

Informing Resource Managers - Using Local Ecological Knowledge of Murre Hunters, A Case Study

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ABSTRACT

Thirty murre hunters in Bonavista Bay, Newfoundland and Labrador, Canada were interviewed during the 2021-22 hunting season to solicit their views respecting the federal regulatory framework in place to manage the hunt and to use hunter local ecological knowledge (LEK) to identify abundance and distribution changes in the study area.

The results suggest that while murre hunters believe they have historic rights to hunt murre, they generally support the regulations in place. Furthermore, hunters would be prepared to accept amendments to the existing regulations to support conservation efforts if they were provided with evidence that was consistent with their own observations. Murre hunter interviews suggest that hunter knowledge of murre biology is weak despite their extensive hunting knowledge and experience.

LEK was used to ascertain hunter temporal and spatial knowledge of murre abundance and distribution in the study area. LEK was useful to identify temporal and spatial distribution and abundance within each murre hunter's hunting territory but was limited as a methodology to quantify abundance and distribution changes within the broader context. Despite this, hunters observed in murre distribution and abundance anomalies within Bonavista Bay due to changes in bait distribution, increasing ocean temperatures, lack of ice over the past decade, hunter pressure, fishing impacts, and wind conditions that impacted their hunting success.

DEDICATION

I would like to dedicate this MES Major Paper to my wife Kay who has endured through the relentless hours of my study, research and writing while simultaneously preparing to move back to Newfoundland and Labrador and building a new home. To my children Grant, Curtis and Catherine and my daughter-in-law Alex, their tremendous support and encouragement to enroll in the MES program has kept me going despite the urge to stay retired and enjoy my other passions of birding, hiking, nature and my many other hobbies. Words cannot express my gratitude for their unwavering guidance, support, and love. Finally, to my friends and former co-workers, who supported me, I will always appreciate their sometimes sarcastic texts and emails to check on my progress.

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TABLE OF CONTENTS

ABSTRACT.....	i
DEDICATION.....	ii
ACKNOWLEDGEMENTS.....	iii
TABLE OF CONTENTS.....	iv
LIST OF FIGURES	v
LIST OF TABLES.....	vi
Chapter One: Introduction	1
Chapter Two: Case Study Overview.....	8
Case Study Background.....	8
Study Area.....	11
Interviewee Demographics.....	11
Chapter Three: Murre Hunters – Informing Conservation Managers, Opportunities and Challenges.....	13
Introduction.....	13
Methodology.....	19
Results.....	21
Perceptions as whether hunters have a historical right to hunt murre.....	21
Hunters’ perceptions of regulatory impacts on murre conservation.....	24
Willingness to submit harvest data.....	27
Hunter recommendations for changes.....	28
Factors that might influence changes to murre hunting regulations.....	32
Conditions under which murre hunters would support increased conservation efforts.....	35
Discussion.....	35
Management Implications.....	40

Chapter Four: Using Murre Hunter LEK to Detect Changes in the Distribution and Abundance of Murres and Attribute Reasons for Observable Changes.....	41
Introduction.....	41
Methodology.....	43
Results.....	46
Temporal changes in distribution and abundance of murres.....	46
Observations on other species with respect to abundance and Distribution	50
Level of effort and perceived factors affecting the level of effort.....	51
Technological changes and the impact on hunting success or lack thereof.....	53
Whether there have been observed changes in diet (stomach content) and fattiness.....	54
Environmental and anthropocentric impacts affecting distribution and abundance.....	55
Discussion.....	61
Management Implications.....	64
Bibliography.....	66
Appendix A: Interview Questionnaire.....	76
Appendix B: Ethics Approval.....	81

LIST OF FIGURES

Figure 1	Study Area, Bonavista Bay, Newfoundland and Labrador, Canada.....	5
Figure 2	Bathymetry Chart of Bonavista Bay Study Area.....	44
Figure 3	Approximate Murre Hunter Routes (Red) Identified by Interviews, Bonavista Bay, NL Depicting Shoals (Dots).....	50

LIST OF TABLES

Table 1	Licensed Hunters, Bonavista Bay, NL, 2015 – 2020.....	8
Table 2	Hunter Profile by Years of Experience Hunting and Year Started Hunting.....	12
Table 3	Some People Say That Murre Hunting is a Historic Right and Should Never be Taken Away from Hunters? You Agree?.....	22
Table 4	Do You Think the Hunt Should Be Opened to Other Species?.....	23
Table 5	Representative Comments Respecting MBCA Regulations and Conservation.....	25
Table 6	Select Comments Raised by Hunters Respecting Enforcement.....	28
Table 7	Hunter Summary Statistics Relevant to Influencing Murre Hunting Regulations.....	30
Table 8	Hunter Responses to Consultation and Willingness to Submit Harvest Data.....	33
Table 9	If You Heard That the Murre Population Was in Danger of Collapsing, Would You Support a Complete Ban on Murre Hunting?.....	34
Table 10	Resistance to Bag and Possession Limit Changes.....	35
Table 11	Hunter Suggested Technological Changes.....	53
Table 12	Hunter Identified Environmental and Anthropocentric Impacts.....	56

Chapter One: Introduction

Marine ecosystems are complex, influence climate, our food supply and the well-being of nations whether those nations are bounded by oceans or not (Kaiser et al. 2011; Van Assche et al. 2014, 2020). These ecosystems are very much influenced by anthropocentric uses and are facing severe impacts ranging from sea-level and circulation changes, seabird and other marine species re-distribution and abundance (Chilvers et al. 2014; Arkema et al. 2015; Mclean et al. 2020; Lieske et al. 2020).

There is an urgent need to further our understanding of marine ecosystems (Einoder 2009; Ellis et al. 2013; Lieske et al. 2020). Marine ecosystem sustainability can be enhanced through the implementation of ecologically based strategies for assessing, monitoring, and management (Sherman 1994; Danielsen et al. 2009). A sustainable ecosystem is one where diversity, productivity and biogeochemical cycling is maintained despite the cycles of disturbances experienced over time (Chapin et al. 1996).

Conservation efforts require rigorous science but bringing science to bear on resource management decisions is challenging (Freiwald et al. 2018). Conservation policy initiatives are rarely based solely on science, despite science being able to provide the data to describe and predict ecological processes for policymakers (Parsons et al. 2003; Rose and Parsons 2015; Darimont et al. 2021). Factors such as societal values, politics and economics can influence policy (Guston 2001; Vann-Sander et al. 2016; Schlüter et al. 2020; Potts et al. 2021). This leads to tension and blurring between science, policy, and politics (Rose and Parsons 2015). The implementation of conservation measures relies strongly on public support from groups and individuals with different motivations (Kelly et al. 2018).

Debate exists on the need to re-examine the structure of marine governance and move towards one with stronger relationships between community and environment, policy integration and multilevel governance (Alvarez-Romero et al. 2011; Beaudreau and Levin 2014; Arkema et al. 2015; Pittman and Armitage 2016; Van Assche et al. 2020). Such approaches provide opportunities for local knowledge, coordination among conservation managers and agencies, the encouragement of checks and balances, and the integration of local policies into broader policy structures (McKinley and Fletcher 2012; Van Assche et al. 2014, 2020; Manfredo et al. 2017; Schlüter et al. 2020).

As the frequency of macro environmental events increase and research related to climate change enter the public realm, citizens are genuinely concerned about the impact humans are having on our environment (Theobald et al. 2015; Benham 2017a; Parrish et al. 2017). Public participation can support scientific research and the knowledge it contributes on how humans utilize, manage, and protect our coastal ecosystems (Martin et al. 2016a, c; Dean et al. 2018). Fostering marine citizenship promotes a stronger public sense of responsibility, understanding the marine environment, public participation and use of local knowledge (McKinley and Fletcher 2012; Martin et al. 2016b).

Local communities are becoming more actively engaged in conservation approaches as a means to promote more sustainable policies and more effective policy implementation (Djosetro and Behagel 2020; Schlüter et al. 2020). Public participation promotes a strong public sense of responsibility, understanding the marine environment, and use of local knowledge (McKinley and Fletcher 2012). Public participation can support scientific research through increased meaningful public engagement with research, and the knowledge it contributes to how humans utilize, manage, and protect our coastal ecosystems (Martin et al. 2016b; Dean et al. 2018).

A variety of terms such as “public participation”, “citizen science”, and “local ecological knowledge” are often used to describe public involvement in science projects, but they often are interpreted differently depending on the extent and type of public involvement (Miller-Rushing et al. 2012). Categorization of public participation such as “contributory projects” which are designed by scientists and the public contribute data; “collaborative projects” designed by scientists but the public contribute by providing data and assist in other manners such as analysis and dissemination; and “co-created projects” where scientists and the public work jointly in all aspects of the study is but one of the attempts to provide clarity to the concept of public participation (Bonney et al. 2009).

Public participation in ecological research, used extensively in terrestrial scientific research is underutilized in marine studies and is gaining momentum as a useful tool to augment scientific research (Bonney et al. 2009; Silvertown 2009; Theobald et al. 2015). Much of the growth in the use of citizen science can be attributed to factors including declining research budgets, an increased need for cost efficient surveys and a realization that citizen science could be a useful and relatively inexpensive tool to help inform conservation managers (Cooper et al. 2007; Silvertown 2009; Ward et al. 2015)

Citizen science is defined as the use of citizens to conduct ecological research by collecting, categorizing, transcribing or analyzing scientific data (Bonney et al. 2014). It can also involve environmental education, observation and using the internet to crowd-source (Dickinson et al. 2012). Citizen science provides opportunities to involve stakeholders in managing marine resources, enhancing scientific literacy, environmental awareness, and resource stewardship. Citizen science can build trust between resource managers and the stakeholders (Freiwald et al.

2018). Citizen science programs can work toward multiple goals to effect change, but there is strong overlap in terms of strategies and best practices (Cigliano et al. 2015).

Local Ecological Knowledge (“LEK”), another form of public participation refers to knowledge related to an area or species that can be obtained through a variety of means such as observation, resource utilization, information passed down through generations in either an oral or written tradition and/or shared among users (Huntington 2000). It provides the public with a voice in environmental decision-making and informs science and policy makers (Dickinson et al. 2012; Chilvers et al. 2014; Berkström et al. 2019). LEK can assist in breaking down the barriers between science, policy, and the public by providing an opportunity to involve stakeholders in managing marine resources, enhancing scientific literacy, environmental awareness, and resource stewardship (Brook and McLachlan 2005; Mallory et al. 2006; Theobald et al. 2015; Kelly et al. 2018). Ultimately, LEK can build trust between resource managers and the stakeholders (Freiwald et al. 2018). Resource managers also use LEK to complement existing datasets and inform management actions (Chaffey 2005; Gilchrist et al. 2005; Cook et al. 2014; Ward et al. 2015; Peñaherrera-Palma et al. 2018; Gorta et al. 2019; Martín et al. 2020), and mitigate conflicts (Brook and McLachlan 2005; Mallory et al. 2006).

Seabirds have frequently been used to support arguments respecting climate change and human impacts on marine ecosystems (Piatt et al. 2007; Ward et al. 2015; Mercer 2019, 2022). Many seabird species worldwide are experiencing changes in foraging behavior, nesting success and population declines (Huettmann and Czech 2006; Einoder 2009; Jenkins 2018).

Anthropocentric impacts include overfishing, loss of habitat, oil pollution, hunting, and the introduction of predators to pristine environments (Montevecchi et al. 2012; Robertson et al. 2014; Arkema et al. 2015; Hedd et al. 2015). Unregulated resource use is unsustainable and a

variety of conservation measures including the establishment of marine protected areas (“MPA’s), hunting regulations, severe fines for violators, public education, and policy enforcement are just some of the strategies used as conservation measures (Montevecchi and Tuck 1987; Mahoney and Jackson 2013; Crandall et al. 2018; Government of Canada 2020a).

In this paper, I use a case study of the regulated hunt of the common murre (*Uria aalge*) and the thick-billed murre (*Uria lomvia*) (“Murres”) in Bonavista Bay, Newfoundland and Labrador, Canada (“NL”) (see Figure 1), to explore whether the opinions and LEK of hunters can contribute towards the regulation and management of a seabird hunt.

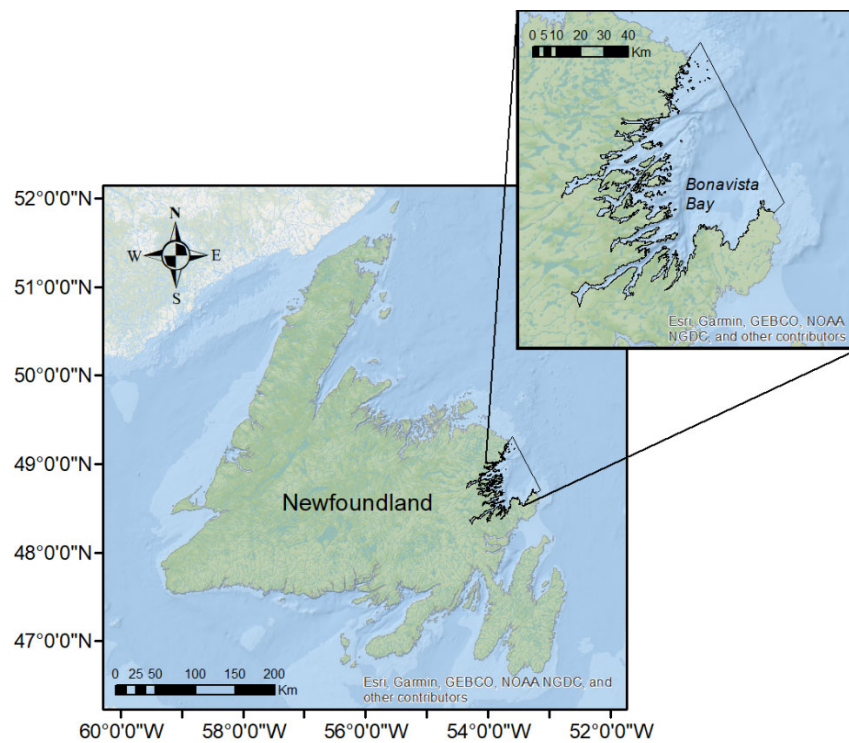


Figure 1 Study Area, Bonavista Bay, Newfoundland and Labrador, Canada

Thick-billed murres breed predominantly in dense colonies on cliff edges in the low and high arctic while approximately 90% of common murres breed in NL (Environment and Climate Change Canada 2019). A small colony of approximately 10,000 nesting pairs of common murre breed on the Cabot Islands which is in the study area (Wilhelm et al. 2015). Both common and thick-billed murres move off their breeding grounds and head south to the eastern edges of the Grand Banks during the winter months (Environment and Climate Change Canada 2019). The populations of murres are apparently stable or increasing (Environment and Climate Change Canada 2019) but concern exists with respect to the impact of climate change and anthropogenic impacts on populations (McFarlane Tranquilla et al. 2010; Montevecchi et al. 2012). Furthermore, the accuracy of harvest estimates have been called into question and work is ongoing to improve the methodology (Environment and Climate Change Canada 2019).

