Recreational Shark fishery in Nova Scotia
Evaluation and Strengthening of the Current Management Framework

Holly Isnor

Advisor: Áslaug Ásgeirsdóttir

University of Akureyri
Faculty of Business and Science
University Centre of the Westfjords
Master of Resource Management: Coastal and Marine Management
Ísafjörður, September 2017
Supervisory Committee

Advisor:
Áslaug Ásgeirsdóttir, Ph.D.

Reader:
Michael Honeth, M.S.c.

Program Director:
Catherine Chambers, Ph.D.

Holly Isnor
Recreational Shark Fishery in Nova Scotia: Evaluation and Strengthening of the Current Regulatory Framework

45 ECTS thesis submitted in partial fulfilment of a Master of Resource Management degree in Coastal and Marine Management at the University Centre of the Westfjords, Suðurgata 12, 400 Ísafjörður, Iceland

Degree accredited by the University of Akureyri, Faculty of Business and Science, Borgir, 600 Akureyri, Iceland

Copyright © 2017 Holly Isnor
All rights reserved

Printing: Háskólaprent, Reykjavík, September 2017
Declaration

I hereby confirm that I am the sole author of this thesis and it is a product of my own academic research.

__________________________________________
Holly Isnor
Abstract

The recreational shark fishery in Nova Scotia is composed of shark derbies and catch-and-release fisheries. Shark derbies began in 1993, under the direction of the Department of Fisheries and Oceans Canada to collect scientific data in a data deficient group of species, as well as to educate the public on shark biology and conservation. This fishery is unique within Canada as it is the only province which permits the landing of sharks. Regulations have changed over the years but follow the guidelines of several plans including the International and National Plans of Action for the Conservation and Management of Sharks, and an Integrated Fisheries Management Plan. This project aims to explore the recreational fishery, including perspectives of participants and organisers of shark derbies across the province. The main motivations identified for involvement were the benefit to the community through non-profit fundraising and recreational activities as well as the involvement in science. Through observations, few educational components of these events were noted, and science has been stagnant for several years, raising concerns about the current state of the fishery. Handling is one area where improvement is necessary, moving to circle hooks and imposing mandatory training for all fishers would reduce the threat to hooked sharks. Furthermore, moving derbies to catch-and-release would not only decrease shark mortality but would also increase tagging efforts, while maintaining the benefits to the community.
“You’re underwater, and you see the thing you were taught your whole like to fear and it’s perfect. It doesn’t want to hurt you. It’s the most beautiful thing you’ve ever seen. Your whole world changes.” – Rob Stewart (Sharkwater)
# Table of Contents

Abstract .................................................................................................................. v

List of Figures ........................................................................................................ xi

List of Tables .......................................................................................................... xiii

Acronyms .............................................................................................................. xiv

Acknowledgements .............................................................................................. xv

1 Introduction ......................................................................................................... 1
   1.1 Research Purpose ....................................................................................... 8
   1.2 Research Questions & Objectives .............................................................. 10
   1.3 Methods, Scope and Limitations ............................................................... 12
   1.4 Thesis Structure ....................................................................................... 13

2 Background Information .................................................................................... 15
   2.1 Research Location ..................................................................................... 15
   2.2 Derbies ...................................................................................................... 16
       2.2.1 Science & Education at Derbies ......................................................... 18
   2.3 Catch-and-release: Tour Operators and Anglers ...................................... 20
   2.4 Sharks of Nova Scotia .............................................................................. 21
       2.4.1 Blue Shark ...................................................................................... 21
       2.4.2 Other shark species ....................................................................... 23
   2.5 Regulatory Framework ............................................................................ 24
       2.5.1 Licensing ......................................................................................... 24
       2.5.2 Species and Size Limitations ............................................................ 25
       2.5.3 Fishing methods ............................................................................ 25
       2.5.4 Log books ...................................................................................... 26
       2.5.5 Disposal of Sharks ...................................................................... 26
   2.6 Post-Release Mortality & Handling Practices ........................................... 27
   2.7 Shark Bycatch in Nova Scotia ................................................................. 29

3 Research Methods ............................................................................................. 33
   3.1 Identifying Key Stakeholders ................................................................. 33
   3.2 Derby Observations .................................................................................. 34
   3.3 Key Stakeholder Interviews .................................................................... 35
       3.3.1 Recruiting Respondents ................................................................. 35
       3.3.2 Data Collection .............................................................................. 35
List of Figures

Figure 1 Map of Nova Scotia demarking derby locations throughout the province. Location 1 & 2 are the derby locations visited in summer 2016. Missing: Split Crow derby.................................................................3

Figure 2 Distribution of the blue shark (Prionace Glauca) in the Atlantic Ocean (Food and Agriculture Organization of the United Nations, 2017).......................23

Figure 3 Circle hook and J hook (Blue Water Fishermen’s Association, n.d.)..................26

Figure 4 Total catch of all commercial fisheries, total discard catches of sharks in commercial fisheries and discarded catch of sharks from the pelagic swordfish and tuna longline fishery, showing a percentage of total catch that discards, from all fisheries account from 1996 to 2009. (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011)...........................................31

Figure 5 Estimated discard catch, in megatons of three pelagic shark species, porbeagle, shortfin mako and blue, in Atlantic Canadian commercial fisheries from 1996-2010 (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011)..................................................................................................................................................32

Figure 6 Photos from the Riverport 2016 Shark Derby. a) DFO Science collecting data b) Shark being weighed and landed c) Spectators observing landed shark on the dock.................................................................41

Figure 7 Number of sharks caught at all derbies in Nova Scotia from 1993-2016..............42

Figure 8 Total weight of sharks landed each year at derbies in Nova Scotia from 1993-2016..................................................................................................................43

Figure 9 Number of individual sharks caught at all derbies each year from 1994 to 2016........................................................................................................................................44

Figure 10 Number of shark derbies held each year from 1993-2016 across Nova Scotia..........................................................................................................................44

Figure 11 Number of sharks landed at each derby held in Lockeport Nova Scotia........45

Figure 12 Number of sharks landed at each derby held in Riverport Nova Scotia...........46

Figure 13 Number of sharks landed at each derby held in Petit de Grat Nova Scotia .......46

Figure 14 Number of sharks landed at each derby held in Louisbourg Nova Scotia.......47
Figure 15 Number of sharks landed at each derby held in Yarmouth Nova Scotia .......... 47
Figure 16 Number of sharks landed at each derby held in Halifax Nova Scotia ............ 48
Figure 17 Number of sharks landed at each derby held in Split Crow Nova Scotia.......... 48
Figure 18 Number of sharks landed at each derby held in Dartmouth Nova Scotia .......... 49
Figure 19 Number of sharks landed at each derby held in Eastern Passage Nova Scotia ................................................................. 49
Figure 20 Number of sharks landed at each derby held in Brooklyn Nova Scotia ........... 50
Figure 21 A) FAO reported landings of all chondrichthyans from 1950 to 2010 B) Proportion of FAO reported catches of Rays and Sharks C) Areas of threat and National share of catch & trade (Dulvy`, et al., 2014) ................... 57
List of Tables

Table 1 Estimated number of fishermen at four Nova Scotian shark derbies in summer 2016 * Number of participants has been estimated from landing data, derby websites as well as interviews (If a committee member stated the number of participants, this was noted and used below. If a derby website stated, the number of participants this was also used directly below. For derbies where this was not the case, research into news articles which may have had this information was included. Finally, as participants are allowed 2 sharks per person per day (or less depending on the derby) this, along with the number of landed sharks was used, i.e. if 50 sharks were caught, and each participant is allowed 2, there would be 25 participants..........................................................42

Table 2 Interview results for overall experience, views on regulations, years involved, and changes in environment of shark populations.................................51
**Acronyms**

COSEWIC: Committee of the Status of Endangered Wildlife in Canada

DFO: Department of Fisheries and Oceans Canada

EEZ: Exclusive Economic Zone

ENGO: Environmental Non-Governmental Organisation

FAO: Food and Agriculture Organization of the United Nations

IPOA-Sharks: International Plan of Action for the Conservation and Management of Sharks

IUCN: The International Union for the Conservation of Nature

NAFO: Northwest Atlantic Fisheries Organisation

NPOA-Sharks: National Plan of Action for the Conservation and Management of Sharks

SARA: Species at Risk Act
Acknowledgements

Thank-you to my wonderful advisor, Áslaug, without which, this project would not be what it is today. Your guidance, knowledge and understanding kept me on track in times when I questioned myself. Thank-you to my family and friends for listening to my constant shark talk. Thank-you to all those who agreed to be part of this project, it would not have been possible without you, and to Warren Joyce from the Department of Fisheries and Oceans Canada who was a wealth of information. Finally, thank-you to my classmates, who made my experience in Iceland truly amazing.
1 Introduction

In recent years, sharks have become a widely discussed group of fishes when it comes to conservation, over-fishing and the general health of our oceans. Globally, declines in many shark species have been documented, most of which is caused by the overexploitation of these slow-recovering stocks. Off the coast of Nova Scotia, Canada, the study area for this project, several species of shark including the blue shark (*Prionace Glauca*), shortfin mako (*Isurus oxyrinchus*), and porbeagle shark (*Lamna nasus*) can be found, the blue shark being the most abundant (Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002; Department of Fisheries and Oceans, 2016; Cailliet, 2017). Currently, Canada ranks 26th globally for highest shark catches and has historically not been amongst the top shark fishing nations (National and Regional Plans of Action, 2017). The Department of Fisheries and Oceans Canada (DFO) are responsible for the management of shark stocks in Nova Scotia and recognise two main areas of importance with regards to shark management across the province; the recreational fishery and incidental catches from other fisheries (Campana, et al., 2015) The primary focus of this study will be the recreational fishery which is composed of; catch-and-release fisheries and shark fishing tournaments, known to locals as derbies (Fisheries & Oceans Canada, 2002). Since 1993, several derbies have taken place each summer province-wide and are government approved events where prizes are awarded for the heaviest catch. Nova Scotia is the only province in Canada with a recreational shark fishery that allows the landing (killing) of sharks (Government of Canada, 2016). There are several reasons that the Department of Fisheries and Oceans supports the existence of derbies; scientific data is collected from all landed sharks and these events serve as opportunities to educate the public on shark biology and raise awareness for shark conservation and management (Government of Canada, 2016). With the issue of shark conservation becoming ever more prevalent, Nova Scotia has been facing some negative media attention, raising the important question: Do the benefits of derbies to the community and science outweigh the potential negative environmental impact, and how can these events be more appropriately managed to maximise their value (in terms of benefit to science and the community)? Answering the above question proves challenging as there are still several gaps in scientific knowledge surrounding the blue
shark specifically, which should be addressed in the future to gain a complete picture of this issue.

Shark derbies began in Nova Scotia in 1991 however, DFO did not begin collecting data until 1993-1994 when Dartmouth, Halifax and Split Crow derbies began. Since then, derbies have taken place in 11 different towns, primarily on the south shore, in the Halifax-Dartmouth area and on Cape Breton Island (See figure 1.) (Campana, Marks, Joyce, & Kohler, 2006). The number of derbies peaked in 2012 with seven derbies but has since decreased, possibly due to lack of support by locals to help organise and run these labour-intensive events. Each individual derby has an organising committee, which is independent of other towns and derbies. Committees are formed of volunteers from the community and include positions such as president, treasurer etc. Recently, community support for these derbies, specifically willingness to organise events has decreased creating an increased workload on few committee members. For example, one participant stated that at the Yarmouth Shark Scramble, the primary event organiser had been running the event alone for several years. When he decided to resign, several community members said they would like to see the events continue, however, no one stepped up to take on the responsibility of organising the event which resulted in the event being cancelled two years in a row (Respondent C, 2016).

As mentioned the fishery accounts for a small percentage of the total shark catch mortality, including both landings and estimated post-release mortality in Canadian waters per year (Campana S., Campana, Marks, Joyce, & Kohler, 2004) Other sources of mortality include bycatch in other commercial fisheries on both the Atlantic and Pacific sides of the country. Most sharks caught at derbies are released, although it is estimated that sharks have 35% post-release mortality rate (Campana, et al., 2015). Currently there is no limit on the number of licenses which can be issued, however, an average of about 1000 licenses are issued per year across the three sections of the fishery; tour operators, individual licence holders, and derbies, wherein licence holders can then catch and release as many sharks as they wish. (Campana, Marks, Joyce, & Kohler, 2006; Government of Canada, 2007).

The primary management strategy for derbies is the implementation of a minimum size of 8ft for blue sharks and 6ft for shortfin mako, species limitations where porbeagle are not permitted to be landed (Fisheries & Oceans Canada, 2002). Further, a maximum number of 2 sharks permitted, of either blue, shortfin mako or thresher sharks to be landed (killed and
brought to the wharf for entry into the winnings) by each participant acts as a quota to limit mortality and simplify the logistics of the event (Fisheries & Oceans Canada, 2002). Chartered tours and individual fishing licenses are restricted to catch-and-release only (Campana, et al., 2015; Fisheries & Oceans Canada, 2002). Due to being catch-and-release, size and species limitations are not necessary, however, handling and post-release mortality are of concern. (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011).

Figure 1 Map of Nova Scotia demarking derby locations throughout the province. Location 1 & 2 are the derby locations visited in summer 2016. Missing: Split Crow derby.

Over the past number of years, there has been growing concerns with the presence of shark fishing tournaments in Nova Scotia, which has been shown through several news articles published across the province. Several news stories outlining the ethical and environmental concerns as well as scientific benefits of these events have been published, mainly with animal rights or Environmental Non-Governmental Organisations (ENGO), such as the Humane Society of Canada voicing their concerns, mainly over the wasteful and unnecessary killing of sharks (The Cape Breton Post, 2014; Beswick, 2014). One respondent discussed that there have been a few instances where activists have even attended events to discuss concerns with committee members, participants, and spectators (Respondent A, 2016). To date, some research carried out by DFO Canada has briefly acknowledged the presence of an ethical perspective by simply stating the department is aware they exist to the fishery, however, are not responsible for exploring this issue. The
role of DFO, in this case, is not to explore the ethics of this situation, which would fall on ENGOs, but rather to manage the fishery and maintain a healthy and sustainable population (Campana, Marks, Joyce, & Kohler, 2006). While the ethical perspective to the events and the recreational fishery is not the primary focus of this thesis, it is a topic of concern which should be addressed through future research.

As a pelagic species, the blue shark is found in multiple Exclusive Economic Zones (EEZs) as well as international waters, management of the shark stock relies on efforts of several states and international agreements, which guide management in Nova Scotia. This cooperation is needed as overexploitation of the stock in one area, whether international or national waters of any North Atlantic country could cause declines of the stock throughout the entire North Atlantic. The migratory nature of the species makes stock assessments difficult though to complete accurately, for instance, in Atlantic Canada, scientists believe that mainly juvenile blue sharks are present, meaning that looking at uniquely Canadian waters would not provide a complete picture of the health of the stock, which would include females and adults. International cooperation from several states would be needed to gain a comprehensive stock assessment. (Campana, et al., 2015). The wide range of the blue sharks in the North Atlantic combined with an unknown overall fishing (targeted and incidental) mortality rate makes catches and discards difficult to quantify, and they often go unreported to the United Nations Food and Agriculture Organisation, meaning that the true mortality rate of blue sharks in Nova Scotian waters is likely much higher than the current estimate. (Worm, et al., 2012; Dulvy, et al., 2008). The FAO compiles catch and bycatch estimates of all fish species globally to report on potential economic loss, as well as areas or species of concern with the aim to guide states to improve resource management, however, lack of reporting can cause inconsistencies in the assessment of management. For instance, Worm (2003) estimated that between 63 and 273 million sharks are caught or die of fishing-related injuries on average per year globally. This wide margin indicates that estimates are far from accurate and as such, management of any shark population should rely heavily on the utilisation of the precautionary approach, which will be discussed in greater detail in the following sections.

