BONAVISTA BAY MURRE HUNTERS IN NEWFOUNDLAND AND LABRADOR PROPOSE FURTHER INTERACTION WITH BIOLOGISTS AND MANAGERS

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ABSTRACT

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Thick-billed Murres *Uria lomvia* and Common Murres *U. aalge*, seabirds with low reproductive rates, delayed reproduction, and high adult survivorship, are hunted in Newfoundland and Labrador (NL) by non-Indigenous residents. The traditional hunt has a complex regulatory history as a result of NL joining Canada in 1949 and the protection of non-game species under the Migratory Bird Convention Act. Thirty hunters from the northeastern region of the island of Newfoundland were interviewed about their knowledge of murres, their hunting practices, and their opinions on current hunting regulations. While the hunters had detailed local species knowledge from the region they hunted, most had a limited understanding of the broader aspects of the species' ecologies, such as breeding locations. Most (76.6%) interviewees said that they would be willing to participate in harvest surveys if the surveys were made mandatory. Interviewees highlighted the need for resource managers to conduct on-the-ground hunter training and engagement. In general, sustainable harvests under current regulations are more likely to succeed if communities are actively engaged through consultations that encourage hunters to participate in conservation efforts.

Key words: hunter opinions, murres, conservation, harvest regulations, Migratory Bird Convention Act, MBCA, *Uria aalge*, *Uria lomvia*

INTRODUCTION

Nearly half of seabird species worldwide are experiencing population declines due to a range of factors (Croxall et al., 2012; Dias et al., 2019), yet some species continue to be hunted for commercial, subsistence, and/or recreational purposes (Naves & Rothe, 2023). Depending on the species and jurisdiction, seabird hunting can occur at colonies during the breeding season or at-sea outside of the breeding season (Naves & Rothe, 2023). Duffy & Peschko (2023) identified fourteen states/provinces, or countries, that currently permit hunting of adult seabirds. Seabirds typically have low reproductive rates, delayed reproduction, and high adult survivorship, so even modest increases in adult mortality can lead to population decline (e.g., Furness & Monaghan, 1987; Naves & Rothe, 2023). Hunting pressure on seabird populations can fluctuate in response to changing socioeconomic factors within human communities (Naves & Rothe, 2023). Therefore, setting hunting quotas to ensure sustained seabird populations requires careful consideration of numerous factors and access to high-quality data (Cox et al., 2024; Ellis et al., 2013; Merkel & Barry, 2008; Naves, 2018; Naves & Rothe, 2023).

Newfoundland and Labrador (NL), Canada, has one regulated hunt for non-Indigenous people for two species protected under the Migratory Bird Convention Act (MBCA; 1994): the Common Murre *Uria aalge* and the Thick-billed Murre *U. lomvia*; collectively "murres" (Montevecchi & Tuck, 1987). At the time NL joined Canada in 1949 (Newfoundland Act, 1949), the Government of Canada attempted to enforce the MBCA by banning the murre hunt (Tuck, 1949). However, enforcement disrupted an important form of food security and the subsistence hunting tradition, which had existed for centuries among residents of NL (Appendix 1, available on the website). Despite an educational campaign to explain the importance of protecting migratory birds (Elliot et al., 1991; Montevecchi & Tuck, 1987; Tuck, 1949), there was strong opposition to the MBCA from residents of NL. As a result, the federal government issued an order-in-council in 1956 allowing rural NL residents to hunt murres for seven months of the year with no daily bag limit (Elliot et al., 1991). By the 1980s, an estimated 600,000–900,000 murres were taken annually, and a need for further restrictions was recognized (Elliot et al., 1991). Between 1995 and 1999, ratified amendments to the MBCA allowed the federal government to implement licensing requirements and adjust hunting season duration, bag limits, and other regulatory measures (MBCA, Article II, no. 5; Clinton 1996; Migratory Bird Regulations, 2020; see Table A1, Appendix 1). Just over a decade later, Montevecchi et al. (2007) argued that the NL murre hunt had transitioned from a subsistence to a recreational hunt, deviating from the original spirit and intent of the practice, and that total anthropogenic mortality pressures on the two murre populations made the sustainability of the hunt questionable.