Known commonly in NL as “turrs” and by a variety of colloquial names, these murres have been hunted extensively since the early settlement of NL (Montevecchi and Tuck 1987). It is estimated that 95% of birds harvested in NL are thick-billed murres (Hedd et al. 2011). The Government of Canada, through the Canadian Wildlife Service (“CWS”), an entity within the Department of Environment and Climate Change Canada (“ECCC”), has jurisdiction over how this hunt is managed (Government of Canada 2017).

Using murre hunter interviews to obtain opinions and LEK based on their hunting experiences I address two major issues:

- 1) Can an analysis of the historical regulatory and cultural framework surrounding the resident murre hunt be augmented by residents’ opinion to provide guidance to resource managers?

- 2) What changes in common murre, thick-billed murre and razorbill (*Alca torda*; a non-hunted species that looks similar to murre) distribution and abundance over the past five decades can be elucidated by residents' LEK?

I have included a methodology section in each of Chapters 3 and 4. It is proposed that these sections will form the basis for two independent peer-reviewed papers. Chapter 3 relies mostly on hunter opinions to inform resource managers, while Chapter 4 relies mostly on hunter LEK requiring slightly different methodologies.

Chapter Two: Case Study Overview

Case Study Background

The federally regulated hunt of thick-billed and common murres by residents of NL (“Hunters”) is the only hunt in North America where non-indigenous hunters are permitted to harvest murres (Montevecchi et al. 2007). A third murre species which occurs in NL, the razorbill (*Alca torda*), is not permitted to be hunted under current regulations. Table 1 presents the number of licenses issued to hunters in Bonavista Bay (BBay), the study area, for the period 2015 to 2020. Despite murre hunting still being a favorite hunting activity in NL with deep historical roots, the number of hunting licenses issued over the period 2015 to 2020 shows a decline in issued licenses. As Table 1 depicts, hunting licenses issued declined from 1139 in 2015 to 649 in 2020, a drop of 43%.

Year	2015	2016	2017	2018	2019	2020
#	1139	1154	936	882	718	649

Source: Canadian Wildlife Service, Environment and Climate Change Canada, 2020

Prior to NL becoming Canada’s tenth province in 1949, hunters harvested murres and other seabirds with few restrictions for generations as it was considered to be a meat staple in most coastal communities (Montevecchi and Tuck 1987). It was alleged that maintaining this subsistence hunt was a condition of NL joining Canada (Montevecchi and Tuck 1987; Montevecchi et al. 2007; Smith 2016; Environment and Climate Change Canada 2019). However, the terms negotiated between Canada and Newfoundland in 1949 were limited, and no reference was made to protect any seabird hunting rights for hunters (Baker and Neary 2018). Upon joining Canada, hunters became subject to the rules and regulations of the federal

government that were in effect at that time, which meant hunters were no longer legally permitted to hunt murre (Turner 2021). Canada's authority to prohibit the hunting of murre in 1949 was vested in the Migratory Bird Treaty Act of 1918 (Treaty) between Canada and the United States, and the corresponding legislation in Canada, the Migratory Birds Convention Act (MBCA) (Great Britain and United States 1916; Government of Canada 1994; Wilhelm et al. 2008). Canada attempted to enforce the full extent of the regulations but the response by hunters and residents was quick and demanded the removal of these restrictions despite Canada's attempt to enforce the terms of the Act (The Western Star 1951; Montevecchi and Tuck 1987). As a result of political intervention, petitions, and an acknowledgement that the hunt for murre potentially would create hardships for NL residents, Canada softened its stand on the enforcement of the MBCA opting instead for a campaign to sell the importance of the MBCA (Tuck 1949; The Twillingate Sun 1950; The Western Star 1950, 1951).

Canada conceded to pressure from NL residents and politicians by providing temporary measures for the hunt to continue, which in effect was a violation of the Treaty (Turner 2021). Multiple interest groups, hunters, researchers, and conservationists expressed concern that these temporary measures could have a deleterious effect on the sustainability of murre populations. Canada understood these concerns and undertook scientific studies, engaged in an extensive consultation process, including, in-depth interviews with hunters and opened negotiations with the U.S. to modify the Treaty, (Montevecchi et al. 2007; Turner 2021). As a result, the U.S. and Canada amended the Treaty in 1995, finally permitting hunters to legally hunt murre for food, but not to sell or offer to sell them (Government of Canada 2020b).

Provisions were made for hunting zones, hunting seasons, bag and possession limits, shotgun restrictions, and enforcement measures, among others (Government of Canada 2020c).

Four NL management zones were set up with different hunting seasons. Zone 4, which includes Bonavista Bay (BBay), the study area for this paper, extends from Western Bay Head to Deadman's Point. Zone 4 had two hunting seasons, from Nov 3, 2021 - Jan 10, 2022, and Feb 2, 2022 - Mar 10, 2022. The adjacent hunting Zone to the north of the study area, Zone 2 extends from Deadman's Point to Cape St. Gregory and has an opening season from Oct 6, 2021 to Jan 20, 2022. Zone 3 to the south of the study area, have a hunting season from November 25, 2021 to March 10, 2022 (Environment and Climate Change Canada 2020). Murre hunters are restricted to a daily bag limit of twenty murre and a possession limit of forty, but no restrictions on the number of hunting trips per season (Environment and Climate Change Canada 2020). A third murre species in NL, razorbill are not permitted to be hunted under current regulations, but are taken incidentally (Wilhelm et al. 2008).

Other restrictions include fines for contravention of the regulations, such as exceeding a daily 20 murre bag limit, a 40 murre possession limit, and exceeding the maximum number of shells capable of being held in the magazine of the gun at any point, among others. Section 15 (1) of the regulations prohibit hunters from using "a shotgun of any description capable of holding more than three shells unless the capacity of the gun has been reduced to three shells in the magazine and chamber combined, by means of the cutting off or the altering or plugging of the magazine with a one-piece metal, plastic or wood filler that cannot be removed unless the gun is disassembled" (Environment and Climate Change Canada 2020) .

The Canadian Wildlife Enforcement Division of ECCC is the primary enforcement entity within the CWS, but only has a limited number of enforcement officers in NL. As a result of the minimal staffing levels, they focus primary on high risk or known offenders using information

provided by the public and a variety of surveillance methods. CWS relies heavily on other enforcement divisions within the Government of Canada (Nowak 2021).

Further, protocols were established to review the regulations every two years, if required. The biennial review mandates the examination of scientific reports, incorporation of regional office recommendations, consultations with stakeholders and the posting of draft proposals for further input before they become law (Government of Canada 1994).

Study Area

The study area is Bonavista Bay (BBay; 3200 km²) on the northeast coast of the island portion of NL, Canada. BBay hunters use predominantly a portion of Zone 4 which extends approximately 10 kilometers northeast of Cape Freels on the northern portion of BBay to 10 km east of Cape Bonavista as the southern point (Fig 1). BBay is indented by approximately 45 small communities, many with small fishing harbors, coves and inlets, numerous shoals, and small islands. Water depths range from exposed shoals that are exposed at low tide, and channels and areas that are as deep as 200 m extending deep into portions of BBay. It was decided to restrict the study area to the partial regulatory Zone 4 to manage the interview process more effectively. Further, hunters from BBay rarely hunt outside of the study area.

Interviewee Demographics

All hunters were male (n=30) with the average age of 56 (range 31 – 72; Table 2). The average years of experience, defined as the date the hunter first started hunting to time of interview was 53 (range 15 - 56), covering the period from 1965 until the 2021. Seventeen

hunters had greater than forty years of hunting experience, with twenty-two of the thirty hunters, having hunted consistently prior to 1995 when there were no bag and possession limits (see Table 2). All interviewees, except for two, were active hunters in the 2020 – 2021 season and all but two hunted other marine and terrestrial species such as eider ducks (*Somateria molissima*, *Somateria spectabilis*), arctic hare (*Lepus arcticus*), grouse (*Bonasa umbellus*, *Falci pennis canadensis*), and moose (*Alces alces*), among others.

Table 2: Hunter Profile by Years of Experience Hunting and Year Started Hunting

Age Cohort	#	Yrs of Exp					Total	Year Started					Total
		0-10	11-20	21-30	31-40	40+		1961-1970	1971-1980	1981-1990	1991-2000	2001+	
20-30													0
31-40	4		2	2			4				1	3	4
41-50	7		1	5	1		7			3	4		7
51-60	5			1	1	3	5		2	3			5
61-70	11					10	10	4	6				10
71+	3					4	4	4					4
Total	30	0	3	8	2	17	30	8	8	6	5	3	30

Chapter Three: Murre Hunters – Informing Conservation Managers, Opportunities and Challenges

Introduction

When the Government of Canada attempted to enforce the MBCA in 1949, it had the potential to seriously disrupt a way of life and subsistence hunting tradition for residents of NL that had existed for centuries. The impacts of the approach linger to this day. To fully appreciate murre hunter opinions of the current murre regulatory regime, it is important that that we investigate the historical regulatory context of residents' reliance on seabirds and the response by residents to Canada's 1949 attempt.

Canadian environmental policy evolved in four stages (Hessing et al. 2005):

(1) Government Inaction, (pre-1800) characterized by a general lack of action by governments other than to secure key resources that related to great financial or military value for the British Empire. Seabirds and other game animals were simply there for the use of settlers as they saw fit.

(2) Revenue Generation, (1800 – 1880) where attention shifted to the development of policies, programs, and institutions, to reap financial benefits from royalties and taxes from the resources

(3) Conservation Era, (1880 – 1950) where pressures both internally and externally to moderate the rate of resource extractions and the accompanying environmental impacts through the development of environmentally focused institutions and new administrative arrangements embedded in regulatory agencies. It was also during this period that Canada's system of National Parks and forest reserves emerged, the Treaty for the International Protection of Migratory Birds ("Treaty") was negotiated and the MBCA received Royal Assent (Green 1976; Lothian 1987; Hessing et al. 2005).

(4) Management Era, (1950 – Present) characterized by the consolidation of environmental protection, overall increases in federal powers and control and increased complexity of legislation and administrative controls (Green 1976; Hessing et al. 2005).

The first “organized European engagement with North American wildlife” occurred off the coasts of NL in the fifteenth century when seafarers and merchants harvested fish and seabirds as theirs to slaughter (Mahoney and Jackson 2013). As a result of the unrelenting slaughter of seabirds and other species, a pro-conservation awareness began to emerge to prevent the extinction of entire species of wildlife that continues to this day.

NL’s first exposure to the application of conservation law was as early as 1793, when Chief Justice Reeves successfully applied the 1533 British Act Against the Destruction of Wildfowl to several men who had taken eggs during closed season from the Funk Island off the coast of Newfoundland. This Act, while eventually repealed in 1831, placed severe penalties on those individuals within the British realm who took wildfowl between the last day of May and the last day of August (Raithay 1811; Montevecchi and Tuck 1987).

NL implemented its first conservation legislation as an independent self-governing entity, well before the Dominion of Canada enacted the MBCA in 1917 (Peters and Burleigh 1951). With the passing of “An Act for the Protection of the Breeding of Wildfowl in this Colony”, on April 23, 1845, all wildfowl, which included seabirds and their eggs, became protected during the breeding season. It was illegal to hunt between May 10th and September 1st with the penalty being a fine of 20 pounds (Peters and Burleigh 1951; The Daily News 1954). An important caveat made by a provision in the April 20, 1859 “Act for the Protection of the Breeding of Wildfowl and Preservation of Game”, which replaced the 1845 Act amended the number of days the season was closed for migratory birds (April 17th to Aug 10th). More importantly for residents

was a provision whereby “poor settlers were permitted to kill game at any time, for immediate consumption, if circumstances made such killing necessary” (The Daily News 1954).

A summary of the major NL regulatory amendments and developments are as follows (Prowse 1896; Peters and Burleigh 1951; The Daily News 1954; Montevecchi and Tuck 1987) :

- 1863, the closed season extended from April 1 to August 20th for hunting and the taking of eggs. Furthermore, hunting on the Sabbath Day was prohibited.
- 1869, “An Act to Amend and Consolidate the Game Laws”, repealed all former acts extending the closed season from March 20th to August 20th, inclusive and completely banned the taking of eggs from all waterfowl at any time throughout the year.
- 1872, the Statutes of Newfoundland were consolidated preventing hunting of migratory birds from January 25th to Sept 1st.
- 1892, the Act for the Preservation of Game was further amended extending the closed season from Jan 12th to Aug 20th.
- 1904, the Game Preservation and Inland Fisheries Board, composed of 5 members chaired by the Minister, was established with a mandate to undertake research and other investigations to protect fish, game, and wildfowl in the Department of Marine and Fisheries. In addition, the first system of wardens was established.
- 1909, the membership of the Board was increased to 22 members.
- 1934, under Commission of Government, responsibility was transferred to the Department of Natural Resources.
- 1941, first licenses and fees system implemented.

- 1943, the first open season for seabirds was enacted from September 1 to May 31st but banned the hunting in summer of shearwaters. Due to backlash, the ban on the summer hunting of Shearwaters was rescinded.
- 1945, advisory boards, composed of representatives of all areas in NL were set up to provide input into environmental policy and conservation measures.

At midnight, March 31, 1949, the “Dominion of Newfoundland” ceased to exist, and it became the tenth province of Canada, subject to the same legislative and regulatory regime as every other province in the country (Government of Newfoundland and Labrador 1949; May 2003). In effect, any measures related to the conservation of seabirds in the coastal region became null and void and NL non-indigenous seabird hunters became subject to the MBCA under the auspices of the federal Department of Natural Resources (Tuck 1949). The implementation of the MBCA meant an immediate ban on the hunting of all seabirds that the residents of the province had historically depended on for food security. This included murre hunting as it had been classified as a migratory nongame bird under the 1916 Treaty. The position of the federal government at the time was that old habits had to be broken in various parts of Atlantic Canada when the act was first implemented and now the province was to pass through a similar period of adjustment (The Western Star 1951). It was clear that the initial intention of the federal government was to fully enforce all aspects of the MBCA to the entirety of the province as soon as possible. According to Natural Resources Minister Robert Winters, at that time, the full MBCA would be extended all over Newfoundland, step by step (The Western Star 1951). During the winter of 1949-50, the federal government applied the full extent of the MBCA to the southern coast of the island Grate’s Point to Cape St. Gregory during the 1950-51 because in their estimations “it was deemed to have the best communications”. The response by

residents of Canada province was quick and vociferous, demanding the removal of these restrictions (Tuck 1949; The Western Star 1951; Montevocchi and Tuck 1987).