These cartilaginous fishes often live long lives, and reproduce at a slow rate with long gestation periods, compared to other types of fishes and produce low numbers of offspring leading to their vulnerability (Worm, et al., 2012). Shark populations are typically quick to
suffer the effects of, and are slow to recover from overexploitation, once again emphasising the need for the precautionary approach (Campana, Joyce, & Manning, 2009; Campana S., Campana, Marks, Joyce, & Kohler, 2004; Campana, et al., 2015). Typically, the management of any fish stock relies heavily on scientific data such as stock assessments, for instance, to set a maximum sustainable yield (MSY), which has never been set for the blue shark in Nova Scotia. Sharks are generally difficult to study and are often highly migratory, causing significant gaps in knowledge (Dulvy, et al., 2008). Lack of accurate stock assessments means that management decisions of shark populations must be based on the best information available, which creates an ongoing challenge (Dulvy, et al., 2008).

As mentioned, the precautionary approach is a valuable tool in sustainable fisheries management. Due to data deficiencies, gaps in knowledge, shark physiology, and recent declines in the blue, mako and porbeagle in the Atlantic, Canada would be wise to use this approach. The precautionary approach, as outlined by the Department of Fisheries and Oceans Canada in the Decisions Making Framework Incorporating the Precautionary Approach is as follows:

“In general, the precautionary approach in fisheries management is about being cautious when scientific knowledge is uncertain, and not using the absence of adequate scientific information as a reason to postpone action or failure to take action to avoid serious harm to fish stocks or their ecosystem. This approach is widely accepted as an essential part of sustainable fisheries management. (Department of Fisheries and Oceans Canada, 2009)”

Further, the Canadian Environmental Law Association defines the precautionary approach as:

“The precautionary principle denotes a duty to prevent harm, when it is within our power to do so, even when all the evidence is not in. This principle has been codified in several international treaties to which Canada is a signatory. Domestic law makes reference to this principle but implementation remains limited.” (Canadian Environmental Law Association, 2017)

Currently, DFO advocates the use of the precautionary principle (Department of Fisheries and Oceans Canada, 2009), however, the department is failing to apply this principle in the case of the recreational fishery in Nova Scotia specifically. In terms of shark derbies,
sharks are landed to gaining scientific data, however, as landing are so small, it is difficult to gain any significant knowledge about mako or thresher sharks specifically, and as their populations are threatened, individuals would be more valuable in the water than on the wharf. For the blue shark, this data is more valuable due to the larger number of catches, and the data deficient stock, however, DFO continues to promote derbies despite not having published data in two years. Currently, DFO does not intend to begin a commercial blue shark fishery and understands that the current rate of bycatch is causing a population decline which has been documented (Campana, et al., 2015). As such, the data collected at derbies is simply not valuable and successful enough to outweigh the risk to the already near threatened blue shark population through landing and post-release mortality and is not yielding significant enough results to justify the presence of catch-and-kill derbies. Further, data on blue sharks had often been collected on-board commercial longline fisheries, and as such, derbies are not needed to obtain this data, and is causing unneeded stress on the population, regardless of the so-called “negligible” catch (Campana S., Campana, Marks, Joyce, & Kohler, 2004) (Campana, et al., 2015).

The responsible utilisation of sharks as a resource should be a priority as they play an integral role in marine ecosystems worldwide. While this often does allow for some harvest, any mortality from fisheries, whether commercial or recreational, should be done in the least wasteful way possible. Sharks are vital to the maintenance of highly productive marine ecosystems globally, many of which humans rely on both economically, and for sustenance. As top predators, many shark species have been at the apex of the food chain in virtually all marine ecosystems for over 400 million years (Dulvy, et al., 2008) (Worm, et al., 2012). The status of shark populations impact species from lower trophic levels and can even change the balance of entire ecosystems, including those with high commercial value, making their conservation not only a priority from an environmental perspective but also from an economic perspective (Worm, et al., 2012). Due to the role of sharks within ecosystems, susceptibility to overexploitation, recent declines and recently increased economic value overall, sharks, as a group, have been in the forefront of discussions surrounding the health of our oceans and over-exploitation, but to date conservation efforts have largely been unsuccessful globally (Dulvy, et al., 2008). This increased economic value comes from the shark fin trade which is prominent in Asia, and the high value of fins has resulted in immense fishing pressure, where only the fins are valuable (Worm, et al., 2012). Blue sharks in Canada have low economic value as finning and the fin trade is not
permitted and fins are in low demand in North America. In Atlantic Canada, trophic changes are already becoming apparent possibly due to shark declines. As discussed by Wang, R (2013), between 12 and 14 species which are known prey of sharks have increased which has been attributed to a decrease of sharks in the region. One may think that because sharks are not economically valuable in Nova Scotia this is not of concern however scientists and fishermen are seeing direct impacts on other species which are considered economically valuable. For example, due to the decline of sharks, cownose rays have increased in population, increased feeding on scallops had caused the collapse of the fishery in Nova Scotia (Jind, 2014). While there could be increases in economically valuable species due to shark declines, this increase would likely be short-lived.

The Department of Fisheries and Oceans Canada is responsible for setting laws and regulations regarding shark fisheries and bycatch in Nova Scotia, and are responsible for enforcement, monitoring, and collect all data on the impact of the fishery. Several management plans are in place which addresses shark fisheries in Nova Scotia including the National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks) and the Atlantic Pelagic Sharks Integrated Fisheries Management Plan (IFMP) which, along with regulations, such as size limits and quotas, create the regulatory framework for the recreational shark fishery Nova Scotia, regulations will be described in Chapter 2 and will be assessed in Chapter 5 (Fisheries & Oceans Canada, 2002) (Government of Canada, 2007).

For this study; combining derby observations, stakeholder perspectives, an analysis of the regulatory framework as well as primary literature will provide an understanding of associated management concerns and identify areas where improvement should be implemented. For example, DFO has stated that derbies and catch-and-release fisheries are thought to account for only 3% of shark mortality in Canadian waters (Campana, Brading, & Joyce, 2011), although the lack of monitoring, quotas and standardised handling practices could make this estimate non-reliable. This project aims to explore and assess the current state of shark management in Nova Scotia through literature research and semi-structured interviews with fishery participants, leading to management solutions which will decrease the impact the recreational fishery is making and maintain participant interest and benefits to the community.
1.1 Research Purpose

The recreational fishery in Nova Scotia is unique within Canada as it is the only fishery with shark derbies, and permitted killing of sharks in the country (Cosandey-Godin, 2009). Management of this fishery relies on limited landing data, such as species, maturity, length, and weight collected at derbies and by recreational fishermen and in literature published by DFO, and is not currently considered a potential threat to shark populations (Campana, Marks, Joyce, & Kohler, 2006).

The motivations for participating and the potential benefits of such a fishery to those involved in the fishery have only been studied outside of DFO Science on one occasion, by WWF Canada and Sonia Jind (Making the switch: Assessing the potential for catch-and-release in Nova Scotia’s recreational shark derbies, 2014) where they explored the opinions of participants and spectators on the possibility of making derbies strictly catch-and-release. This project will be discussed further in chapter 6 where the results of this project will be used to support management suggestions moving forward.

This study will focus on the motivations of tournament fishers and organisers to participate in these events as well as their views on the current regulatory framework. This research aims to address any shortcomings in the current regulations which may pose a threat to the conservation and effective management of shark populations in Canadian waters, and fill gaps in research, specifically, stakeholder perspectives and a critical assessment of the regulatory framework directly related to Nova Scotia, through literature and qualitative research involving individuals who participate in the derbies, to gain a unique perspective on the fishery, which to date has not been well represented.

From a management perspective, there are three distinct areas which should be addressed; derby fishing, catch-and-release fishing and bycatch from other fisheries. These three management areas are responsible, for a large proportion of shark mortality in provincial waters, and should be a management priority (Campana, et al., 2015). These areas of the fishery are responsible for the mortality of sharks, in varying amounts; however, all could have negative impacts on shark populations. For this project, derbies, as well as catch-and-release fishing, will be the focus. While bycatch will be briefly discussed, this issue is much larger than the context of this project. As such, effective management is necessary to prevent depletion to populations caused by this fishery. The analysis of these areas will
show areas where improvements can be made to the regulation and how these improvements might be imposed (Campana, et al., 2015).

Firstly, bycatch is a large problem for sharks on a global scale; Nova Scotia is no exception (Campana, Joyce, & Manning, 2009). Oftentimes, the key to managing such a problem is to understand its severity, move forward using the precautionary approach and diminish this problem through time. In Nova Scotia, sharks are often caught incidentally in pelagic longline fisheries. (Campana, Joyce, & Manning, 2009). Between 1996 and 2010 an estimated 19394mt (metric tonnes) of porbeagle, mako and the blue shark has been caught incidentally in 4 Atlantic Canadian commercial fisheries; swordfish and tuna longline, porbeagle longline, ground fish longline, gillnet and otter-bottom trawl in Atlantic Canadian Fisheries. The blue shark is the most commonly caught species incidentally, likely due to the high abundance compared to other species. In 2005-1696mt of blue shark along were caught incidentally in commercial fisheries, while only 1706mt of targeted species were caught in the same fisheries (Campana, Brading, & Joyce, 2011) current estimates of shark mortality from bycatch are likely underestimated. Currently, the pelagic longline fishery for swordfish and tuna have the highest rate of shark bycatch in the province (Campana, et al., 2015).

Secondly, the catch-and-release fishery currently does not limit the number of licence holders and does not enforce the submission of logbooks (Government of Canada, 2016). In addition, individual fishers may not have any previous experience in shark handling. As there are limited monitoring and enforcement, it is difficult to ensure that fishers are fishing responsibly, handling sharks properly, and releasing catches according to the current regulation, which will be discussed in Chapter 2. Hence the true mortality caused by this section of the fishery is difficult to estimate and could be much higher than the current estimates if there is a compliance problem by licence holders.

Finally, shark fishing derbies, which account for a “negligible catch” as stated by DFO, has been largely disregarded as being a potential cause of declines in populations by the scientific community (Campana S., Campana, Marks, Joyce, & Kohler, 2004). Although derbies account for only 3% of documented shark removal in Canada per year, these deaths may still be too high if the overall rate of removal is higher than the carrying capacity of the population, thus putting the population at risk. As we currently do not know the carrying capacity of the blue shark population this has not yet been determined and caution
should be used (Campana, Joyce, & Manning, 2009; Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011). Currently, none of the species caught is considered to have a completely healthy population, making risk assessment necessary. As these are estimates, there is a margin of error which could mean that the mortality rate is once again higher than the estimate, even considering post-release mortality. While these estimates could mean the true mortality rate is lower, looking at it from a precautionary standpoint, management should be looking at the upper end of that margin and acting upon the worst-case scenario rather than the best-case scenario, especially since there are uncertainties. Certain handling practices and fishing gear have been directly linked to a decrease in mortality rates and should be utilised, is it important to ensure that handling practices are aiming to decrease mortality. Currently, for both derbies and catch-and-release fishing, there are no regulations, other than the mandatory use of rod and reel around the methods used for catching, handling and releasing, as such, there are many improvements which could be made. Creating regulations which limit the type of hook used, and handling would address the need for better handling practices.

1.2 Research Questions & Objectives

The aim for this thesis project is to explore the current state of the recreational shark fishery in Nova Scotia through literature research and interviewing key stakeholders which include event organisers (committee members) and participants. Currently, perceptions of derby participants and organisers are not well represented in scientific literature and can serve to supplement literature in assessing the regulatory framework of this fishery. Emphasis will be on the state of knowledge of blue sharks, gaps in scientific data, the current regulatory framework and the identification of possible improvements. Bycatch will not be the focus of this project, however, is a large management challenge for the Department of Fisheries and Oceans Canada and will be integral in determining the state of shark populations in the future. Future research should focus on ways to improve the selectivity of fishing gear, and improving enforcement and monitoring.

Although many scientific papers have been written on the fishery in Canada and the effects of the fishery, to date, few projects have focused specifically on those involved and their recommendations for the future of the fishery. Having participated in the fishery, some for
many years, participants can identify from a unique perspective, the positive and negative aspects of the fishery as well as which regulations are working in practice, and which can be improved upon. By identifying areas where improvements could be made, the framework can be strengthened to ensure that stakeholders continue to benefit from the positive aspects of the fishery, while concerns from ENGOs can be addressed. Many ENGOs main concerns are regarding the validity of the DFOs argument that these events are effective educational tools, and provide valuable scientific information. Some have also voiced concerns regarding the wastefulness of events as sharks are simply disposed of after the event. The Humane Society of Canada has addressed concerns regarding derbies by stating that they are “cruel and problematic”, and overall do not support their presence (MacDonald, 2016).

By engaging participants and organisers of shark derbies across the province, their opinions on the current regulations can be explored, as well as their motivations for participating. Using stakeholder perspectives as a method for guiding future management can serve as a useful tool to monitor the effectiveness of the regulatory framework involved and the management challenges involved in the fishery. As participants and organisers experience the effects of regulatory decisions directly and have first-hand experience with these events, they can identify areas of possible improvement in the regulatory framework as it relates to the organisation and execution of derbies. In many cases, compliance is a large issue in fisheries management. Arlinghaus (2005) discuss how adverse effects of regulations on fishers often leads to non-compliance, which has been linked to population decline in some fisheries. Further, compliance has been linked to acceptance of regulations, highlighting the importance of stakeholder engagement in decision making. Monitoring and enforcement are often difficult to maintain in recreational fisheries due to the individual nature of activities. Having regulations which are easy to comply to as well as enforce and monitor, and which are created with input from stakeholders can greatly improve compliance, and increase the chances of obtaining a positive outcome of regulatory changes. Identifying areas of importance to participants can guide management in a direction where the benefits for participants remain while improving in other areas such as handling practices and educational and scientific value. This project aims to answer the following research questions and meet the following objectives:
Research Questions:

1. What is the current regulatory framework for recreational shark fisheries shark catches in Nova Scotia and is this framework managing removal rates in a way where fishing activities are not causing population declines?
2. Do derby organisers and fishers in the fishery think the fishery is being managed appropriately, from their perspective?
3. What improvements can be made to the regulatory framework to improve effectiveness?

Research objectives:

1. Describe the current regulatory framework of the recreational shark fishery in Nova Scotia.
2. Through literature research, describe the blue shark and the impact of the fishery on the species.
3. Identify key stakeholders involved in the recreational shark fishery across Nova Scotia.
4. Explore the perspectives of tournament committee members and tournament participants through semi-structured interviews.
5. Identify any gaps or weaknesses in the current regulation and suggest future improvements.

1.3 Methods, Scope and Limitations

Methods consisted of several parts beginning with a literature search composed of; regulatory documents such as the National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks) or International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), documents published by DFO, and primary scientific literature of relevance were used as the base for data collection.

Next, the identification of key stakeholders in the recreational fishery guided primary data collection. Key stakeholders of concern were; tournament committee members, tournament participants, chartered fishing companies and individual fishers. Following the identification of key stakeholders, derby organisers and participants were chosen to be interviewed in a semi-structured format, with questions relating to the regulation currently
in place, as well as motives for participating in the fishery. Interview results were used in conjunction with the literature research to identify areas of importance within the fishery. Finally, data published by the Department of Fisheries and Oceans Canada regarding shark fishing tournaments were used to demonstrate any trends in catches.

This study is limited to the fishery in Nova Scotia and is not directly applicable to other Canadian provinces or countries; however, strategies such as fishing technique, handling practices and size limitations could be applied to other regions which have similar fisheries.

In total, six respondents were interviewed, all were contacted either in person at events, or through contact information obtained from DFO. Respondents were difficult to recruit, due only being able to attend two derbies, and their resistance to being contacted, which resulted in only a small number of participants were successfully interviewed. Results rely on the views of individuals which were interviewed and does not reflect the views of all individuals participating in the fishery. This study will focus entirely on those directly involved in either fishing or organising derbies and will not include stakeholders such as Environmental Non-Governmental organisations (ENGO), or citizens of Nova Scotia not involved in the fishery. The above stakeholders were chosen for this project as they have the experiences with derbies which will best meet the objectives of this project. ENGO’s and citizens of the province who do not participate in the fishery are not included in this study as their perspectives, while valuable, do not align with the objectives of this project. Further, ENGOs are often very vocal about their concerns and move governments to make changes using the platform they already have. Studies of this nature are also valuable as they provide a platform for voicing their opinions, which is currently underrepresented. Management strategies directly impact fishers and their activities and as such their knowledge can prove valuable to future management efforts.

