Therefore, all evidence points towards the conclusion that Muskoka does not have an adequate flood management system, climate change is the reason there is an anomaly in the number of floods, and there may be future floods that could present unfavorable conditions in the Muskoka Region. However, future research could potentially be acquired to gauge the feasibility of future development within Muskoka's floodplains, and if this development is possible, what demographic category may decide to go through with it. Future research could also be conducted to increase the District of Muskoka's ability to mitigate and adapt to the impacts of floods as their current floodplain map is outdated (Farmer, 2019).

Discussion: The Current State of Muskoka's Natural Environment

After reviewing available scientific monitoring data and conducting five elite semi-structured interviews, I can infer that Muskoka's environment is currently in good condition. However, what has not yet been assessed is the most significant risks to Muskoka's environmental components, such as its biodiversity, water quality, air quality, erosion, and flooding—the environmental components that make up the Muskoka Region. Although my expert elite interviewees suggested the most significant risks to Muskoka's environment are climate change and new development, further analyses are needed to fully understand these impacts and which stakeholders in the region may be driving them. This can be done by understanding the current perceptions about impacts on the natural environment of homeowners, seasonal residents, short-term visitors or tourists (the three stakeholders of the region), and how they may lead to actions and activities that could be increasingly putting stress on Muskoka's natural environment. Therefore, the next step in this report is to understand the historical state of Muskoka's environment and compare it to the current state to gauge the three stakeholders' values, how they changed from past to present times, and what this may mean for Muskoka's natural environment.

Results Continued: The Historical State of Muskoka's Natural Environment

To understand the current arrangement of Muskoka's environmental factors such as its biodiversity, water quality, air quality, erosion, and flooding, it is also helpful to understand the historical state of Muskoka's environment, what has changed, and, why. Specifically, if I understand the past values of the three stakeholder groups who resided in and visited Muskoka, then I can see how their values may have changed throughout time and what this meant for the composition and state of natural resources and wildlife in Muskoka. To do this, online data and the results from elite interviews will be referenced to provide a brief overview of the impacts that permanent residents, seasonal residents, and tourists had on Muskoka's environment, starting from the 1800s up until the present.

A report called *Understanding our Past to Protect our Future* does an excellent job explaining the historical state of Muskoka's environment, and what stakeholder group may have impacted it. Therefore, this report will outline the historical state of the environment and explain the relative impacts of each stakeholder group.

First, there is no denying that Muskoka's permanent residents were the leading cause of environmental degradation and land transformation in the region's early years. Specifically, starting in the 1800s, ecological degradation in the Muskoka Region occurred through the establishment of, and increase in locations of sawmills through the area (Muskoka Watershed, 2012). These sawmills were established by the locals who resided within the region as they made a living from cutting down trees, processing them, and selling them to the market. This land transformation resulting from extensive deforestation resulted in a "decline in biodiversity of the plants and animals" in the Muskoka Region, elite interviewee #1 explained (Table 1). This decline in biodiversity can also be supported by the Muskoka watershed council, where this deforestation "dramatically affected the mix and number of species in Muskoka's forests" (Muskoka Watershed, 2012). Starting in the late 1860s, permanent residents "entrepreneurial instincts" (Muskoka Watershed, 2012) saw that the construction of dams would allow for steamboat transportation, facilitating the transfer of goods and services. Although dams' construction generally allowed for an increase in revenue in the region, contributing to a thriving economy, the construction of these dams also negatively impacted fish stocks and migration. However, the extent to which is unknown (Muskoka Watershed, 2012). Shortly after, the demand for tanneries also increased. This increase in demand again elevated the overall revenue of the region and boosted the economy. However, the chemicals used in tanneries "extremely affected the water quality in Muskoka during that time period," as suggested by elite interviewee #2. After establishing tanneries, rail transportation soon followed, quickly expanding northward and generally "improved income opportunities for fleets of steamboats operating in Muskoka" (Muskoka Watershed, 2012). Then, in the middle of the 19th century, settlement and agriculture rapidly increased within the region, causing a rapidly evolving economy, fueling population growth. It can be estimated that close to 40% of Muskoka's land had been settled, with clearing underway (Muskoka Watershed, 2012). Also, at this time, the improved transportation by steam train and steamship and later by roads encouraged settlement and the development of small towns and villages (Muskoka Watershed, 2012).

Until this point, the only group of people who impacted the Muskoka Region was the permanent residents who already lived in or decided to settle in Muskoka. They were mostly a resource focused demographic that wanted to derive profit from extracting components of Muskoka's natural environment. Therefore, the degradation that occurred in Muskoka from the early 1800s until the early 1900s resulted from the economic expansion of permanent residents in

the region – "the need to accrue resources to sell them to secure a better livelihood," suggested elite interviewee #5 (Table 1). However, after this point in history, two new categories of demographics groups slowly started to visit the region and, therefore, were slowly gaining a "stake" in the region (tourists and then seasonal residents).

Although during the early 1900s, timbering and transportation drove settlement, human desire to experience nature amidst Muskoka's lakes, rivers, wetlands, and forests encouraged the start of tourism in Muskoka (Muskoka Watershed, 2012). It was not until the last two decades of the 19th century that the tourism industry began to flourish, and hotels and resorts opened up, attracting large numbers of tourists (Muskoka Watershed, 2012). This increase in tourism generally expanded Muskoka's economy and slowly started to transition the utility of the region, where it used to be solely valued for its natural wealth in the form of resource extraction, it was also a place to visit and enjoy the company of nature. Therefore, up until the end of the 19th century, the Muskoka Region was a mix of permanent residents and tourists. These demographics may have had very different values and ideas of what the Muskoka Region is best suited for. However, soon after tourists began to visit Muskoka, the ecosystem services Muskoka provided to its residents and visitors could not be denied, and seasonal residents started to buy land and visit Muskoka, slowly earning their own stake in the region.

As the 20th century dawned, "the natural beauty of the area spurred the development of cottages throughout the district" (Muskoka Watershed, 2012). There was soon a ton of seasonal homes, especially around Georgian Bay, Lake Joseph, Roseau, and Muskoka. These seasonal homeowners were "mostly residents of the greater Toronto area," said elite interviewee #5 (Table 1). These seasonal residents only had an average commute time of 2 hours, "showing the regions close proximity to Ontario's urban core," posited elite interviewee #3 (Table 1). This steady growth in cottage development that occurred from the 1960s until present started and has continued to "erode the viability of the resort and steamship industry," showing a stark decline in old resorts and the steamships that served them (Muskoka Watershed, 2012). Although the transition away from a resource-based economy to tourism and second-home development decreased the overall environmental degradation in the region, this decrease in resorts and subsequent increase in the development of new cottages/second homes has led to a much more significant impact on the shoreline environment of Muskoka, and, this impact is still quite present today (Muskoka Watershed, 2012).

Throughout Muskoka's history, what the region is best suited for has been continuously altered. Initially, the region was best suited for natural resource extraction. The region had an inherent natural wealth, which is what the permanent residents wanted from the region, showing a simple relationship between supply and demand. However, as time progressed, the region's natural wealth started to be degraded due to human practices, presenting relatively fewer trees and other wildlife that previously provided profits to local residents. This decline in capital and subsequent increase in awareness of the region's ecosystem services could provide, instituted tourism into the region, changing its historical values. As tourism increased, resource extraction decreased, slowly transitioning Muskoka's economy to be centered around tourism and seasonal home development, rather than resource extraction. Then, seasonal homes in the form of cottages started to rapidly increase in the region, again furthering the region's values that support a "seasonal/tourist" based economy.

This section of the report serves to explain how Muskoka's economy transitioned from being resources to a "seasonal/tourist" based economy and how that decreased the relative stress on Muskoka's environmental components such as its biodiversity and water quality. Therefore, by understanding the past values of the three stakeholder groups who resided in and visited Muskoka, we can see how their values may have changed throughout time and transitioned away from mass resource extraction. This idea that Muskoka's environment is currently in much better condition than during massive resource extraction in the form of tanneries and lumbering can be supported by elite interviewees #1, 2, and 3 (Table 1). Here is what they said, respectively:

Muskoka's environment is in much better condition than it was back to the days of lumbering. If you look back to a picture of Bracebridge during heavy days of lumbering, there were no trees in the downtown core. When you look now, the grow-back is impressive. The district of Muskoka has done a great job of preserving and revitalizing its natural environment. The district and its citizens have also started to realize the value of native vegetation.

Muskoka's water quality is much better than the time during tanneries where harmful chemicals leaked into Muskoka's watershed. In fact, I think just based on the water quality is much worse and the extensive lumbering that occurred back decades ago, Muskoka's environment is in much better condition now.

I think the values of the people in today's society are a lot better regarding environmental stewardship. Due to the increase in awareness that humans can destroy and alter the environment, I think they can increasingly mitigate their impacts on environmental

components. This idea is very real for Muskokans as I think both seasonal residents and locals care about the environment. They want to see it healthy and will go out of their way to help it. This is because they have a stake in the region, and therefore, their livelihood and property values are directly impacted by the state of Muskoka's environment.

Conclusion

After analyzing The Muskoka watersheds *Understanding our Past to Protect our Future* and conducting my interviews, I understand that Muskoka's environment is currently in better condition than during the period of high resource extraction. I also understand that seasonal residents and tourists stakes in the region increased, as there was a relatively higher population of these two demographics as history progressed. However, even though Muskoka's current state of the environment is better than historically, and that it remains in "good condition," the state of Muskoka's environmental components are still being altered, and the leading cause(s) and motivation(s) of these alterations merit future attention. Specifically, the Muskoka watershed council highlighted the increased stress on shoreline environments with more cottages being constructed in Muskoka. The main motivations and stakeholder group(s) who are developing these new cottages merits future attention. Also, as posited by elite interviewee #3 (Table 1), as a person's stake increases within the Muskoka Region, they tend to care about the surrounding natural environment.

Multiple sources of online evidence and content from the elite interviews point to the fact that permanent residents have the highest stake in the region and, therefore, care the most about the natural environment, followed by seasonal residents and then tourists. These same sources suggest that new development and the values tourists hold who visit the region may be the leading causes of the current land transformation and ecological degradation in Muskoka. However, this is not a straight cut line and requires the opinions of each stakeholder group.

REPORT 2: STAKEHOLDER PERCEPTIONS OF MUSKOKA'S NATURAL ENVIRONMENT

Introduction

One important goal of environmental education is to provide citizenry perspectives on various components of their experienced biophysical environment, making people aware of its associated problems, and encouraging work towards a meaningful solution (Newman & Fernandes, 2015). In doing so, researchers can explore the factors associated with the formation of environmental concern, which can motivate individuals to act pro-environmentally. However, researchers can also explore the factors that spur a culture of environmental indifference, which can lead to individuals degrading their surrounding environment. The idea that you can explore and understand the physiological factors related to environmental concern, developed by Dietz et al., is an increasingly important field of environmental education because of its ability to identify, predict, and control variables believed to be determinants of environmental concern and behavior (Newman & Fernandes, 2015).

In Report 1, I provided information on the current and historical anthropogenic threats to Muskoka's natural environment. It is necessary to understand the current state of Muskoka's natural environment to start to find out how the different perspectives of the stakeholders within the region may lead to differential impacts on its natural environment. In Report 1, I only briefly mentioned that permanent residents have the highest stake in the region and, therefore, care the most about the natural environment, followed by seasonal residents and then short-term visitors or tourists. I also briefly mentioned that the values that short-term visitors or tourists hold who visit the region may be the underlying cause of the current land transformation and ecological degradation in Muskoka. Report 2 builds off the empirical evidence and data from the elite interviews from Report 1. It aims to understand further the values that stakeholders hold which lead to the current ecological degradation and land alteration in the Muskoka Region.

This report seeks to contribute to the study of both environmental behavior and environmental education through developing, distributing and displaying the results of the 2020 Sustainability Stakeholder Survey (SSS). Precisely, this study gauges the environmental perspectives and attitudes of three different stakeholder groups in the Muskoka Region (short-term visitors or tourists, permanent and seasonal residents) to identify and predict the variables believed to be associated with environmental education and stewardship, how that may connect to the

relative environmental degradation within the area, and what stakeholder group may be the most responsible for it. In doing so, I hope to verify my original ideas posited in Report 1, where the higher a person's stake, the more environmentally conscious they will be, that short-term visitors or tourists are the leading causes of ecological degradation, and, new development is currently the most prominent risk to Muskoka's natural environment.

The survey consists of 18 questions, many of which examine the connection between a respondent's relative "stake" within Muskoka and their environmental concern, while others address my other two preliminary assumptions along with new topics.

Methods

The 2020 SSS includes results from 138 respondents' surveys over two weeks starting on Monday, June 15th and ending on Monday, June 29th, 2020. To collect the desired demographic of respondents to answer the 18 questions in the 2020 SSS (*Appendix A*), I posted flyers (*Appendix B*) around the Muskoka Region in four focus areas. The first type of focus location of posted flyers aimed to attract Muskoka's permanent residents, as they were posted in local areas that were estimated to have many permanent residents, attempting to get the highest number of respondents as possible (Figure 1.0). The second type of focus location of posted flyers aimed to attract survey responses from Muskoka's short-term visitors or tourists. They were displayed in areas where short term visitors or tourists were predicted to frequent (Figure 2.0). The third type of focus location of posted flyers aimed to attract survey responses from Muskoka's seasonal residents, as they were posted in spaces where seasonal residents often visit (Figure 3.0). The last type of focus location aimed to attract survey responses from all three of the stakeholder groups. I posted the flyers in places that were estimated high numbers of short-term visitors or tourists, permanent, and seasonal residents (Figure 4.0). Other methods of gathering survey responses were considered, but not implemented as it was not worth risking respondents' legitimacy to increase the number of respondents.