Canada responded by issuing a Press Release clarifying the new regulations but acknowledging a need to provide some leeway in the case of murre hunting. The federal government in acknowledging the hardships of residents, went further in its willingness to bend the rules with respect to the application of the MBCA, while commencing somewhat of an educational campaign to explain the importance of the MBCA (Tuck 1949; The Twillingate Sun 1950).

“It is recognized that many people around the coasts of Newfoundland are accustomed to depending on the meat of the murre, or turr, as it is locally called, for food and have made no substitute provision for the winter. Hardship might be experienced by these families if those birds could not be obtained. While the Migratory Birds Treaty does not provide an open season for the turr, since it is not one of the game birds, the authorities do not for the present propose to interfere with residents of Newfoundland who, because of need, take and possess turrs for their own use and that of their families” (Tuck 1949). Further “...as a special concession, scoter and eider ducks may be sold in Newfoundland during the open season for these birds, which is from October 1 to November 30 in the Avalon Peninsula and September 15 to November 30 in the remainder of the island (Tuck 1949).”

In 1951, tensions between NL and Canada heated up to such an extent that Progressive Conservative Gordon Higgins introduced a private Members Bill requesting an amendment to the MBCA with the backing of all NL representatives, despite differing political affiliations, in the House of Commons and a petition with more than 6,000 signatures on it. The effect of the lobby resulted in Gordon Winter, the Natural Resources Minister and the External Affairs

Minister, Lester B. Pearson, to agree to approach the U.S. authorities to ascertain what they would be able to accept in order to allow Residents to hunt murre to stave off hardships (The Western Star 1951). Winters acknowledged that if “Newfoundlanders had realized their turre-shooting rights were in jeopardy, they would have undoubtedly have turned down Confederation” (The Western Star 1951). The federal government for all intents and purposes eventually retrenched its position amidst public outcries allowing the hunt to continue.

It was not until 1995 that some semblance of modern-day conservation strategies began to emerge in the management of the murre hunt off NL. In 1995, the Protocol Amending the 1916 Convention for the Protection of Migratory Birds was signed and formally presented to the U.S. Senate by President Bill Clinton which recategorized murre as a Migratory Gamebird and thereby allowing the federal government to fully implement strategies such as licensing, vary open and closing seasons and take other measures permitted under the MBCA. Further, the right of non-indigenous residents of Newfoundland and Labrador to hunt murre for food was fully acknowledged by Article II, #5 in the Treaty (Clinton 1996; Government of Canada 2020b).

It is alleged that non-indigenous residents have a historic right to hunt seabirds for subsistence and food security as a condition of Newfoundland and Labrador (“NL”) joining Canada in 1949 (Montevecchi and Tuck 1987; Montevecchi et al. 2007; Smith 2016; Environment and Climate Change Canada 2019). Furthermore, it also suggested that due to societal and regulatory changes, the murre hunt has transitioned from a subsistence hunt to a recreational hunt (Montevecchi et al. 2007). Environment and Climate Change Canada, (2019) has also acknowledged that gaps in the empirical database exist, especially with respect to harvesting data, to manage the murre hunt effectively. Any of these factors can lead to conflicts

between conservation management decisions that could be out of sync with the observations of hunters and may result in conflicts.

Methodology

Following a field test of the interview questions with two murre hunters in May 2021, minor modifications were made to the proposed questionnaire. These included amendments to clarify several of the proposed questions, to add photographs of the three murre species in breeding and nonbreeding plumages, and to include a larger scale map of BBay depicting key oceanographic features such as water depth, shoals, deep water channels and islands. Thirty interviews were completed between July 2021 and March 2022 to ascertain hunter knowledge and views on the regulatory and cultural aspects of the murre hunt (approved by York University's Human Participant Review Committee). Candidates were selected using snowball sampling as the predominant method (Noy 2008; Braga and Schiavetti 2013; Etikan 2016). Twenty-seven hunters resided and hunted in the study area, two hunters resided outside the study area in the adjacent bay to the north, Notre Dame Bay, and one hunter, resided and hunted in the adjacent bay to the south, Trinity Bay. The three interviews outside the study area were undertaken to ascertain similarities or differences in hunter views respecting the hunt as those obtained through Hunter interviews in BBay.

All interviewees had hunted murre, with most having hunted every year (n=25), two having stopped hunting completely and three intermittently. A semi-structured questionnaire (Appendix A) was used to guide the interview, but participants were encouraged to speak freely. Interviewees were shown a detailed oceanographic map of Bonavista Bay and presented with photos of razorbill (local name, "tinker"), common murre ("turr", "eye-glass bird", "our bird")

and thick-billed murre (“turr”, “northern bird”, “black-headed bird”) in their breeding and non-breeding plumages and asked to identify the birds using the names they most often use to identify them (Montevecchi and Tuck 1987; Turner 2021).

The interviews ranged from approximately fifty-five minutes to two hours and fifty minutes depending on the hunter’s availability and eagerness to continue the conversation. The interviews were audio recorded and manually transcribed due to the dialects and local terminology. Major points and comments were then coded according to the key themes.

Responses were categorized and analyzed to investigate seven key areas for Chapter Three: “Murre Hunters – Informing Conservation Managers, Opportunities and Challenges

Perceptions as whether hunters have a historical right to hunt murre

Hunters’ perceptions of regulatory impacts on murre conservation

Recommendations for changes, if identified

Resistance to bag and possession limit changes

Factors that might influence changes to murre hunting regulations

Conditions under which murre hunters would support increased conservation efforts

Willingness to submit annual harvest data

Original source documents, such as newspapers, archived government documents and scientific papers were used to provide an overview of the regulatory and cultural context of the hunt to augment Hunters interviews. Newspaper accounts from 1949 to 1954 that documented the struggle of hunters to retain hunting rights after NL became a Canadian province were identified through electronic searches at Memorial University of Newfoundland Archives, St. John’s, NL using mostly “murre” and “seabird” hunting as keywords. These searches yielded

numerous articles and press releases from notable newspapers at the time, including the Twillingate Sun, the Daily News, and the Western Star.

Documents obtained through electronic searches revealed important background on the regulatory and conservation environment such as the 1949 Terms of Union between NL and Canada, the Great Britain Statutes from 1811, including current legislation. Several earlier books, including *A History of Newfoundland: from the English, Colonial, and Foreign Records* by D.W. Prowse in 1896, and *Newfoundland Birds, Exploitation, Study, Conservation* by Montevocchi and Tuck in 1987 provided a historical context to the importance of seabird hunting in NL.

Results

Perceptions as whether hunters have a historical right to hunt murre

Hunters were questioned with respect to their perspectives on a range of issues related to their hunting culture and hunting rights. Most interviewees (n=27) felt that they had an historical right to hunt murre (Table 3). Despite several studies and media suggesting that hunter's rights emanated from a right acquired when NL joined Canada, few hunters acknowledged that as the source of the right (n=6). As one hunter stated, "when we joined Canada, it was a part of the deal Joey [Smallwood, NL's first Premier] signed".

Most hunters felt that an historical right emanated from a history of hunting for generations that was intertwined within the current lifestyle of rural NL residents. One hunter commented, "back in our grandfather and their fathers time it was a source of protein that got their families through the winter". Another commented, "the tradition stayed around here. In around town, they got used to chicken, and the younger people got an acquired taste for other

food, but around here if you didn't have turr, they'd think you were a lunatic. It is still a big part of the diet here and should never be taken away”.

Table 3: Some People Say That Murre Hunting is a Historic Right and Should Never be Taken Away from Hunters? You Agree?	
Yes (n=27)	No / Uncertain (n=3)
Yes, when we joined Canada, it was a part of the deal Joey signed	Don't think we should be hunting regardless of right if there is a negative impact on the population, though there might be a possibility we may have one
People in the cities don't realize how this is a part of our culture. Every season brings a different thing. We are almost like native people. We have no rights because we have no Indian blood in us, we are used to doing ourselves	All foolishness. Anyone can afford a chicken now. No one needs to live on a turr now. Yes, 50 years ago. One time, I wanted a fridge full. If you want to see a turr now, go into the dump in the spring
Believes we have a right. Back in our Grandfather and their fathers time it was a source of protein that got their families through the winter.	Not sure how to answer that
Around here, if you didn't have turr, they'd think you were a lunatic. It is still a big part of the diet here. It should never be taken away, maybe lower quota. It is a god given right under Confederation. People don't understand it is a part of our culture	
Yes for everyone and not only for Newfoundlanders. It should be a Canadian right	

All murre hunters identified themselves as hunters of other bird species and land animals that were permitted to be hunted on an annual basis and murre were refrigerated or processed for year-round use as well as moose, rabbit, grouse, and berries, home grown vegetables, and others. Many hunters commented murre were not the primary source of protein, but it was still an important part of the annual diet. Reflecting the sentiment of most hunters interviewed, a hunter commented, “I value being able to hunt, pick berries, grow vegetables, and take pride in being able to provide as much as I can that is out there. But I also steer away from something that is not cost effective.”

To address whether hunting was cost effective and a factor in their decision to continue to hunt, hunters were asked how much a typical murre hunting trip cost, excluding the cost of the boat, assuming they left from their own wharfs, which was typical in BBay. In part, because of the newer more fuel-efficient engines, between the costs of fuel, food, and shotgun shells, the

cost per trip ranged between \$100 to \$150. Hunters share the full cost of the trip among each other, so if two hunters harvested 20 murre per trip in total, the cost per murre harvested was \$2.50 to \$3.75 on the higher end.

Hunters were questioned whether there should be a hunting season for other species (Table 4). The responses suggest that hunters' awareness of past hunting experiences extends well beyond murre hunting but also for seabird species that are not permitted to be hunted. While the number of respondents suggesting a hunting season and the reasons in favor of it varied depending on species, there were several notable differences.

Table 4: Do You Think the Hunt Should Be Opened to Other Species?		
Cepphus grylle (black guillemot)	Yes (n=13)	No (n=17)
	Good eating	No, sin to kill them; not very thick
	Definitely, thousands	No, not enough
	Everyone is not going out and hunting pigeons, but there are a few birds killed;	Not too worried about pigeons, should not be open, not very plentiful
	Best bird to eat	Don't know the numbers; no vast flocks
	Why not? I know some people who kill them now	Nice eating, but don't think they can take a lot of beating
Rissa tridactyla (black-legged kittiwake)	Yes (n=20)	No (n=10)
	Yes, millions	Not thick enough
	Can't see why not with a small bag limit	Don't see many around
	Yes if someone likes them	Not interested in them
	They are good tasty birds, better than anything	See lots around but never paid any attention to them
	Little quota, maybe 20 a boat, best bird alive just like the honey	Don't see many in the bay
	Thousands / millions definitely open for at least 20 per man	
	Most plentiful bird there is around; steaming through them for hours, love to get	
Larus sp. (gull)	Yes (n=19)	No (n=11)
	Do need to be thinned out but no one will eat them	They clean up a lot of mess
	I think gulls should be culled every now and then; destroying duck and turr eggs, young birds	No point. Gull population has declined because of Cormorants. Not one gull breeds on the Shag Rocks anymore
	Overpopulated	No but, grandfather used to kill gulls all the time
	Yes, Needs to kill them but not many people will kill them; not going to change anything; years ago people would raise them and then kill them	Don't make any difference
	Why not but no one wants to eat them	Not interested (Labrador Turkey)
Phalacrocorax auritus (double-crested cormorant)	Yes (n=29)	No (n=1)
	Yes; lot better bird to eat; I've eaten one, not allowed to kill them though	No, not sure if birds are impacting anything
	Kill all of them; young salmon in the brook here - will not be one; the harbor will be full of them; when I was growing up, there was a cormorant here; global warming and no one killing them	
	Yes, invasive. Eating young ducks and young turrs. Weren't here 30 years ago	
	If not open season, there won't be a fish here	
	Full season on them; neck was full, everything they are eating; was about 300 there one day when the smelt was going up	
Monus bassanus (northern gannet)	Yes (n=1)	No (n=29)
	Yes if the numbers are up	Not many going to eat gannet
		They are nice to look at; beautiful bird; not destroying things, not a big lot of gannets
		Leave them alone; nice birds to have around
		Never eaten them. Nice bird to watch
		When you see gannets, you find bait
Ardenna gravis (great shearwater); Ardenna grisea (sooty shea)	Yes (n=28)	No (n=2)
	Absolutely. Used to get 5 gal bucket each year / now, might get one or two	None in the bay
	Yes, thousands, in 10 minutes we would have a 100	No interest
	Should be allowed to kill them, millions	
	Yes; better tasting bird; everyone had them in their fridge	
	Definitely; sooner have bawkes than turrs; lot of black bawkes around this year	
Fratercula arctica (atlantic puffin)	Yes (n=2)	No (n=28)
	Who cares if puffins are pretty, there are millions of them; I'd like to be able to go out and kill a doz puffins; I don't want to kill them all; Iceland and Greenland are killing the puffins;	Not very often you see many puffins, but once upon a time, there were a lot of puffins in the bay
	Why not, we used to eat them once	Sin to kill them
		Hard to cook them
		We used to eat puffins, not so thick as they used to be and don't know why
		Don't see many of them on this side of the bay

Most hunters identified great shearwater (*Ardenna gravis*), sooty shearwater (*Ardenna grisea*) n=28, and black-legged kittiwake (*Rissa tridactyla*) n=20 for an open hunting season because they perceived them to be in large numbers, could sustain a limited hunt and as a preference for taste. Hunters also identified these species as seabirds that were traditionally hunted in NL. Most hunters, as well, identified gulls (*Larus sp.*) n=19, and especially the cormorant (*Phalacrocorax auratus*) n=29, for culling due to their perceived impact on other species, including fish in inland waters, habit loss for other species, among others. Very few hunters expressed any interest in hunting Atlantic puffin (*Fratercula arctica*) (n=2) and the northern gannet (*Monus bassanus*), citing reasons such as those birds were nice to look at, their numbers weren't large, and they weren't bothering anything.

Hunters' perceptions of regulatory impacts on murre conservation

Hunters' perceptions of the impact of murre hunting regulations on conservation were presented frequently in the context of a discussion of hunting practices before the implementation of the MBCA 1995 regulations and often, referring to the practices of their fathers and grandfathers (Table 5). One hunter stated, "before, we only had a 20 (horsepower engine) or less and couldn't get out into the squatch holes (holes in among the ocean ice where relatively large numbers of murrens would congregate and were easy to harvest), then we had the 40 and we had it made because we would get into the squatch holes. Now there are 100 hp". Another hunter explained, "now hunters are making a lot more trips and having to travel longer distances but have more money to buy bigger boats and engines and can chase down birds, but in the older days, hunters were busy trying to make a living and made a smaller number of trips but got a lot more birds per trip".