1.4 Thesis Structure

This thesis is separated into six chapters, Chapter 1 is this introduction. Chapter 2 is comprised of background information including a detailed description of the research location as well as each of the three identified sources of shark mortality addressed in this project; derbies, catch-and-release fishing and incidental shark catch in longline fisheries.
Chapter 2 also includes a description of the current regulatory framework for this fishery. Chapter 3 outlines the research methods used to complete this project including field observations as well as semi-structured interviews with identified key stakeholders. Chapter 4 describes the results obtained through literature research and primary data collection. Chapter 5 is an assessment of the current state of the management framework for the recreational fishery and incidental shark catches in Nova Scotia which includes a critical analysis of several regulatory documents and the current laws and regulation in place. Chapter 6, the discussion and conclusion will discuss both strengths and shortcomings of the framework and documents outlines in chapter 5. Chapter 6 will also provide recommendations to address the gaps in scientific knowledge identified as well as any weaknesses in the current framework.
2. Background Information

2.1 Research Location

Nova Scotia is the second smallest province in Canada, with the Atlantic Ocean on the east coast, and the Bay of Fundy on the West, it is home to several species of shark. The Scotian Shelf is an important feature of the marine ecosystem off the coast of the province. It is the continental shelf which spans 700 km across the sea floor off the east coast of Nova Scotia. Pelagic shark species are most often found on the edge of the Scotian shelf as it straddles the line between productive coastal waters and the open ocean. (COIN Atlantic Coastal and Ocean Information Network, 2016; Historica Canada, 2015). The waters around the province are rich in biodiversity creating ideal fishing grounds for many species, but also creating the need for effective management and the prevention of over-exploitation by both domestic and international vessels (Campana, et al., 2015). Some of the most productive fisheries in Nova Scotia are the lobster and ground fisheries (Historica Canada, 2015). In 2012 the landed value of all Nova Scotian fisheries was $77 million Canadian. Nova Scotia also has a long-line fishery directed towards swordfish and tuna within which sharks are often caught incidentally (Campana, Brading, & Joyce, 2011).

Four communities held derbies in August 2016; Lockeport, Louisbourg, Petit de Grat and Riverport. Two of these are located on the mainland of Nova Scotia, on the south shore, and two are on Cape Breton Island, the northern island of Nova Scotia (Government of Canada, 2016). All four communities are small towns which have active commercial fishing activities and small ports. As derbies are non-profit, they often require sponsorship from local businesses, as well as revenue from other sources such as; registration fees, and fundraising through activities and stalls on the wharf to cover the costs of running the event. Any excess revenue is typically donated to local charities. For instance, in 2015, the Mako my day! Shark Derby in Louisbourg donated $8000 to the local Regional Hospital. (Cape Breton Island, 2016).

The federal government in Canada is responsible for creating and enforcing all the regulations with regards to fisheries, including regulations within the recreational shark
fishery through the Department of Fisheries and Oceans (DFO) (Government of Canada, 2007). It is also important for regulations to be created using the guidance of the FAO, which will be discussed in greater detail below, however, the federal government is ultimately responsible for regulations within the Canadian EEZ.

This chapter will provide an overview of the background information necessary to critically analyse the regulatory framework surrounding shark mortality in Nova Scotia. An overview of shark derbies, the catch and release fishery and shark bycatch in the pelagic longline commercial fishery will be described, including the regulation of these areas, and their impact on science, education, the blue shark, shortfin mako shark and porbeagle shark. Further, an overview of the current challenges facing management of these fisheries will also be addressed throughout the chapter, including post-release mortality, bycatch levels and mitigation, as well as other management challenges.

### 2.2 Derbies

As mentioned, the recreational shark fishery is unique within Canada due to the presence of shark fishing derbies (Cosandey-Godin, Strengthening Shark Conservation in Canada- a Management Blueprint, 2009). No other province has shark fishing tournaments or permits the landing of sharks from a recreational fishery. Shark fishing derbies take place each summer across the province (Government of Canada, 2016). The number of derbies has fluctuated through their history, however, 4-5 derbies typically take place each year. The Lockeport derby has been the longest running derby, which started in 1991 before DFO began collecting data from derbies. The other three derbies have not been running for as long, with the Riverport event beginning in 2002, the Petit de Grat in 2011 and the Louisbourg derby in 2012. These tournaments are non-profit, run by local volunteers and are usually funded by local business, community donations and registration fees (Government of Canada, 2016).

For a tournament to take place the event must obtain a recreational fishery licence from DFO. All participants are then permitted to fish during the derby under that licence (Government of Canada, 2016). There is no limit to the number of participants, however, there are limits on the number of landings, which DFO has set at 2 sharks per person per day of the event. Some, of the individual tournaments, Lockeport for example, have altered
these limits both for logistical purposes and conservation (Respondent A, 2016). All boats must be registered and each participant paying their registration fee which varies per event. with the registration fees as follows; Lockeport $30, Riverport $25, Petit de Grat $20, Louisbourg $150. (Association, 2016; Derby, 2016; Cape Breton Island, 2016; Riverport Rum Runners Sea Festival, 2016) Normally the events take place over two days. The boats call out early on Saturday morning and return to port in the afternoon Sunday (Government of Canada, 2016). Boats are owned and run by participants. Each boat usually has several participants per boat, who also obtain gear such as rod and reel. Louisbourg however, states on their website that all gear is provided, including boats and no previous experience is necessary (Cape Breton Island, 2016).

During shark derbies, sharks are killed, then landed and all sharks are turned over to the DFO. (Cosandey-Godin, 2009). As prizes are awarded for the boat or individual which catches the largest shark, participants must bring the shark to port, where it is weighed, meaning that they must kill it to submit the catch in the competition. In addition to this quota, there are restrictions on the length of animal and species which can be caught. Each boat is permitted to land two sharks per person per day during a derby and can catch and release as many as they wish. All catches over and above this must be released, after being tagged if possible (Government of Canada, 2016). The captain of each vessel is responsible for keeping a catch log including information such as size, species and sex of all sharks caught. (Campana, Marks, Joyce, & Kohler, 2006; Government of Canada, 2016; Government of Canada, 2007) As there is no regulation for handling and tagging, onboard monitors are not necessary, however, dockside observers are present to ensure boats do not land more sharks than permitted. Upon return, the sharks are weighed and handed over to DFO which collects scientific data. Each year, it is mandatory that all sharks landed in shark fishing tournaments are given to The Department of Fisheries and Oceans Canada (DFO), which takes measurements, identifies the species, sexes the sharks, identifies the stomach contents and occasionally takes tissue samples. As well, all sharks caught, including those released must be logged into a mandatory log book which is given to DFO at the end of the derby (Government of Canada, 2016).

The boat that catches the shark with the highest weight is to win a prize, usually monetary, which varies depending on the event and year. The Petit de Grat derby awards a first-place prize of $1000, second-place of $600 and third-place $400. Riverport also awards a first-
place prize of $1000. The Lockeport and Louisbourg Derby prizes are not available on their website. (Cape Breton Island, 2016, Derby, 2016, Government of Canada, 2016, Riverport Rum Runners Sea Festival, 2016). It is also important to note that many of these events are part of a larger festival where sport-fishing for other species takes place. For some derbies, such as the Lockeport derby, the shark portion is only a small component of the overall event.

2.2.1 Science & Education at Derbies

For many years, the recreational shark fishery, primarily chartered and derby fishing has provided scientific data to the Department of Fisheries and Oceans Canada, with the goal of helping to fill gaps in knowledge and maintain healthy populations. Log books, landing data and tagging are all important for ongoing research (Government of Canada, 2016). The history of the beginning years of shark derbies (1991-1993) is not formally recorded and is widely disputed. Some participants believe that it was first started by DFO, however, DFO did not begin collecting data formally until 1994, making this unlikely. What is known is that the first derby took place in Lockeport, Nova Scotia in the summer of 1991 and has continued until today, suggesting it was a successful event. DFO began collecting data to fill gaps in knowledge surrounding the populations of porbeagle and blue sharks, which did not have stock assessments at the time, and whose biology was poorly understood. This allowed them to monitor the effect that a potential commercial fishery may have and determine how sensitive these species are to over-exploitation. (Campana S., Campana, Marks, Joyce, & Kohler, 2004)

Today, DFO uses the data from derbies, both from landings and from log books to monitor the health of shark populations, primarily that of the blue shark as they are the largest proportion of catches. As stated on the DFO website for shark derbies, using biological indicators such as the size composition, size at sexual maturity and catch per unit effort, over several years can aid in detecting negative population changes. DFO can then adjust management to maintain a healthy population, which will be discussed in greater detail in section 5. (Government of Canada, 2016)

Furthermore, each event has a tagging program, which has been in place for several years, in conjunction with DFO, where as many released sharks as possible are tagged using recapture tags. Some training is provided to fishers to determine the species, sex, tagging
methods and measurements, and fishers are also informed if one of their tags is recaptured (Campana, Marks, Joyce, & Kohler, 2006; Government of Canada, 2016).

Conventional, or recapture tagging is done using a small subdermal “spaghetti tag” which is inserted into the shark directly in front of the dorsal fin on the dorsal side. A small portion of the tag will be visible on the exterior of the shark. If a shark is recaptured, DFO instructs boat captains, to return the shark, whole and frozen to DFO where they can obtain the tag and collect data on the shark. If the fisher is not able to send the shark whole, they are asked to cut out the portion of the backbone where the tag is located. In either case, the shark must be killed to collect data from this type of tag. Alternatively, there are satellite pop-up tags and archival tags, which do not require the recapture of the shark as they collect data from the time that are placed on the outside of the dorsal fin. As such, this type of tag does not require sharks to be killed. Currently, derbies only use conventional recapture tags. (Blue sharks (prionace glauca) international tagging program, 2016)

As stated on the DFO website dedicated to shark derbies, the data, such as sex, maturity, length, weight and species, provided from these events can be used to assess biological indicators (Shark Derbies , 2016). The recapture tagging program, which has similar sister programs all over the Atlantic can be useful to gain insight into shark migration and behaviour, however, to gain this information, sharks must be recaptured. Recapture tagging has yielded sparse data as recapture rates are low, preventing concrete conclusions to be formed. (Campana, Marks, Joyce, & Kohler, 2006; Kohler, Turner, Hoey, Natanson, & Briggs, 2001). Although the tagging program has not yielded significant results, it has helped show the migration of blue sharks specifically, which is now understood to span the entire North Atlantic (Campana, et al., 2011). Satellite pop-up tags do not require the recapture of the shark which prevents injury from being caught again and yields a larger quantity of data as tags return to the surface after being released from the shark, where they can be collected and data analysed. (Kohler, Turner, Hoey, Natanson, & Briggs, 2001; Skomal & Natanson, 2003)

DFO states that derbies aid in educating the community about sharks and shark conservation, however, the DFO website dedicated to derbies does not describe how they accomplish this or how this is monitored and enforced, nor do any DFO frameworks associated with derbies (Government of Canada, 2016). Educating community members and fishers on the importance of sharks within the ecosystem, their vulnerabilities, biology
and behaviour can impart a sense of responsibility, respect and urgency within these groups of people which can make them more conscious of the effects of their actions. DFO often collects data in front of event guests, and often speak with guests, even giving shark teeth to children attending the event. While this can spike the interest of those to learn more about sharks, very minimal educational elements were present at the two derbies observed. Having a representative from DFO Science or a scientist from a local university present with education materials would likely increase the education portion of these events. For example, having an announcer which can describe the data being collected, how this data will be used, and explain the biology of the shark to spectators would add an educational element to the event.

In summer of 2016, at both the Lockeport and Riverport derbies, no formal educational element was observed. The Petit de Grat derby, which is organised by a marine centre, seems to be much more advanced in their elements of education and seems to be much more active in using the information available to lessen the impacts of their derby, based on stakeholder interviews, however, this event was not attended. The Louisbourg Derby, which was not visited, advertises species information, displayed landings and an explanatory shark fishing video as an educational element.

### 2.3 Catch-and-release: Tour Operators and Anglers

There are two main divisions of the catch-and-release recreational fishery, which does not include derbies; tour operators, and individual licence holders. Tour operators take guests on shark fishing expeditions and operate primarily in the summer months, from Halifax and the surrounding area. These are strictly catch-and-release, wherein no landing of sharks is permitted (Campana, Marks, Joyce, & Kohler, 2006). Secondly, there is the part which allows Canadians to apply for licence and fish from their own boats at their leisure, which is once again catch-and-release only (Government of Canada, 2016). This fishery is strictly rod and reel. Agreements can be made with DFO, or external researchers allowing the tagging of live releases for chartered tour companies, which is done quite frequently. Log books for all licence holders are required and must be submitted as outlined in the licence agreement. These measures have been helpful in gathering vital information but have low return rates, likely due to lack of enforcement (Campana, Marks, Joyce, & Kohler, 2006; Campana S., Campana, Marks, Joyce, & Kohler, 2004). The derbies and
catch-and-release fishery use a different regulation and licensing system under the DFO regulations but fall under a common management regime (Fisheries & Oceans Canada, 2002; Government of Canada, 2016). In terms of management of this fishery, the main challenges are in the catch, handling and release practices, as well as enforcement, which on chartered boats is not difficult, however, individual licence holders have no monitoring.

2.4 Sharks of Nova Scotia

2.4.1 Blue Shark

As the blue shark represents 99% of recreational catches the blue shark will be the focus of this project. The blue shark (Prionace Glauca) is a large pelagic shark species of the family Carcharhinidae and is one of the most abundant shark species in the world, and the North Atlantic (Stevens, 2017). Fishing pressure, mainly through bycatch, has resulted in the species being near threatened on the IUCN Redlist of Threatened Species (The IUCN Redlist of Endangered Species, 2009). Measuring up to 3.8m (13ft) in length and weighing up to 550lb (250kg) at maturity (Gaelan & WWF Canada). Blue sharks are thought to live up to 20 years (Skomal & Natanson, 2003). In the summer season, the blue shark is the most abundant species off the coast of Nova Scotia (Campana, Marks, Joyce, & Kohler, 2006) (Skomal & Natanson, 2003).

Blue sharks are viviparous, meaning that they give birth to live young. They have a gestation period of about 9-12 months and typically give birth to 25-50 pups measuring 40-51cm (Department of Fisheries and Oceans, 2016). They are measured by total length, as opposed to age, as ageing sharks remains an inexact science. Blue sharks typically reach maturity at around 5 years of age (Skomal & Natanson, 2003). In terms of sharks, the blue shark has quite a high rate of reproduction, having more pups per litter than most other shark species; for example, the porbeagle typically has litters of 4 pups, however, it is still much lower than non-viviparous fishes (Campana, Marks, Joyce, & Kohler, 2006).

Caught commercially worldwide, primarily in the Pacific for the fin trade, the blue shark has a low economic value compared to other species, however, is very common making it the desired species for finning. Finning is the practice of cutting off the fins of sharks, disposing of the rest of the body at sea, and landing only the valuable fins. Finning is
considered the main threat to shark populations on a global scale and is responsible for the decline of several stocks globally (Campana, Marks, Joyce, & Kohler, 2006).

As a highly migratory species, the blue shark ranges across the entire Atlantic Ocean, the Pacific and Indian Oceans, where there are temperate and tropical waters. Genetic testing shows that all individuals in the North Atlantic Ocean are part of one stock (Skomal & Natanson, 2003).

The blue shark can often be caught in the high seas, in addition to within state EEZs. They are also the commonly caught as bycatch in all Atlantic longline fisheries, as well as gillnet and other fisheries (Campana, Marks, Joyce, & Kohler, 2006). In Nova Scotia, there is currently no active commercial blue shark fishery; however, there is still a high removal rate through bycatch, as well as recreational fisheries (Campana, Marks, Joyce, & Kohler, 2006). In 2010, it was estimated that 1414mt of blue shark were incidentally caught and discarded in Atlantic Canadian commercial fisheries, 99% of that from the swordfish and tuna longline fishery. Of that 1414mt, 495mt did not survive, either before release or post-release. (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011).