Results

The results from the 2020 SSS include responses from 54 seasonal residents (39%), 48 short-term visitors/tourists (34%) and 38 permanent residents (27%). I converted all results into percentages for comparison.

To measure the statistical significance of my results, I conducted a series of Pearson's chi-square tests. This test is designed to determine if there is a statistically significant difference between the observed and expected frequencies of results concerning one or more categorical variables. Questions 5-18 were analyzed with the different stakeholder positions as the categorical variables (short-term visitors or tourists, seasonal and permanent) and the survey response options as the measured frequencies. Of these, the results from Questions 14 and 16 proved not to be statistically significant ($P > 0.05$), while the remainder of the Questions 5-13, 15, 17 and 18 were statistically significant ($P < 0.05$). Question 9 was further analyzed with age brackets (18-25, 26+) as the categorical variables. These results proved to be statistically significant ($P < 0.05$). Question 10 was further analyzed with gender as the categorical variable (male, female, gender and non-binary). These results were also statistically significant ($P < 0.05$). In summary, all results that led to figures were statistically significant other than the results in Question 14 and 16 which should be considered when drawing conclusions from those figures. The exact p-values can be seen in the description below each unique graph (See *Tables and Figures*).

Questions 1 through 4 gauged the respondents' demographics and Question 5 documented the three stakeholder's reasons to visit or live within Muskoka. To make it easier to compile data, options 2 and 4 in Question number 5 were put together under "to enjoy the natural environment," having 5 possible answers instead of 6 (*Appendix A*).

The results from Question 5 showed seasonal residents, permanent residents and short-term visitors or tourists' reasons to visit or live within Muskoka. Seasonal residents' most frequent reasons to visit/live within the region were to recreate (28%), enjoy the natural environment (27%), and to escape busy and highly populated urban areas (24%). There was a small number of seasonal respondents that visit/live within Muskoka that wanted to learn about the region (14%) or secure their livelihood (7%) (Figure 5). Short-term visitors or tourists' main reasons to visit the Muskoka Region were to recreate (26%), learn about the region (25%), enjoy the natural environment (23%), and to escape busy and highly populated urban areas (21%). A small number of short-term visitors or tourists visited the region to secure their livelihood (5%) (Figure 6). Permanent residents' most frequent reasons to live within Muskoka were to secure their livelihood (30%), escape busy and highly populated urban areas (24%), to enjoy the natural environment (24%) and to recreate (20%). A small number of permanent residents lived within

the region that wanted to learn about the region (2%) (Figure 7). The results from Question 6 are not displayed as there were no meaningful correlations that could be analyzed or discussed.

The results from Question 7 show the stakeholder's preferred image of a lakefront cottage regarding its outdoor arrangement: manicured, natural or a combination of the two. Seasonal resident's most preferred option was a combination of the two (52%), followed by the natural look (25%) and the manicured look (13%). Short-term visitors or tourist's most preferred option was a combination of the two (54%), followed by the manicured look (31%) and the natural look (15%). Permanent resident's most preferred option was the natural look (70%), followed by a combination of the two (26%) and manicured look (4%) (Figure 8). The results from Question 8 display stakeholder's opinions of the greatest threat to Muskoka's natural environment. Seasonal resident's most selected option was new development (52%), followed by plastic, litter, and chemical pollution (43%). Short-term visitors or tourist's most desired option was plastic, litter, and chemical pollution (60%), followed by new development (27%). Permanent resident's most desired option was new development (79%), followed by plastic, litter, and chemical pollution (15%). There was a small total percentage of responses between the three stakeholder groups for the categories of boating and other recreational activities and local air pollution (7%) (Figure 9).

The results from Question 9 show stakeholder's opinion on whether climate change threatens Muskoka's natural environment. Seasonal resident's most answered option was definitely yes (44%), followed by probably yes (43%). Seasonal residents did not have many answers in might or might not, probably not and definitely not (13% total). Short-term residents or tourists most answered option was probably yes (33%), followed by definitely yes (31%). Short term residents or tourists did have a lot of answers in the remaining question options (36%). Permanent resident's most answered choice was definitely yes (62%), followed by probably yes (35%). Permanent residents did not have many answers in the remaining 3 answer options (3% total) (Figure 10). The results from Question 10 display stakeholders' care for the health and sustainability of Muskoka's natural environment. Seasonal resident's most answered option was strongly agree (67%), followed by agree (30%). Seasonal residents did not have many responses for somewhat disagree, somewhat agree, neither agree nor disagree, disagree, and strongly disagree (3% total). Short-term residents or tourist's most preferred answer was strongly agree (56%), followed by agree (20%). Short-term residents/tourists did have many responses to the remaining answer options (24% total). Permanent resident's most preferred answer was strongly

agree (60%), followed by agree (40%). Permanent residents had no answers in the remaining options (0%) (Figure 11).

The results from Question 11 show stakeholder's willingness to change their behaviors to reduce their impact on Muskoka's natural environment. Seasonal residents most frequently chosen option was agree (41%), followed by strongly agree (33%) and somewhat agree (20%). Seasonal residents did not have a lot of answers in neither agree nor disagree (2%), somewhat disagree (1%), disagree (3%), and strongly disagree (10%). Short-term visitors or tourists most frequently answered option was strongly agree (35%), followed by agree (31%) and somewhat agree (13%). Short-term visitors or tourists did not have many answers in the remaining categories (21% total). Permanent residents most frequently chose response was strongly agree (67%), followed by agree (23%). Permanent residents did not have many answered in the remaining categories (10% total) (Figure 12). The results from Question 12 show stakeholder preference for building or buying a cottage. Seasonal residents most prefer to build their own cottage (45%), followed by wanting to buy one that already exists (20%), having already built their own (15%), and bought one that already existed (20%). Short-term residents or tourists most prefer to build their own cottage (58%), followed by wanting to buy one that already exists (42%). Short-term visitors or tourists did not have any answers in the remaining categories (0% total). Permanent residents most prefer to buy a cottage that has already been built (58%), followed by wanting to buy one that already exists (15%), having already built their own (12%), and bought one that has already been built (15%) (Figure 13).

The results from Question 13 display the stakeholder's perspective on what type of economy the Muskoka Region is best suited for. Seasonal resident's most preferred perspective was a combination of the two (70%), followed by recreational/tourists-based jobs (30%). Seasonal residents did not have any responses in the remaining category of resource-based jobs (0%). Short-term visitors or tourist's most preferred perspective was a combination of the two (67%), followed by recreational/tourists-based jobs (33%). Short-term residents or tourists did not have any responses in the remaining category (0%). Permanent resident's most preferred perspective was a combination of the two (50%), followed by recreational/tourists-based jobs (38%). Permanent residents did have answers in the remaining category (12%) (Figure 14). Question 14 documented stakeholder's ideal image of the future for the Muskoka Region. Seasonal resident's most desired answer was to leave it the same (66%), followed by transition to more development (19%) and

transition to more resource (15%). Short-term visitors or tourist's most desired answer was to leave it the same (71%), followed by transition to more resource (16%) and transition to more development (13%). Permanent resident's most desired answer was to leave it the same (76%), followed by transition to more resource (17%), and transition to more development (7%) (Figure 15).

The results from Question 15 show stakeholder's opinions on development in the Muskoka Region. Seasonal resident's most preferred answer was that it should remain (44%), followed by it should decrease (40%). Seasonal residents did not have many answers for the categories it should stop (9%), and it should increase (7%). Short-term visitors or tourist's most preferred answer was it should remain (45%) followed by it should decrease (29%) and it should increase (24%). Short-term visitors or tourists did not have many answers for the category it should stop (2%). Permanent resident's most preferred answer was it should decrease (68%). Permanent residents did not have a lot of answers for it should remain (13%), it should stop (13%), and it should increase (6%) (Figure 16). Question 16 documented stakeholder's opinions if they would like to have more access to chain restaurants or stores while living in or visiting Muskoka. Seasonal resident's most frequent answer was yes (85%), followed by no (15%). Short-term visitors or tourist's most frequent response was "no" (76%), followed by "yes" (24%). Permanent resident's most frequent answers was "no" (86%), followed by "yes" (14%) (Figure 17).

The results from Question 17 display stakeholder's opinions on their preferred cottage aesthetic. Seasonal resident's most preferred answer was a combination of the two (51%), followed by hidden (38%) and stand out (11%). Short-term visitors or tourist's most preferred answer was a combination of the two (60%), followed by stand out (20%) and hidden (20%). Permanent resident's most preferred answer was hidden (85%), a combination of the two (12%), and stand out (3%) (Figure 18). The results from Question 18 show stakeholder's perspectives on which stakeholder group they think has the most significant impact on Muskoka's natural environment. Seasonal residents most frequently answered option was short-term visitors or tourists (63%), followed by seasonal residents (20%), and permanent residents (17%). Short-term visitors or tourists most frequently answered question option was short-term visitors or tourists (43%), followed by permanent residents (30%) and seasonal residents (27%). Permanent residents most frequently answered option was short-term visitors or tourists (88%), followed by seasonal residents (9%) and permanent residents (3%) (Figure 19).

The results from the graph “Gender’s Relative Care About Muskoka Environment” show the degree of care for Muskoka’s natural environment by gender. Male's most preferred option was strongly agree (66%) followed by agree (26%). The remaining options were barely chosen (8% total). Female's most preferred choice was strongly agree (55%), followed by agree (33%). The remaining option were barely chosen (11%). Non-binary’s data cannot be interpreted due to a lack of respondents (3) (Figure 20). The results from the graph “Views on Climate Change by Age” show stakeholder’s opinions on whether or not climate change threatens the natural environment of Muskoka by age. 18-25-year-olds most frequently answered option was probably yes (47%), followed by definitely yes (29%), might or might not (11%), probably not (11%), and definitely not (2%). Respondents over the age of 25 most frequently answered option was definitely yes (67%), followed by probably yes (20%), might or might not (10%), and probably not (3%). Respondents over the age of 25 had no responses in definitely not (0%) (Figure 21).

Discussion

The point of the 2020 SSS was for me to try to understand the average values of each stakeholder group to comprehend why Muskoka's environment is in its current state, what values may be leading to the increase in ecological degradation, and, how this may impact the future sustainability of the region. In order do to this, I will analyze and discuss the results from each unique question, explaining why a person's amount of time in a region may impact their behaviors towards the environment and views on other environmental influences such as new development, climate change, and recreational activities. To do this, I am going to discuss three different types of results. The first type of results aligns with my original thoughts, while the second talks about the results that stakeholders had in common and the third displays new ideas for future research that could be done to enhance this report's saliency.

Type 1: Confirmation of Original Ideas

The first type of results are geared towards understanding how a person's stake can impact their environmental behaviors within the Muskoka Region. This section contains data from questions in the 2020 SSS and will prove my original thoughts in report 1. Specifically, I will analyze the data from these questions chronologically. They will all show that as a person's stake increases in Muskoka, their values, attitudes, knowledge, or behaviors become more

environmentally conscious, presenting a potential decreased impact on their surrounding environment.

In Question #5, stakeholders were asked about their reasons to visit or live within the Muskoka Region and permanent residents most popular choice was to secure for their livelihood (30%), as opposed to seasonal residents (7%) and short-term visitors/tourists (5%) (Figure 5,6 and 7). These statistics support the fact that permanent residents have the highest stake in the region, followed by seasonal residents than tourists. This idea can be backed by elite interviewee #3, where "seasonal residents and locals care about the environment. They want to see it healthy and will go out of their way to help it. This is because they have a significant stake in the region, and therefore, their livelihood and property values are directly impacted by the state of Muskoka's natural environment" (Report 1, Historical State). Also, permanent residents wanted to learn about the region the least (2%), followed by seasonal residents (14%) and short-term visitors or tourists (25%) (Figure 5,6 and 7). Permanent resident's diminished desire to learn about the Muskoka Region implies that a person may be less interested in learning about Muskoka as their relative stake increases because they have inhabited it enough to acquire a sufficient amount of information. Therefore, the results from Question 5 align with not only the idea that permanent residents have the highest stake in the region, followed by seasonal residents than short-term visitors or tourists but also the fact that permanent residents may be the most informed about the regions environmental issues, showing a potential correlation between environmental education and environmental stewardship. Therefore, I believe it is pertinent to understand that permanent residents have the highest stake within the region, followed by seasonal residents and tourists as this will be assumed for the remainder of this proposal in order to connect that idea to the results of the 2020 SSS through analyzing and then drawing conclusions.

In Question #7, respondents were questioned about their preferred image of a lakefront cottage, and short-term visitors more frequently preferred a manicured look (31%) in comparison to seasonal residents (13%) and permanent residents (4%) (Figure 8). These statistics show a correlation between an increased stake in the region and aesthetic opinions that minimize harm. This trend primarily reflects the values of the different stakeholder groups. As a person's stake increases in Muskoka, their opinions are more cognizant of the region's environmental health. This increased stake equates to a decreased impact on Muskoka's lakefront environments because manicured lawns are significantly worse for Muskoka's environment than those left in a more

natural state. Manicured lawns have less of an ability to buffer harmful chemicals and nutrients from entering Muskoka's watershed (John Wright, 2019). These harmful pollutants could have detrimental effects on both human health and biodiversity. In conjunction with this, the results from this question also support the ideas posited by elite interviewee #2 (Table 1) regarding short-term visitors or tourists tending to prefer manicured lawns down to the water. This preference is the exact aesthetic that many large resorts in Muskoka offer, contributing to non-point source runoff of harmful chemicals into Muskoka's watershed (Report 1, Water quality). Therefore, although some seasonal residents and permanent residents prefer a manicured lawn, I believe the values that tourists hold may be the most influential cause of the current environmental alterations seen to Muskoka's lakefronts and the potentially harmful environmental impacts that come with those alterations.