Some hunters questioned the purpose of specific regulations and suggested modifications but still strongly supported the existing regulatory regime. All hunters interviewed (n=30) were supportive of the intent and success of the regulations even though some clearly violated the regulations. Many hunters felt that if restrictions weren't imposed, because of the hunting practices prior to 1995 and technological change especially boat, motor, navigation, communication equipment, and weapons used, the murre population would have been severely depleted. Another hunter retorted, "I was one of those who advocated for the bag limit, and they finally got the bag limit on and that was what saved the turrs".

Table 5: Representative Comments Respecting MBCA Regulations and Conservation
<i>Before Regulations - Pre 1995</i>
Most I ever had on one trip were 95 turrs
There was no bag limit
Down around Greenspond, it was a slaughter in the ice pockets and I couldn't fit any more in the boat
In the 80's seemed like everyone was at it and were overhunting
Always got their daily limit and then some and everyone was doing the same thing; I would go out at least 20 times a season
I have had the gun so hot once that I warped the barrel; fired off a box and a half of shells and after that the gun always shot left.
Back in old days, 30 years or so ago, 150 - 200 turrs, no problem getting them
One year we went well over a thousand birds
Once up a time, there was no quota, you'd sell a few, bottle up a few, give a few away and then probably have enough to pay for your gas for the next day, You had the slob, no quota, kill what you wanted; they were all eaten
Before regulations, on a average day we would kill 150
In my grandfather's time , there not as many hunters, but a lot more birds were taken
At one time we would kill a hundred or more per day. And with 10 crews from here in the early 80's; likely 3,000 birds per crew; 20,000 to 30,000 birds per season with a lot sold for \$2 to \$3 per bird.
At one time, you would kill whatever you wanted
Many other birds were shot such as ticklelaces (Black-legged Kittiwakes) pigeons (Guillemots) and bawkes (Shearwaters) were shot
<i>Post Regulations, Post 1995</i>
There are more hunters but hunting less now because of the regulations.
Hunters will not take a chance to lose their boat
Received a \$3K fine for hunting out of season
Checked by Fisheries Officer a couple of times.
Don't hear so much about illegal hunting now
Got fined for selling turrs
Got checked almost every year until about 4 years ago when they stopped trying. When we were younger we used to do everything, but we stopped many years ago and rarely go hunting now since we got older.
Most of the hunters who are checked are at the wharfs where there are fisheries officers. I have never been checked.
Got checked a couple of times when I came into the wharf

Underlying hunter comments concerning murre conservation on a broader scale was a general lack of knowledge of even basic information about murre, especially thick-billed murre which were identified by hunters as their favorite murre to hunt (n=22). Overall knowledge such as where the murre breed, age of birds, and plumage changes, abundance outside BBay, population health was lacking. Hunters' general knowledge of where thick-billed murre breed (n=4) was in sharp contrast to where common murre breed was mostly related to proximity to BBay (n=23), but common murre breeding beyond the immediate environs of BBay was poor (n=4). While most hunters knew the general migratory patterns in and out of BBay, there was speculation on where they went. Most hunters speculated that common murre moved out of the bay to the area around the Grand Banks (n=27) and thick-billed murre migrated from somewhere up north, along by Cape Freels and Cape Bonavista to the South Coast of NL (n=28).

When shown pictures of murre in various season plumages, most hunters were unable to recognize some of the plumages, often confusing species or indicating that they had not seen them before. Two hunters were able to correctly identify all murre in their various plumages.

All hunters readily admit that they knew it was illegal to shoot razorbills but did so accidentally (n=28), and in small numbers. Hunters stated that if they were able to recognize razorbills amongst a flock of murre, either swimming on the water or flying, they would not shoot. Many hunters could identify a razorbill when shown pictures (n=24) mostly by the bill shape and size. Yet, hunters who stated they could identify razorbills either flying or on the water while hunting was small (n=9). Similarly, hunters who could readily identify thick-billed murre from common murre while hunting was slightly higher, was still small (n=15).

The difficulty to readily identify murre in a hunting situation and the lack of knowledge of murre biology is in sharp contrast to hunting knowledge. A hunter's knowledge to predict the

likelihood of a successful hunt in BBay was based on a variety of factors such as technology, information gleaned from friends about hunting success or lack thereof in other bays, wind direction, ice coverage, ice movement, and time of day / year, etc. All hunters interviewed knew the best times of day and places to hunt, such as early in the morning, northerly wind conditions, and when ice was being pushed in a southerly direction around Cape Freels.

As reported by hunters, hunting practices and relative success, as measured by the number of murrelets harvested, has changed over the years in response to hunting technology and environmental conditions (e.g., wind, ice conditions and bait). Most hunters interviewed now own fiberglass boats, with larger more fuel-efficient engines (n=26), use GPS units and communication tools such as cellular phones and VHF radios to communicate with each other while hunting. Hunters can now travel through thin ice, travel longer distances, and cover more hunting territory faster. As one hunter stated, “when we started birding, we had a 6 horsepower, then a fifteen took us to Shag Rock, then a twenty-five to Flower's island, then a thirty took us to Cabot Island. Now there is no room for the bird to rest and there are more hunters than ever before. Everything is getting driven. Any bird coming into BBay is committing suicide.”

Willingness to submit harvest data

Hunters would submit annual harvest data if it were mandatory as a part of license requirement (Table 6). No hunters were identified who submitted harvest data or responded to any volunteer data questionnaire in recent years. In several cases, hunters (n=4) deferred to their spouses if they had ever submitted harvest data with all indicating they had not as well.

Hunter recommendations for changes

Overall, there was widespread support for the MBCA, and Migratory Birds Regulations (“Regulations”) in effect for the murre hunt. Despite some recommendations to modify the existing regulations, in some instances, hunters acknowledged that their position could change if they understood the purpose behind some of the regulations.

Twenty-three hunters indicated that more consultation was required, with recommendations including mandatory annual surveys and community meetings (Table 6). As one hunter stated, “we are not consulted enough. We never see anyone. They should use community meetings and not use social media”. Another commented, “real hunters don’t use Facebook”. Another hunter reflected that, “once upon a time, we were visited a lot by the wildlife guys doing surveys. They would come and ask us questions and tell us about what they were doing. I have never heard from anyone in years”.

Table 6: Select Comments Raised by Hunters Respecting Enforcement
Us hunters might not like what others are doing, but we will never report them because we might need them at some time in a small community
I was checked for plug and then lead shot
I was checked once on the water by a fishery officer
I was checked many times at the wharf
I was checked many times by Fishery Officers for fish but I never heard of anyone being checked for turrs
Some of the officers are idiots. Some of them are just f...’n stun
I had one person come aboard the boat and couldn't even tell the difference between a razorbill and a turr. If it wasn't for another officer who was there who knew the difference, I could have been fined
There needs to be more enforcement, quotas are only part of it.
Selling going on; some people have to justify that the boat is paying for itself
Trades scallops for turrs sometimes
Not much illegal stuff going on nowadays

Hunters stated interest in learning more about the species they hunt was not being met by wildlife managers (n=19). They commented that if they knew more about murre biology, it would help them understand more the reasons why certain regulatory decisions are made. All hunters used local names to identify murre and many hunters were not aware that all turrs were murre among others, sometimes calling what they perceived to be old birds as murre, irrespective of species, etc. As one interviewee commented, “some people don't know what type of birds they are hunting, not even basic information”.

Despite overwhelming support from hunters for the MBCA and regulations, some had recommendations for changes for the hunting season opening times (n=9). While some hunters had differing opinions respecting opening times, 7 out of 9 favored the opening of the season to be the same as Zone 2 to the north. Rationales provided by those preferring to have the season opening the same time as Zone 2 included better timing for when murre are present, winds were lower earlier in the season which meant that hunters could get out on the water, and those from Cape Freels had an advantage because they can hunt both bays from their own towns.

Some hunters (n=14) questioned the merits of the shotgun capacity restriction regulation. Hunters were generally aware that others had developed ways around this regulation. One stated “most fellows throw away the manufacturers plug. It is fast to switch out the plug with a pencil. It can be taken out quickly and put back in if he sees an enforcement officer coming. If the enforcement guys board the boat, all they do is shove a few shells in and check to see if all they cannot get any more than the three shells, check our license and the number of birds on board and then leave”. Another hunter commented, “you are not able to find many people around here with the proper plug in it”.

Several hunters said that most of the time there were three people in a boat hunting and were each allowed to carry a gun. This meant there were nine shots available for a flock of turrs. They further argued that whether they shot turrs with guns without plugs was irrelevant if they did not go over their daily limit of 20 turrs per person. It could mean that hunters would be on the water less time, cost less, safer for the hunters, and murrees would experience reduced harassment.

Table 7: Hunter Summary Statistics Relevant to Influencing Murre Hunting Regulations				
	Yes	No		
Can you tell the difference between the different species before you shoot them?	n=5	n=30		
Can you identify a Razorbill while flying	n=5	n=25		
Are there years where you feel the population of murrees changed more than any others?	n=21	n=9		
Do any of the species of murrees arrive in Bonavista Bay before others?	CM n=27	TBM n=3		
Do any of the species leave Bonavista Bay before others?	CM n=5	TBM n=25		
Are you seeing any change in the physical condition of the murrees over time when you clean them? For example, Are they fatter or thinner than usual? Any other observations?	n=11	n=19		
Do you normally get your daily limit when you hunt?	n=16	n=14		
How many times did you hunt in the last season that you hunted? Is that more or less than other seasons you have hunted?	10> n=7	<10 n=21		
Do you agree with a possession limit of 40 murrees?	n=30			
Have you ever been checked by an enforcement officer? If so, how many times? Which ones? (RCMP, Fisheries, Canadian Wildlife Service, Local Wildlife, Other)	n=17	n=13		
Have the murre populations changed since you first started hunting?	Lesser n=22	Same n=6	Greater n=2	
Why do you think those changes happened?	Bait n=23	Ice n=29	Wind n=19	Hunting n=12

All hunters were aware of the bag and possession limits, and despite all agreeing with those restrictions (Table 10), a number (n= 11) had recommendations for what they considered to

be improvement. There was no established annual limit, so hunters could legally make frequent trips during the season if they did not exceed the bag and possession limits. Hunters often legally harvested many more murrelets on a consolidated annual basis than that set by the bag and possession limits. Some hunters reported the total number of murrelets hunted on an annual basis to be more than 100 (n=16). Reasons such as personal consumption over the season and giving murrelets to family members were the most common. Several hunters heard of bartering or selling murrelets, including knowledge of the price for murrelets locally, with one hunter openly admitting that he bartered for murrelets not realizing it was illegal to do so. When asked what a successful hunting season is, most hunters commented that 40 murrelets was more than enough for the winter season but one hunter commented, “we only make 3 or 4 trips a year now and if I have 30 murrelets in the fridge, I know I got enough”. Another hunter responded in the following manner, “for a family, if you have 60 murrelets you have had a good year. Thirty to give away and 30 for yourself”. One hunter went so far as to say “one time, I wanted a fridge full. If you want to see a murrelet now, go into the dump in the spring”.

Some hunters (n=17) raised issues related to exceedance of the bag and possession limits but agreed that the number of people flaunting the regulations now was low compared to in the past. The predominant reasons provided were that a lot of hunters are older and do not have the same desire to hunt, they don't need that many murrelets any longer, and the risks were too great if they were caught. Four hunters did express concern over hunters ignoring regulations in Placentia and Notre Dame Bays, and nine expressed concerns about hunting pressure in Placentia Bay and had given up hunting there because of the substantial number of hunters in that bay.

Many hunters (n=16), without prompting, raised the issue of replacing the daily limit and

possession limit with an annual quota system. Most of those hunters would be okay with an annual limit on the lower end of the range from thirty to eighty murre, with few suggesting a range over one hundred. One hunter commented that, “the number of turrs we are allowed to kill must be large enough to make it worth our while to go out.”

6 recommendations for change were identified, with varying degrees of support:

1. Remove the 3-shell restriction in shotguns
2. Amend the hunting season opening date in BBay to be consistent with Zone 2
3. Establish a mechanism for more hunter consultation at the community level
4. Establish a program to educate hunters on murre biology
5. Establish a tag system capping the annual number of murre harvested
6. Establish a mandatory hunter harvest survey as a part of the license system

Factors that might influence changes to murre hunting regulations

Hunters’ comments reflected a wide range of issues that could influence changes to murre hunting regulations including enforcement, murre abundance and distribution (see Chapter 4), hunting pressure, environmental effects, and fishing bycatch.

There were no specific questions addressed to hunters respecting their views of enforcement measures, other than asking hunters if they had ever been checked by enforcement officers. Despite this, hunters made frequent comments concerning their personal experiences and views respecting this issue (Table 8). Seventeen hunters indicated they had been checked by an enforcement officer, while thirteen had never been checked during all their years of hunting murre. One hunter received a fine for hunting eider ducks out of season more than 10 years prior to the interview, another for selling murre 30 years prior. Four hunters had been

checked multiple times, of which three were checked upon landing at a public wharf near a Fisheries Office. One hunter, was checked almost yearly at various locations, using multiple surveillance strategies, and was never caught in violation of the murre hunting regulations. Hunters were sometimes reported by the public. As one hunter related, “I took one gun and went down to Shear's Rock about thirty years ago. It was no time after that, a Fisheries Officer showed up and searched my place and couldn't find anything. Somebody called them.”

Do you think that hunters are consulted enough on murre hunting?	Not (n= 23)	Yes or Ambivalent (n=7)
	Would be nice to learn more about them	Yes, if I need any information, I can find it
	People don't know what type of birds they are hunting, not	Does not matter
	Not enough consultation; there is no info about the birds	No issue
	Not consulted enough, never see anyone	Don't care
	Most hunters just don't care as long as they can go out and kill their 30 or 40 birds. If the hunt is shut down, there will be a lot of upset people and then they will say that you never consulted us	Most hunters just don't care as long as they can go out and kill their 30 or 40 birds. If the hunt is shut down, there will be a lot of upset people and then they will say that you never consulted us
	Most all the regs are there but should consult if there are any major changes	
Would you be willing to submit annual harvest data?	Yes (n=30)	No (n=0)
	Not required now, is voluntary but would submit if required	No hunters interviewed submitted annual harvest data
	I think my wife does (spouse interjects as says she does not because it is voluntary)	
	Do not, but would if you had to as a part of my license	
	Should be an annual survey as a part of your license	
	Not sure if hunters will tell the truth and will only tell what they think you want to hear	

Some interviewees were very open with respect to the various methods that have been used that were violations of the regulations, including harvesting other species, selling, and bartering of murrens, modifying of the guns to increase their capacity. Most hunters interviewed where these issues came up were very clear that they did not support breaking the law, understood the risks of doing so, but would never report anyone to the authorities they knew who did. As one hunter commented “we live in a small community and one day I might need their help sometime”. Another commented “it goes on sometimes, but it doesn't happen much anymore and there are only a very small number that do it”.