Due to the migratory nature of the Atlantic blue shark population, their management and stock assessments can have inferences across the Atlantic, meaning that there are implications for actions across multiple nation’s EEZs as well as the high seas. For example, a stock assessment by the Department of Fisheries and Oceans Canada, solely in Canadian waters would not provide an accurate picture of the state of the entire blue shark population of the North Atlantic. Alternatively, an assessment which encompasses the efforts of all North Atlantic Nations in which blue sharks are found would provide a comprehensive assessment of the health of the population. (Northwest Atlantic Fisheries Organization, 2016). It is not uncommon to manage stocks with scientific uncertainty, however, the more information available on the state of a fish stock will make management of said stock more exact, and often more effective, understanding a problem, and assessing risk before providing a solution ensures that the desired outcomes are met. Blue sharks’ migration is thought to be influenced by three major factors; water temperature, reproduction and prey (Skomal & Natanson, 2003). Blue sharks in the Atlantic are thought to migrate in a clockwise manner around the Atlantic gyre, likely due to the current aiding migration (Skomal & Natanson, 2003). This has been determined through recapture
tagging studies. In the Northwest Atlantic, mature or pregnant females are seldom seen, instead, this area is dominated by juvenile blue sharks, both male and female (Campana, Marks, Joyce, & Kohler, 2006).

In Nova Scotia, blue sharks are primarily seasonal visitors, staying mainly through the warm summer months. As such, it would be necessary to perform the population assessment over a large distance and would be expensive and labour intensive. Many assessments rely on recapture tagging programs. (Campana S., Campana, Marks, Joyce, & Kohler, 2004). Currently stock estimates for the blue shark in Nova Scotia, show that the population is thought to be in a relatively healthy condition, especially when compared to other pelagic shark species, but may have dropped up to 60% (Campana, Marks, Joyce, & Kohler, 2006; Campana S., Campana, Marks, Joyce, & Kohler, 2004; Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011).

Figure 2 Distribution of the blue shark (Prionace Glauca) in the Atlantic Ocean (Food and Agriculture Organization of the United Nations, 2017)

2.4.2 Other shark species

The blue shark represents 99% of catches in the recreational fishery, including derbies in Nova Scotia. Other sharks are seldom caught but include the porbeagle shark, thresher shark and shortfin mako (Campana, Marks, Joyce, & Kohler, 2006).
Porbeagle Sharks are ovoviviparous and typically have litters of 4 pups after maturity at age 7, significantly less than the blue shark. This slower rate of reproduction causes an increased susceptibility to overexploitation and depletion. Studies suggest the migration of the porbeagle follow a North to South trajectory along the east coast of Canada and the United States from the Grand Banks to North Carolina. (Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002)

In Nova Scotia, a porbeagle directed fishery existed which followed the same trajectory as several fisheries before. In the early 1960’s the directed commercial porbeagle fishery was very successful with catches of about 4500mt per year, however, this success lasted only for about 6 years before the fishery collapsed. Several years later, in the 1970s and 1980s, the fishery began to increase, with much smaller landings of about 350mt per year. While at the time this was thought to be much more sustainable, the fishery increased and a 1000mt TAC was set for 1997-1999. As this was regularly exceeded fishermen began to see a population decline, prompting extensive research in 1998.

In the western Atlantic, the shortfin mako ranges from the Grand Banks to Uruguay and northern Argentina. (Cailliet, 2017) The shortfin mako is the largest shark which is caught in the recreational fishery and incidentally on a regular basis. There has never been a commercial fishery for the species as it would not be viable economically. This species is currently considered vulnerable on the IUCN Redlist due to estimated declines and poor management. Shortfin makos are often caught incidentally in pelagic fisheries.

### 2.5 Regulatory Framework

#### 2.5.1 Licensing

Licensing for the catch and release fishery, both chartered tours and individuals, is issued online via the Department of Fisheries and Oceans (Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002). There are no limits on the number of licenses which are issued. Individuals can purchase a license at a cost of only $10 Canadian Dollars, which makes the licenses easily accessible to many citizens of Nova Scotia (Shark Derbies, 2016), although it is important to note that while the licence is inexpensive, gear such as boats are expensive and necessary due to the target species being pelagic, and would likely only be accessible to those who already own this gear for another
purpose, such as work in a commercial fishery. Licensing for derbies is also issued by DFO although has recently changed and is no longer given to individuals or vessels, instead they are issued for each event, and all fishers for the event fall under a single license (Shark Derbies, 2016). Previously, licensing for derbies was issued similarly to the catch and release fishery, however, this change was meant to streamline the licensing process (Campana, Marks, Joyce, & Kohler, 2006; Shark Derbies, 2016; Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002). Some interview respondents have voiced that there were some challenges when making this change however, feel that DFO has been helpful in remediating and issues (Respondent A, 2016).

2.5.2 Species and Size Limitations
Throughout the recreational fishery, the blue shark, shortfin mako shark, thresher shark and porbeagle shark are the species which are most often caught (Shark Derbies, 2016). The porbeagle and any other at-risk species of shark are not allowed to be landed and must be released, as they are protected under the Species at Risk Act (SARA) (Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002). Since 2004, size limitations have been imposed on the fishery. Specifically, for derbies, no blue shark less than 6 feet is permitted to be landed (Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002). All other species of any size can be landed, except for the porbeagle was listed as endangered under COSEWIC in 2004, following over-exploitation in a short commercial fishery (Canadian Atlantic Pelagic Shark Integrated Fisheries Management Plan, 2002). These regulations have been created based on the size at maturity of individual species (Shark Derbies, 2016). As the other sections of the recreational fishery are catch and release only these limitations are not applicable. (Gaelan & WWF Canada; Campana, Marks, Joyce, & Kohler, 2006; Campana S., Campana, Marks, Joyce, & Kohler, 2004)

2.5.3 Fishing methods
All recreational shark fisheries are done using rod and reel, using either a j or circle hook. Circle and J hooks differ in the angle of the point in relation to the main shaft of the hook. On a J hook, the point is in line with the shaft however on a circle hook it curves to be perpendicular to the shaft. There are no restrictions on the strength or width of the rod and reel as set out by the federal government in the Canadian Atlantic Pelagic Shark Integrated
Fisheries Management Plan (2002). In terms of price, both hooks are comparable, however, the circle hook has been proven to cause less damage and post-release mortality in many species including some shark species. As such, it is recommended to use circle hooks in the recreational fishery to decrease the post-release mortality rate. (Gallagher, Serafy, Cooke, & Hammerschlag, 2014).

2.5.4 Log books

Derby participants are required to complete log books and turn them over to DFO at the end of each fishing season. The DFO require fishers to enter their fishing activity in the log books, including information such as catches, species, sizes and location of catches (Shark Derbies, 2016; Campana, Marks, Joyce, & Kohler, 2006; National Plan of Action for the Conservation and Management of Sharks, 2007). Catch-and-release fishing also has log books, which are considered mandatory although DFO has stated that few of these books are turned in every year, although no exact return rate is given, making them ineffective as a monitoring strategy.

2.5.5 Disposal of Sharks

Following the end of the shark fishing tournament, when DFO is finished gathering information, the carcass of landed sharks must be disposed of. It is not permitted to sell the carcasses from these events for profit to any individual or the event committee, although they can be sold if the proceeds are donated to a non-profit in the area. This regulation has been set as derbies are part of the recreational, not commercial fishery and must be non-profit. Sharks caught at these tournaments are not suitable for human consumption, as they are not kept on ice once caught and are not treated as consumable by fishermen and are
simply waste following data collection. (Fisheries & Oceans Canada, 2002). One respondent even discussed the logistical difficulty of disposing of the sharks and that this was one motivation for the tournament to limit landings further (Respondent A, 2016).

### 2.6 Post-Release Mortality & Handling Practices

The recreational shark fishery in Nova Scotia, apart from organised derbies, is strictly catch-and-release (Cosandey-Godin, Strengthening Shark Conservation in Canada- a Management Blueprint, 2009). Having a catch-and-release fishery, as opposed to one with landing quotas will help to keep the mortality rate of sharks killed in the fishery as low as possible, and at least in part follows the precautionary principle, as DFO states they aim to follow. This would greatly decrease the overall mortality rate of sharks, which would be much higher if landings were permitted in the fishery. (Kohler, Turner, Hoey, Natanson, & Briggs, 2001)

Several studies by Campana et al (2009, 2011) have observed the estimated mortality rate of sharks’ post-release from incidentally caught blue and porbeagle sharks in the North Atlantic. There are several factors which contribute to this statistic. To prevent injury, it is recommended by DFO and WWF Canada to not put excessive pressure on the shark during handling, which would include sitting or putting significant weight on the shark (Gaelan & WWF Canada). Furthermore, in the recreational fishery, hook and lines are used to catch sharks, which will inevitably injure the shark in some way. In many instances, sharks can be hooked in body parts other than the mouth, for instance the abdomen, which can cause serious injury including, internal bleeding, damage to eyes etc. (Skomal G. B., 2007). Typically, hooks are removed before release, however in some cases hooks become stuck and cannot be removed leaving permanent injury which can increase susceptibility to infection. Preventing this using a hook which will cause the least injury possible is imperative to maintaining the highest possible standards for fishing. Furthermore, sharks need water to be constantly flowing over the gills to absorb oxygen, the longer the shark is on the boat, the more harm can be caused. Finally, studies have shown that many pelagic fishes, including certain species of shark, undergo chemical changes in the bloodstream due to stress, referred to as the stress response. These chemical changes in the blood may decrease chances of survival. Signs of diminished health or even death post-release have been observed due to stress. (Skomal G. B., 2007; Gallagher, Serafy, Cooke, & Hammerschlag, 2014)
There are however a few improvements which could be made to the current fishing, handling, release and tagging process (Jind, 2014). First and foremost, studies show that a change from a j hook to a circle hook can greatly reduce injury to individual sharks and other pelagic fishes (Skomal G. B., 2007). Due to the curved shape of circle hooks, they typically do not penetrate as deeply into the tissue as the j hook decreasing the severity of the injury, and isolating the injury to surface tissue, not vital organs (Cosandey-Godin, 2009). Further, it may be that smaller sharks have higher rates of post-release mortality although it remains unclear as to why (Gallagher, Cooke, Serafy, & Hammerschlag, 2016).

Post-release estimates for the blue shark in Atlantic Canada are typically done through either a scientific fishing expedition or onboard a commercial vessel from other fisheries such as long-line fisheries. There is currently no standardised method for assessing the post-release mortality rates in sharks (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011). It is difficult to determine the true cause of mortality, which would allow for the improvement of handling practices, in all aspects of the recreational fishery (Gallagher, Serafy, Cooke, & Hammerschlag, 2014). When out at sea, it is also difficult to control conditions and handle sharks the same way each time to ensure the reliability of the research making it difficult to assess techniques for handling (Campana, Marks, Joyce, & Kohler, 2006). Research has shown, however, that there are several ways to reduce mortality caused by handling including; minimising out of water time, removal of hook, using a circle hook instead of a J hook.

Commercial fishing boats are often utilised by researchers to collect data on post-release mortality. Firstly, they are at sea frequently, and sharks are often incidentally caught but must be released, making them ideal for monitoring post-release mortality. It is difficult to directly apply these finding to the recreational shark fishery in Nova Scotia due to methods varying within these fisheries. Long-lines are often used in commercial fisheries, as opposed to rod and reel in recreational fishing, which may cause a varying amount of stress. Hook type may differ as well as the target species is not a shark. (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011)
WWF Canada had been working to improve shark management in Nova Scotia. WWF is focused on bycatch reductions, including the creation of new more selective technologies to employ in other fisheries, as well as promoting better catch, handling and release practices across commercial and recreational fisheries which frequently encounter a shark. Through a consultation process, WWF along with local chartered fisherman, Art Gaelan have developed a set of guidelines for the responsible catch, handling and release of sharks which can be used in the recreational fishery as well as the commercial long-line fishery. Further, a Code of Conduct for Recreational Shark Fishing had been created, although monitoring is sparse and guidelines may not be followed consistently. (World Wildlife Fund Canada, 2015) As derbies take place only once a year, it may be difficult to perfect methods used in tagging, handling and release, however, it is important to follow guidelines laid out by both the organising committee and the Department of Fisheries and Oceans. The World Wildlife Fund has also published an educational brochure outlining the least harmful practices (Gaelan & WWF Canada). This brochure which was jointly created with a local shark fishing tour operator outlines best practices for shark handline in a 5-step plan, including every step of handling from preparation, which gear to use, fishing technique, handling onboard, and release. One suggestion, which has not been found in any other literature is the use of non-stainless hooks. They explain that this type of hook if left in the shark, would eventually corrode and fall off. They do not address the use of J or circle hooks in this brochure but do discuss the use of force and the damage sitting, kneeling and holding the shark by the gills can cause (Gaelan & WWF Canada). This document could be a valuable resource to the fishing community, however, it is uncertain how many fishers follow these recommendations.

2.7 Shark Bycatch in Nova Scotia

As stated previously, there are currently no active commercial pelagic shark fisheries in Nova Scotia. As recreational fisheries account for only a small percentage of the overall mortality in these waters, the incidental catch of large pelagic species in other commercial fisheries accounts for the largest proportion of mortality. The pelagic longline fishery for swordfish and tuna is responsible for the most catches and to a lesser extent the groundfish longline, gillnet and bottom otter trawl. The porbeagle fishery, which was formerly a directed commercial fishery until the stock was over-exploited, has also historically been
responsible for the incidental catch of other pelagic shark species. Today, the blue shark, shortfin mako and porbeagle are the main species caught incidentally, the blue shark making up the largest proportion due to its sheer abundance. (Fisheries and Oceans Canada)

Regulations for bycatch management in Nova Scotia are set by DFO although the FAO and NAFO have both set recommendations for bycatch reduction, which will be analysed. In Canada, there is a 100% on-board observer coverage for all foreign vessels fishing in the country, however, for domestic vessels, there is only 5% coverage (Cosandey-Godin & Worm, 2010).

Bycatch of sharks is managed under several policies and frameworks in Canada. Species such as the endangered porbeagle are managed under the Species at Risk Act (SARA), and other species fall under the NPOA-Sharks in 1995 the FAO published the Code of Conduct for Responsible Fisheries with the purpose of guiding states to adopt more sustainable fisheries management strategies. Following this, in 2010 FAO published International guidelines for bycatch management and reduction of discards. As Canada signed this Code of Conduct, they have created and implemented several plans, which specifically address the incidental catch, or bycatch of species in commercial, recreational and aboriginal fisheries. This policy has two objectives;

“1. to ensure that Canadian fisheries are managed in a manner that supports the sustainable harvesting of aquatic species and that minimizes the risk of fisheries causing serious or irreversible harm to bycatch species; and
2. to account for total catch, including retained and non-retained bycatch.” (Policy on Managing Bycatch)

Figure 4. shows the overall discards of large pelagic shark species in commercial Canadian fisheries. Total catch refers to the total catch or targeted species whereas total discard catch refers to the catch of non-target species. Most commercial fishing methods are not highly selective and have a large proportion of incidental catches, the longlining being one of main concern. As the figure demonstrates, discards frequently exceed 50% of the number of targeted species, which is not economically positive for fishermen, nor is it healthy for species caught incidentally. (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011)
Figure 4 Total catch of sharks in all commercial fisheries, total discard catches of sharks in commercial fisheries and discarded catch of sharks from the pelagic swordfish and tuna longline fishery, showing a percentage of total catch that discards, from all fisheries account from 1996 to 2009. (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011)
Figure 5 Estimated discard catch, in megatons of three pelagic shark species, porbeagle, shortfin mako and blue, in Atlantic Canadian commercial fisheries from 1996-2010 (Campana, Brading, & Joyce, Estimation of Pelagic Shark Bycatch and Associated Mortality in Canadian Atlantic Fisheries, 2011)
3 Research Methods

Nova Scotia was chosen as the research location for this study due to the uniqueness of the recreational fishery (Cosandey-Godin, 2009). The inclusion of tournaments in the fishery creates a challenge for managers which separates the province from others. Although there are gaps which exist in our knowledge of the overall effect of the recreational fishery the data collected by DFO has provided some information regarding the state of shark fisheries and stocks in Nova Scotia and will be used in this study (Campana S., Campana, Marks, Joyce, & Kohler, 2004; Campana, Brading, & Joyce, 2011).