In Question #8, stakeholders were asked about their opinion on what local activity presents the greatest threat to Muskoka's natural environment, and the majority of permanent residents believed it to be new development (79%), followed by seasonal residents (52%) and short-term visitors or tourists (27%) (Figure 9). These statistics show a correlation between an increased stake in the region and knowledge of what local activity presents the greatest threat to Muskoka's environment. In an environmental assessment developed by the District of Muskoka, it was stated that the new development is the current local activity that presents the greatest threat to Muskoka's environment (District of Muskoka, 2017). This idea aligns with the thought that as a person's stake increases in Muskoka, their awareness of what local activity actually presents the highest threat to Muskoka elevates, as permanent residents have the most significant stake within the region and the best idea of its greatest environmental threats. This awareness suggests that permanent residents are the most informed about what local activity affects Muskoka's environment and may explain the different values that each stakeholder group has and how that may impact the way they choose to treat Muskoka's surrounding natural environment. In a report called *Informed People Make Better Environmental Decisions*, it was stated that the more knowledgeable a person is on an environmental issue, the more likely they are to mitigate their impact on that given issue due to their increased awareness (News Staff, 2010). Therefore, I believe it may be true that permanent residents have the smallest impact on Muskoka's environment, followed by seasonal residents than short-term visitors or tourists, as they seem to be the most educated group on the Muskoka Region's most pressing environmental issue.

In Question #9, respondents were asked their opinion on whether climate change threatens Muskoka's natural environment, and a clear majority of permanent residents answered either definitely yes or probably yes (97%) (Figure 10). Seasonal residents and short-term visitors or tourists also respectively had a majority of responses in either defiantly yes or probably yes (87%) (64%) (Figure 10). These statistics show a correlation between a more substantial stake within Muskoka and an increased belief that climate change threatens its natural environment. This correlation is not only evident in the total responses for defiantly yes and probably yes, as permanent residents have the highest percentage, followed by seasonal residents and tourists, but can also be seen in the total percentage responses in the remaining categories. Permanent residents had the smallest amount of responses in the remaining categories of might or might not, probably not, and defiantly not (3%), followed by seasonal residents (13%) and short-term visitors/tourists (36%) (Figure 10). After analyzing the data from Question 9, it is clear that as a person's stake within the Muskoka Region becomes larger, their belief in whether climate change threatens the natural environment increases. This significant belief is probably because permanent residents are the most informed about the region's environmental issues as they more commonly rely on the region for employment than any other stakeholder group and may recognize the threat that climate change presents to their livelihood. The idea that climate change definitely or probably threatens Muskoka's natural environment can be supported by exterior research. According to the Muskoka Regional Website, the greatest threat to the Muskoka is climate change (Merton, 2015), as there has been a substantial increase in extreme weather events such as heatwaves, floods, and storms (Muskoka Watershed Council, 2020). Therefore, it was correct for the substantial majority of permanent residents (97%) to believe that it was either definite or probable that climate change threatens Muskoka's natural environment (Figure 10). I believe that permanent residents are the most informed about the effects of climate change on Muskoka's natural environment because they have the largest stake within the region, implying that they care a great deal about the estimated effects of climate change on their livelihood.

In Question #10, stakeholders were asked about their care for the health and sustainability of Muskoka's natural environment, and permanent residents' most popular answers were strongly agree (60%) and agree (40%). Seasonal residents' most popular answers were strongly agree (67%) and agree (30%), although they also answered somewhat agree (3%). Short-term visitors or tourists' most popular answers were strongly agree (56%) and agree (20%), although they also had answers

in somewhat agree (4%), neither agree nor disagree (8%), disagree (8%) and strongly disagree (4%). These statistics show a clear correlation between an increased stake within the Muskoka Region and care for Muskoka's natural environment's health and sustainability. Permanent residents had the highest number of answers in strongly agree and agree (100%), followed by seasonal residents (97%) and short-term visitors or tourists (76%) (Figure 11). Therefore, I believe these statistics align with the idea that as a person's stake increases, they care more about the health and sustainability of Muskoka's natural environment, implying a potential connection between an increased stake and decreased impact on Muskoka's environment.

In Question 11, respondents were asked about their willingness to change behaviors and activities within the Muskoka Region to reduce their impact on the natural environment. All stakeholders had their majority of answers in strongly agree and agree. Permanent residents, however, had the most responses (90%), followed by seasonal residents (74%) and short-term visitors or tourists (66%) (Figure 12). These results, similar to that of Question 10, align with the idea that as a person's stake increases in the Muskoka Region, their willingness to change their behaviors to reduce their impact on the natural environment increases. Therefore, I believe that as a person's stake increases, they are more willing to change their behaviors to reduce their impact on Muskoka's natural environment, showing a direct relationship between a person's stake in the region and how that affects their relative impact on their surrounding environment.

In Question 12, stakeholders were asked about their preference for building or buying a cottage. Permanent residents most common answer was that they would prefer to buy one that already exists (58%), followed by them preferring to build their own (15%), having bought one that has already been built (15%), and having built their own (12%). Seasonal residents most common answer was that they would prefer to build their own (45%), followed by preferring to buy one that already exists (20%), having bought one that has already been built (20%), and having already built their own (15%). Permanent residents also have a much higher proportion of responses in I would prefer to buy a cottage that already exists (58%). In contrast, seasonal residents had a higher proportion of responses in preferring to build their own (45%) (Figure 13). The data from short-term visitors or tourists is not important as their preferences do not need to be considered because none of them answered that they own a cottage (0%). The results from this question align with the idea that as a person's stake increases in Muskoka, their preference for building or buying a cottage becomes more environmentally friendly, as buying a cottage that

already exists is better for the environment. The development of a new cottage can be terrible for Muskoka's natural environment as it can pollute the water, resulting in cut down trees and harming wildlife (Blinch, 2017). Therefore, I believe that the values that seasonal residents hold tend to be more harmful to the natural environment of Muskoka as they may have built more cottages throughout the years, leading to potentially more environmental degradation. This question also supports the idea that permanent residents have the highest stake in Muskoka, followed by seasonal residents and then tourists. Permanent residents own a good portion of cottages (27%), even though "the majority of permanent residents live off the lake," explained elite interviewee 3 (Table 1) (Figure 13). Although seasonal residents have a higher percentage of responses for owning a cottage (35%), they do not live within the region full time and depend on it less for their livelihood, showing a decreased stake relative to permanent residents. According to the 2020 SSS, short-term visitors or tourists do not own any cottages or live within the region (0%), showing their small stake relative to seasonal residents. Therefore, I believe the results from Question 12 show that Permanent resident's preference for building or buying a cottage is the most environmentally friendly, and that they have the most significant stake in the region, followed by seasonal residents and short-term visitors or tourists.

In Question #15, respondents were asked about their opinion on development in Muskoka, and permanent resident's most popular response was it should decrease (68%). Seasonal residents' most popular two answers were that it should remain (44%) and decrease (40%). Short-term visitors or tourist's most popular three answers were it should remain (45%), followed by it should decrease (29%), and it should increase (24%). The majority of permanent residents think development should decrease or stop (81%), while the majority seasonal resident want development to either remain or increase (51%) and the majority of short-term visitors or tourist also want it to remain or increase (69%) (Figure 16). Therefore, I believe these results align with the idea that as a person stake increases within Muskoka, their relative opinion on development becomes better for the environment, as permanent resident's values were the most against development, the largest current threat to Muskoka's natural environment, followed by seasonal residents and short-term visitors or tourists.

In Question #17, stakeholders were asked about their opinion on their preferred cottage aesthetic, and a clear majority of permanent residents preferred to have it hidden (85%), compared to less than half of seasonal residents (38%) and short-term visitors or tourists (20%) (Figure 18).

These statistics align with the idea that as a person's stake increases within Muskoka, their opinions on preferred cottage aesthetic are more aware of the surrounding natural environment, showing a potential decrease in impact. According to a study on riparian buffer protection, cutting down trees next to the water eliminates the surrounding environment's ability to buffer harmful chemicals from entering the lake (Skyes, 2019). "It also obstructs other cottager's views and is a sign of little experiencing having a cottage on a lake and a lack of environmental stewardship," said elite interviewee #4 (Table1). Therefore, I believe that permanent residents may treat their cottage's surrounding environment, especially trees, with the most respect followed by seasonal residents and then short-term visitors or tourists.

In Question #18, respondents were asked about their perspectives of which stakeholder group has the most significant impact on Muskoka's natural environment and permanent residents most answered response was short-term visitors or tourists (88%), as were seasonal residents (63%) and short-term visitors or tourists (43%) (Figure 19). The data from this question supports the idea that as a person's stake increases within Muskoka, their impact on the environment decreases. This idea, according to elite interviewee #5, is because "people who live in a region full-time tend to treat it well, as that is the main environment they inhabit. However, as a person's stake decreases, they may care less about the environment because they increasingly do not have to deal with or see the consequences of their actions" (Table 1). This question not only aligns with my original idea that seasonal residents may be the most significant negative impactors of Muskoka's natural environment but also serve to support the fact that all stakeholders (even short-term visitors or tourists) believe that short-term visitors or tourists have the biggest impact on Muskoka's natural environment. The fact that short-term visitors or tourists most answered response was themselves shows their acknowledgment that they may be the biggest stressors on Muskoka's natural environment.

Although I believe that short-term visitors or tourists have the biggest impact on Muskoka's natural environment, I want to acknowledge that permanent residents barely even answered themselves as being the biggest impactors on Muskoka's natural environment (3%) (Figure 19). This small number of responses may show a lack of ownership for permanent residents because they could be a significant cause of land alteration and ecological degradation in the Muskoka Region.

The results and discussion from the questions leading up until this point align with my original idea that as a person's stake increases in Muskoka, their values, attitudes, knowledge, and behaviors become more environmentally conscious, showing a potential decreased impact on their surrounding environment. Although this study is not definitive, it can be said that permanent residents have may have the smallest impact on Muskoka's natural environment, followed by seasonal resident and short-term visitors or tourists.

Type 2: Stakeholders Agreement on Various Topics

The second type of results show how stakeholder groups can agree on topics regarding the Muskoka Region. This section contains the results from Questions #13, 14, and 16, where stakeholders were largely able to agree on the type of economy Muskoka should have, their ideal image of the future for the Muskoka Region, and if there should be more access to chain restaurants or stores. Therefore, these questions will help write report 3, as I will be trying to balance the values of all stakeholders and propose a sustainable future for the Muskoka Region.

In Question #13, respondents were asked about their perspective on what economy the Muskoka Region is best suited for, and all stakeholders had similar responses. Permanent residents had a higher proportion of responses in a combination of the two (50%), as did seasonal residents (70%) and tourists (67%). Permanent residents had a lower proportion of responses in recreational/tourists-based jobs, such as working for a brewery or owning a sailing camp (38%), as did seasonal residents (30%) and tourists (30%) (Figure 14). These results support the fact that the current state of Muskoka's economy is a combination of resource-based jobs and recreation, as Muskoka's economic strategy (The District Municipality of Muskoka, 2012) is to offer both of these types of jobs, and that is precisely what each stakeholder group wants.

In Question #14, stakeholders were asked about their ideal image of the future for the Muskoka Region, and they all stakeholder had similar responses. Permanent residents had the most answers in "the same" (76%), followed by short-term victors or tourists (71%) and seasonal residents (66%) (Figure 15). These statistics show a similarity between all stakeholders regarding their ideal image for the future of the Muskoka Region.

In Question 16, respondents were asked if they would like to have more access to chain restaurants or stores, and all stakeholders had similar responses. Permanent resident's most popular answer was no (86%), followed by yes (14%). Seasonal resident's most popular answer was no

(85%), followed by yes (15%). Short term visitors or tourist's most popular answer was no (76%) followed by yes (24%) (Figure 17). These statistics show an apparent similarity in responses between all stakeholder groups and their opinion on whether they would like to have access to chain restrains or stores as all stakeholder groups have a clear majority of responses in the category no.

The results from Question #13, 14, and 16 will be helpful in report 3, where I will propose a sustainable pathway into the future for the Muskoka Region. The data analysis from these questions will help balance each stakeholder group's values, as some agreements can be drawn between all demographics. For example, permanent residents, seasonal residents, and short-term visitors or tourists all can agree on what type of economy the Muskoka Region is best suited for currently and moving into the future. This agreement is a huge step forward in regards to understanding the desires of each stakeholder group, as I can now more effectively balance and address each stakeholder's values to mitigate the harm on Muskoka's natural environment while still offering each group with the ability to continue and maybe even enhance their utilization of the region.

Type 3: Prospect for Future Research

The last type of results display combined data from different questions to examine the connection between gender, age, and care for topics related to Muskoka's environment. The analysis of these results is an excellent idea for future research as little to no conclusions can be drawn out of these two phenomena given the data I have from the questions in the 2020 SSS.

When asked about their relative care about Muskoka's natural environment, each gender's response was different (Figure 20). Male's most common answers were strongly agree (66%) followed by agree (26%), equating to the majority of responses (92%). Females most common answers were strongly agree (55%) and agree (33%), equating to the majority of responses (88%). The data for non-binary individuals cannot be discussed due to a lack of responses (3) (Figure 20). These statistics do not align with exterior research as, on average, females tend to care "more about environmental problems and [are] more willing to adopt environmental behaviors" (Hunt, 2020).