Table 9: If You Heard That the Murre Population Was In Danger of Collapsing, Would you Support a Complete Ban on Murre Hunting?	
Complete Closure (n=18)	Reduce Quota (n=12)
If the population was in trouble, shut it down, don't let it go the way of the Northern Cod; but it needs to be what we see to; if I go out there and the birds are not there then I will be the 1st to say that it is time to figure out what is	Try reduction in quota first; turr will fly a long way for bait; just because you are not seeing them in the bay, doesn't mean they are not somewhere. Seeing turrs outside the 200m limit
Close it, but not at that stage; turrs are down by 1/2 on Cabot	Reduce the quota for a while
Definitely. Might not help me but will help others because my time is over	Don't agree with closing it because you will never get it back; so cut it back
Full closure for several years. We have to have trust in the science; but most people don't trust science and we have seen no science on the turrs	Reduce the quota with more enforcement. A man should have a right to get a bird
Shut it down for a few years; if it keeps declining after, then you know hunters are not the problem	Ease back on them

The aging population of hunters was identified by many hunters during discussions as harvesting less murre and making less hunting trips. As one elderly hunter said, “we don’t hunt near as much as we did. There might be some interest loss, but it was almost like a sickness when we were young”. Many elderly hunters stated that they are spending less time now hunting and are harvesting only what they need for the winter. Hunters, sixty years and older (n= 13) made up the greatest proportion of hunters making less than 5 murre hunting trips per season.

Very few hunters acknowledged that their children would likely take up murre hunting and only seven referenced younger family members expressing an interest in hunting murre. As one hunter commented, “the young ones coming up, I don't know if they will ever shoot a turr or not”.

The decline in potential future hunters may not necessarily reduce hunting pressure. As one hunter commented, “there is almost unlimited money to buy bigger boats, a lot by younger people coming back home working shift work, 2 weeks on and off, who go out when they are here”. Another hunter said, “there are more boats at it now than before and if it is a good day you may see as many as twenty-eight to thirty boats, but a lot of times you might only see a half a dozen”.

While a small number of hunters felt there was overhunting in BBay (n=3) and made comments such as, “any turr entering Bonavista Bay is committing suicide” and “any turr

coming down from St. Anthony is running a gauntlet”, most hunters (n=24) felt that turrs now are not being overhunted. Several hunters (n=12) commented that despite the larger number of boats and hunters on the water in BBay, there are less murre being taken than in the past. One hunter stated, “we would kill more in a week when we were younger than we do now in a full season”.

Conditions under which murre hunters would support increased conservation efforts

Because hunters had difficulty readily differentiating individual species while on the water hunting in varying environmental conditions it would be difficult to enforce regulations restricting hunting of either species singly. Therefore, hunters were asked whether they would support a ban of all murre hunting and if yes, under what conditions. While hunters supported either quota reduction or a complete ban on hunting for a period to allow the population to recover (Table 9), their responses were cautionary however, because some were concerned that they would not get their rights back.

Table 10: Resistance to bag and possession limit changes		
	Yes	No
How many murre are you allowed:	(20) n=30	(20) n=0
Are you ok with a daily bag limit of 20 murre?	n=30	n=0
Do you agree with a possession limit of 40 murre?	n=30	n=0
Are you in agreement with the timing of the season now?	n=21	n=9

Discussion

Hunter interviews support the hypothesis that hunters can provide guidance to resource managers, but effective mechanisms and resources are not in place to facilitate such input.

Hunters believe that they have an historical right to hunt murre and feel privileged to have that right. Many hunters believe that right extends beyond murre to other seabird species such as black-legged kittiwakes and shearwaters and terrestrial wildlife. However, hunters would be prepared to relinquish those rights for an interim period if science and their own observations show that the murre populations are at risk. While the interviews suggest that despite the hunt trending towards it being a recreational hunt, murre are still an important, cost-effective source of protein, if hunters can harvest their full daily quota and costs are shared with other hunters on the trip. Many interviewees, however, do not believe that the murre populations are in jeopardy as they have not been provided with any scientific evidence of that being the case and it does not reflect their own observations at the time these interviews were conducted.

Interviews also identified a significant gap in hunter knowledge of murre biology, such as breeding, migrations, overall populations, etc. in general, in contrast to their knowledge of murre behavior of murre in hunting regions. Hunters are interested in further consultation with resource managers but have stated that while there was regular contact and information sharing in the past, in recent decades, communication at the hunter level, for the most part is sporadic or non-existent.

A review of archival materials suggests that conflict with resource managers is deep rooted highlighting the potential exists for future conflict if regulatory amendments do not involve hunter consultations. Hunters support the regulations in effect and feel that the regulations have had a positive impact on the murre hunt but have made some recommendations to existing regulations. Further, hunters raise the prospect of further declines in hunters prosecuting the hunt due to declining interest among younger people and declining interest, despite indicating that they see more vessels on the water hunting.

The North American regulatory system, which includes Canada, has evolved around a number of principles which include wildlife as a public trust resource, prevention of illegitimate uses including commercialization, wildlife managed as an international resource and science as the basis for conservation policy (Mahoney and Jackson 2013). Increasingly, ecologists and resource managers are using public participation to provide input into conservation policy and to provide new scientific insights using varying methods to obtain input (Miller-Rushing et al. 2012; Winkler and Warnke 2013; Bonney et al. 2014; Lepczyk and Duffy 2019). A review of the MBCA and Treaty as well as hunter interviews tend to support these principles.

Including public input into environmental governance regimes is increasingly recognized as essential to effective conservation policy (Benham 2017b). Despite there being a tendency among conservation managers to prefer empirical research, qualitative research is becoming increasingly important in providing valuable information in conservation policy (Draheim et al. 2015). Hunter interviews, a form of qualitative research, highlight opportunities and challenges for murre conservation managers in the context of the above principles underlying policy development. These are highlighted below.

As presented earlier, the number of licenses issued to hunters in BBay has declined significantly and hunter interviews suggest that trend will continue. Hunter participation and waning interest in hunting is not unique to the NL murre hunt (Winkler and Warnke 2013; Lovelock et al. 2022). Reasons often cited include lifestyle changes, aging hunter populations, urbanization, alternative recreation activities, changing regulations, increasing competing demands for time and increased costs, are often cited (Winkler and Warnke 2013). The decline in hunters is increasingly becoming a concern to conservation managers. Hunter support for conservation efforts, and declining revenues from licenses to support programs are among some

of the factors identified in other jurisdictions (Halvorsen 2003; Cooper et al. 2015; Lovelock et al. 2022).

NL hunters interviewed were very passionate about the murre hunt. There is a widespread perception among hunters that their historical hunting rights were guaranteed by an incorrect assumption that they were a condition of NL becoming a part of Canada in 1949 or guaranteed because their forebears hunted. The use of terms such as “our birds”, “our turrs that breed here” and “they are trying to take away our right to hunt turrs” suggest an anthropocentric view of conservation. This view however can run counter to murre management as an international resource as per the Treaty and consequently issues related to murre management in jurisdictions outside NL could be challenged if it requires regulatory amendments affecting the NL hunt.

Hunter interviews also highlight a mistrust of conservation managers, often referring to their perceptions and experiences of offshore fisheries mismanagement (CBC News 2012, 2022; Palmetier 2022; Sheppard 2022) and whether they will get their right back to hunt if there is a cessation of the hunt. This mistrust could be a barrier for policy makers who feel it is important to be aware of hunting practices and hunter views as they change over time (Benham 2017b; Byrd et al. 2017).

Hunter interviews suggest conservation managers have an opportunity in BBay to involve hunters in the management process. Interviews suggest that BBay hunters, despite some of them flaunting existing regulations, support conservation measures and are prepared to do their part to assist. The incorporation of local knowledge into environmental governance is now recognized as a significant part of conservation efforts (Byrd et al. 2017). Most hunters are willing to take part in consultations and are aware of their shortcomings with respect to the broader picture respecting murre management. Most hunters interviewed have little to no knowledge of murre biology

including plumage variations, aging, sexing, breeding distribution and the overall health of murre, but they know what is happening in their hunting region extremely well. They know when and where to hunt, and they usually are the first to know if anomalies appear in the Bay that should be brought to the attention of conservation managers. However, they typically will not respond to hunter questionnaires unless they are mandatory and will jeopardize their ability to hunt murre. This means other forms of hunter involvement need to be developed and implemented.

Mechanisms such as community forums, hunter interviews and social media are all forums for local input. Social media such as Facebook has been used to share information with varying results and have been rarely relied on cautiously (Martin et al. 2016c). However, few hunters interviewed in this study used social media such as Facebook to stay informed, with most relying on their own networks to gather information.

Other than hunter interviews which are time consuming, public meetings with stakeholders, workshops and advisory committees are all options, among others (Chess and Purcell 1999). Workshops can provide an opportunity for resource managers to educate hunters, to engage in discussions with murre hunters and receive valuable feedback. They all can be forums for hunter participation, assist in breaking down barriers between resource managers and hunters and engaging hunters more fully in murre management and conservation. Whichever forum is used, it has been demonstrated that hunter education has been an effective tool in seabird conservation (Blanchard and Nettleship 1992; Environment and Climate Change Canada 2019).

Management Implications

Existing conservation regulations under the MBCA require stakeholder consultations on a biennial basis. Hunters support the overall intent of the regulations, but they are suspicious of conservation managers' policies respecting the long-term sustainability of the hunt. Hunters believe there is a gap in consultation and interactions with resource managers and acknowledge there is a deficiency in their own knowledge base respecting murre biology. Conservation managers have an opportunity to build relationships with hunters through direct consultations, using a variety of techniques such as workshops, hunter interviews, or community meetings, etc. Resource managers can develop programs to educate hunters and in return receive valuable insights from hunters with the long-term goal of obtaining hunter buy-in of policy changes.

Chapter 4. Using Murre Hunter LEK to Detect Changes in the Distribution and Abundance of Murres and Attribute Reasons for Observable Changes

Introduction

Globally, scientists studying nearshore ecosystems and processes often use seabirds as an indicator species to study the effects of climate change and anthropogenic activities (Ward et al. 2015). Such research is data intensive, expensive, often require long term data sets, and continually under pressure due to a lack of resources and declining budgets (Murray et al. 2011; Ward et al. 2015; Peñaherrera-Palma et al. 2018). Often a scarcity of data, especially in ecological research, is pressured to explore other sources of information to augment empirical data for conservation management (Cook et al. 2014). Additionally, many policy makers are now requiring the use of methodologies to include public input into conservation policymaking and management (Sjare et al. 2003; Gilchrist et al. 2005; Ruddle and Davis 2011; Dawe and Neis 2012).

Local Ecological Knowledge (LEK) has received increased interest to augment scientific data and provides the public with a voice in environmental decision-making and is touted as a realistic alternative to provide information to resource managers (Davis and Wagner 2003; Berkström et al. 2019). There is no universally accepted definition of LEK (Murray et al. 2011; Cook et al. 2014) . For example, one definition of LEK focusses on practical skills developed locally through direct experience and can incorporate technical and scientific information excluding information passed down through generations (Cook et al. 2014). A second defines LEK as knowledge related to an area or species that can be obtained through a variety of means such as observation, resource utilization, and information passed down through generations in either an oral or written tradition and/or shared among users (Huntington 2000). For the purposes of this chapter, LEK will be consistent with (Chaffey 2005) which refers to the

knowledge of local hunters obtained by experience and/or generational, who have acquired a detailed knowledge of their hunting areas, local environments, local hunting practises, and knowledge of abundance and distribution of murre over “a relatively long temporal scale and a small spatial scale” (Chaffey 2005).

LEK assists in breaking down the barriers between science, policy, and the public (Brook and McLachlan 2005; Mallory et al. 2006; Theobald et al. 2015; Kelly et al. 2018) by providing an opportunity to involve stakeholders in managing marine resources, enhancing scientific literacy, environmental awareness, and resource stewardship. Ultimately, LEK can build trust between resource managers and the stakeholders (Chaffey 2005; Freiwald et al. 2018).

Conservation managers are using LEK to complement existing datasets, inform management actions (Chaffey 2005; Gilchrist et al. 2005; Cook et al. 2014; Ward et al. 2015; Peñaherrera-Palma et al. 2018; Gorta et al. 2019; Martín et al. 2020), and mitigate conflicts (Brook and McLachlan 2005; Mallory et al. 2006). The use of LEK is becoming more valued in scientific research, especially in monitoring the health of ecosystems (Chaffey 2005; Gilchrist et al. 2005; Cook et al. 2014). LEK has been used to augment scientific data related to abundance, population trends, distribution as well as a cost effective technique to collect data (Mallory et al. 2003a; Chaffey 2005; Ryan et al. 2006; Cook et al. 2014; Martinez-Levasseur et al. 2017).

Despite the increasing use of LEK in ecological research, it is not without its weakness. LEK is difficult to quantify (Ward et al. 2015), responses among participants may be very variable (Ryan et al. 2006), respondents may not be fully aware of ecosystem dynamics (Ruddle and Davis 2011), people’s abilities to recall may be affected by perceptions (Peñaherrera-Palma et al. 2018), a lack of convergence between science and responses (Mclean et al. 2020), and differences between the spatial and temporal scales of science and LEK can emerge (Dawe and

Neis 2012), among others. The accuracy of LEK is poorly understood despite the success of my studies involving LEK (Cook et al. 2014). The weakness of LEK can be managed by researchers through a variety of means including using systematic approaches and being more attentive to methodology (Davis and Wagner 2003) and the selection of participants and developing criteria for the use of LEK (Dawe and Neis 2012), and combining LEK with other data sources (Mallory et al. 2003a).

“The realization that for millennia peoples all over the world have been quite successful at meeting these needs with their understandings of how ecosystems work provides irrefutable evidence concerning the effectiveness and value of LEK, however disputable contemporary debate on the various roles of LEK might become” (Ruddle and Davis 2011).

LEK use in NL have been valuable (Mallory et al. 2003b; Sjare et al. 2003; Chaffey 2005; Ryan et al. 2006). However, care must be exercised by conservation managers using LEK without scientific scrutiny could be damaging to seabird populations and not contribute to conservation (Gilchrist et al. 2005). The combination of LEK and science can reduce the uncertainty of conservation decisions (Chaffey 2005).