The primary methodology of this thesis consists of a comprehensive literature review. Documents including scientific research, reports, government and policy documents as well as news articles and ENGO published documents served as the foundation for this literature. Each piece of literature was categorised into one of the following three themes: Management Plans & Frameworks, Department of Fisheries and Oceans Research, and Independent Research. Themes were chosen following a preliminary search which was done using key phrases such as Shark Derby/Tournament Nova Scotia, Recreational Shark Fishery Nova Scotia, and Shark Fishing Nova Scotia. Relevant news articles were also included in this search and considered as independent research for the purposes of this project, which included those reporting of DFO studies and related topics. From this preliminary search, relevant documents which fell into one of the above themes were read, and relevant information for this project compiled. Any Management Plans and Frameworks will be analysed in Chapter 5, and relevant information included in chapters 1, 2 and 6. DFO and independent research are also used throughout chapters 1, 2, 5 and 6.

The secondary methodology used for this thesis is a series of semi-structured with derby participants and organisers exploring their perspectives on derbies. In the following sections, stakeholder identification will be explained in greater detail.

3.1 Identifying Key Stakeholders

The key stakeholders identified include; derby organisers, derby participants, chartered fishing company owners and employees as well as individual licence holders. Further, the
Department of Fisheries and Oceans and shark fishing associations/organisations are considered key stakeholders in this study. For the purposes of this project, the stakeholders which have been chosen to be interviewed are; derby organisers and participants. This group of stakeholders was chosen due to their direct involvement in derbies and the catch-and-release fishery. Representatives from DFO were not interviewed as they are not participants in the fishery (i.e. do not compete in derbies) and do not organise derbies.

Using published scientific and management literature, as well as local news stories, key stakeholders relevant to this study were identified. For this study, a stakeholder will be any person, group of people or organisation (government or non-government) which either influences shark derbies or are affected by the shark derbies. Key stakeholders, however, are those groups of people which participate actively in the recreational shark fishery. Although ENGO’s are an important and relevant stakeholder in this fishery, their perspective is vastly different than the perspective this study aims to highlight, and thus stakeholders such as ENGO’s will not be the focus of this study. However, there are groups which may have an interest in this fishery including ENGOs such as the Ecology Action Centre Nova Scotia, World Wildlife Fund Canada, and the Humane Society of Canada all of which will be briefly discussed.

### 3.2 Derby Observations

I attended two of the four shark derbies in Nova Scotia in August 2016. These derbies were the Lockeport (attended August 13th, 2016) and Riverport Derbies (attended August 21st, 2016). These two derbies were chosen as some derbies took place on the same days and these events and were the most accessible both geographically and financially. The two derbies which were not attended were the Petit de Grat and Louisbourg derbies in Cape Breton. Of importance was the overall event including size, participants, location and venue as well as weather, overall atmosphere and how the execution of the tournament itself. General observations, as well as photos, were recorded during the two events. The number of participants was also be estimated using catch data and regulations.
3.3 Key Stakeholder Interviews

3.3.1 Recruiting Respondents

Interview respondents were recruited either through contacting them via email or phone or by direct communication at derbies. One respondent was recruited through word of mouth from a relative. A connection at DFO provided contact information for a representative for the Lockeport, Petit de Grat, Louisbourg, and Riverport derbies, as well as the inactive Yarmouth derby. At derbies, respondents were recruited by introducing myself, along with a brief description of this project, and asked if they would be interested in doing an interview in one of the three following ways; in-person at the event, in-person at an arranged time outside of the event, or over the phone on a different date. For those which said they would be interested in being interviewed outside of the event, their contact information was obtained, or alternatively, mine was given to them. All respondents will have access to the results of this study when it becomes available in this thesis on skemman.is.

3.3.2 Data Collection

Data was collected using a semi-structured interview format, meaning that pre-prepared questions are used, however, there is some flexibility in the interview process, should a topic arise which may be relevant or of interest. Interviews were conducted with respondents from the identified key stakeholder groups which include; past or present derby participants and committee members. A total of six interviews were conducted either over the phone or in person. Respondents were difficult to contact as contact information was only available through attending derbies and speaking with participants as well as word of mouth, resulting in the low number of interviews. All interviews consisted of a set of 10 questions and were about 20 minutes in length. Questions addressed motivations for participation, overall experience, changes in the environment as well as views on the current regulation. Before each interview was conducted, a confidentiality statement was read, and permission to record was obtained. All interviews were individual and recorded using a digital recorder and later transcribed onto a Word document to prepare for analysis. Those interviews which were in-person were conducted in a one-on-one setting with as little outside influence as possible, to reduce external factors.

Interview Questions:
1. Can you tell me about your involvement in shark fishing tournaments, which ones have you attended and for how long have you been attending them?
   a. For organisers: What is your current position within the organisation, and what are your duties?
2. Why do you participate in/organise shark derbies?
3. If you had to describe these events to someone who had never heard of them, how would you do it?
4. Overall, how has your experience been with regards to shark derbies?
5. How have things changed, in your time working with shark derbies? This could be in terms of regulation, fishing methods, environmental & ethical aspects, event organisation, event advertisement, participation or public opinion of the events etc.
6. What are your views on the current regulation associated with shark derbies?
7. Have you noticed any changes in the natural environment in your time involved with derbies?
8. Have you noticed any changed in shark populations in your time involved with derbies?
9. Do you have any recommendation which could be made to shark derby regulations in Nova Scotia and if so, what would be your recommendations?
10. Is there anything else you would like to add?

### 3.3.2 Data Analysis

Data were analysed using qualitative data analysis software HyperResearch 3.7.3. Text transcripts were uploaded to the software and emergent themes were identified by identifying frequently used words, phrases or topics. Codes, including; Community, water temperature, fun etc. were used to identify these themes. As the goal of interviews was to explore the strengths, weaknesses, and recommendations for derbies through the perspective of fishers and organisers, codes were chosen if they were either discussed by respondents in a manner where they were considered a positive or negative aspect of derbies, or where suggestions for the future were made. Each interview transcript was read, and codes were applied where appropriate. Once all transcripts were coded, the frequency of each code as well as how many respondents used each code was identified.
3.4 DFO Data

Researchers and volunteers from the Shark Laboratory, located at the Bedford Institute of Oceanography in Dartmouth, NS, and who represent the Department of Fisheries and Oceans Science division are present at each derby. During the events, all landings are handed over to these researchers and volunteers, which then take biological data. Data collected includes fork length (measured from tip of snout to middle of caudal fin rays), total length, sex, species, maturity, weight, stomach contents, and tissue samples if necessary. All data collected is accessible to the public through the DFO website, regardless of if data is published in a paper. From 1993-2016 the number of catches and the overall weight (kg) is available for use in this study.
4 Results

4.1 Derby observations

The purpose of this section of data collection is to observe the elements of these events, what components they consist of, for example; food stalls, vendors, activities for spectators, shark landings, of as well as to observe spectators and fishers at the event to identify any areas of interest. Components of derbies which are of interest include interactions between DFO Science and spectators, areas which seem to be of interest to spectators and educational or awareness-raising observations. At both the Lockeport and Riverport derbies, the first part of the observation was to simply walk around the event and to note the location of all the parts of the event such as vendors etc. Following this, the recruitment of respondents was done. At the Lockeport derby, participants were wearing hats which identified them, whereas at the Riverport Derby did not have a distinguishing feature for fishermen.

4.2.1 Lockeport Derby

Lockeport is a port town whose main industry is commercial fisheries. Located on the southeastern coast of Shelburne County, Lockeport has a population of only 531 (Statistics Canada, 2017). On the day of the derby, landings began mid-afternoon. The day of the event was warm and sunny, ideal for fishing in warmer waters are known to bring more sharks, and clear skies make visibility ideal. The event took place on the town’s government wharf, which is a small wharf with one covered building where DFO data was collected. Sharks were landed at the end of the dock using a hoist to remove catches from the deck of the boats. Third party dockside observers were present to monitor landings and ensure regulations were followed. The hoist, which was equipped with a scale, weighed the sharks as they were landed. Sharks were often left on the hoist for a few moments for spectators to take pictures. After being marked with their weight and which boat caught them, sharks were transported, by forklift, to a garage type building where DFO-science volunteers were present to collect data outlined below. On the dock, there were also tents
set up which sold light food, sold merchandise and was the location on landings of ground fishery tournaments, which included species such as mackerel, pollock, and haddock.

In terms of education at this derby, there was no active element where spectators could learn about sharks. Spectators were permitted to watch DFO-Science volunteers collect data, which included the dissection of one large mako with a seal skull and porpoise head as stomach contents. DFO-Science representatives were very open to answering any questions that spectators had, however, there was no organised location where spectators, including youth, could go to obtain more information on shark biology and conservation. At this derby, a large mako was landed, which is the second largest ever landed at a derby in Nova Scotia. The mako weighed 1079 pounds, only 3 pounds behind the mako (1082 pound) caught in 2004 at the Yarmouth derby. The mako shark was dissected by DFO-Science and the contents of the stomach, which included a seal and porpoise was placed on display in the garage for spectators to see and take pictures of. During the derby, the dock was busy with spectators and participants enjoying the day. Many spectators were present and lined the wharf when sharks were landed. Some spectators and fishers spoke to DFO Scientists and volunteers in the building where data was being collected. Questions included things like, how much does it weigh, what species is this and is it female or male. Spectators were mostly intrigued by the large female mako which was caught and several of them were asking about its stomach contents, some even asked if they could have a picture with it. This shark was the biggest attraction. One spectator asked how long ago the shark would have eaten the porpoise and seal, which DFO said would have been quite recently. Overall interaction among committee members, fishers, spectators, and DFO was open and dialogue about the derby was fluid. There was some informal educational value in this conversation however, spectators had to seek out this information.

4.2.2 Riverport Derby

Riverport is a small town on the Atlantic coast of Nova Scotia, near the town of Bridgewater. Riverport has a small population of 350 people and is in Lunenburg County (Mosher & Uhlman). The day of the derby was warm and sunny, good for fishing and hosting the event. Once again, landings took place mid-afternoon. Sharks were removed using a hoist, equipped with a scale that weighed the landings as they were transported to the dock. Once again, third party dockside observers were present to ensure regulations were followed. Following this, DFO Science representatives collected data on the dock,
which was set up with a viewing area for spectators, this area remained full for the duration of the landings. There were several food vendors and an entertainment tent where a small orchestra performed. Children at this event could receive the teeth of landed sharks, as well as touch sharks and ask questions to DFO representatives. The children present seemed very excited to see and touch a real shark and asked the DFO science representatives about the shark. Questions from spectators related to size, species, what the scientists were doing, if the sharks could be consumed, as well as what happens to the sharks after the derby. There were many spectators and participants on the wharf, most of which were concentrated around the viewing area where sharks were dissected and measured by DFO. The DFO representatives were engaging spectators, where possible and answering any questions they may have. The Riverport event had more vendors and other activities for spectators to engage in other than watching the shark landings, although there was no planned educational aspect to the derby. The only education that was present was that from DFO-Science as the collected data. Other fishing, such as ground fish and mackerel was somewhat present however was less prominent than at the Lockeport derby.

![Figure 6 Photos from the Riverport 2016 Shark Derby. a) DFO Science collecting data b) Shark being weighed and landed c) Spectators observing landed shark on the dock](image)
Table 1 Estimated number of fishermen at four Nova Scotian shark derbies in summer 2016 * Number of participants has been estimated from landing data, derby websites as well as interviews (If a committee member stated the number of participants, this was noted and used below. If a derby website stated, the number of participants this was also used directly below. For derbies where this was not the case, research into news articles which may have had this information was included. Finally, as participants are allowed 2 sharks per person per day (or less depending on the derby) this, along with the number of landed sharks was used, i.e. if 50 sharks were caught, and each participant is allowed 2, there would be 25 participants.

<table>
<thead>
<tr>
<th>Derby Location</th>
<th>Estimated number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lockeport</td>
<td>Up to 194 (likely 60-70)</td>
</tr>
<tr>
<td>Petit de Grat</td>
<td>Up to about 70-75</td>
</tr>
<tr>
<td>Riverport</td>
<td>Up to about 60</td>
</tr>
<tr>
<td>Louisbourg</td>
<td>Up to about 170</td>
</tr>
</tbody>
</table>

4.2 Data from DFO

![Sharks Caught per year at derbies in Nova Scotia from 1993-2016](image)

Figure 7 Number of sharks caught at all derbies in Nova Scotia from 1993-2016

Figure 7 shows the trend in catches since derbies began being monitored by DFO in 1993. Changes in catches could be a result of several factors; the number of derbies which occurred that year, the quota each derby follows, weather conditions, water temperature and the location of the derby. In 2006, new regulations were imposed on derbies which
limited the species which could be caught, to exclude the porbeagle shark limited the number of landings permitted, and is likely the cause of the rapid decline in catches shown in Figure 7.

![Total weight of sharks landed at derbies in Nova Scotia from 1993-2016](image)

**Figure 8 Total weight of sharks landed each year at derbies in Nova Scotia from 1993-2016**

Figure 8 shows the total weight of sharks landed at derbies in Nova Scotia since they began being monitored by DFO in 1993. There are two periods of decline on the above graph, which could have occurred for several reasons. Firstly, as this demonstrates the total weight, smaller sharks may have been landed in both 1999 and 2004, before the tightening of regulations to include size limits. Secondly, the number of derbies dropped in 1999 from 5 to 4, which could also be a factor. Furthermore, around this time, we began to see a drop in sharks being caught at derbies in the Halifax area, of which all have since been cancelled. Participation could also be a factor influencing this decline.
Figure 9 Number of individual sharks caught at all derbies each year from 1994 to 2016

Figure 9 shows a rapid decline in the number of sharks being caught at each derby beginning in about 2006 when stricter regulations were imposed both by DFO and by individual events.

Figure 10 Number of shark derbies held each year from 1993-2016 across Nova Scotia

The number of derbies per year has ranged from 2 (1993) to 7 (2012) but has remained overall consistent at 4 or 5 per year on average. Changes in the number of derbies could be a result of cancellations due to weather or lack of support for organising.
Figures 11-20 show the number of sharks caught at each derby every year they were held except for the Jeddore derby, which only had landings for one season. The Lockeport Derby is the longest running and shows several increases and decreases in catches, although after 2006, when new regulations were imposed, a noticeable drop in catches can be seen. The Riverport derby has also seen an overall decrease in catches after 2006, both suggesting that the new regulations were successful in decreasing the number of individuals removed from the population. The Petit de Grat and Louisbourg derbies are much newer and began in 2011 and 2012 respectively, several after the new regulations were imposed.

![SHARKS LANDED AT LOCKEPORT DERBY EACH YEAR](image)

*Figure 11 Number of sharks landed at each derby held in Lockeport Nova Scotia*
Figure 12 Number of sharks landed at each derby held in Riverport Nova Scotia

Figure 13 Number of sharks landed at each derby held in Petit de Grat Nova Scotia
Figure 14 Number of sharks landed at each derby held in Louisbourg Nova Scotia

Figure 15 Number of sharks landed at each derby held in Yarmouth Nova Scotia
Figure 16 Number of sharks landed at each derby held in Halifax Nova Scotia

Figure 17 Number of sharks landed at each derby held in Split Crow Nova Scotia
Figure 18 Number of sharks landed at each derby held in Dartmouth Nova Scotia

Figure 19 Number of sharks landed at each derby held in Eastern Passage Nova Scotia
4.3 Interview Results

I interviewed six respondents, 4 males and 2 females, all of which are participants (1) or committee members (5) who participated in three of the four shark derbies in 2016. All committee members interviewed live in the community where the events take place, however, one participant (is not a committee member) travels from Ontario every year to participate. Respondents ranged from 30 to 69 years of age. Three (3) participants are from the Lockeport derby, two (2) from the former Yarmouth derby and one (1) from the Petit de Grat Derby. No respondents were obtained from the Louisbourg derby or the Riverport derby, despite several attempts to contact multiple individuals. Themes identified below are not mutually exclusive and often overlap.