Similar to the analysis of gender, the connection between views on climate change and age can be understood. When questioned about their views on climate change, a clear majority of people over the age of 26 (87%) believed that climate change either definitely or probably threatens

Muskoka's natural environment. Although most respondents aged 18-25 believe that climate change would either definitely or probably threaten Muskoka's natural environment, a smaller number of them believed this to be true (76%). These results also do not align with exterior research, as younger people tend to care more about global issues such as extreme poverty and climate change (Winston, 2019). Therefore, I believe that future research should be conducted on the effect of gender and age on environmental attitudes and behaviors within the Muskoka Region to gauge what demographics may degrade the environment, don't care relatively as much about the future of the region, and why.

Conclusion

The results of the 2020 SSS largely reflect my original assumptions. It is indeed the case that as a person's stake increases within the Muskoka Region, they are increasingly educated, willing, and able to engage in activities and behaviors that do not degrade Muskoka's natural environment. It is also the case that new development may be the leading current cause of ecological degradation and land transformation in the Muskoka Region, and the values that short-term visitors or tourists hold tend to be the most impactful on Muskoka's natural environment. This was extremely clear in many of the results from the 2020 SSS, as the majority of questions supported one of the phenomena mentioned above that I predicted at the end of Report 1.

Some of the results show a similarity of responses between all stakeholder groups, making it easier to propose an equitable and sustainable pathway into the future. These results, specifically the data and analysis from Questions #13, 14, and 17, are highlighted in Report 3, as it would make sense to include the wants of each stakeholder group from these specific topics as they all are more-or-less agreed upon by every demographic.

The last set of results, type 3, suggests the need for new research to enhance this study's saliency further. Specifically, the connection between gender, age, and environmental topics such as climate change and care about Muskoka's environment were discussed. However, there was not enough sample size to draw out any significant results, as the only results that were seen did not reflect outside research, suggesting that it should not be used for discussion or conclusive purposes. Therefore, I believe future research should be done regarding age, gender, and various topics related to Muskoka's natural environment.

As a whole, I think the 2020 SSS was extremely successful in gauging each stakeholder group's values. There are clear correlations that can be seen between a person's relative stake, the values they hold, and how that affects the surrounding environment. I also think this report was successful in informing a proposal for the future that balances each stakeholder group's values while allowing for an increase in sustainability measures to aid the health of Muskoka's natural environment. Therefore, in the final and following report, I will use the findings of this report to propose a sustainable and equitable future for all who inhabit or visit the Muskoka Region.

REPORT 3: PROPOSING A SUSTAINABLE FUTURE FOR THE MUSKOKA REGION

Introduction

The goal of this summer research initiative is to propose a pathway towards a sustainable future for the Muskoka Region. This means that I will display eco-friendly suggestions to each stakeholder group to alleviate their personal and aggregate impact on Muskoka's natural environment, thereby making it more "sustainable." To do this, I had to more thoroughly understand the values that short-term visitors or tourists, seasonal and permanent residents may have that impact Muskoka's natural environment. It is beneficial to understand each stakeholder group's values that lead to environmental degradation when trying to propose a sustainable and equitable future for all who inhabit or visit the Muskoka Region. This is because it allows me to assess both the actual causes of environmental degradation and the perceptions of the causes of environmental degradation and, thus, what can be done to mitigate them in the context of stakeholder views. The available online empirical scientific data, expert opinions on Muskoka's environment, and responses from a broader public survey are required to advance solutions. They have all helped to make this report more credible, salient, and legitimate, allowing the possibility to propose such solutions.

It is with great pleasure that I can say that I have helped to make this possible, as the results of the 2020 SSS show apparent discrepancies between stakeholders and also present data that can be useful when suggesting how each stakeholder can become a better steward of the environment, showing a potential overall decreased impact on Muskoka's natural environment. Below you will see suggestions that can help each stakeholder group become more conscious of the impacts they may cause in the hope that they take it upon themselves to make the necessary behavioral and mental changes to reduce their impact on Muskoka's natural environment. In a report called *Environmental Education and Stewardship*, the connection between environmental consciousness and a decreased individual impact on a surrounding environment is discussed. Expressly, it was stated that as people become more aware of what negative impacts their daily actions may cause on their surrounding environment, they will be more inclined to adjust some of those actions to be relatively less harmful (Larson, 2020). Therefore, I attempt to increase every stakeholder's consciousness of what actions they may engage in that degrade Muskoka's environment in hopes that they change their behaviors to reduce their overall impact, increasing the region's sustainability threshold. Below you will see four categories. The first category is geared towards

permanent residents, while the second is for seasonal residents, and the third is for short-term visitors or tourists, all of which have unique suggestions for their intended stakeholder group on how to reduce their impact on Muskoka's natural environment. The final section includes my ideas for prospective future research and planning to enhance the overall strength, resilience, and sustainability of the very precious and unique Muskoka Region in Ontario, Canada.

Category 1: Permanent Residents

According to the results of the 2020 SSS, permanent residents may have the smallest impact on Muskoka's natural environment relative to any other stakeholder group. Despite this, efforts can still be made to enhance the sustainability efforts of Muskoka's permanent residents. When permanent residents were asked which stakeholder group had the most significant impact on Muskoka's environment, a minimal number of them answered themselves (3%) (Figure 19). This small number of responses shows a lack of ownership. Permanent residents live in the region all year round, and may underestimate the total impact they have in doing so. This lack of ownership may also be a result of spitefulness that permanent residents hold towards seasonal residents and tourists, as "they are jealous that seasonal residents and tourists can better access Muskoka's watershed even though permanent residents live there all year," posited elite interviewee #5 (Table 1). This potential lack of ownership may lead to permanent residents impacting Muskoka's environment more than anticipated, as permanent resident's average opinion of their severity of impacts could be more than perceived. Therefore, I think that permanent residents need to more actively think about the effects that their daily actions may have on Muskoka's environment, as they may be too comfortable in the fact that they believe they are the best stewards of Muskoka's environment, in comparison to seasonal residents and short-term visitors or tourists. Therefore, the findings from my summer research initiative are pertinent for permanent residents to understand and learn from as they reveal the historical and current impacts on Muskoka's environment and how they were caused. Here are some brief numbered suggestions I have made to help permanent residents reduce their impact on Muskoka's natural environment:

1. Take ownership for degradations that you may be causing (think: year-round daily activities) and continue trying to learn new things that can promote sustainability.

2. Work with, not against, the other stakeholder within the region, as collaboration is the key to sustainability.
3. Acknowledge that these results are summative, meaning they show the average responses across all categories. They by no means absolve permanent residents of responsibility. Please consider the impacts discussed in reports 1 and 2, and if you participate in any of them, try to mitigate your impacts as much as possible.

If permanent residents adopt these values, then it may be true that Muskoka's future could be more sustainable, as permanent residents have the most significant stake within the region, and therefore, what they say and do matters.

Category 2: Seasonal Residents

According to the results of the 2020 SSS, seasonal residents may have the second-largest impact on Muskoka's natural environment. Specifically, seasonal residents own the greatest number of cottages compared to that of any other stakeholder group (35%) (Figure 13), and new development, especially in the form of cottages, may be the leading cause of degradation within the region (Figure 9). Also, the majority of seasonal residents would prefer to have their cottage stand out or a combination of the two (62%) (Figure 18). I suggest that if the seasonal residents who own a cottage decided to more frequently prefer that their cottage be hidden behind trees and other native shrubbery, there would be less ecological degradation due to land alterations around seasonal residents' cottages. For the seasonal residents who do not own a cottage, I suggest that they focus on their preferred image of a lake-front cottage to reduce their relative environmental impact. The majority of seasonal residents preferred either a manicured look or a combination of the two (65%) (Figure 8). If seasonal residents who visit or rent a lake-front cottage decided to adjust their values to prefer a natural look, then the people offering those accommodations may be more inclined to leave their property unscathed. This adjustment of values could result in a decreased impact on Muskoka's biodiversity and water quality. For all seasonal residents, I suggest that they acknowledge their unique and seasonal impact on Muskoka's environment and economy. When the summer months approach, a massive influx of seasonal residents in the region results in substantial changes to Muskoka's environment, usually in the form of new development and recreation (Figure 5). If seasonal residents are more cognizant of how to develop and recreate more sustainably, Muskoka's environment could be

better relative to its current state. Here are some brief numbered suggestions I have made to help seasonal residents reduce their impact on Muskoka's natural environment:

1. Buy an old cottage instead of a new one. This will eliminate the need for new land clearing in order to develop a cottage.
2. If you already have a cottage, or really feel the need to build your own, cut down as few trees as possible and don't alter native vegetation. This harms the soil's ability to buffer harmful nutrients from entering Muskoka's watershed, decreases the overall terrestrial and aquatic biodiversity, and obstructs other cottagers' views of a natural shoreline.
3. When visiting or renting a cottage, ask if they have taken out their native vegetation. This not only will help others understand why this is bad for Muskoka's natural environment, but may sway property owners to start to adjust their image of a lake-front cottage, as their customers are demanding a more natural and sustainable look.
4. When launching boats, make sure they are clean to avoid the spread of invasive species.
5. When driving boats, be cognizant of the impacts your boat has on wave activity, exposition of products and byproducts, and noise pollution. A detailed essay is available in *Appendix C* that more thoroughly outlines how a boat may negatively impact a freshwater system and how you can regulatorily and individually mitigate these impacts.

If seasonal residents adopt these values, it may be true that Muskoka's future could be more sustainable, as seasonal residents are the second largest contributor to the ecological degradation that the Muskoka Region currently experiences.

Category 3: Short-term Visitors or Tourists

According to the 2020 SSS, short-term visitors or tourists have the most substantial impact on Muskoka's natural environment. There are, however, significant efforts that can be made to reduce their impact on Muskoka's environment. Specifically, short-term visitors or tourists are the least caring and willing to change their behaviors to reduce their impact on Muskoka's natural environment. This may be because they have the smallest stake within Muskoka and are affected the least by the degradations that the region may be experiencing. However, short-term visitors or tourists should realize that pristine environments, such as Muskoka, are becoming increasingly harder to come by, as the age of the Anthropocene is causing rapid land alterations and degradation all around the world. Therefore, short-term

visitors or tourists should take it upon themselves to be good stewards of Muskoka's environment because the exact values they hold regarding having a small stake and a significant environmental impact are contributors to the global environmental degradation that Earth is experiencing (The World Counts, 2020). In addition, seasonal residents' preference for things such as their ideal cottage aesthetic or development in the region could be more environmentally friendly. For example, short-term residents most frequently prefer to have a lake-front cottage that they visit stand out (20%) (Figure 18). They also most frequently preferred development to increase (24%) (Figure 16). Therefore, if short-term visitors or tourists read this report and understood how these preferences might lead to environmental degradation, then I hope that some of them would start to think about adjusting their values to become better stewards of the environment. It can be assumed, based on the results of the 2020 SSS, that short-term visitors or tourists are the leading causes of the ecological degradation within the Muskoka Region. If short-term visitors or tourists are more cognizant of their values that lead to environmental degradation, then the health and sustainability of Muskoka's natural environment should increase, presenting all stakeholders with a relatively more beautiful, functional, and sustainable region. Below are some numbered suggestions I have made for short-term visitors or tourists to reduce their impact on Muskoka's natural environment:

1. Acknowledge your duty to be a good steward of the environment, as sustainability is one of the main goals for the millennial generation.
2. Respect natural environments, no matter how long your duration of stay. People deserve to have access to the same environment that you got to experience, and what you do matters to the overall values other people hold. If you enjoy experiencing beautiful and almost pristine environments such as Muskoka, make sure that you act sustainably.
3. Start to learn more about the environmental health of a region before you visit. There is interesting stuff that you can learn to help you hold a relational value to a given place, which may make you more inclined to care about your personal impact on the surrounding environment.
4. Realize that a manicured lawn is not necessary to enjoy, have fun, or recreate within the Muskoka Region.

5. Understand that there should only be sustainable development in the Muskoka Region. Not everything is about short-term utilization; instead, long term health will provide every demographic within the Muskoka Region with relatively more utility.
6. Better understand the greatest threats to Muskoka's natural environment through research, speaking with locals and reading this whole summer research initiative (Report 1, 2, and 3).

If short-term visitors or tourists adopt these values, then it may be true that the Muskoka Region could become more sustainable while still giving everyone the option of enjoying it.

It is important to note that all stakeholders should review the above three categories' suggestions, as some stakeholder groups' impacts may overlap. For example, all stakeholders enjoy recreation within the region, including boating. Therefore, it would be helpful for all of them to read the essay on boat waves' impact on freshwater systems in *Appendix C* of the appendices. It is also essential for each stakeholder group to read all of the above categories because it will better help them understand what the whole community needs to accomplish to reduce their impact on the beautiful and unique Muskoka Region. I hope these suggestions help reduce every stakeholder's impact on Muskoka's natural environment.

Category 4: Proposed Pathway into the Future

When proposing a sustainable future for the Muskoka Region, I think it is important to consider each stakeholder group's desires. However, in doing so, certain criteria need to be met that balance these desires with the overall preservation of Muskoka. Developers must shift their large-scale development that is occurring in Muskoka to be more sustainable. This means not cutting down as many trees and replacing the native vegetation and simply not developing as much. It is also helpful if developers do not build cottages close to the water to preserve the shoreline.

Regarding the values that each stakeholder holds, the above suggestions in the categories are necessary to follow through with to enhance Muskoka's natural environment. With this being said, I believe that the Muskoka Region should remain functioning more-or-less the same as it is now. When stakeholders were asked what type of economy the region is best suited for and what they wanted the future of the region to look like, they most frequently answered a combination of the two and the same (Figure 14 and 15). This idea that Muskoka's economy and overall way of life should remain the same can be supported by elite interview #5, where "the best future for the

Muskoka Region is one that is the same as it is right now, as I think there is a perfect balance of between recreation/tourism and resource extraction and the different demographics within the region" (Table 1). Therefore, if every stakeholder group on average became a better steward of the environment, then I think that the Muskoka economy and overall way of life can keep functioning normally. However, this is contingent upon if developers and stakeholders start to shift their values and actions to become increasingly sustainable.