In this paper, I consider whether hunter LEK can contribute towards elucidating common murre and thick-billed murre distribution and abundance over the past five decades.

Methodology

Following a field test of the interview questions with two murre hunters in May 2021, minor modifications were made to the proposed questionnaire. These included amendments to clarify several of the proposed questions, to add photographs of the three murre species in breeding and nonbreeding plumages, and to include a 24” x 24” navigation chart of BBay

depicting key oceanographic features such as water depth, shoals, deep water channels and islands (Figure 2).

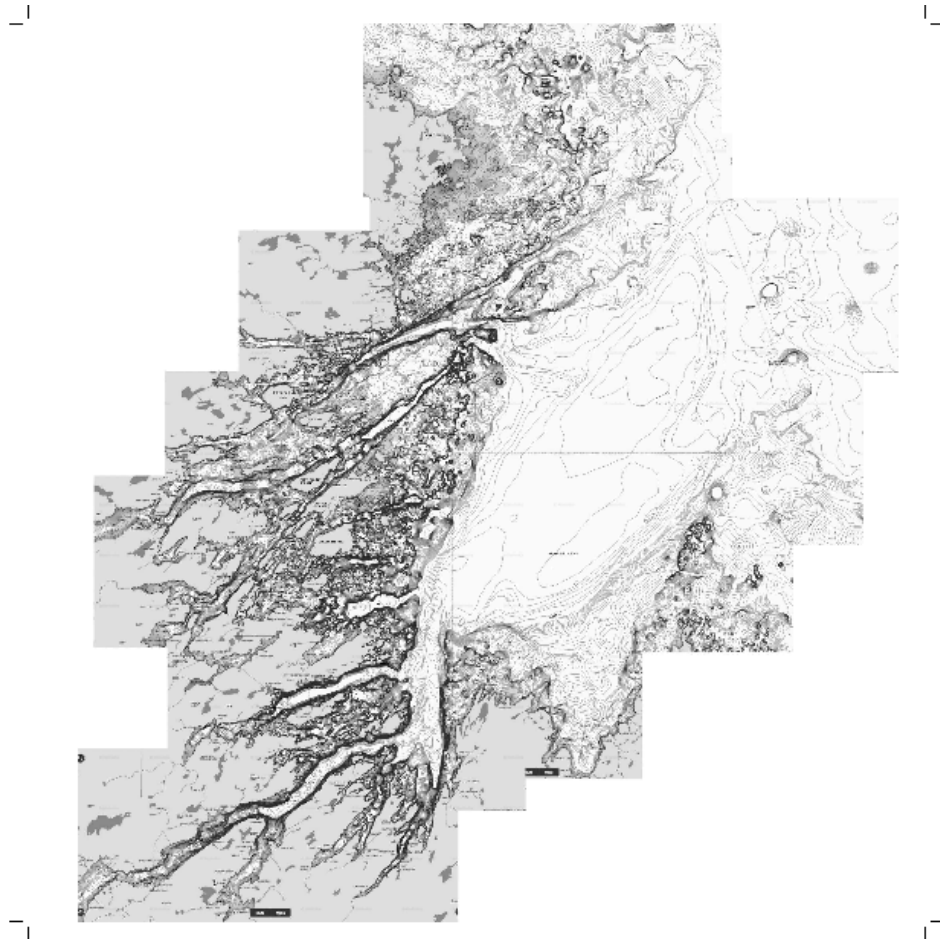


Figure 2 Bathymetry Chart of Bonavista Bay Study Area

Interviews focusing on the LEK of thirty murre hunters were completed between July 2021 and March 2022 to obtain hunter knowledge of any changes in the abundance and distribution of murres and perceptions of reasons for those changes (approved by York University's Human Participant Review Committee). Candidates were selected using snowball sampling as the predominant method (Noy 2008; Braga and Schiavetti 2013; Etikan 2016).

Twenty-seven hunters resided and hunted in the study area, two hunters resided outside the study area in the adjacent bay to the north, Notre Dame Bay, and one hunter, resided and hunted in the adjacent bay to the south, Trinity Bay. The three interviews outside the study area were undertaken to ascertain similarities or differences in hunter views respecting the hunt as those obtained through Hunter interviews in BBay.

All interviewees had hunted murre, with most having hunted every year ($n=25$), two having stopped hunting completely and three intermittently. A semi-structured questionnaire (Appendix A) was used to guide the interview, but participants were encouraged to speak freely. Interviewees were shown a detailed oceanographic map of Bonavista Bay and presented with photos of razorbill (local name, “tinker”), common murre (“turr”, “eye-glass bird”, “our bird”) and thick-billed murre (“turr”, “northern bird”, “black-headed bird”) in their breeding and non-breeding plumages and asked to identify the birds using the names they most often use to identify them (Montevecchi and Tuck 1987; Turner 2021).

The interviews ranged from approximately fifty-five minutes to two hours and fifty minutes depending on the hunter’s availability and eagerness to continue the conversation. The interviews were audio recorded and manually transcribed due to the dialects and local terminology.

To address the issues of abundance and distribution, two primary techniques were used. Hunters were requested to delineate on the oceanographic map, areas where they hunted and if their preferred hunting areas had changed over time, to identify those areas as well. The use of maps in the interviews was important as they also became a focal point in the discussions. A mapping component is sometimes used in LEK interviews to identify species locations and ecological hotspots (Sjare et al. 2003; Chaffey 2005; Martinez-Levasseur et al. 2017).

Furthermore, hunters were asked to identify areas where they fished if they were fishermen or took part in the recreational cod fishery. Cod fishing using hooks, is permitted for all residents during predetermined periods during the summer and early fall (Government of Canada 2021). This was important to identify other potential anthropocentric events that could affect murre distribution and abundance.

In addition to the mapping component, hunters were asked if they noted any changes in abundance and distribution over 10-year increments and similarly whether they could identify increases or decreases in abundance by 20 % increments. Hunters were also asked whether they observed any changes in the physical condition of murres in 10-year increments.

Major points and comments were then coded according to key themes and categorized focusing on six areas:

Temporal changes in distribution and abundance of murres

Observations on other species with respect to abundance and distribution

Level of effort and perceived factors affecting the level of effort

Technological changes and the impact on hunting success or lack thereof

Whether there have been observed changes in diet (stomach content) and fattiness temporally and opinions on why that might be the case

Environmental and anthropocentric impacts affecting distribution and abundance

Results

Temporal changes in distribution and abundance of murres

Hunters interviewed noted that thick-billed murres migrating from the north, rounded Cape Freels and tended to head in the direction of Cape Bonavista in almost a direct line from

Cape to Cape and depending on conditions, some entered BBay either to rest, feed, etc. Most interviewees (n=26) preferred to harvest thick-billed murre.

Most interviewees generally were not able to quantify abundance and distribution changes using specific year or percentage cohorts. Only four hunters were willing to attribute percentage changes in murre populations. Those four hunters indicated that the number of murre had decreased by 50% to 80% since they started hunting. Hunter recollections of changes in distribution and abundance for years beyond 5 years from the 21-22 hunting season tended to be expressed in general terms such as “there were a lot more turrs when I first started hunting”, and “there are not as many birds now and we have to work harder to get them”. Hunters have noticed changes in abundance from year to year but attribute those changes to variations which happen off and on. As one hunter stated “they change but hard to know if there is a pattern to it. Some years, there are more and others less”.

Responses also varied by area hunted. Those hunters who frequently hunted at both Capes (n=8) stated that there were no changes in abundance, but two hunters indicated that they noticed the flock sizes flying by tended to be smaller but more frequent, in comparison to earlier years where flock sizes were in the hundreds but less frequent. Hunters (n=22) who hunted further in the bays at varying times, stated that there was a change in abundance in the nearshore portion of BBay. Many hunters when they first started hunting would only need to venture short distances (less than 5 km) to harvest murre. Eleven hunters indicated that in the years prior to the implementation of the quota system in the mid 1990’s, murre populations began to decrease in the areas where they hunted. Six of those interviewed stated that murre populations have stayed the same while two stated they have increased.

Hunters have particularly noted decreases in murre populations further in the bays within the last 10 years and more so in the last five years. Hunters (n=23) were not willing to attribute those changes to overall population declines but rather to the birds moving elsewhere. Some hunters interviewed (n=11) noted the relatively large numbers of common murres in the bay leading up to the weeks preceding the opening of the season as evidence of healthy populations of both species of murres. A hunter commented “the turrs are in good shape; we were out a month ago jigging and the birds were by the thousands”. Several hunters also reported that some of their friends on offshore vessels heading to the Grand Banks reported sailing through large numbers of murres, reinforcing their belief that the population of murres was healthy. Three interviewees suggested that there may be a decline occurring in the Cabot Island murre populations through observations of the numbers of murres on the rocks as they have passed by on route to their fishing grounds.

With respect to thick-billed murres, hunters of the southern side of the bay noted that murres generally left the bay around the end of November, with one hunter being specific as to a date of November 23. Hunters in that region also indicated that the murres return on the Trinity Bay side off the Elliston to Catalina area in mid-March to early April.

Most hunters preferred to hunt in the second part of the season, after Christmas, purporting there was more work cleaning the birds due to emerging pin feathers, so therefore it was difficult to ascertain abundance and distribution in parts of the study area early in the season because there were less hunters hunting consistently. Three hunters interviewed only hunt in the first half of the season, while some hunters (n=17) only hunt in the second half with ten others only take occasional trips in both seasons. Hunters have identified a distinct change in murre abundance in the 2021-2022 hunting season with a significant decline in murres from the start of

the season until several weeks before the end of the season in March. At the commencement of the season, hunters were having very little success getting their quotas and having to travel longer distances. Three hunters were reinterviewed near the end of the hunting season and noted that on multiple trips, they failed to get anywhere near their daily quota from the commencement of the season onward until near the end of the season when murre appeared in the bay in large numbers. Those hunters felt that at the beginning of the season, thick-billed murre did not stop in the bay and either continued migrating on or stayed well offshore to feed during migration.

Abundance of murre in Bbay also varies by time of day. Most hunters (n=27) have a preference to hunt in the morning starting at daylight. Hunters in BBay prefer to shoot murre while they are on the water as opposed to many other bays where hunters shoot murre while flying. According to interviewees murre tended to move into the bay overnight to feed or rest and were therefore much more abundant at that time of day. By early to mid-morning murre moved off and out of the bay depending on factors, including wind, ice, and hunting pressures.

Hunter interviews and the mapping component (Figure 3) highlight hunting routes typically used by hunters in recent years. Hunters have had to shift their hunting territories and routes in response to distribution changes within BBay. Hunters have moved further offshore with hunters travelling longer distances, having to cover more territory, with distances from land ranging often from 15 km to 50 or more kilometers at times, covering almost the full length of the bay to get their quotas. These hunters tended to hunt along the edges of the deep trenches, off the shoals, in areas known for baitfish and infrequently in deep water. Hunters in BBay prior to the last 10 years have rarely had to travel long distances to obtain their daily quotas, often obtaining them within 5 or less kilometers of their home ports.

Murre Hunter Routes, Bonavista Bay, 2021

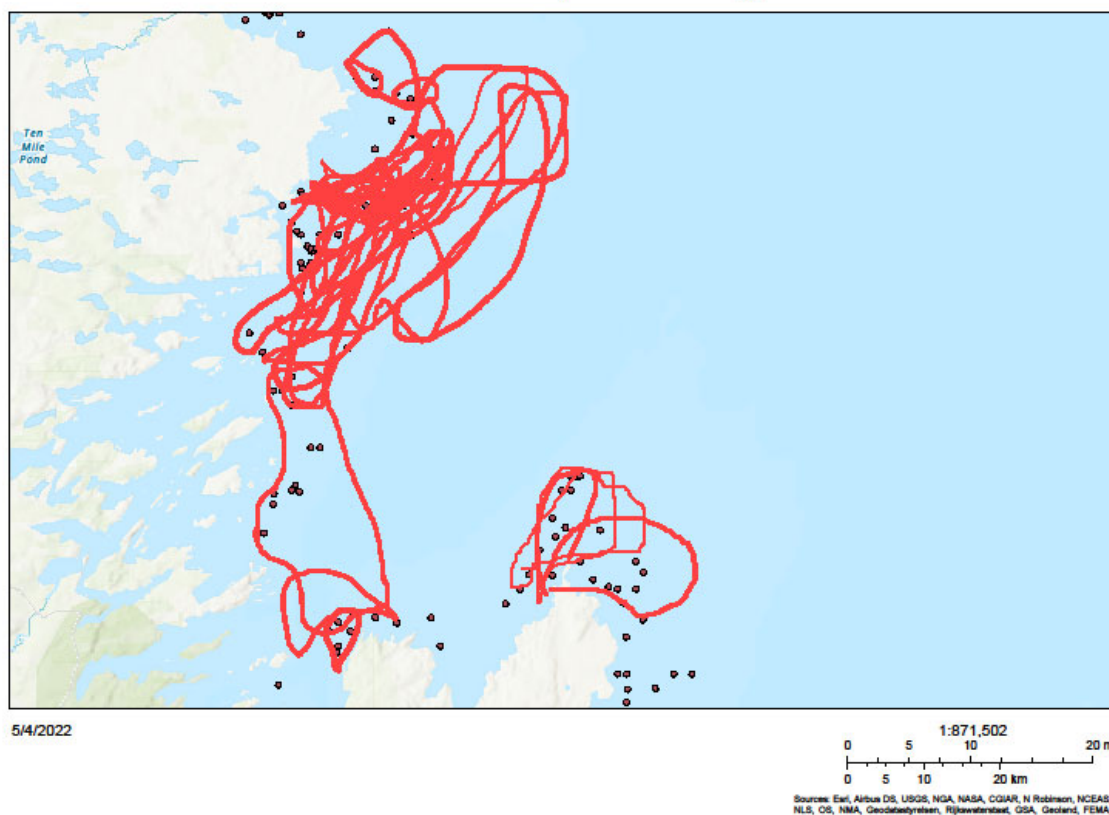


Figure 3 Approximate Murre Hunter Routes (Red) Identified by Interviews, Bonavista Bay, NL
Depicting Shoals (Dots)

Observations on other species with respect to abundance and distribution

To ascertain whether changes in abundance and distribution was occurring in other species as well as murre, hunters were questioned whether there should be a hunting season for other popular seabirds that use Bonavista Bay and why. Interviewee responses are shown in Table 4. Black-legged Kittiwakes, shearwaters and cormorants were highlighted as species that were perceived to be increasing in abundance. Cormorants were identified as a species that was increasing significantly and perceived to be placing pressures on other species for habitat. Gulls were perceived to be in high abundance in some locations but were being supplanted on some

islands in the bay by cormorants. Black guillemots were perceived to be low but stable and more focused on rock outcrops and small islands further in the bays as opposed to headlands. Puffins were not perceived to be in large numbers on the northern side of the study area but were perceived to be stable in the vicinity of Cape Bonavista.