The five emergent themes identified through data analysis are as follows;

1. Benefits to the community, both through non-profit fundraising, and recreation/enjoyment
2. The main motivation for participating is the enjoyment from fishing and helping the community and science
3. Science, education and tagging programs are considered, by respondents to be making a positive impact
4. Regulation is considered overall good by respondents, although some derbies have imposed stricter regulations where DFO has not.
5. There has been no noticeable change in the natural environment of shark populations from either fishers or committee members.
Table 2 Interview results for overall experience, views on regulations, years involved, and changes in environment of shark populations

<table>
<thead>
<tr>
<th>Respondent #</th>
<th>Overall experience</th>
<th>Views on Regulations</th>
<th>Years involved</th>
<th>Change in environment observed</th>
<th>Change in shark population observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 1</td>
<td>Positive</td>
<td>Positive</td>
<td>26</td>
<td>Year to year, no long-term trend</td>
<td>Year to year, no long-term trend</td>
</tr>
<tr>
<td>Respondent 2</td>
<td>Positive</td>
<td>Positive</td>
<td>10</td>
<td>No</td>
<td>Fishermen think they've increased</td>
</tr>
<tr>
<td>Respondent 3</td>
<td>Positive</td>
<td>Positive</td>
<td>6</td>
<td>No</td>
<td>Fishermen better at catching, larger shark sightings</td>
</tr>
<tr>
<td>Respondent 4</td>
<td>Positive</td>
<td>Positive</td>
<td>19</td>
<td>No</td>
<td>No, DFO updates them</td>
</tr>
<tr>
<td>Respondent 5</td>
<td>Positive</td>
<td>Positive</td>
<td>19</td>
<td>No, water temp dependant</td>
<td>No</td>
</tr>
<tr>
<td>Respondent 6</td>
<td>Positive</td>
<td>Positive</td>
<td>13</td>
<td>No</td>
<td>No, luck of the draw</td>
</tr>
</tbody>
</table>

Theme 1: Benefits to the community, both through non-profit fundraising, and recreation/enjoyment

Respondents all stated they believe that shark derbies are good for the community, providing recreational and enjoyable activities both on the water and on the wharf where the events are held. Many respondents emphasised the positive activities for youth in the community, stating that they have tried to aim derbies in this direction. In addition, as derbies are non-profit, any proceeds from the event are donated to local charities, ensuring positive benefits stay within the community.

It was expected for most or all respondents to easily state positive aspects of these derbies as they have participated for several years and would not if there was not some reason for doing so. Some of the positive aspects, which were found in the literature are included in this theme, such as the positive financial aspect for the community. Less expected perhaps was the extent of the financial contribution of derbies to the community, for example, the Yarmouth Shark Scramble where “All the proceeds used to go to Skate Yarmouth of the Hope Centre for the vans and Crime Stoppers and all local organisations. We used to give anywhere from $1000 to $7000/ $8000.”

Also expected was the enjoyment of the event for fishers who have the opportunity to spend the weekend doing something they enjoy. For example, one respondent said that
“It’s a good weekend to get out on the water, and the thrill of the chase too.” Respondents who participate in fishing all stated that the event is fun and enjoyable.

Respondents also touched on the positive impact on youth in the community, one even discussing how a little girl who attended a derby now wishes to become a marine biologist. Many derbies have been trying to incorporate more events and activities for children to truly make the events beneficial for the entire community. In Lockeport, they have tournaments for fish species other than shark which allows those under 16 to participate. Furthermore, having activities on the wharf was noted as being beneficial for children and youth.

**Theme 2: The main motivation for participating is the enjoyment from fishing and helping the community and science**

Committee member’s motivations for organising derbies all surrounded the idea that derbies are beneficial for the community and are an opportunity for scientific inquiry through landings and tagging. Surprising is the attentiveness of committee to the scientific element and not just to the enjoyment of the event, some truly seem to feel they are making a positive impact on the populations through the scientific aspect of the derby.

One respondent stated that they continue to organise these events because nobody else from the community has stepped up to take over this role. Similarly, in Yarmouth, the derby has been cancelled the last two years for the same reason, that there is simply not enough support from an organising perspective. “Well if somebody doesn’t do it, it doesn’t get done and it’s a small town and you have to chip in. It’s a good thing and I don’t want to see it gone and if we don’t do it it’s going to go by the wayside and it will probably will eventually because we can’t get anybody to replace us.”

Once again, respondents spoke about the benefits to the community, and even mentioned how fishing is a large part of the history of Lockeport and that derbies inform people on the importance of fishing. “It’s great for the town and the main reason is that people enjoy it so much and I feel it’s a big part of our history in this area because it’s a fishing village and people really need to know why fishing is so important to so many people and why it’s a great was of life and this gives them the experience to check it all out and see what its like.”
Some respondents who had some part in starting a new derby spoke about their motivations for doing so in their town. Unknown was that in Petit de Grât, the main motivation was the partnership between DFO and the local marine centre and the information and contribution for science the event would bring. “Were a marine centre, its was more the link to DFO for us, so the Department of Fisheries and Oceans in Nova Scotia don’t really have a lot of access to information about shark so for us it was also the tagging aspect, a lot of fishermen from our derby are really encouraged and this year all the tagging kits went out to tag shark in the water but also when they do collect the shark they come back to shore, the get information from some of those shark that they wouldn’t have accessible to them in any other way.” Other respondents spoke more about the benefits that derbies would bring to the community as their main motivation for starting the derby. “A shark derby would be something for the community and it was a non-profit organisation that we wanted to start and we thought that it would just add, just as a community event basically for recreation for something for people to do.”

When asked why they participate, one respondent said “Well my main reason is I am a sportsman myself, I enjoy sports and fishing and with having a community with the beautiful waterfront that we have I just thought that it would be something advantageous to two sectors I guess, one being the community and the other being, you know having all the lobster fishing boats here and having all the people here I just thought it would be a good thing for the community and the fishermen and sportsmen in the area”

Respondent A, a committee member, emphasised the importance of the other aspects to their events, as youth can participate, and much of the tournaments funds come from these registration fees. (Respondent A, 2016). As such, community benefits could continue even if the shark portion of the event was altered or removed.

Through both theme 1 and 2, it is clear that respondents identify strongly with the impact of derbies on the community and see these events as something which will bring people together for a good cause, and will provide recreational activities to all members of the community whether they fish or not.
Theme 3: Science, education and tagging programs are considered, by respondents to be making a positive impact

As stated, DFO justifies the presence of derbies by using them for scientific data collection and education, as mentioned in the NPOA-Sharks. In relation to this issue, all respondents mentioned how important derbies are for collecting scientific data, although tagging data was more commonly referred to than landing data, suggesting that participants are willing to maintain or increase tagging efforts, and are in a lot of cases, proud of their involvement in science. DFO has in the past contacted fishers who tagged a shark that was later recaptured and have even sent them incentives such as hats to thank them for their efforts.

One respondent spoke about how science and conservation efforts have evolved over the years, and pointed out that “Every fish that was caught and released was tagged, and marked all the information down for science so we were always there for science but it seemed the tournaments have evolved to be more environmentally friendly, more in tune with doing the right thing with regards to not wasting stocks.”

A respondent also stated that “We educated a lot of people, we did have some protesters, the activists, we gave them the option to have a table right on the waterfront and they would distribute their papers, their pamphlets, we give them the choice to do that” which demonstrates that ENGOs have at least been given some opportunity to be present at derbies and voice their concerns.

Theme 4: Regulation is considered overall good by respondents, although some derbies have imposed stricter regulations where DFO has not.

All respondents stated that they believe that overall, regulations for shark derbies are effective and appropriate, whether for size limits, quotas, licensing, or handling. Some stated that they have suggested improvements in the past and that DFO has been very accommodating to their needs. Others have changed regulations within their organisations, the most common being allowing fewer sharks to be landed than the DFO imposed, 2 sharks per person per day. Most derbies instead allow 2 or 3 sharks per boat per derby, decreasing landings significantly. At the Lockeport derby, on the second day of the derby you must catch a bigger shark than the biggest shark landed on the first day.

Interestingly, derby organisers are quite aware of the possible impacts that derbies may have on shark populations and have taken the initiative to change regulations where DFO
may not have strict enough. A respondent from the Lockeport derby stated that “DFO used to allow us and they still do, 2 sharks per person per day and we said, well that’s too many sharks so we put our own regulation in 2 sharks per boat per day… it’s good and it’s enjoyable but why take out, really we have first, and second place is luck of the draw so why do we even need to bring anything in if there’s no chance of winning. So, we said, were not going to do that, it’s a good conservation thing.” Implying that the derby is trying to minimise catches and to be more conscious of possible impacts. Currently, at least the Petit de Grat and Lockeport derbies have tightened regulations within the event as they wish to decrease unnecessary landings and simplify the organisation of the event.

- In Petit de Grat they have increased the minimum length to at least 6 foot 9 inches for any species caught
- In Lockeport, they allow only 2 sharks per boat, per derby, as opposed to 1 shark per person per day, as permitted by DFO.

Respondent one commented on the issue of enforcement of the regulations that DFO set, and voiced some concern regarding possible overregulation and lack of enforcement. “I don’t want to see overregulation, too much regulation because they can do that sometimes and really if you enforce the regulations that you have most of the time you don’t need anything new, but most of the time its not enforced and looked after. Enforce the regulation that you have be active you know.”

**Theme 5: There has been no noticeable change in the natural environment of shark populations from either fishers or committee members.**

Of course, DFO would be responsible for analysing any long-term changes in the environment or shark populations which landing and log book data would help with. To this point, if there had been a large variation through time, participants from derbies which have been around for many years could have observed some changes. When asked about any changes, no participants said that they had seen a noticeable difference in the natural environment or shark populations. Rather, most participants stated that this was very much weather and water temperature, dependant. Sharks are seen more often in warmer waters. Weather can also interfere with fishing activities, which could lead to decreased catches in any given year but does not indicate a population decrease. Two participants said that they, or someone that have spoken with believe that there could be an increase in sharks,
although one respondent attributed this to fishermen improving their baiting skills and ability to locate shark. This highlights the need for active science to monitor shark populations and ensure that they remain healthy as those involved in the fishery may not be see trends through time.
5 Assessment of regulatory framework

Chondrichthyan a taxonomic group containing sharks, skates, chimeras and rays currently have the lowest percentage of species of “least concern”, and nearly a quarter of sharks and rays are facing extinction if management does not improve. Currently, 74 species of sharks are considered threatened, including several in Canadian waters. (IUCN, 2015) Global catches of sharks and other cartilaginous fishes have more than doubled since 1950, resulting in the depletion of stocks world-wide. This fishing pressure is largely the result of few nations, Indonesia, India and Spain, the top 3 shark fishing nations are responsible for nearly 1/3 of shark catches (Lack & Sant, 2011).

Figure 21 A) FAO reported landings of all chondrichthyans from 1950 to 2010 B) Proportion of FAO reported catches of Rays and Sharks C) Areas of threat and National share of catch & trade (Dulvy et al., 2014)
Due to the depletion of shark populations on a global scale, the Food and Agriculture Organisation of the United Nations implemented the International Plan of Action for the Conservation and Management of Sharks in 1998 (United Nations Food and Agriculture Organisation, 1998). With the then new understanding that sharks are vulnerable to over-exploitation and the increases of shark landings internationally driven by their rising economic value and demand, the purpose of the plan was to address these concerns on a global scale and urge nations to create a national plan of action for the conservation and management of sharks. In March 2007 Canada published their National Plan of Action (NPOA-Sharks) with a follow-up progress report in 2012 (Government of Canada, 2007). The Department of Fisheries and Oceans Canada has also published several management plans and frameworks over the years, the first being the Canadian Atlantic Shark Integrated Fisheries Management Plan to be implemented from 2002-2007 and follow the blue shark, porbeagle and shortfin mako. Currently these documents serve as management guidelines to oversee commercial and recreational fisheries, including derbies in Nova Scotia (Northwest Atlantic Fisheries Organization, 2016; Fisheries & Oceans Canada, 2002; United Nations Food and Agriculture Organisation, 1998; Government of Canada, 2007). The following chapter is a critical analysis of a non-exhaustive list of relevant documents having an impact on one or more of the following; incidental catches of sharks in commercial fisheries, recreational fisheries (including derbies, chartered licenses and individual licenses) in Nova Scotia and frameworks which impact how regulations concerning these areas are created such as the DFO Decision Making Framework.

5.1 IPOA-Sharks

IPOA Sharks was set out with the objective to “ensure the conservation and management of sharks and their long-term use”. It is a voluntary document which urges all states with waters within which sharks are caught, either by domestic or international vessels, both directed and incidentally. Additionally, following three guiding principals; participation, sustaining stocks and nutritional and socio-economic considerations, states were encouraged to create a national shark plan by 2001.
“The Shark-plan should aim to:

1. Ensure that shark catches from directed and non-directed fisheries are sustainable;
2. Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use;
3. Identify and provide special attention, in particular to vulnerable or threatened shark stocks;
4. Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States;
5. Minimize unutilized incidental catches of sharks;
6. Contribute to the protection of biodiversity and ecosystem structure and function;
7. Minimize waste and discards from shark catches in accordance with article 7.2.2.(g) of the Code of Conduct for Responsible Fisheries (for example, requiring the retention of sharks from which fins are removed);
8. Encourage full use of dead sharks;
9. Facilitate improved species-specific catch and landings data and monitoring of shark catches;
10. Facilitate the identification and reporting of species-specific biological and trade data.” (United Nations Food and Agriculture Organisation, 1998)

Of the 113 States, which have reported shark landings to the FAO, 12 have adopted their NPOA-Sharks, including Canada. Due to the voluntary nature of this initiative to improve shark management globally, it has been largely unsuccessful in improving shark conservation. To further this concern, many of the states which have implemented a national plan of action have not addressed all the above management objectives, including Canada. (United Nations Food and Agriculture Organisation, 1998) (Cosandey-Godin, Strengthening Shark Conservation in Canada- a Management Blueprint, 2009)

In relation to the recreational fishery in Nova Scotia, aim number 8 under the IPOA-Sharks “Encourage the full use of dead sharks” is of particular interest. Derbies do not utilise dead sharks, other than for the purposes of collecting scientific data. Following the collection of this data, sharks are not sold or eaten and are simply disposed of. Data which is collected, could be largely, apart from the stomach contents, collected at sea, on live sharks, which could then be released, therefore Canada is currently not meeting this goal. Although
sometimes proving as valuable data, stomach contents (volume and composition) are often inaccurate due to sharks vomiting as a stress response to being caught. Aim 4 “Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States” is also relevant to the recreational fishery. Currently there is a DFO Consultation Framework and Decision-Making Framework which will be discussed in greater detail in the following sections. An Integrated Fisheries Management was also created in 2002, and was in effect until 2007, which also addressed this aim of IPOA, although a new plan had not been created since 2007.

To further this discussion, the IPOA focuses a lot of the above aims on improving our scientific understanding of shark and shark use. For example, Aim 1 “Ensure that shark catches from directed and non-directed fisheries are sustainable” is a vague aim, and leaves a lot of room for interpretation from nations designing their own NPOA-Sharks. In Canada for instance, DFO has found that, based on the current estimate of removal rates, blue sharks are being taken at a sustainable level which the population can handle. However, we have seen an estimated 60% decline between 1958 and 2000 in the species, suggesting that the population cannot reproduce at a rate fast enough to maintain the population (Campana, et al., 2015). Although a 60% decline is not critically low, the questions remains if this can be considered sustainable in the long term. Furthermore, as discussed, shark population estimates are often inexact and as such, the rate of exploitation, or decline could be far worse than previously thought. As such, DFO Canada is not meeting this aim.