Therefore, I propose that the stakeholder within the Muskoka Region should push for sustainable development and environmental stewardship. I think it is in the benefit of all demographics to treat the environment of Muskoka with respect as many people from every stakeholder group come to the region for the ecosystem services it provides (Figure 5,6 and 7). I also want people to continue to have fun and recreate as that is another main reason why all stakeholders visit the region (Figures 5,6 and 7). This can be done by looking at the above suggestions in each category and understanding that to have a sustainable region, there needs to be a balance between the amount of recreation, development, and natural areas to ensure sustainability. In doing so, I think the Muskoka Region can be sustainable and equitable while providing utility to all of its stakeholders as long as the above criteria are met. However, in addition to the threat that each stakeholder group currently poses to Muskoka's future, there is another potentially significant threat to Muskoka's future sustainability—climate change.

Muskoka's sustainable future is threatened by climate change, as the earth's global warming trend is causing intense storms, floods, and harmful algal blooms in Muskoka (HAB) (MWC, 2016). As mentioned in Report 1, Muskoka's dams cannot manage floods from storms, and it is hard to mitigate the formation of HAB's that are naturally caused by heat stress. Therefore, climate change may continue to present increasingly unfavorable environmental conditions such as storms and HAB formation, decreasing the sustainability and overall utility of the region. The idea that climate change threatens Muskoka can be supported by elite interviewee #2, as it was said that Muskoka is most threatened by climate change (Table 1). It is pertinent that the District of Muskoka and the stakeholders within the region start to plan and adapt to this new norm of severe floods and storms and the impacts that come with them. Therefore, future research should be done on what can be done to mitigate and adapt to the predicted impact of climate change in the Muskoka Region.

The finalization of Report 1, 2, and 3 have allowed me to set the stage for the Muskoka Region to become more environmentally sustainable. The next step is for these reports to reach the most extensive number of short-term visitors, permanent and seasonal residents as possible. If this report reaches a vast breadth of people, then I believe it could help them become relatively more environmentally conscious. This means that if stakeholders read and understand this report, it could increase the Muskoka Region's sustainability threshold because the anthropogenic impacts would be less than currently. To do this, I have gotten in touch with the District of Muskoka, Lake of Bays Heritage Foundation, Muskoka Conservancy, and the Muskoka Watershed Council to email out and post this full proposal on their websites.

Overarching Conclusions

To conclude the contents of all three reports, I believe it is important to summarize the findings and goals of each report briefly, how they connect, and what this could ultimately mean for the future of the Muskoka Region.

The findings of Report 1 show that the current state of Muskoka's environment is in better condition than it was during the time of high resource extraction despite the fact that seasonal residents and short-term visitors' impacts have and continue to increase since then. This means that Muskoka has transitioned from a resource-based economy to more of a recreational/tourists-based economy relative to historical times. With this transition came increased impacts in the form of new development and tourism, highlighting the need to transition sustainability efforts in the Muskoka Region from decreasing resource extraction to managing the impacts of new development and the values that tourists hold. The idea that the Muskoka Region has to transition to more of a recreational/tourist based-economy and that the District of Muskoka needs to manage better the impacts associated with the development and recreation/tourism stems from evidence in online empirical data and elite interviewees, thereby enhancing the legitimacy of these findings. The goal of Report 1 was to ultimately understand the current threats to Muskoka's natural environment and what stakeholder group may be causing them. This was a necessary conclusion to uncover because I knew that it would help me set up a hypothesis for Report 2, where I discuss the findings from a public survey geared towards understanding the values of each stakeholder group that may lead to environmental degradation. Therefore, Report 1 was successful in understanding the current threats to Muskoka's natural environment and starting to grasp the

potential largest threats to Muskoka's environment and what stakeholder group may be the most impactful on it.

The findings of Report 2 show that as a person's stake increases in Muskoka, their relative impacts on the surrounding natural environment decreases and new development is the largest current threat to Muskoka's sustainability overall. This means that the hypothesis posited in Report 1 aligns with the findings of Report 1, as both reports concluded that new development and the values that tourists hold are the biggest threats to Muskoka's natural environment. This report's goal was to understand the average values that each stakeholder group holds regarding their anticipated level of environmental stewardship and associated impacts to help me propose a sustainable pathway into the future. I wanted to know what impacts each stakeholder group has to tell them what they can do to become more environmentally conscious, thereby alleviating their impact on Muskoka's natural environment. The findings of Report 2 also show that stakeholders can agree on various topics regarding Muskoka's economy and environment. These agreements allowed me to propose a sustainable future more efficiently while still being equitable as I found various topics that each stakeholder group could agree on. Therefore, Report 2 was successful in proving my original thoughts in Report 1 that new development and the values that tourists hold may be the largest threats to Muskoka's natural environment and also provided useful results that were used when proposing a sustainable and equitable future for the Muskoka Region.

The findings of Report 3 show that there are ways that each stakeholder group can mitigate their personal and aggregate impact on Muskoka's natural environment. This means that each suggestion in Report 3 helps stakeholders reduce their impact on Muskoka's natural environment. It was suggested that permanent residents need to have more accountability for their impacts on Muskoka's natural environment, seasonal residents need to adjust their values towards a lake-front cottage aesthetic and recreation, and short-term visitors/tourists need to be more cognizant of their overall values which lead to ecological degradation for the Muskoka Region to become more sustainable. Therefore, Report 3 was successful in proposing a sustainable future for the Muskoka Region, as I gave unique suggestions to each stakeholder group based on the findings of Report 1 and 2.

The finalization of Reports 1, 2, and 3 has allowed me to set the stage for the Muskoka Region to become more environmentally sustainable, as they have been compiled and sent to a large group of stakeholders on various platforms. Ultimately, the distribution of these reports could

be the difference-maker for the Muskoka Region to achieve sustainability. I thank you all for reading this, and please consider and attempt to become more environmentally conscious, as we only have one earth and one chance to sustain it. I hope you found this research initiative to be both thought-provoking and insightful, but beyond that, I hope that it is able to enact meaningful change in the very special and important Region of Muskoka, Ontario, Canada.

TABLES AND FIGURES

Table 1.0 Results from elite interviews. Their interviews were conducted from Monday, May 25th to Wednesday, June 3rd, 2020.

Elite Interviewee	Topic of Expertise
1. Management Biologist	Biodiversity and conservation
2. Muskoka Watershed Environmental Scientist	Water quality (secchi depth, total phosphorus, temperature, total coliform)
3. Muskoka Conservancy Employee	Muskoka's history, air and water quality and conservation.
4. Muskoka Watershed and Water Web affiliate	Erosion and flooding
5. Lake of Bays Heritage Foundation Employee	Environmental, cultural, and economic history



Figure 1.0: Example location of posted flyer attempting to attract permanent resident respondents. This picture was taken of Norwood Theatre in downtown Bracebridge, Muskoka on Thursday, June 18th at approximately 11:30 am.



Fig 2.0 Example location of posted flyer attempting to attract short-term visitors/tourist respondents. This picture was taken of Port Cunningham Lodge on Thursday, June 18th at approximately 2 pm.

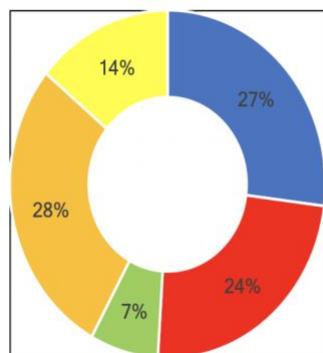


Fig 3.0: Example location of posted flyer attempting to attract seasonal resident respondents. This picture was taken of Port Cunningham Marina on Friday, June 18th at approximately 9 am.



Fig 4.0: Example location of posted flyer attempting to attract all stakeholder groups. This picture was taken of the Lake of Bays Brewery on Saturday, June 18th at approximately 11 am.

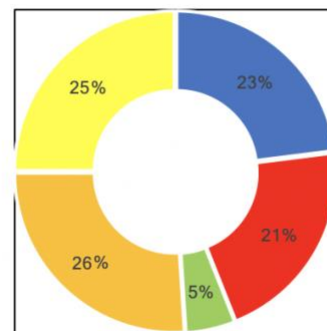
Q5: Seasonal Residents Reasons to Visit/Live Within Muskoka



■ Enjoy ■ Escape ■ Employment ■ Recreation ■ Learning

Figure 5.0: Seasonal Residents' reasons to visit/live within the Muskoka Region. Chi Value: 2.16811E-13.

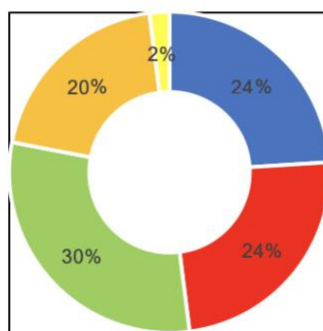
Q5: Short-term Visitors/Tourists Reasons to Visit Muskoka



■ Enjoy ■ Escape ■ Employment ■ Recreation ■ Learning

Figure 6.0: Short-term Visitors/Tourists' reasons to visit the Muskoka Region. Chi Value: 2.16811E-13.

Q5: Permanent Residents Reasons to Visit/Live Within Muskoka



■ Enjoy ■ Escape ■ Employment ■ Recreation ■ Learning

Figure 7.0: Permanent Residents' reasons to live within the Muskoka Region. Chi Value: 2.16811E-13.

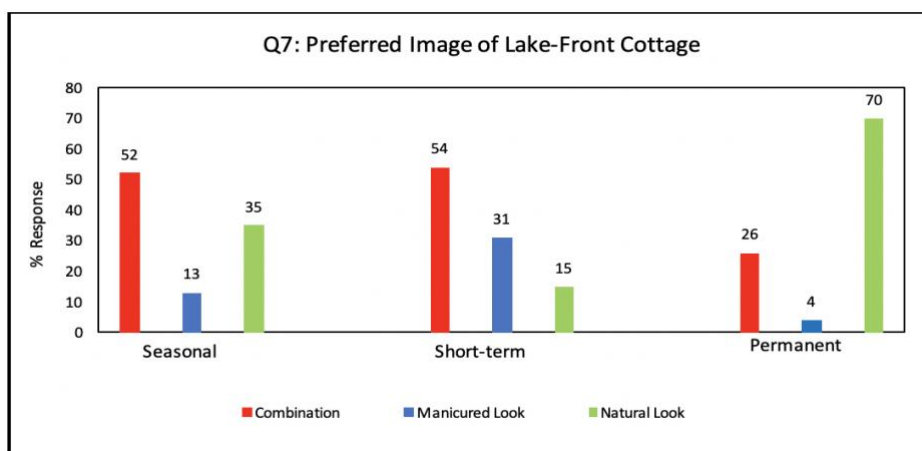


Figure 8.0: Stakeholders preferred Image of a lake-front cottage in regards to its outdoor arrangement. Chi Value: 4.02391E-09.

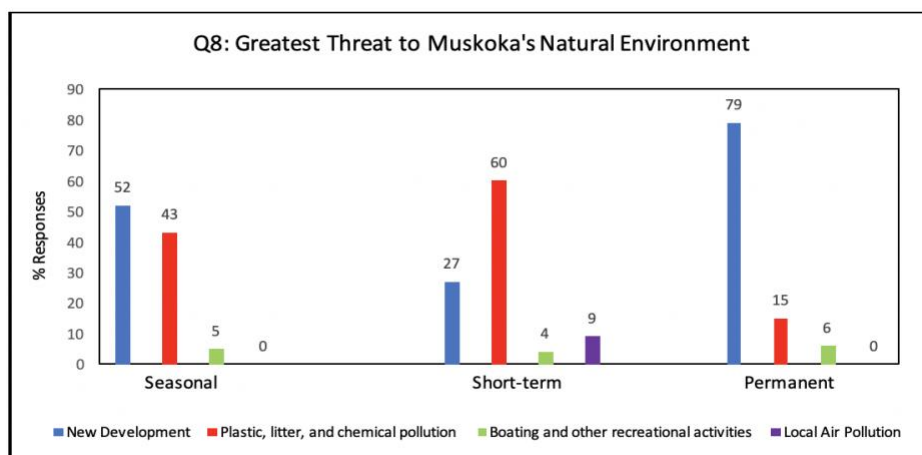


Figure 9.0: Stakeholders opinion on what local activity presents the greatest threat to Muskoka's natural environment. Chi Value: 4.07248E-05.

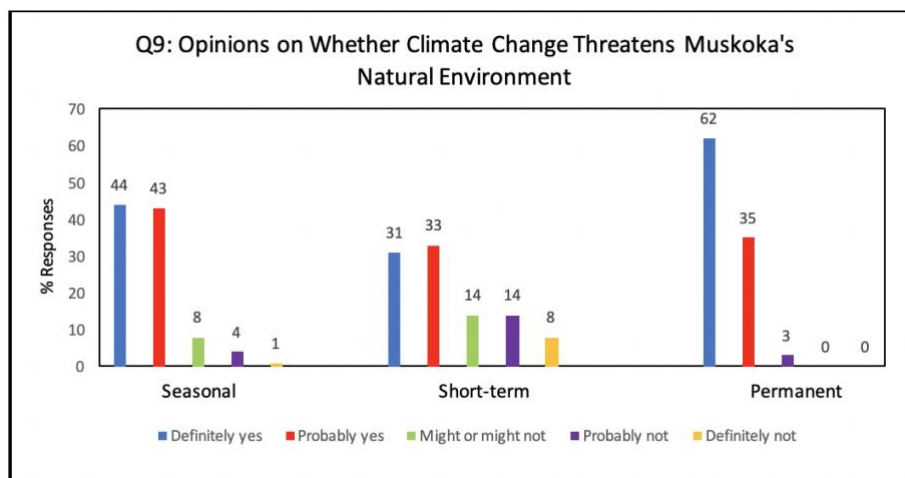


Figure 10.0: Stakeholders opinion on whether climate change threatens the natural environment of Muskoka. Chi Value: 0.018728501.