Eider ducks were not on the list of species requiring a response as there is an existing regulated hunt in place, however, several hunters (n=9) expressed concerns that eider duck abundance was declining in BBay. Several others suggested the opposite (n=5). Two of the hunters referenced above (one of which who hunted in Notre Dame Bay to the north of the study area) who were re-interviewed at the close of the 2021-22 murre hunting season hunted eiders during the 2021-22, stated that during this eider hunt, harvested eiders were full of small black crab, instead of their usual preferred food of mussels. Both hunters acknowledged that in all their years of hunting, it was their first time witnessing this. Razorbills were not perceived to be in large numbers in BBay, but often single birds were mixed in with a flock of other murre.

Level of effort and perceived factors affecting the level of effort

I use “level of effort” and “perceived factors affecting the level of effort” to solicit discussion about hunting pressures and distribution and abundance in the study area. Most interviewees (n=26) stated that they are having to travel much further and travel longer distances to harvest their daily quotas. Hunters highlighted increased costs of shells and gasoline as factors in the cost of hunting murre, birds are dispersed, ice conditions, and more boats chasing the same birds as factors that are affecting hunting effort. The lack of harbor ice, however, has meant that hunters now can operate from either their own wharves or harbors in proximity and hunt with relative ease. In the past, hunters stated that because temperatures were lower, harbors were

frozen well out from shore, they often had to push their boats over ice, sometimes for considerable distances to start hunting.

Hunters were asked to identify the costs of a single trip. Citing safety, efficiency and sharing the costs, most interviewees had three hunters per boat (n= 22), several (n=7) hunted with two onboard and only one hunted by himself. For hunters who were successful in harvesting their daily quota, a murre costs between \$2.75 and \$3.50 per murre, excluding the amortized cost to purchase the boat.

Hunter interviews suggest that hunting pressure in BBay evolved through at least three distinct stages. Hunters stated that when their parents and grandparents hunted, they took less trips but harvested many more birds in part because they only hunted enough to last the winter and they were often busy involved in other activities necessary for survival. As one hunter stated, “in the olden days, hunters were busy making a living; there were a smaller number of trips but more birds per trip”. Prior to the advent of the regulations and with the emergence of outboard engines, hunters stated that there were a lot more hunters, taking a lot more birds. A hunter commented “every Tom, Dick and Harry got a boat and hunted every chance they could. On a time, there was no quota, you'd sell a few, bottle up a few, give a few away, sell some and then probably have enough to pay for your gas the next day. You had the slob, no quota, kill what you wanted but they were all eaten. Turrs would be around every day”.

Hunters interviewed (n=23) suggest today that there are a lot more boats on the water, but they don't take as many hunting trips, and they take less murre.

Technological changes and the impact on hunting success or lack thereof

Hunter interviews suggest technological changes have had an impact on hunting success related to abundance and distribution as follows (see Table 11):

Fiberglass boats

More powerful and fuel-efficient engines

Improvements in navigation and communication technology

Improvements in weapons

Table 11: Hunter Suggested Technological Changes	
Fiberglass boats	n=27
Larger boats	n=28
Upgraded, larger and more fuel efficient engines	n=30
Semi-automatic or pump action shotguns	n=29
GPS / depth sounders	n=26

Twenty-seven interviewees now use a 100 % fiberglass boat with fiberglass over wood identified in only 3 interviews. Prior to the advent of fiberglass boats, hunters used primarily wooden boats which often were covered with materials such as crazy carpet, metal, or extra planking to protect them going through the ice. In addition to the construction materials, interviewees (n=28) have increased the size of their boats, with the majority now a minimum of 20 feet or more. Hunters stated the advantages of these boats include less maintenance, and an ability to withstand the impacts of ice and therefore safer.

All hunters now use more powerful engines with most using engines of 90 horsepower or more and several with more than 150 hp. Hunters have indicated that the newer 4-stroke engine use almost 50% less fuel than the older engines and are virtually maintenance free. \

Hunters also identified improvements in navigation, such as GPS units, and communication technology allowing them to travel further out the bay and often into areas out of sight of land. Communication technology also means hunters can communicate between hunting parties providing information such as the presence of birds and weather conditions.

Twenty-nine hunters interviewed use either semi-automatic or pump action shotguns allowing quick response when coming across flocks of murre and therefore improving the shooting efficiency. One hunter still uses his original single shot weapon. Respondents were quick to acknowledge that their hunting success was very much affected by weather conditions, and they rarely return using one shotgun shell per bird. If the water was rough, they sometimes would use more than double the number of shells and sometimes injure birds that they sometimes could not retrieve.

Many hunters interviewed state that the effect of improved hunting technology mean the hunters can get to their hunting territory faster, can travel longer distances, cover more territory, and affect the distribution of murre. Several (n=10) suggest that because of the larger and faster boats, the murre are being pushed out the bay due to hunting pressure and often do not get a chance to rest and feed.

Whether there have been observed changes in diet (stomach content) and fattiness

Few hunters noted the stomach content and diet of murre (n=4). A larger number of hunters (n=17) did comment of the general health of the harvested murre. Hunters have noted

changes in the condition of murrelets but were unable to put forward a trend temporally. Those that did, purported that murrelets migrating back north tended to be thinner. Several hunters noted that murrelets returning off Catalina in March tended to be more emaciated in recent years suggesting that one of the reasons was because of hunting pressure. As one hunter noted “the murrelets coming back from south to off Catalina are not fit to eat”. Another hunter noted that “generally most murrelets are very fat and healthy, but this year you could go out one day they were fat and healthy looking but the next day they looked starved”.

Interviewees (n=7) noted that there has been a change in the bait in BBay and that could be affecting the condition of some murrelets. One hunter commented that once upon a time, the murrelets were full of krill, now it seems the krill are all gone and the murrelets are now filled with small herring, capelin, and sand lance. Another hunter commented that “one time the murrelets would be as fat as pigs”. Most hunters suggested that there was no trend in changes in the condition of murrelets but occasionally it happens.

Environmental and anthropogenic impacts affecting distribution and abundance

Considerable discussion took place during the interviews with respect to the movement of murrelets in and out of the BBay and the reasons for it. As per Table 12, hunters identified the following factors affecting the distribution and abundance of murrelets in the study area:

- Climate change
- Bait
- Ice coverage
- Water temperature in the Bay
- Hunting Pressure

-Fishing

-Wind direction

Climate Change

Only three hunters were willing to link changes in distribution of murrelets to long term climate change rather instead to link changes to events and environmental conditions they considered to be cyclical. One hunter commented “nature is going to take care of itself. We are likely accelerating it, but a volcano eruption puts out more than humans”. A second hunter commented “we don't see turrs now like we used to. Northern turrs are down by about 60 to 80% in the bay. Best guess is that the bait is not there. Global warming maybe and the bait is further out, and we are not reaching out”

Table 12: Hunter Identified Environmental and Anthropocentric Impacts	
Climate Change	n=3
Bait	n=30
Ice Coverage	n=30
Water temperature in Bbay	n=9
Hunting Pressure	n=14
Inshore Fishery	n=11
Wind direction	n=28

Bait

Several hunters noted that cod, whales, and seabirds congregated in areas where there was bait. A hunter commented that “If you go out in the fall and you see whales in Nov, then head towards them and there will be bait and there would be turrs”. Another hunter commented that if he was out hunting and it was foggy, he would turn off his motor and listen for whales. If

he heard whales, he would head in that direction and he would find murre. All hunters (n=30) established a direct link between the presence of murre and bait. One hunter commented “last few years in the fall, seems like the birds in Bonavista Bay are not so grouped up. It might have to do with bait. Last few years little bait in the bay. Capelin is their main food but this year there is a lot of mudge herring in the bay”. Hunters (n=15) felt that within the last ten years there was a change in bait within the bay in terms of type and distribution. Hunters (n=7) noted that krill essentially disappeared in the bay, with krill moving further out to deeper and colder water. Hunters speculated that one of the reasons why murre are not stopping in the bay and were not moving into the bays further was because bait had moved out of the bay.

Other hunters (n=12) speculated that the capelin stocks are being depleted and that was affecting murre. A hunter / fisherman felt that for the past few years, “there was little bait in the bay, and the capelin is their main food, but it has been over fished”. A second hunter, also a fisherman, commented “capelin doesn't seem like they come to the rocks anymore; that doesn't happen anymore; the biomass that used to come to the rocks, we have it eaten and destroyed it; the 2nd biomass is still there, the ones that are in 20 fathoms of water, because we are not targeting it because the purse seiners cannot get there”. A third hunter who fishes on the Grand Banks commented “this year we made twelve trips. We would be marking capelin for 80 miles coming in off the Grand Banks. This year, nothing but on the last trip we saw a bit. Seems the capelin would start up southern and head north, but this year it seems to have started up north and worked its way south”

Ice

All hunters identified the presence of harbor and bay ice as having a significant impact on hunting murre in the BBay. According to hunters, this ice would form in the bays and harbors

and move around the coast pushed by wind and tide and as it moved down the coast, the murrens would be moving in front of it. Several hunters said they would not go hunting until they knew the ice was coming around Cape Freels. One hunter commented “I remember one year ice came in and murrens were in front of the ice and they were tens of thousands”. Further, as ice moved in and out of the bays, it would push murrens into the bays where they were easy to get at for hunters. This ice also created pockets of open water where murrens would congregate. One younger hunter commented that when his father hunted, there could be hundreds of murrens packed into one of those openings in the ice. An elderly interviewee commented “slob ice helped the hunt because it held up the birds. In prior years, if ice came in, hunters waited until the wind came up and loosened the ice up. Therefore, many did not go out until mid morning and only went out short distances”.

However, ice has not been consistently present in BBay for more than a decade. As one hunter from the north of BBay stated, “It has been years since we have seen slob ice. Once upon a time, we would be rocking and rolling to get out of the cove as far as Flowers Island. We haven't had to do that in 12 -15 years”. A second interviewee commented “you could steam up on a hole in slob ice and bang, bang and you'd have your 20 birds. I haven't seen that in 20 years” As another person commented, “everything was frozen when we were younger, now there is no slob so people can go jump aboard and go on”.

The lack of ice is affecting murre distribution in BBay and because of that they are having to change their hunting strategies according to hunters. “Usually, Bonavista Bay will fill up with ice in a northeast wind and then slack off in a westerly wind. The birds now going from Cape to Cape, and we have to go out 12 to 14 miles off Cabot Island. It's a job to see Cabot Island from where we are. Usually killing most of the birds well outside the Cabot”.

Temperature

Some interviewees (n=9) suggest that BBay is experiencing a significant warming of temperatures. A hunter who is also a diver commented that he is diving in areas now where he couldn't 10 years ago and is sweating with just a tee shirt in a dry suit compared to years ago when he would be bungled up in multiple layers while diving. A hunter commented "if it was a cold winter, we would tow boats out on ice, but when dad and they used to hunt, they used to tow their boats almost out to Greenspond. Last year it didn't freeze here". Another hunter commented that on some of shoals, he would climb up on the ice 8 to 10 feet to hunt eiders, but now ice doesn't form up on the rocks because it is not cold enough. A third hunter commented that the cod have moved off into deeper water because of the warm water this year. A fourth hunter commented "Ocean is staying warmer longer. It may only be a cycle; I am not a true believer in this big change in global warming".

Hunting Pressure

Hunters (n=14) generally agreed that because of larger boats, better weapons, and more boats on the water hunting, it was influencing murre distribution. As one hunter commented "Now there is no room for the bird to rest and there are more hunters then ever before. Everything is getting driven. Any bird coming into Bonavista Bay is committing suicide." When I started, there were likely 10 boats, but then it started picking up". Another commented "There are more boats at it now than before. More people have boats and if it is a good day you may see as many as 28-30 but lot of times, might only see 1/2 doz".

Inshore Fishing

Hunters (n=11) felt that inshore fishing had a significant impact on murre abundance in BBay up until the codfish moratorium in 1992. One hunter commented "from the 70's up until

moratorium, there were lot of birds taken in gill nets around the breeding colonies”. Another commented “we are not getting turrs in gillnets any longer due to the time of year. We used gillnets when caplin arrived and the fish wouldn't take the hook for 2 to 3 weeks”. Another commented “fishermen are the biggest destroyers on this earth with Cod nets. We went out one night and picked out 60 and we went out the next night, another 50. Some would tie salmon nets on their leaders. I know another fellow who picked out about 100 from his leaders”. Another fisherman commented “Back in the 70's, down by Gull Island I saw as many as 500 turrs in the nets at one time. We would break them open and take the breasts out of them and bottle them. Now the gillnet fishery doesn't start until August as birds have spread out a lot. From the 70's up until the moratorium there were lot of birds taken in gill nets around the breeding colonies”.

One fisherman who used nets in a different part of the Bay commented “we did not get many turrs in the nets about 6 years ago when we were at the cod off Greenspond”. But another hunter suggested that the fishing grounds overlap birds and catching murre was especially problem with inshore gill nets and when the flattie fishery (winter flounder or black-backed flounder) (*Pseudopleuronectes americanus*) existed sometimes as many as 150 to 200 birds per net. Six hunters identified the flattie fishery which took place close to the breeding grounds of the common murre in proximity of the Cabot Islands as being very detrimental as it took place during the times when murre were breeding. A hunter commented “there were lot of turrs caught in flattie nets. When the capelin are spawning that is when flatties are showing up and that is when the turrs are feeding”.

Wind

Hunters (n=28) identified winds from the north and northeast as being the preferred wind direction for hunting as those winds push murre into BBay. If winds are blowing offshore, murre tend to move further out to sea.

Discussion

Thirty murre hunters in Bonavista Bay were interviewed to ascertain whether there have been changes in abundance and distribution of thick-billed and common murre in the bay and factors that might influence those changes. The results determined that changes in both distribution and abundance have occurred and continue to occur. Most hunters were not willing to attribute those changes to climate change, instead to cyclical changes that sometimes occur.