5.2 NPOA-Sharks

Published in 2007, six years after the recommended completion date in the IPOA-Sharks, the Canadian national plan aims to follow the recommendations set out through the IPOA-Sharks to improve management of shark stocks in Canadian waters. The document outlines that prior to 1995, sharks were not commercially valuable in Canada and were not of concern. DFO also emphasized that the precautionary principle should be used when addressing shark management and conservation, and that there are gaps in knowledge such as; inaccurate stock assessments and removal rates, which should be considered in management. This document was created following the outlined framework by the IPOA
as well as the federal regulatory framework which includes; the Department of Fisheries and Oceans Act, Oceans Act, Fisheries Act, Coastal Fisheries Protection Act and the Species at Risk Act. Management of Canadian fisheries is comprised of; Integrated Fisheries Management Plans, Research and Consultation and Fisheries Monitoring Programs. (Government of Canada, 2007)

The NPOA is largely descriptive and has dedicated only a small portion to objectives and actions to improve shark conservation and management. The NPOA does not adequately address stakeholder consultation and relies heavily on previously created committees of stakeholders and researchers. The Regional Advisory Process for Atlantic Canada, has resulted in several peer-reviewed reports on the blue shark, porbeagle and shortfin mako.

As the blue shark is the most commonly caught species off the coast of Nova Scotia and has underestimated mortality rates combined with limited knowledge of the population the NPOA considers research on “population dynamics of blue sharks, including assessment of mortality due to commercial discarding and shark derbies” of particular importance (Government of Canada, 2007). Of the nine means of data collection and research outlined in the plan, this is the only one which addressed shark derbies and incidental catch and none address the catch-and-release recreational fishery directly (Government of Canada, 2007).

Bycatch Reduction and Reporting of Discard Mortality is also of concern, however the means of achieving this objective are vague and do not describe specific methods in which this will be achieved. NPOA also states that it will “continue annual shark derbies as opportunities to raise public awareness about shark species, their biology and identification criteria” as well as “encourage commercial and recreational fishers and other industries to be more aware of the shark species present in Canadian fisheries waters, their biology, risks these species face, and catch-and-release practices through the advisory committee processes”, neither of which are outlined in detail which states how this will be accomplished. Progress was monitored by DFO periodically and a progress report, which served the purpose of addressing the key actions taken following the implementation of NPOA-Sharks, was published in 2012. The progress report will be discussed in the
following section and (Cosandey-Godin, Strengthening Shark Conservation in Canada- a Management Blueprint, 2009) (Government of Canada, 2007)

The IPOA set out recommended contents of the NPOA, which included; the state of shark stocks, populations, fisheries and management and its framework; the objective of the shark plan and the strategies for achieving objectives. The NPOA succeeded at describing the management framework and the objectives of the plan but fails to describe in detail the state of stocks and strategies for achieving the objectives. (United Nations Food and Agriculture Organisation, 1998) Many international and national plans of this nature have fallen short as there is no enforcement of the plan, which is integral to creating the changes needed to see noticeable positive results. This lack of action is likely due to the NPOA being voluntarily, and creating the image for Canada that they are making efforts to strengthen shark management and conservation.

Godin (2009) developed a matrix which compared how effectively the Canadian NPOA-Sharks addressed the objectives set out by the IPOA-Sharks. Overall, the NPOA does not address several objectives, specifically 2, 3 & 8 of the IPOA and fails to describe how specific objectives will be met. A timeline within which the objectives should be met was not provided and overall the plan lacks the contents necessary to deliver initiatives to improve shark management. (Cosandey-Godin, Strengthening Shark Conservation in Canada- a Management Blueprint, 2009)

As previously mentioned, there are several areas of concern when looking at shark conservation in Nova Scotia; bycatch levels, derbies, catch and release fishing, and the identified gaps in knowledge. In terms of the fishery in Nova Scotia, the NPOA does not address many of the issues outlined in DFO research and fails to emphasize the need for bycatch reduction, improved regulation, and monitoring due to the lack of detail in how this plan will meet specific goals and objectives. With regards to the blue shark, there is a goal of researching population dynamics but the lack of a timeline minimises the urgency of such findings and the use of the precautionary approach, as much of the regulations have remained the same within these fisheries. (Cosandey-Godin, Strengthening Shark Conservation in Canada- a Management Blueprint, 2009) NPOA does not adequately address derbies, or catch-and-release fishing, or bycatch reduction. While the report
mentions the need to fill gaps in scientific knowledge, it lacks the focus and detail to prioritise this issue. Below is a list of all the points in NPOA-Sharks where the above issues were addressed as either goals, objectives, or means of meeting an objective.

- “Continue annual shark derbies as opportunities to raise public awareness about shark species, their biology, and identification criteria.

- Continue awareness-raising efforts among commercial and recreational fishers and other resource users about the risks facing certain shark and shark-like species (e.g., dogfish caught in the Pacific sports salmon fishery) and promote conservation-based release practices to reduce discard mortality;

- Encourage commercial and recreational fishers, and other industries to be more aware of the shark species present in Canadian fisheries waters, their biology, risks these species face, and catch-and-release practices through the advisory committee processes;” (Government of Canada, 2007)

Over the entire 31-page document, only the above 3 means and objectives were mentioned with regards to the recreational fishery and derbies. Having attended 2 of the 4 derbies taking place in the summer of 2016, there was no formal educational element or awareness-raising which I could identify through general observation, other than DFO giving shark teeth to young children and naming the species to the spectators. In terms of awareness-raising efforts, DFO does review handling practices with fishers each year at pre-derby meetings, however the NPOA does not address this, or outline requirements for these meetings. While there could be the presence of education and awareness-raising through word of mouth among attendees, which is valuable, for the Canadian NPOA-Sharks and DFO to rely on this as a legitimate and enforceable method of education and awareness-raising is questionable. No data was provided which shows that derbies are in fact effective in these areas, and no plan to monitor this was laid out. As such, the first objective mentioned has not been met. The derbies could serve as an educational platform for education if programs were implemented, but to date, this has not been the case. With regards to the second objective above, while there is some awareness-raising, such as the education of fishers on which species are not permitted to be landed at derbies, porbeagle being the main concern, few efforts have been made within derby fishing to address catch-and-release practices, although chartered companies are well educated and often have independent researchers on-board to collect data. The third point which encourages education of industries on the threats facing sharks through an advisory committee processes educate stakeholders on the state of sharks in the area, as well as topics of
concern and create an awareness wherein stakeholders feel more connected to the species they fish and perhaps use this information to educate others and handle species more responsibly.

One of the areas of concern in NPOA-Sharks Canada is bycatch reduction and reporting of discard mortality. As bycatch accounts for the highest rate of blue shark mortality in Nova Scotia, the reduction and management of incidental catch of sharks in the pelagic long-line fishery is incredibly important to maintaining healthy populations. The main objective, as outlined in the report is “To reduce levels of bycatch and increase reporting of discard mortality within other fishing industries. How this objective will be met is as follows:

“Canada will move ahead with measures to:

• Improve the reporting of discarded bycatch and the associated mortality rates in domestic fisheries through better data collection and species identification by at-sea fisheries observers, as well as through mandatory reporting of all bycatch for the commercial and recreational fishing industry;

• Continue awareness-raising efforts among commercial and recreational fishers and other resource users about the risks facing certain shark and shark-like species (e.g., dogfish caught in the Pacific sports salmon fishery) and promote conservation-based release practices to reduce discard mortality;

• Encourage the strengthening of regulations of relevant RFMOs with regard to both the handling and release of shark bycatch species and to improve the identification and reporting of bycatch and associated mortality; and

• Review the current practices in all commercial and recreational fisheries and implement, where feasible, new rules or technologies with the potential to reduce both the bycatch of sharks and associated mortality.” (Government of Canada, 2007)

Since 2007 when this document was created, no new regulations involving the recreational fishery, including derbies have been implemented. Practices involved in derbies and catch-and-release fishing has not been changed, although DFO and WWF have made efforts, through education of fishers to improve in these areas. The aim to continue derbies as awareness raising and educational events has continued, however the effectiveness of these events to serve this purpose is questionable.
The focus of this document is the management of incidental catch levels, and as such there are more objectives on this subject than on recreational fisheries. Canada has made efforts to meet some of the above 4 goals.

5.3 National Plan of Action- Sharks Progress Report

In July 2012 DFO published Canada’s Progress Report on the Implementation of Key Actions Taken Pursuant to the National Plan of Action on the Conservation and Management of Sharks. This document aims to highlight progress Canada is making to better shark conservation and management efforts, and identify areas which need strengthening. Like the NPOA-Sharks, this document lacks detail and remains descriptive. Many initiatives such as; bycatch reduction and reporting, enhancing education and outreach efforts, and the use of satellite tags in the future, are discussed within the progress report however specific means and timelines of reaching objectives are not discussed. (Government of Canada, 2012)

One of the primary topics which the report addressed is the need for better scientific data to base management decisions on. The progress report discusses briefly on-going studies on species which have already been identified as endangered, threatened or of special concern. What is missing from this report is any mention of the blue shark population, that has seen declines in recent years, which DFO does not consider significant but have lead to the species being listed as special concern under COSEWIC.

As sharks are not a significant economic resource compared to ground fish or shellfish, for instance, the shark fisheries in Canada and Nova Scotia are not essential to the economic prosperity of the area. Rather, as the fisheries are largely recreational and are responsible for only a supposedly small amount of mortality they are not of significant concern. Although this may be the case, lack of scientific data and lack of studies to obtain such data create a problem wherein the stock could be declining at unforeseen rates which DFO may not be aware of.
5.4 Integrated Shark Fisheries Management Plan

Several management plans have been created by the Canadian Government and DFO however the Atlantic Pelagic Shark Integrated Fisheries Management Plan is that which primarily affects the Nova Scotia Fishery on a regional level (Fisheries & Oceans Canada, 2002). This plan was in place 2002 to 2007. As pelagic sharks including the porbeagle, blue and shortfin mako have been exploited on the eastern coast of Canada, this plan aimed to govern the exploitation of the above three species during these years. (Fisheries & Oceans Canada, 2002)

This document is comprehensive, giving a brief overview of the history of shark exploitation on the Atlantic coast, the current state of management measures, including commercial and recreational sectors, economic and scientific background knowledge as well as reasoning for many decisions, particularly relating to shark fishing tournaments.

In comparison to the NPOA-Sharks, this plan goes into much greater detail about the current state of the fishery, stock status of affected species and current management issues. It then goes on to explain in detail objectives for the fishery which includes; conservation, the precautionary approach, international considerations and domestic considerations such as derbies. Specific management measures including licensing and monitoring are then discussed followed by enforcement measures, financial responsibilities and a performance review. Within this document is a Recreational Shark Fishing Management Plan which will be discussed later. As this was published in 2002, the stock status in this document can not be considered current and will not be discussed, however, at the time, blue shark and shortfin mako were poorly understood and porbeagle had a detailed stock assessment as it was being commercially exploited. When this document was published, the collection of data on blue sharks was largely done through landings at shark derbies (Fisheries & Oceans Canada, 2002).

The main management issue outlined in the plan was conservation, although by-catch fisheries habitat disruptions, conflicts among ocean resource users and orderly conduct of the fishery were also mentioned briefly. In terms of conservation, as sharks are considered “less resilient to fishing pressure than most other fishes” and sharks had been steadily declining at that time, the fishery management must take a conservation oriented approach.
The main long-term goal of this plan was to establish a fishery which was both commercially and biologically sustainable, utilising the precautionary approach. Currently there is no commercial directed shark fisheries in Atlantic Canada. Five specific management objectives for conservation and sustainability were established;

“7.1 Conservation/Sustainability

1. There will be no by-catch of tunas or swordfish allowed. Any such incidental catch shall be released immediately back to the fishing grounds, using methods that will minimize damage to the fish.

2. There will be no directed, commercial fishery for shortfin mako or shark species other than porbeagle and blue shark. Landings of mako and species other than porbeagle and blue shark can only occur as a by-catch and must be less than 50% of the total weight of directed shark species on board.

3. Subject to item 5, in other large pelagic fisheries, shark by-catch in traditional fisheries shall not be restricted for the duration of this plan.

4. Incidental catch of sharks in fisheries other than large pelagics will be limited to the lessor of 10% or 500 kg by weight on board the vessel per trip, providing the vessel has a condition of licence authorizing by-catch of shark.

5. In order to ensure that the total catch remains within the TAC during the period of this plan, the needs of traditional by-catch fisheries will be considered first when determining when and how to close the directed fisheries each year of the plan. Based on an Atlantic-wide review of all available shark by-catch data prior to the establishment of the first shark management plan in 1995, traditional fisheries were identified as the swordfish and other tunas longline fleet and groundfish fixed gear fleets for all shark species. A review of 1998-2002 Gulf Region data later determined that by-catch of blue and mako shark has also occurred in that Region's mackerel gillnet fishery.” (Fisheries & Oceans Canada, 2002)

Objective 1, is very strict in not allowing by-catch of tunas or swordfish, both highly economically valuable, in this fishery, although shark bycatch is permitted, and occurs at a high rate in tuna swordfish fisheries. This demonstrates the priority of DFO to protect and conserve valuable populations, however, if this regulation can be created for bycatch in the shark fisheries it could also be imposed in the tuna and swordfish fishery. Objective 3 and 4 does address shark bycatch in other fisheries, where shark bycatch is unrestricted in traditional fisheries and allows for less than 10% of catches per commercial trip to be shark. However, as stated in objective 5, traditional fisheries were identified as swordfish and tuna longline fisheries, currently considered the greatest threat to blue shark
populations, meaning that these fisheries had unrestricted shark bycatch. The utilisation of
the precautionary approach in this document was based only on the porbeagle fishery, with
no mention of the blue shark of mako shark in the objectives in this section.

This plan states that for the catch-and-release and derby portion of the recreational fishery,
there will be no limit on the number of licenses issued, due to the precautionary nature of
the fishery. The plan aims to create a stock assessment for blue sharks through derby
landings, which has since been published.

The specific management measure laid out in the document mostly relate to the
commercial fishery which is not longer active, making this information outdated. Under
quota allocations, the recreational fishery is briefly mentioned;

“There is no allocation for the recreational fishery; however, shark derbies may be
approved if conducted in accordance with the recreational shark CHP approved by
DFO in 2002 (Annex IV). Shark landed in authorized derby or fishing tournaments
become the responsibility of the organisers to dispose of appropriately, once DFO
Science has had sufficient opportunity to analyze the catches. Such shark carcasses
may be sold with the proceeds to go to a recognized charity. No landed shark from
recreational fishing is to be retained for personal consumption or financial gain
during the period of this plan.” (Fisheries & Oceans Canada, 2002)

As stated, a recreational shark derby fishing plan, effective in 2002 is an appendix to this
document. Which outlines a background to the fishery as well as reporting, scientific and
monitoring programs. Nowhere in the IFMP or the derby fishing plan is education as
derbies addressed, one of the main justifications for the events. Many of these areas have
not been changed since this document was published. For instance, the required presence
of DFO-Science was outlined in this plan, as well as the submission of log books.

The integrated shark management plan, which is still considered the standard for shark
management in Nova Scotia has not been updated since 2007, the year that the NPOA-
Sharks was published, meaning that the management plan does not reflect many of the
objectives laid out in the plan. The IFMP, while at the time of publishing would have been
a valuable document outlining in detail the management of both commercial and
recreational fisheries, the management concerns and scientific gaps have changes in a
significant enough way that most of the guidelines in this program are no longer relevant or effective. As such a new plan, should be created, which more closely follows the objectives of the IPOA-Sharks, of a new, more focused NPOA-Sharks.

5.5 DFO Decision making Framework

The DFO Fishery Decision-Making Framework Incorporating the Precautionary Approach is used to implement harvest strategies which incorporate the precautionary approach. “The [precautionary approach] is in general, about being cautious when scientific information is uncertain, unreliable or inadequate and not using the absence of inadequate scientific information as a reason to postpone or fail the take action to avoid serious harm to the resource.” (Department of Fisheries and Oceans Canada, 2009)

As stated within the document, when applying this framework, all sources of mortality of the stock in question must be identified and considered.