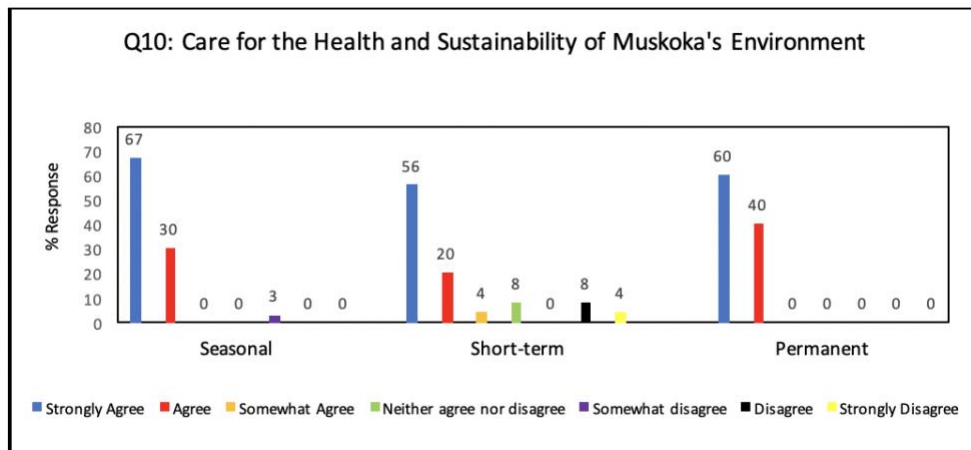


Figure 11.0: Stakeholders care for the health and sustainability of Muskoka's natural environment. Chi Value: 0.0038817.

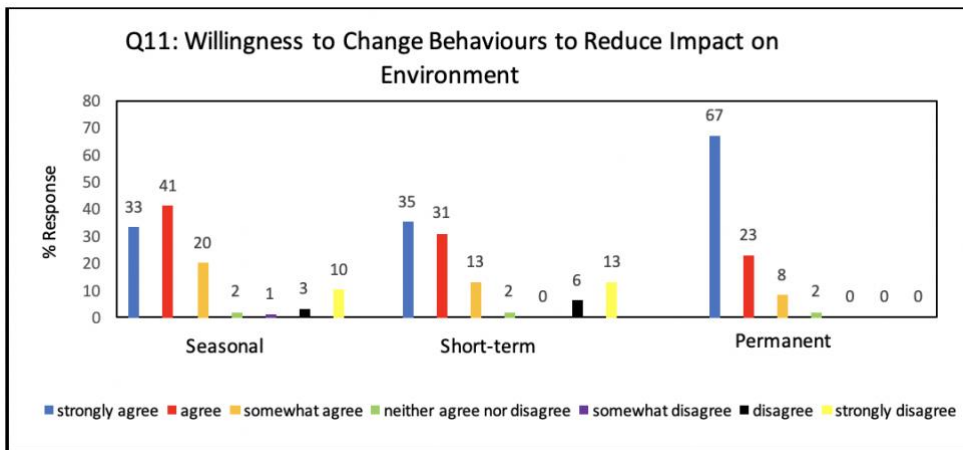


Figure 12.0: Stakeholders willingness to change behaviors and activities within the Muskoka Region to reduce their impact on the natural environment. Chi Value: 0.042832885.

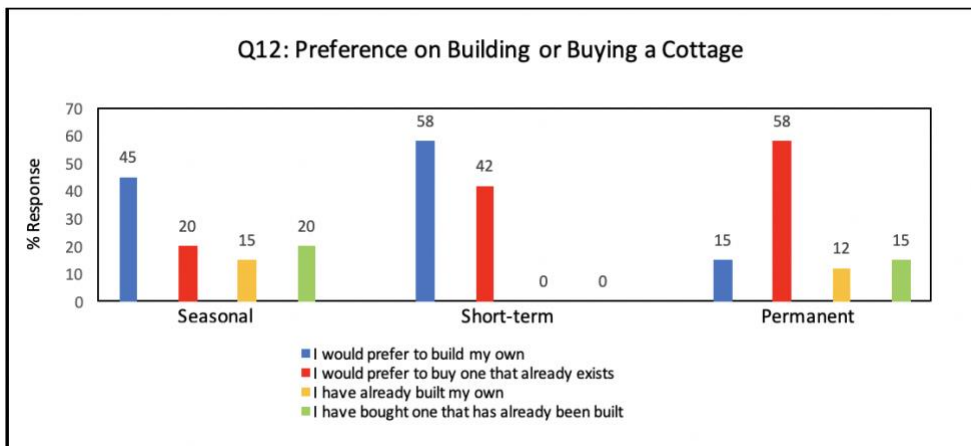


Figure 13.0: Stakeholders preference on building or buying a cottage. Chi Value: 7.32916E-06.

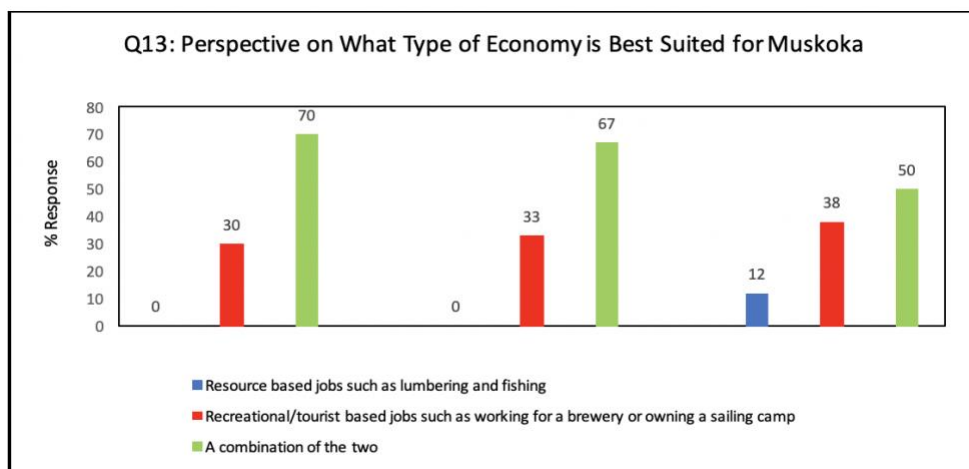


Figure 14.0: Stakeholders perspective on what type of economy the Muskoka Region is best suited for. Chi Value: 0.007601368.

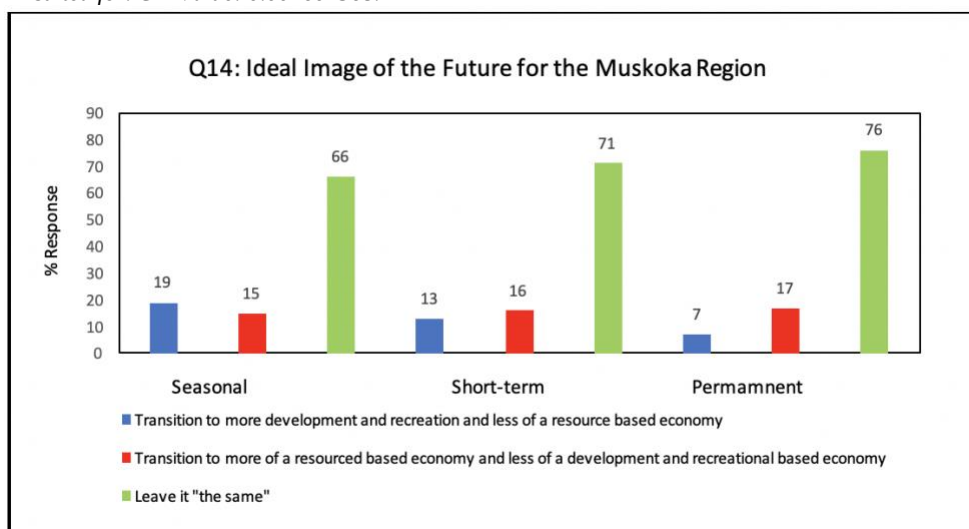


Figure 15.0: Stakeholders ideal image of the future for the Muskoka Region. Chi Value: 0.566813756.

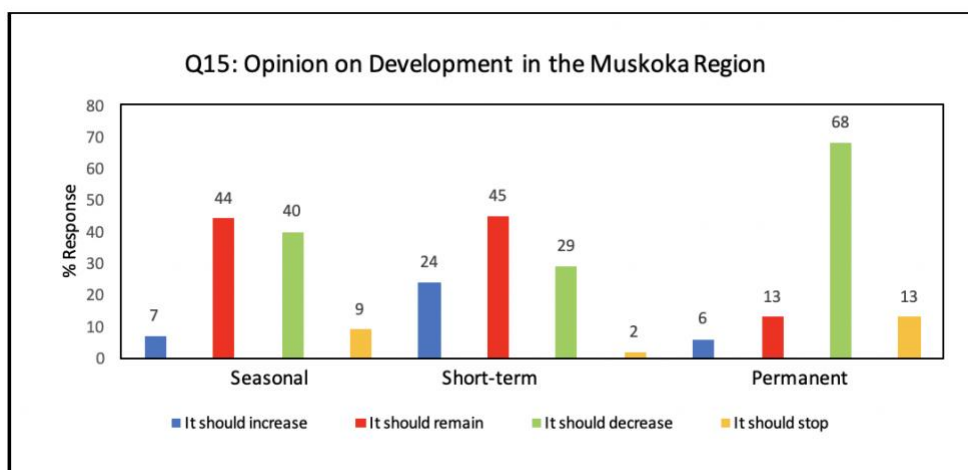


Figure 16.0: Stakeholders opinion on development in the Muskoka region. Chi Value: 0.000661287.

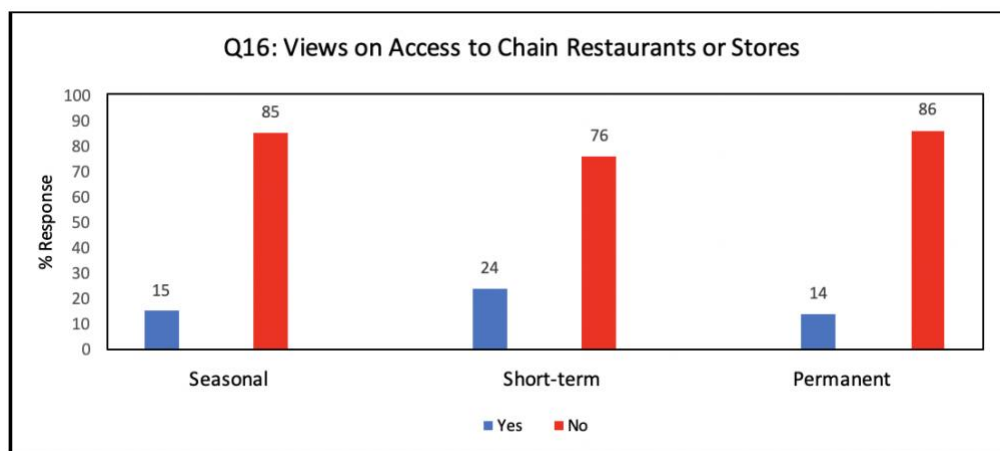


Figure 17.0: Stakeholders opinion if they would like to have more access to chain restaurants or stores while living in or visiting the Muskoka Region. Chi Value: 0.592233635.

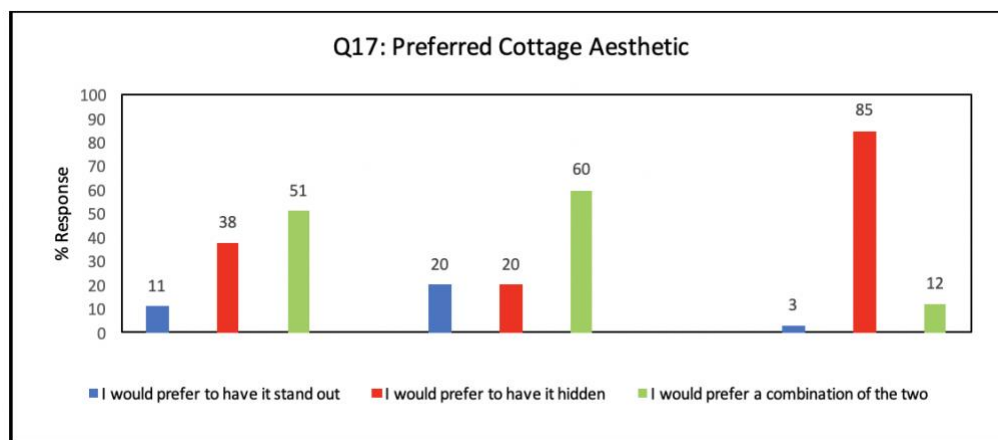


Figure 18.0: Stakeholders opinion on their preferred cottage aesthetic. Chi Value: 1.09818E-07.