The interviews suggest that hunter recollections beyond five to ten years decline significantly. Notwithstanding, hunters suggest that murre abundance had decreased significantly prior to the implementation of murre hunting regulations in the mid 1990's and murre distribution within the bay has changed dramatically, especially in the last ten years. Murre are very infrequently found in abundance in the bays where hunters traditionally hunted, frequently forcing hunters to move further offshore and to travel longer distances to obtain their daily quota. Hunters do not attribute these changes to overall population declines but rather to other conditions such as lack of slob ice, availability of bait notably capelin and krill and increasing water temperatures, among others. The analysis suggests that hunter LEK has use to augment empirical data related to murre distribution and abundance. Hunter LEK related to details appears to decline substantially after approximately five years and it is possible that hunters were less confident about their assertions beyond 5 years previously (Ryan et al. 2006).

The use of spatial and temporal analyses is becoming increasingly common (Degnbol 2005; Ward et al. 2015). Through hunter interviews it was discovered that there are limitations with the use of LEK to obtain hunter opinions of murre abundance on the broader spatial scale. The majority of BBay hunters tended to hunt in small, traditional hunting territories in proximity to their home ports. Except for those hunters with larger boats, more powerful engines and navigation aids, hunters rarely strayed outside those traditional territories. It was in those traditional territories where hunters best understand where, when and how to hunt to be the most productive. Most hunters knew little about the abundance and distribution of murre outside their traditional hunting territories other than through secondhand information. This spatial and temporal limitations of LEK can create a bias in results as it is difficult to confirm abundance and distribution of species on a population basis, and to identify whether certain species are at risk or not (Martinez-Levasseur et al. 2017). Care has to be exercised when combining expert-based data and that from LEK because of the temporal and spatial and temporal differences in collection and analysis (Brook and McLachlan 2005). The reliability of LEK improves when it is combined with scientific data and the LEK is systematically collected from a large sample of experienced hunters (Chaffey 2005).

LEK has informed us that with hunting regions and hunting strategies differed in parts of BBay, and most hunters tended to confine themselves to traditional hunting territories. As a result, theoretical saturation (Hennick et al. 2017), respecting abundance across the entirety of BBay was difficult to achieve. Theoretical saturation could have been made easier by selecting hunters by identified traditional hunting territories, but this may have been difficult using snowball sampling. LEK confirmed that hunting strategies, and abundance varied across BBay, which made it difficult to reach a consensus on overall abundance of the murre species on the

broader temporal and spatial scale. For instance, hunters who hunted off both Cape Bonavista and Cape Freels, at opposite ends of BBay, hunted within relatively short distances of the land, rarely moved from these locations, and used different hunting strategies than those that hunted further in BBay. This group of hunters had differing views of abundance than those hunting further in the bays. The number of hunters interviewed who hunted off the Capes was too small to obtain theoretical saturation. This limitation can be further affected by differing spatial and temporal observations of hunters (Chaffey 2005).

Achieving theoretical saturation for abundance and consolidating those results into a BBay consensus may be best achieved by identifying the respective hunting territories beforehand and establishing initial sample sizes for hunting territories used by individual hunters.

The protection of these environments lag behind terrestrial environments (Montevecchi et al. 2012). Hunter LEK has established a link between the presence of murre, other species such as cod, black-backed flounder, and whales and a preferred forage species, capelin. This suggests that some of these hunting territories may be hot spots of ecological diversity and be supporting a significant amount of biomass (Sjare et al. 2003). The majority of these hotspots are associated with the consistent presence of forage fish prey and predators such as seabirds and whales (Davoren 2013a). Hunting areas in proximity to Cape Freels, Cape Bonavista, the Cabot Island to Flowers Island corridor and around the Offer Islands need to be studied further to confirm hunter LEK.

Hunter LEK has indicated that changes have occurred in the distribution and abundance of murre in Bonavista Bay potentially linked to several factors including hunting pressures, fishing bycatch, temperature changes, the lack of ice and forage species, notably capelin. The

presence or absence of capelin can be influenced by a change in water temperatures where capelin have a tendency to move to demersal sites (Davoren 2013b). Furthermore, fishing bycatch, which has become less of an issue in inland waters, has been responsible for some of the largest mortality events for murre (Hedd et al. 2011, 2015; Ellis et al. 2013; Lieske et al. 2019). The redistribution of murre of eastern NL is influenced by ice coverage and reduced hunting pressure (Environment and Climate Change Canada 2019).

It has been argued that because for millennia peoples all over the world have had to meet their needs by understanding how their ecosystem works, that is irrefutable evidence the LEK works (Ruddle and Davis 2011). The findings within this study suggests that despite differences in spatial and temporal data on the broader scale, there is evidence that there is some congruence between hunter LEK in BBay and empirical data, despite difficulties in quantifying the output of LEK.

Management Implications

Hunter LEK can be a valuable tool to inform resource managers about threats that can affect murre abundance and distribution in Bonavista Bay. Most hunters were concerned about the conservation of murre but were generally not aware of overall murre populations in the study area, much less than on a broader basis. However, hunters were very receptive to sharing their perspectives, observations, and experiences. Hunter LEK in the study area suggests that there is some synergy between hunter observations and empirical data, despite the temporal and spatial differences, suggesting that LEK can be used to augment empirical data reliably.

If resource managers are to use hunter LEK, it is important that the methodology be thoroughly vetted and planned. The findings of this study suggest that the observations of

hunters tend to be specific to the area they hunt, and knowledge of abundance and distribution vary depending on those locations. For example, the observations of the hunters near breeding colonies, those that hunt at the Capes and those that hunt from deep in the bays can often vary. This means the observations of smaller samples of hunters cannot be generalized to broader population issues either within the Bay or globally. Consequently, management decisions made based on LEK with poor sampling methodologies that do not account for hunting territories may have unintended consequences. Snowball sampling for example, while may be useful for certain types of research would not be the most effective methodology to obtain information as it would be very time consuming for larger scale qualitative research projects.

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Appendix A: Interview Questionnaire

Hunter Demographics

- HD1 Name _____
- HD2 Age _____
- HD3 Occupation _____
- HD4 Education _____
- HD5 Contact info
Mailing Address _____
Telephone # _____
Email address _____
- HD6 Did you hunt for murre in the 20-21 season? ___ Y ___ N
- HD7 Do you still hunt murre and if not, why did you stop?

- HD8 How old were you when you first started hunting Murre? _____
- HD9 Do you hunt other birds, animals and if so, what are they?

- HD10 Do you hunt murre in zones other than the one you live in? If so, which ones have you hunted in? _____

Hunter Knowledge

- HK1 How many types of murre can you hunt? What are their local names?

- HK2 Can you tell the difference between the different species when they are:
Sitting on the water? _____
When flying? How? _____
- HK3 Can you identify a Razorbill:
When flying? ___ Yes ___ No How?

When on the water? ___ Yes ___ No How?

- HK4 Do you know where common murre breed? _____
- HK5 Do you know where thick-billed murre breed? _____
- HK6 How many eggs does each species produce in a breeding season?
Thick-billed murre _____
Common murre _____
- HK7 Have you noticed any changes in murre behavior over time? For example, are they spending more time flying, sitting on the water, diving?

- HK8 Have you noticed any changes in the stomach content of murre over time?

- HK9 Do you know of any other places in the world where murre are hunted?

Abundance

A1 Have the murre populations changed since you first started hunting? Y N

Can you give me an estimate by how much of a change?

Thick-billed 0-20% 20 – 40% 40-60% 60 – 80% 80 – 100%

Common 0-20% 20 – 40% 40-60% 60 – 80% 80 – 100%

A2 Are there years where you feel the population of murrens changed more than any others?

Thick-billed 1980-90 1990-2000 2000-2010 2010-2020

Common 1980-90 1990-2000 2000-2010 2010-2020

A3 Why do you think those changes happened? The following are some examples:

- Lack of forage fish
 - Ice conditions
 - Inclement weather
 - Overhunting
 - Problems on the breeding grounds
 - Other
-
-

A4 1. Do any of the species of murrens arrive in Bonavista Bay before others?

2. Has that changed over time?

3. Why do you think that?

A5 Do any of the species leave Bonavista Bay before others? _____

Has that changed over time? _____

Why do you think that?

Distribution (incl Map Questions)

D1 Show me on the map where you generally hunt murrens. Are there any places better than others?

D2 Have these locations changed over time and if so, why do you think that?

D3 Can you draw for me the typical route you follow when you hunt?

D4 If you change places, what things influence you to make those changes, and how do you know where to go?

D5 Are there any differences in location where you see each type of murre?

D6 Show me on the map any traditional cod trap and other fishing grounds you know of.

D7 Have you noticed any changes in murre behavior over time? For example, are they spending more time flying, sitting on the water, diving?

D8 Are murrens wary of hunters (i.e., are you able to get close to them in a boat?)

Is it different by species? _____
Does that change during the season? _____
Has it changed from when you first started hunting? _____

Harvesting

H1 Are you seeing any change in the physical condition of the murre over time when you clean them? For example, Are they fatter or thinner than usual? Any other observations?
1980-85 1985-90 1990-95 1995-2000 2000-05 2005-10
2010-15 2015-20

H2 Do you normally get your daily limit when you hunt? Y N
H3 How many times did you hunt in the last season that you hunted? Is that more or less than other seasons you have hunted?

1 2 – 5 5 – 10 10+

H4 How many murre do you usually get when you hunt / average per trip? ____

H5 On average, do you get more of one type than the other type?

If so, which one? _____

Has that changed over the years? _____

Does it change during the season? _____

H6 What type of weapon do you use? _____

What was your first gun? _____

H7 Do you feel you are an average, above average or less average hunter in terms of the number of birds harvested? _____

H8 How many people go hunting with you per trip? ____

Has this changed over time? ____

H9 Are you expecting your children, if any, will take up murre hunting? Y N

H10 What kind of boat are you now using to hunt from? _____

How have the boats changed over time?

H11 How much do you think each trip costs you (gas, shells, food, etc.)? _____

Do you usually share the cost of each trip with someone else? _____

H12 Do you think it is easier now to get your daily limit than in previous years? Y N

What do you think are the factors that changed that?

__ Weather patterns

__ Sea ice conditions

__ Less birds

__ Too expensive

__ Too many hunters in the bay

__ Others

H13 Is there any time of day that is best for hunting? _____

Why?

Have you seen any change in that pattern? _____

- H14 Are you seeing more hunters on the water now than before? Why do you think the reason is for that?
- More / Less people getting licences now than before
 - More / Less people hunting now
 - More / Less local hunters (live in the bay)
 - More hunters from communities from outside the region
 - Other (specify) _____
- H15 Have you noticed any changes in murre behavior over time? For example, are they spending more time flying, sitting on the water, diving?
-
- H16 How many murre do you think you would harvest in a season now?
- H17a How about 5 years ago?
 - H17b How about 20 years ago?
 - H17c What would be your best guess before the regulations came into effect?
- H17 Have you ever seen or reported a banded bird?

Conservation / Enforcement Questions

- CE1 How many murre are you allowed:
 To shoot? _____
 Is that per trip or per day?
 To have in your possession. _____
 What does “in your possession” mean? _____
- CE2 Are you ok with a daily bag limit of 20 murre? Y N
 Do you think it should be reduced or increased? Y N
- CE3 Do you agree with a possession limit of 40 murre? Y N
- CE4 Are you in agreement with the timing of the season now? If not, why not?
-
- CE5 Do you think the hunt should be opened to other species?
- Guillemots
 - Black-legged Kittiwakes
 - Gulls
 - Cormorants
 - Gannets
 - Sooty Shearwaters
 - Greater Shearwaters
 - Others
- Why? _____
-
- CE6 Have you ever been checked by an enforcement officer? If so, how many times? Which ones? (RCMP, Fisheries, Canadian Wildlife Service, Local Wildlife, Other)
- CE7 Here are some common problems you hear in the media with murre hunting? Tell me which you think are the most common if any are, at all?
- Hunting without a license
 - Hunting at night

- Going over the bag limit
 - Going over the possession limit
 - Using unplugged shotguns
 - Not retrieving all crippled birds
 - Shooting protected species
 - Selling murre
- CE8 Do you think that hunters are consulted enough on murre hunting? Y N
- CE9 What do you think is the best way for murre hunters to be involved in making conservation decisions?
- CE10 Some people say that murre hunting is a historic right and should never be taken away from hunters? You agree? Y N
-
- CE11 If you heard that the murre population was in danger of collapsing, would you support a complete ban on murre hunting? Y N
- CE12 Would you be willing to submit annual harvest data?
- CE13 How do you hear about season opening times, regulation changes, etc.
- Newspapers
 - TV
 - Radio
 - Friends
 - Brochure from CWS, etc.
 - Facebook or other social media
- CE14 Do you feel privileged to be allowed to hunt? _____
- CE15 What is the total # of murre killed where you feel you have had a hunting season that has met your min needs (total birds harvested for period fall through winter)?
- | | | | | | |
|--------|---------|---------|---------|----------|------|
| 5 – 10 | 10 – 30 | 30 – 50 | 50 – 75 | 75 – 100 | 100+ |
|--------|---------|---------|---------|----------|------|

Appendix B: Ethics Approval



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Certificate #:	STU 2021-058
Approval Period:	05/28/21 - 05/28/22

ETHICS APPROVAL

To: Wayne Humphries
Graduate Student of Environmental Studies & Urban Change
waynehumphries01@gmail.com

From: Alison M. Collins-Mrakas, Sr. Manager and Policy Advisor, Research Ethics
(on behalf of Veronika Jamnik, Chair, Human Participants Review Committee)

Date: Friday, May 28, 2021

Title: Is it Turr or Murre? A Framework for Local Ecological Knowledge in Coastal Zone Governance

Risk Level: Minimal Risk More than Minimal Risk

Level of Review: Delegated Review Full Committee Review

I am writing to inform you that this research project, "Is it Turr or Murre? A Framework for Local Ecological Knowledge in Coastal Zone Governance" has received ethics review and approval by the Human Participants Review Sub-Committee, York University's Ethics Review Board and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines.

Note that approval is granted for one year. Ongoing research – research that extends beyond one year – must be renewed prior to the expiry date.

Any changes to the approved protocol must be reviewed and approved through the amendment process by submission of an amendment application to the HPRC prior to its implementation.

Any adverse or unanticipated events in the research should be reported to the Office of Research ethics (ore@yorku.ca) as soon as possible.

For further information on researcher responsibilities as it pertains to this approved research ethics protocol, please refer to the attached document, "RESEARCH ETHICS: PROCEDURES to ENSURE ONGOING COMPLIANCE".

Please note that prior to commencing any research activities, researchers are advised to review the latest updates on research involving human participants at:
<https://www.yorku.ca/research/researchers-faqs/>

Should you have any questions, please feel free to contact me at: 416-736-5914 or via email at: acollins@yorku.ca.

Yours sincerely,

Alison M. Collins-Mrakas M.Sc., LL.M.
Sr. Manager and Policy Advisor,
Office of Research Ethics