There are three main components of this framework:

1. Reference points and stock statue zones (Healthy, Cautious and Critical).
2. Harvest strategy and harvest decision rules
3. The need to take into account uncertainty and risk when developing reference points and developing and implementing decision rules

The following section will be an overview and analysis of this framework in relation to the recreational shark fishery in Nova Scotia, with the primary focus being on the blue shark stock in the North Atlantic. (A Fishery Decision-Making Framework Incorporating the Precautionary Approach, 2009)

As stated previously, to date there has not been a stock assessment for blue sharks in Nova Scotia which is considered accurate. Data, while available, is very limited and due to the migratory nature of the stock, may not accurately represent the health of the population. Finally, the decision-making framework describes the need for participation of Fishery Interests which includes fishers participating in the fishery. In this case, these stakeholders would be those groups identified above as being key stakeholders, and which were interviewed as part of this project. (Department of Fisheries and Oceans Canada, 2009)
Removal rates of sharks, specifically blue sharks in the recreational fishery are conservative, and follow, at least to an extent, the Precautionary approach as outlined in the decision-making framework. When evidence has shown that the removal rate of a species is no longer sustainable, as was the case with porbeagles, DFO has adjusted regulations to lessen fishing pressure on the population. Further, DFO has altered regulations through the history of derbies to improve handling and removal rates, however there remains several areas of concern, which will be discussed in the following chapter. (Department of Fisheries and Oceans Canada, 2009)
6 Strengthening Management

6.1 Overview of Management problem

As determined by DFO, the recreational shark fishery in Nova Scotia is not currently considered a risk to the population of blue sharks. Since 2006, when more rigid regulations were imposed upon the fishery, catches have decreased and, as stated by DFO are only responsible for 3% of annual Canadian catches (Campana, Brading, & Joyce, 2011). Some of the potentially positive aspects of the fishery, primarily derbies are the scientific aspect to the derby including tagging programs, education of locals on shark conservation and biology and community benefits such as donations to local charities. Science and education have the potential to be a very positive aspect to derbies, however, currently they are not being utilised to their full potential. On the other hand, there are several weak spots in the regulatory framework which should be addressed to minimise shark mortality from Nova Scotian fisheries. Below, these areas will be addressed with specific and general recommendations to strengthen the current regulatory framework.

Firstly, as some of the possible positive aspects of the fishery include science, education and the community, derbies and chartered fishing organisations should aim to improve these aspects through mandatory formal programming in each aspect of the fishery. In terms of scientific data collected from the fishery, tagging programs should be improved upon. The recapture tagging program in Canada which is part of both derbies and chartered fishing should continue as it is valuable at collecting data for the migration of sharks. However, with the addition of increased satellite pop-up tags the need for a recapture of tagged individuals would be eliminated, and as such should increase. Using this method, DFO researchers can gain valuable knowledge on the true rate of post-release mortality as they can follow the individual immediately after tagging (Kohler, Turner, Hoey, Natanson, & Briggs, 2001).

There are several factors which are of importance to consider when assessing the management of shark mortality in Nova Scotia. First, there is no singular, current document published by DFO which outlines all the regulations relating to recreational
fisheries in Nova Scotia. Secondly, there are several areas within the regulation which are not being adequately addressed, such as hook type, log books, handling practices as well as education. If the regulations relating to these issues were tightened, and education was at the forefront of goals for the fishery, it would go a long way to ensuring the continued health of shark populations off the coast of Nova Scotia. Through this research, two main areas of concern have been identified;

1. The efficacy of having lethal shark derbies.
2. The current state of catch-and-release practices.

Below are recommendations for improving these two areas, both broadly and more specifically. Along with improvements in this area, updated stock assessments for the blue, porbeagle and shortfin mako, along with all recommendations below should be placed in an updated Atlantic Pelagic Shark Integrated Fisheries Management plan.

### 6.2 Shark Derby Management

According to DFO Canada, the scientific and educational value of shark derbies is one of the main reasons why they still exist. However, these potentially positive aspects to the events have been scrutinised and in some cases, have been essentially non-existent. DFO collects data from each shark landed, but also collects mandatory log books from participants which raises the question if the sharks need to be landed to obtain the valuable information. In an article published by CBC, a researcher at Dalhousie questions the value of the data DFO is collecting from derbies and states that “collecting data doesn’t make it science” (Luck & CBC News, 2016). Much of the data DFO collects, is also the same measurements that are recorded by participants in their individual log books. The singular variation to this would be recording the stomach contents of landed sharks. Sharks, however have been documented to essentially vomit the entire contents of their stomach while being caught by rod and reel, due to stress, making this information non-reliable (Campana, Brading, & Joyce, 2011).would be relatively simple and low-cost to educate fishers on the proper techniques of data collection, as they currently do for DFO volunteers, at the pre-derby meetings. Furthermore, following the departure of Steven Campana, the head of the shark research lab at DFO-Science, little of the data collected at derbies has been published or made accessible to the public. His departure was likely in part, due to the regulations imposed by Prime Minister Harper on government scientists,
which limits the scientific findings they are permitted to publish, raising questions about the accuracy of research published to date (CBC News, 2015). Moving to catch-and-release derbies would, with consultation with committee members and participants, allow the scientific value of derbies to be upheld, while shifting to a more conservation approached event.

Tagging programs, which are voluntary, have proved useful to track the migration of blue sharks however are only useful if sharks are released, alive, then caught a second time and killed (Department Of Fisheries and Oceans Canada, 2016). This raises the question, do sharks need to be landed as part of shark derbies. This suggests that sharks may be more scientifically valuable alive than dead. Creating a culture shift among participants, where conservation, science and education are the main priorities and maintaining the aspects of derbies that draw in most participants will prove valuable. For example, creating a prize category for the boat which tags the most sharks could be incentive to promote release.

Furthermore, little educational value from the two events attended was noted through derby observations. Could the scientific and educational value of shark derbies be upheld or even improved upon if these events became catch-and-release as opposed to catch-and-kill?

Respondent B, stated the possibility of the Petit de Grat event moving in this direction, and stated several benefits in doing so. One of the main concerns with this option would be the awarding of prizes, as they are based on size, as well as the possible resistance from participants. Several respondents stated that one of their main reasons for participating is the fun or thrill of the catch, which a catch-and-release event would maintain and all respondents said that they support scientific research and tagging programs.

As awarding of prizes is regulated within the organisation, this is not a management priority for DFO, however, there are several ways this could be dealt with. Prizes could be awarded for length as opposed to weight. This could be monitored through photo proof from fishers, with measurements visible in the frame. As prizes are one of the possible motivations for participation, it is important to maintain them as incentive for successful events, however changing how prizes are awarded would be required for a move to catch-and-release.
Promoting catch-and-release practices would have several benefits. Firstly, it would decrease mortality from derbies significantly. Secondly, it would further support the commitment to education and conservation that they are known for and lastly, would provide an better opportunity for tagging. Much of the negative publicity these events have received through the years would shift, with the shift to a conservation based system.

Jind (2014) Assessed the possibility of moving derbies in Nova Scotia from lethal events to catch-and release events. Using a combination of boat-captain surveys, and case studies from other areas the feasibility of moving to catch-and-release was assessed. Jind found that participants from newer derbies, such as Petit de Grat were more open to a catch-and-release derby than those from older derbies, such as Lockeport. This study found that, of the derby boat captains surveyed, half of them had never received any handling training, and that their main motivation was the interaction with sharks, making catch-and-release a viable option.

Moving shark derbies in Nova Scotia to catch-and-release only would surely prove a long process which would require the input from several stakeholders and several changes in regulation and organisation. However, as many events are lacking in willingness to organise, this change may prompt interest from the community. The following three possible steps could be followed to begin the implementation of catch-and-release derbies.

1. Consultation with DFO, ENGO, fishermen, and committee
   a. Discuss training of catch-and release, and data collection
   b. Logistical changes i.e. prize, log books, monitoring
   c. Educational tools which should include the presence of DFO-Science and ENGOs

2. Pilot project with monitoring and assessment of feasibility by all groups in consultation
   a. Petit< de Grat location of pilot project
   b. Make this derby catch-and-release for one year, where all changes are made.
   c. Evaluate the success of this event based on several factors; participation, sharks tagged, overall organisation, spectatorship, funds raised, quality of scientific data collected.
3. Re-evaluate catch-and-release derbies, continue the consultation process and attempt to expand this initiative.

Of course, the success of this proposed shift, in relation to shark conservation, relies heavily on the promotion of the best catch-and-release practices we have. This would include the above mentioned mandatory training as well as the mandatory use of non-stainless circle hooks.

During the process of changing to catch-and-release, all other derbies will follow stricter catch regulations.

1. Two sharks per boat per derby for all derbies as more than this is not necessary to award prizes, and lessens the logistical concern for organisers.
2. Mandatory use of non-stainless circle hooks as they will eventually degrade if left in a shark.
3. Mandatory handling training at pre-derby meetings, to decrease post-release mortality.
4. Landing blue sharks only as they are the only species with a population currently not considered threatened.
5. Minimum 8-foot length on landings as is currently in place for the blue shark.
6. Mandatory educational program incorporating DFO-Science and/or a local ENGO at all events.

6.3 Catch-and-Release Practices

The purpose of catch-and-release fishing is to enjoy the sport of fishing, while causing the least harm to populations as possible. This is especially important for species, like sharks, which are easily susceptible to overexploitation. As would be expected, some hooked individuals will subsequently die from their injuries, however, there are means of reducing post-release mortality.

Circle hooks have been proven to greatly reduce mortality, and should be provided to all fishermen from the organising committee at derbies, and required in all recreational fisheries where either tour operators or individual fishers purchase the hooks themselves. Making the switch from circle hooks would not be difficult as fishers already must purchase hooks.
Mandatory training for all recreational fishers before the season begins on proper handling techniques, following the guidelines set out by WWF Canada, should occur at pre-derby meetings every year as well as at determined meeting times for those not involved in derbies. For chartered fisheries, the tour operator should be required to debrief all clients on the proper handling as well as to educate them on the threats facing sharks in our waters. For individual fishers, ensuring that all licence holders obtain the mandatory training would be a much greater challenge as they are able to purchase online, as such, along with their licence, they should also be provided educational materials. Of course, it would not be possible to ensure that every individual uses these recommendations, but it could improve the handling of some. All handling guidelines should follow the brochure which WWF has published (see appendix), with the addition of the mandatory use of circle hooks. All sharks which are released on chartered of derby fishing boats should be tagged, with an increasing number of satellite pop up tags being utilised to reduce future mortality.

6.4 Updated Integrated Fisheries Management Plan

As a regional management plan has not been actively in effect since 2007, one should be written which includes the following specific guidelines which follow recommendations set out in chapter 5 and 6:

1. Required training on shark handling, tagging for all derby fishers, individual fishers and chartered employees and owners.
   - WWF Canada had created a brochure (See Appendix) which outlines specific guidelines for handling caught sharks. Within this document are best practices to minimise injury and subsequently mortality. In 2013, WWF Canada attended the Yarmouth and Louisbourg derby to hand out brochures and provide a minimum 10-minute training to fishermen on the subject. In the future, a required training session for all recreational shark fishermen should be imposed. This training would happen during the pre-derby captains meeting, and dockside before boats hail-out.
   - Training would be completed by representatives from DFO-science or an ENGO such as WWF.
   - This training would include all aspects of fishing, handling, tagging and release, as well as species identification.
2. Require each derby to have an active element of education incorporated in the event
   • One of the main justifications, aside from science that DFO uses for permitting derbies is that they educate the community on many aspects of sharks. The NPOA-Sharks specifically address derbies as a means of education but fails to impose and specifications on how this will be achieved.
   • Every derby should be required to have one of its vendor stations be taken by a ENGO with stake in shark conservation. The representatives can then hand out brochures, posters and other educational material outlining the importance of sharks in our ecosystems, educating on shark biology, shark conservation and the species found in Nova Scotia.

3. Address how DFO plans to achieve increased scientific goals (address the current gaps)
   • DFO uses landings from derbies as a large source of scientific data, although recently, they have been criticised for collecting data which is not useful for the management of the populations in Nova Scotia (Luck & CBC News, 2016).

4. Improve tagging programs
   • Currently, in the recreational fishery, tagging of sharks is voluntary, although many fishermen participate. This should continue however the results obtained from this program have been quite sparse as sharks must be recaptured to collect any data. DFO should begin using more satellite pop-up tagging to obtain more useful data. While this might pose a problem during derby fishing, chartered vessels would be a good area to begin this.

5. Move derbies from catch-and-kill to catch-and-release
   • The main motivation for participating in these events is to fish for sharks, not necessarily to kill them. Making the move to catch-and-release would greatly decrease mortality rates. DFO Science would still be able to collect their data, as almost all the data currently being collected can be done from a live individual apart from stomach contents and tissue samples.

Limitations of this study
This study is directly limited to the shark fishery and shark mortality in Nova Scotia. Some of the main limitations of this study include the short timeline of data collection and the limited number of interview respondents. While several groups of stakeholders were identified, it was difficult to successfully recruit respondents. Furthermore, logbooks
provide valuable information to DFO which may show trends which differ from other literature, and thus not having access to this information could limit the findings of this study. No respondents from areas of the fishery other than derbies were interviewed, as regulations may be perceived differently by these groups, and priorities may differ, much of the results from interviews are limited to derbies.

**Conclusion**

As has been shown by the Department of Fisheries and Oceans Canada, the blue shark population is thought to be able to withstand the current rate of removal and mortality from the recreational fishery, although there are gaps in knowledge to be filled in the future. Stakeholder perspectives have been explored in this project and overall, stakeholders feel that DFO is regulating the fishery in an effective way which will not cause a decline in populations. Benefits to the community and the enjoyment of derbies is the main motivation of those interviewed. In terms of management, tagging programs, handling, education and science should be promoted through the creation of an updated Integrated Fisheries Management Plan. Moving derbies to catch-and-release, with required handling training can be beneficial by promoting the positive aspects of the derby and decreasing the overall mortality rate as a result of the events.
7 References


Campana, S., Joyce, W., & Manning, M. J. (2009, July 28). Bycatch and discard mortality in commercially caught blue sharks (Prionace glauca) assessed using archival


Dulvy, N., Baum, J., Clarke, S., Compagno, L., Cortes, E., Domingo, A., . . . Valenti, S. (2008, May 22). You can swim but you can't hide: the global status and
conservation of oceanic pelagic sharks and rays. *Aquatic Conservation and Marine freshwater Ecosystems, 18*, 459-482. doi:DOI: 10.1002/aqc.975


Fisheries and Oceans Canada. (n.d.). *Policy on Managing Bycatch*.


MacDonald, M. (2016, Aug 01). Canada's only shark derbies start in Nova Scotia this weekend.


Respondent A. (2016, 8). (H. Isnor, Interviewer)


Appendix

Commonly Caught Sharks

Blue Shark
Ocellate Common
Max Size and Weight: 3 m (10 ft) - 500 lb (227 kg)
Key Features: Long slender body and pointed bill, with dark blue markings. Tips of body are deep indigo blue with white undersides.

Shortfin Mako Shark
Ocellate Common
Max Size and Weight: 3 m (10 ft) - 1200 lb (545 kg)
Key Features: Prominent, streamlined body and beak, no caudal fin at the posterior end, single pointed curved dorsal fin which extends to the tail end.

Pilchuck Shark
Ocellate Common
Max Size and Weight: 3 m (10 ft) - 300 lb (136 kg)
Key Features: Honey gill slits body with prominent primary caudal fin, plus a smaller secondary fin. Tonsil teeth not clearly visible and two smaller lateral organs that do not stick out at mouth where it is short.

Why Catch and Release?
Sharks play an important role in regulating the ecological balance and function of the ocean, because many shark populations undergo a decline due to overfishing, bycatch, and climate change.

Promoting best practices of catch and release shark fishing, like those provided here, helps maintain the predator-prey relationships of sharks, supports sustainable fishing practices, and aids in the rebuilding of shark populations.

Recreational Shark Fishing Rules
1. A shark license must be obtained for fish the species, size limit, and type of shark fishing. These are based on the number of sharks licensed to each crew.
2. Dorsal for CDFW-monitored dories, there is mandatory catch and release requirements for all sharks caught in recreational fisheries in California.
3. All recreational shark fisheries, including deeply-penetrated hook and line and hook and line, are restricted to red and white. There are no restrictions on hook types and size.
4. For shark fishing opportunities:
   a. Shark sizes larger than 18" total length can be retained, except sharkfin sharks and sturgeon sharks, which must be at least 60" total length.
   b. There are no species restrictions, except for the 60" total length limit on black sharks.
   c. Derby participants and recreational fishermen may develop a tagging program in collaboration with scientists.