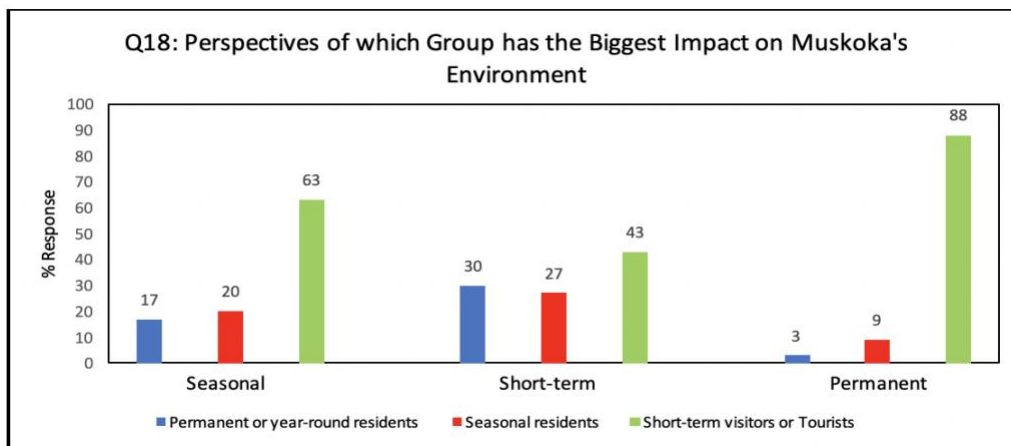


Figure 19.0: Stakeholders perspectives of which stakeholder group has the biggest impact on Muskoka's natural environment. Chi Value: 0.001569491.

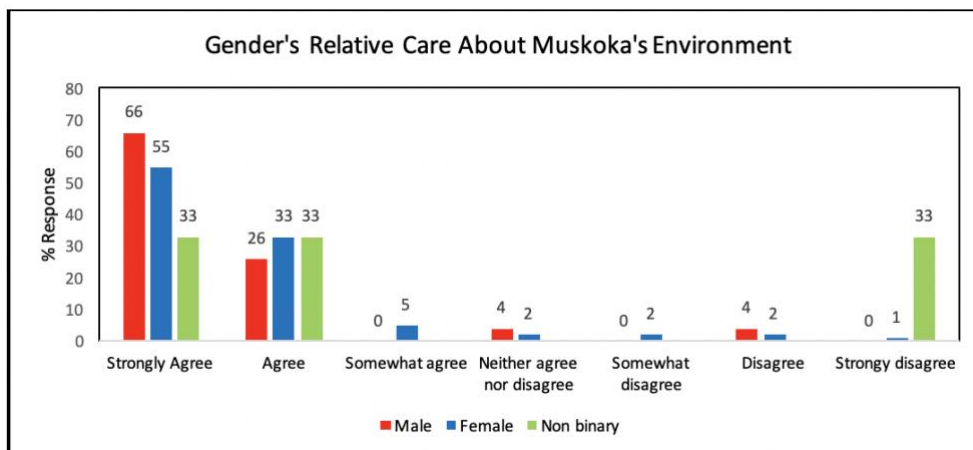


Figure 20.0: Stakeholders degree of care for Muskoka's natural environment by gender. Chi Value: 0.002303091.

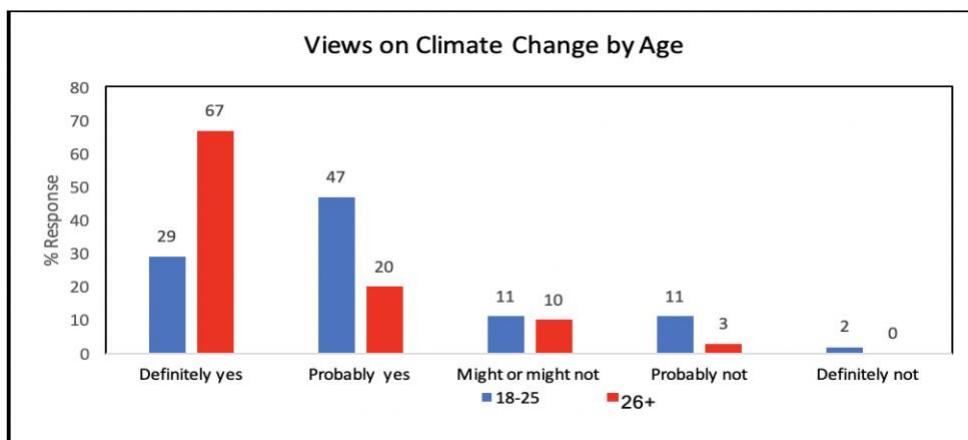


Figure 21.0: Opinion on whether climate change threatens the natural environment of Muskoka by age. Chi Value: 0.00010491.

APPENDIX A: 2020 SUMMER SUSUTINABILITY SURVEY

Q19 The purpose of this study is to understand the different values of the seasonal residents, tourists and permanent residents who live in the Muskoka. This study is supported by an Emerson Fellowship at Hamilton College, Clinton, NY, USA awarded to Andrew Court and is under the supervision of his advisor, Professor Aaron Strong.

This study is an **anonymous survey** and you do not need to provide your name or any personally identifying information. Your answers are entirely voluntary and you can stop answering questions at any time. **Completing the survey will take approximately five (5) minutes.**

There are no risks to your participation in this study. By completing the survey, you are consenting to participate.

If you have any questions about the study, you may contact Andrew Court at 905-630-6668 or acourt@hamilton.edu, or his faculty supervisor, Professor Aaron Strong at 315-859-4863 or astrong@hamilton.edu. Questions or concerns about institutional approval should be directed to Jeffrey Ritchie, Interim Chair of the Institutional Review Board for Human Subjects, 315-859-4678 or iboard@hamilton.edu.

Q1 How old are you?

- ☐ 18-25
- ☐ 25-32
- ☐ 32-39
- ☐ 39-46
- ☐ 46-53
- ☐ 53-60
- ☐ 60+

Q2 What is your gender?

Q3 What category best fits your relationship with the Muskoka Region?

- ☐ Seasonal resident
- ☐ Short-term visitor or Tourist
- ☐ Year-round resident or Permanent resident

Q4 Choose which selection best describes how long you visit/stay in Muskoka:

- ☐ I am a year-round/permanent resident and I live in Muskoka all the time
- ☐ I am a year-round/permanent resident but I also have another residence elsewhere
- ☐ I am a seasonal resident who visits Muskoka on weekends and other occasions
- ☐ I am a seasonal resident who lives in Muskoka full-time during the summer
- ☐ I am a short-term visitor/tourist and have previously visited Muskoka frequently
- ☐ I am a short-term visitor/tourist and have not previously visited Muskoka frequently

Q5 Select all choice(s) which apply to your reason(s) to visit/live within the Muskoka Region:

- ☐ To secure my livelihood/for employment
- ☐ To enjoy the natural environment of Muskoka
- ☐ To escape busy and highly populated urban areas
- ☐ To enjoy Muskoka's ecosystem services such as it's clean water and air
- ☐ To recreate and have fun within the region
- ☐ To learn about the region

Q6 Select all activities that you enjoy doing in the Muskoka Region:

- ☐ Canoeing, Sailing, and other non-motorized recreational activities
- ☐ Camping
- ☐ Boating
- ☐ Water-sports (tubing, wakesurfing, wakeboarding, waterskiing)
- ☐ Hiking and Biking
- ☐ Golfing
- ☐ Simply enjoying the natural beauty

Q7 What is your preferred image of a lake-front cottage in regards to its outdoor arrangement?

- ☐ "The Manicured Look" (a mowed lawn all the way down to the water front, cleaned up vegetation and trimmed shrubbery)
- ☐ "The Natural Look" (property left more-or-less the same as it was in its natural state)
- ☐ A combination of the two

Q8 In your opinion, what local activity presents the greatest threat to Muskoka's natural environment?

- ☐ New development
- ☐ Boating and other recreational activities
- ☐ Local air pollution
- ☐ Plastic, litter, and chemical pollution

Q9 Do you think Climate Change threatens the natural environment of Muskoka?

- ☐ Definitely yes
- ☐ Probably yes
- ☐ Might or might not
- ☐ Probably not
- ☐ Definitely not

Q10 Please mark the extent to which you agree with the following statement: **I care about the health and sustainability of Muskoka's natural environment:**

- ☐ Strongly agree
- ☐ Agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Disagree
- ☐ Strongly disagree

Q11 Please mark the extent to which you agree with the following statement: **I am willing to change my behaviors and activities within the Muskoka Region to reduce my impact on the natural environment:**

- ☐ Strongly agree
- ☐ Agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Disagree
- ☐ Strongly disagree

Q12 Would you prefer to build your own cottage or buy one if you had the chance to do so?

- ☐ I would prefer to build my own
- ☐ I would prefer to buy one that already exists
- ☐ I have already built my own
- ☐ I have bought one that has already been built

Q13 Please select what type of economy you think the Muskoka Region is best suited for:

- ☐ Resource based jobs such as lumbering and fishing
- ☐ Recreational/tourist-based jobs such as working for a brewery or owning a sailing camp
- ☐ A combination of the two

Q14 What choice best aligns with your ideal image of the future of the Muskoka Region?

- ☐ Transition to more development and recreation and less of a resource-based economy
- ☐ Transition to more of a resourced based economy and less of a development and recreational based economy
- ☐ Leave it "the same"

Q15 The Muskoka Region has experienced frequent and widespread development of infrastructure over the past few decades. In the future, how do you think this development should continue?

- ☐ It should increase
- ☐ It should remain
- ☐ It should decrease
- ☐ It should stop

Q16 Would you like to be able to have more access to chain restaurants or stores (such as Boston Pizza and McDonald's) while living in or visiting the Muskoka Region?

- ☐ Yes
- ☐ No

Q17 When constructing, looking at, or having a cottage, would you prefer to have it stand out, or would you prefer to have it hidden behind trees or other natural vegetation?

- ☐ I would prefer to have it stand out
- ☐ I would prefer to have it hidden
- ☐ I would prefer a combination of the two

Q18 In your opinion, which stakeholder group has the biggest negative impact on the natural environment of Muskoka?

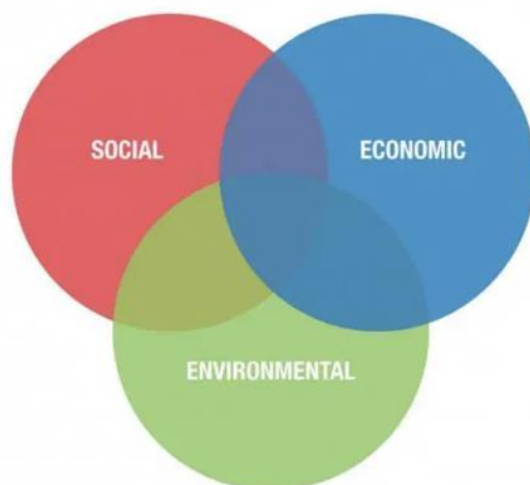
- ☐ Permanent or year-round residents
- ☐ Seasonal residents
- ☐ Short-term visitors or Tourists

End of Block: Stakeholder Survey

APPENDIX B: 2020 SUMMER SUSTAINABILITY SURVEY FLYER

SHARE YOUR VOICE

2020 Sustainability Summer Survey



Dear valued members of the Muskoka Region,

Please take this 2020 stakeholder survey to help provide a more equitable and prosperous future for all who inhabit or visit the Muskoka Region. This survey gauges Muskoka's permanent residents, seasonal residents, visitors and tourist's perspectives on the region's most pressing social, economic and environmental issues. If you are reading this and fall into one of the above categories (which I'm sure you do), please take 5 minutes of your time to complete this short survey. It would be greatly appreciated and could make a lasting and impactful difference.

If you are willing to participate, please either type in the link or scan the barcode below using your mobile device or computer (you can simply open your camera, point it at the barcode, and press on the link that pops up).

<http://tinyurl.com/MuskokaSurvey>



Also, if you have any questions about this survey or summer research initiative, please email Andrew Court, lead researcher and analyst or his Director, Aaron Strong. Their emails are below:

Andrew Court
Summer research Analyst at Hamilton College
acourt@hamilton.edu

Aaron Strong
Head of Environmental Studies, Hamilton College
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APPENDIX C: MOTORBOATS IMPACT ON FRESHWATER SYSTEMS

A summer tradition in Southern Ontario includes trips to cottage country in the Muskoka Region. Only two and a half hours north of Toronto is a vast wilderness of pristine lakes, secluded lake houses, and resorts for rest and relaxation. My family and I have a cottage on Lake of Bays that has been around for generations. It has filled my summers with joy as I partook in summer-long sailing and tennis camps throughout my youth. Recently, I have been participating in a new sport called wake-surfing, which is similar to wakeboarding and water skiing. This sport is only performed on specific boats that are able to make an adequate surfing wave that is big enough and shaped well enough to surf. In my case, I own a Centurion Enzo FX44, a world championship wake surfing boat. The boat is 6,000 pounds and is propelled by a 550-horsepower engine. It can hold 16 people, is 24 feet long, and can fill up three individual 2,000-pound water tanks (they are called ballast tanks and are at the bow, starboard, and port ends of the boat). The boat has a unique system where it can fill up any or all of the tanks which produce different wave shapes and sizes. The boats overall weight with all tanks filled is over 12,000 pounds, which is a substantial amount of weight for a boat that is only 24 feet long. Furthermore, the boat's weight, unique hull shape, and new technology enable it to dig deep into the water and cause enough drag that an individual can surf its wave endlessly without a rope. I have been wake-surfing for five years and every summer it seems there are more wake-surfing boats tearing along the shoreline. With this increased popularity comes increased impact on the environment. As an example, one day, when I was at the back of the boat watching my brother surf, I looked far past him to see where the waves would end up. Surprisingly, I had never been conscious enough to realize the force of our wake as the massive waves barreled over the top of docks, caused trouble for smaller vessels, and pounded against the shore. Motorboat waves—particularly those made by wake-surfing boats—create waves that rarely occur in nature and it led me to this question:

I wonder what negative impacts my boat and those of my fellow cottagers have on the environment?

Almost as soon as I asked the question, I witnessed my boat's wave wash over another dock and slam against the shoreline and, intuitively, I concluded that boat traffic was likely harmful to natural ecosystems. With the rising popularity of recreational boating, these impacts are compounded by the increasing number of boats affecting these natural habitats. Therefore, boaters should consider the negative environmental impacts of their recreational boating activities. The impact of recreational boating can be divided into four main categories: the degradation caused by turbulent waves on the ecosystem, the emissions produced by gas-fueled engines, the sound disturbances polluting the natural habitat, and the introduction of invasive species.

First, motor boating on a lake increases wave activity in an ecosystem. Specifically, recreational boating generates waves that pull up sediment and block the naturally occurring sunlight that is necessary for the macro infauna. Boat generated waves are unnatural occurrences that affect biotic life by increasing the turbidity which increases the opacity of the water and changes resource availability (Bishop 2007).

Second, the use of recreational motor boats expose fish to their products and byproducts. Motorboats are usually powered by either diesel or a petroleum and oil-based mixture, both of which are sometimes accidentally spilt into waterways when filling up tanks or servicing engines close to the body of water (Whitfield and Becker 2014). Therefore, when a motorboat is underway, both fuel types emit exhaust fumes into the water which negatively impact fish gene expression,

overall health, and reproductive output. The emission of products and byproducts of recreational boating ultimately degrade the natural environment.

Third, the sound of boaters on the water can be heard not only far away from the lakeside, but can also be heard below the lake's surface. Noise caused by boater traffic has behavioral implications on fish causing changes in physiology, predator/prey relationships, and overall communication within species (Hans Slabbekoorn et al. 2010). The increased level of sound pollution impacts lakes, as it is an unnatural burden that creates new challenges for fish stocks.

Finally, motorboats have a negative effect on the environment through invasive species transportation. Boats visit many regions in a single season and without careful cleaning between visits to different lakes, foreign species can enter ecosystems where they have no natural predators to regulate population growth. Recreational motorboats are effective transmission vehicles for aquatic invasive biota, mainly through the transport of alien fish species, invertebrates, and plants (Whitfield and Becker 2014). Ultimately, motorboats allow the transportation of invasive species which have adverse effects on the health of aquatic ecosystems.

Highlighting the behaviors and impacts of boaters is a necessary endeavor. In this essay, I will take an in-depth examination of how these boats create unnatural wave occurrences, release undesirable products and byproducts into the ecosystem, generate noise pollution, and enable invasive species to enter the environment, showing that boats have a significant negative impact on freshwater systems. Ultimately, the act of boating is a tragedy of the commons and in order to alleviate this negative impact, consciousness must be raised.

Concerns often arise about the effects of recreational boating on fresh water systems. These concerns become particularly prevalent when the waves from boats cause turbidity that reduce the amount of sunlight macrophytic plants absorb and alter the composition of the water (Whitfield and Becker 2014). Increased turbidity submerges macrophytes, increases the opacity of the water, and changes food availability. In a British study on fresh water canals, quantitative relationships between boat traffic density, water turbidity, and the abundance of aquatic macrophytes were analyzed. The study revealed that the outcome of heavy to critical levels of boat traffic resulted in elevated levels of submerged macrophytes (Murphy and Eaton 1983). These submerged macrophytes get less sunlight because they are covered in sediment.

Furthermore, boat generated waves increase the opacity of the water thereby decreasing macrophytes exposure to the sun. In a study on the Norfolk Broads, a system of small lakes and rivers, results concluded that where there were high levels of boat induced turbidity, reduced growth rates of macrophyte plants were seen (Hilton and Phillips 1982). Therefore, it can be said that boat generated waves decrease primary productivity by increasing turbidity which reduce rates of photosynthesis. In addition, boat generated waves change resource availability by stirring particles in the water, including fish larval food supply. A study conducted on a body of water in Maryland surveyed the effects on striped bass larvae prey consumption in 25-minute feeding trials when turbidity was high. The study suggested that when turbidity was elevated, striped bass larvae fed on 40% fewer prey (Denise 1988). The decrease in consumption led to smaller larvae populations and higher rates of starvation. Consequently, boat generated waves cause unnatural wave occurrences that block the necessary sunlight for macrofauna photosynthesis and change resource availability.

Negative side effects can also be produced from recreational boating's emissions of products and byproducts. Motorboats are usually powered by either petroleum and oil-based mixtures or diesel; both of which accidentally spill into waterways, impacting fish gene expression, overall health, and reproductive outputs. Diesel is a commonly used fuel for motorboats which

contaminates lake water and influences the gene expression of fish. In a study conducted on guppies (*Poecilia vivipara*) toxic effects elicited by diesel fuel harmed their biotransformation, membrane transport, and immune system (Mattos et al. 2010). Another study conducted in Placentia Bay, Newfoundland, on winter flounder (*Pleuronectes americanus*) suggested that the overall health of winter flounder is negatively impacted by petroleum contamination caused by boating (Khan 2003). Analyses of fresh water samples show that there is a direct correlation between the level of recreational boating and the level of MTBE (Methyl Tert-Butyl Ether) which is a fuel additive and now a banned substance. In a study conducted on Lake Kinneret, the MTBE emissions of both watersheds and boats were monitored. The research revealed that recreational boating was the main cause of MTBE emissions, contributing to 65% of its annual load, while the watershed contributed only 35%. This is relevant because high exposure to MTBE can impair the reproductive output of fish, (Ellen et al. 2015) which ultimately degrades Lake Kinneret's ecosystem. The reality Lake Kinneret faces mirrors that of fresh water systems worldwide where recreational boats emit products and byproducts that harm fish gene expression, health and reproductive output.

The noise created by recreational boating, specifically the long durations of sound it produces, can affect fish physiology, predator/prey relationships, and communication. The underwater environment is filled with abiotic and biotic sounds. Countless freshwater organisms use ambient underwater sounds to navigate, feed, breed, and socialize. In a study on the largemouth bass (*Micropterus salmoides*), evaluations were done at the organism-level to assess recreational boating effects on their cardiovascular systems. The study revealed that exposure to noise increased cardiac output, altering daily behaviors and posing sublethal physiological disturbances (Graham et al. 2009). Boat induced disturbances cause the daily habits of fish to be more active and mobile, especially when boating is at a high volume.

Recreational boating sounds also affect predator/prey relationships. Some aquatic predators use sound for hunting and require levels to be consistent. With increased boating comes increased levels of sound, which presents less suitable foraging areas for predators to catch prey efficiently (Slabbekorn et al. 2010). Therefore, prey will be consumed at less of a rate when sound disturbance is high. In addition, sound pollution from boats affect overall communication within aquatic species. A review on the effects of underwater sound levels on fish suggests that underwater sounds are increasing because of rising levels of motor boating. When underwater sound levels are high it impedes an aquatic organism's ability to hear biologically relevant sounds, thereby affecting critical functions like acoustic communication (Slabbekoorn et al. 2010). Overall, boating noise goes beyond being a public nuisance as the elongated periods of artificial sound negatively affect aquatic species physiology, predator/prey relationships, and communication.

Finally, introduction of invasive species into lakes is nothing new, as it has been happening since the 1800's (Fischer 2003). With increased popularity of recreational boating comes increased transportation of invasive species to surrounding fresh water systems. In a study on small-craft boats and trailers, evidence suggests that two thirds of boaters are not consistently taking the necessary steps to clean their boats off prior to transportation (John et al. 2010), which inevitably results in the transportation of invasive species. This integration of invasive species can cause declined rates of many native species, but most specifically phytoplankton. This is seen in a study on the Hudson River that indicated that invasive species have caused reduced rates of phytoplankton. Many invasive species feed on organisms on the bed of the river altering its composition. A common invasive species prevalent in these freshwater systems is the zebra mussel

(*Dreissena Polymorpha*). The zebra mussel feeds on microscopic plants and animals, removing them from the base of the food web limiting the amount of food for native fish. Therefore, the invasion of the zebra mussel causes the average cell density of phytoplankton to decline, dampening its taxonomic composition (Thomas et al. 1998). Ultimately, as recreational boats travel between lake ecosystems, the potential impact of invasive species propagation causes trophic imbalances that pose adverse health effects within a biotic system.

The available evidence suggests that recreational motor boating has a negative impact on freshwater systems. As someone that actively participates in recreational boating, understanding the impact of the activity creates an environmental consciousness that will influence my decisions. Although I will continue to enjoy the sport of wake-surfing, I will ensure that I take the necessary measures to protect these cherished freshwater ecosystems. Specifically, a cognizant boater should know that recreational boating creates unnatural wave occurrences which reduces biotic life, emits harmful products which influence the overall health of fish stocks, creates sound pollution posing adverse side-effects on a fish's physiology and that the transportation of these boats leads to the introduction of invasive organisms that alter trophic levels. In order to maintain these natural habitats and prevent a tragedy of the commons, boaters must consider the impact their recreational activities have on the freshwater systems that they look forward to enjoying.

Potential for Mitigation

After understanding the evidence above, it is quite evident that recreational boating has negative effects on the environment. In this section I will consider these impacts and provide methods and suggestions that could help alleviate the negative impact of boating. Recently, steps have been taken by the boating community to lessen their ecological footprint (Whitfield and Becker 2014) and with increased individual consciousness comes less impact on the environment.

Boat generated waves increase wave activity and pull up sediment that blocks the naturally occurring sunlight necessary for photosynthesis and changes resource availability (Bishop 2007). Although it may seem that this impact is hard to solve as an individual could think that the only solution to stopping boat induced turbidity is to stop boating altogether. However, boaters could cause less wave turbidity if they were more conscious of their speed in relation to depth. When increasing speed, boats produce higher levels of turbidity. In addition, macrophytes are harmed in a more severe manner when at a shallow depth (Garrad and Hey 1987). Therefore, controlling boat speed at shallow depths is imperative for the biotic life below the surface and boaters can reduce their impact on abiotic life on the bed of fresh water systems if they monitor their speed in shallow water. Currently, there is no widespread regulations that focus on specifically boat speed, depth, and how they relate to turbidity, but, people are becoming aware and taking action to protect abiotic life in lakes and oceans. In Florida, they have set laws that designate no wake zones to prevent manatee deaths (Peebles and Raver 2016). Even though this regulation is not directly related to boat turbidity's effect on macrophytes in fresh water, it shows not only an increase in government consciousness, as government agencies are enacting policies to limit boating's effect on biotic life, but also, because of this widespread regulation, individuals are becoming more aware and slowing down in appropriate zones, lessening their impact on aquatic systems.

Recreational boating does not only increase turbidity, it also exposes biotic life to its products and byproducts (Whitfield and Becker 2014). Although emissions of byproducts into the water are an inevitable outcome with current boating technology, reduced rates of harmful emissions are achievable. In the past, Americans have spent over 500 million dollars yearly on recreational boating and were held to a low efficiency standard. However, it wasn't until 2010 that

the U.S. Environmental Protection Agency initiated more stringent emission standards for marine engines—both inboard and outboard (Smith 2016). Although this regulation is strictly in the United States and solely for marine vessels, it is an example of a government agency regulating its citizens' boating emissions in order to help the natural environment. By initiating regulations, the government makes the population more aware of the environmental degradation boating causes, and holds its citizens more accountable. When the government makes laws in accordance with scientific evidence, it raises the consciousness of its citizens, which not only leads to the establishment of regulations that citizens must follow, but also creates an awareness that causes individuals to be less likely to pollute aquatic systems. For example, accidental spillage of motorboat fuel directly into fresh water can negatively affect algal biomass (Nayar et al. 2004). Therefore, if an individual is more careful when fueling up their boat, they will inevitably spill less, emitting fewer harmful chemicals into aquatic environments. As you can see there are successful ways to decrease emissions of products and byproducts, but only if conscious efforts are made to establish regulations and increased individual awareness occurs.

Multiple lines of evidence point toward the negative effects recreational boating has on fish behavior. Although sound pollution has been proven to impact fish's physiology, predator prey relationships, and overall communication, all of these side effects can be lessened if boat frequency diminishes (Scholik and Yan 2002). Currently, there are no boat frequency regulations as anyone is allowed to boat in fresh water systems without restrictions. However, if regulations were implemented to allow only a certain volume of boats in a given area, sound pollution would be lessened and so would recreational boating's effect on the environment.

Similar to sound pollution generated by boats, little regulations have been established to limit the transportation of invasive species. Additionally, there has been little empirical research on the type and quantity of invasive species being transported or on the implementation of regulations (Rothlisberger et al. 2010). The transportation of invasive species through recreational boating has adverse effects on the health of ecosystems and causes trophic imbalances. There are insufficient current regulations and evidence suggests that two thirds of boaters do not consistently take the necessary steps to clean their boats off prior to transportation (John et al. 2010). However, if stricter regulations were made on boat cleaning prior to loading it into the water, steps could be made to alleviate the amount of invasive species propagation.

As you can see recreational motor boating degrades natural aquatic environments. Recreational boating's impacts on aquatic biota can be seen through increased turbidity, emissions of byproducts and products, sound disturbance, and invasive species propagation. Although these are concrete forms of evidence to support that recreational boats harm the environment, steps can be made in all of these areas to initiate regulations and raise individual consciousness, which can help decrease the impact of boating on the environment. However, it would be helpful if in the future there was more extensive research done to address the extent of how recreational boating affects sound disturbance, the transportation of invasive species, and how to manage these impacts. If research was done on these topics it would allow for a better understanding; therefore, allowing for a greater potential for the implementation of regulations and an elevated collective environmental awareness. Ultimately, the health and vitality of fresh water systems lies in the hands of humans to decide what their collective values and morals are. If humans decide they want to become more conscious of their negative effects on fresh water systems, then regulations can be made and alleviated impacts could be seen.

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