The implementation of regulations and societal changes can lead to conflicts between conservation management decision-makers and hunters (Bruskotter et al., 2019; Ingram, 2013; Lopez-Darias et al., 2011; Montevecchi & Tuck, 1987; Somerville, 2020). One approach to reduce conflict and improve conservation policy is to incorporate public input (Bonney et al., 2014; Draheim et al., 2015; Lepczyk & Duffy, 2019; Miller-Rushing et al., 2012; Winkler & Warnke, 2013). Although qualitative approaches

have been applied extensively in terrestrial research, they remain underutilized in marine contexts, despite growing recognition of their value for augmenting scientific research (Bonney et al., 2009; Theobald et al., 2015). One such approach is interviewing hunters to understand how, or whether, hunting regulations are effectively protecting target species (Breisjøberget et al., 2017; Dinges et al., 2014; Holmgaard et al., 2018; Schroeder et al., 2014). For example, Holmgaard et al. (2018) used hunter input to develop an adaptive management strategy for a growing Pink-footed Goose *Anser brachyrhynchus* population to ensure hunter compliance with proposed regulations. However, hunter opinions on regulations do not always achieve conservationists' population goals of the target species. For example, in a survey of new hunting restrictions for ptarmigan *Lagopus* spp., Breisjøberget et al. (2017) reported that proposed management actions could not be reconciled with hunters' goals and that more information, both on the effects of hunting and alternate management options, was needed. When establishing the NL murre regulations in the 1990s, hunter surveys were used to create harvest plans, which were then presented to individual hunters, a Murre Advisory Group, and the public at large (Chardine et al., 1999). The final regulations were estimated to reduce murre harvesting by 50%, thereby achieving sustainable population objectives (Chardine et al., 1999).

Murres in NL

There are four NL management zones, each with different open season dates for the murre hunt (Fig. 1, Table 1). The open season hunt dates were calibrated to overlap with the presence of murres, while also meeting the MBCA requirements (Chardine et al., 1999). Further restrictions include an upper limit on the number of shells that may be held in the magazine of the gun at any time, a daily bag limit of 20 murres, and a possession limit of 40 (Environment and Climate Change Canada, 2020). Penalties for violations include a range of fines and possible imprisonment (e.g., in 2024, two hunters were each fined $10,000 CAD for unplugged shotguns; Environment and Climate Change Canada, 2024). The annual estimated harvest was 200,000–300,000 birds in the mid-1990s, prior to the implementation of regulations. However, seasonal take declined beginning in the 2010s to 100,000 birds, and by 2018, it had decreased to 72,000 (Chardine et al., 1999; Environment and Climate Change Canada, 2019; Frederiksen et al., 2019; see also Cox et al., 2024 and Smith et al., 2022).

Common Murres exposed to the NL hunt breed primarily around the island of Newfoundland (Ainley et al., 2021), including Funk Island (the largest colony in the western North Atlantic; Wilhelm et al., 2015), Witless Bay, and Baccalieu Island (Montevecchi & Tuck, 1987). The NL population is currently stable or increasing (Ainley et al., 2021). However, there are concerns about future impacts from climate change and other anthropogenic forces (Cox et al., 2024; McFarlane Tranquilla et al., 2010; Montevecchi et al., 2012; Regular et al., 2010), including a recent increase in the proportion of Common Murres taken during the NL hunt (Ainley et al., 2021). Surveys conducted by the Eastern Canadian Seabirds at Sea (ECSAS) Program from 2006–2011 showed that both Common Murres and Thick-billed Murres were observed at low densities during September–October, were widely distributed from the coast of Newfoundland to offshore areas in November–December, occurred mostly offshore in January–February, and appeared in high numbers near the coast in March–April (Hedd et al., 2011). Specific to Common Murres, geolocator data from ten birds originating on Funk Island show dispersal offshore after the breeding season (mid–August); the majority of birds stayed offshore through January–February (Hedd et al., 2011).

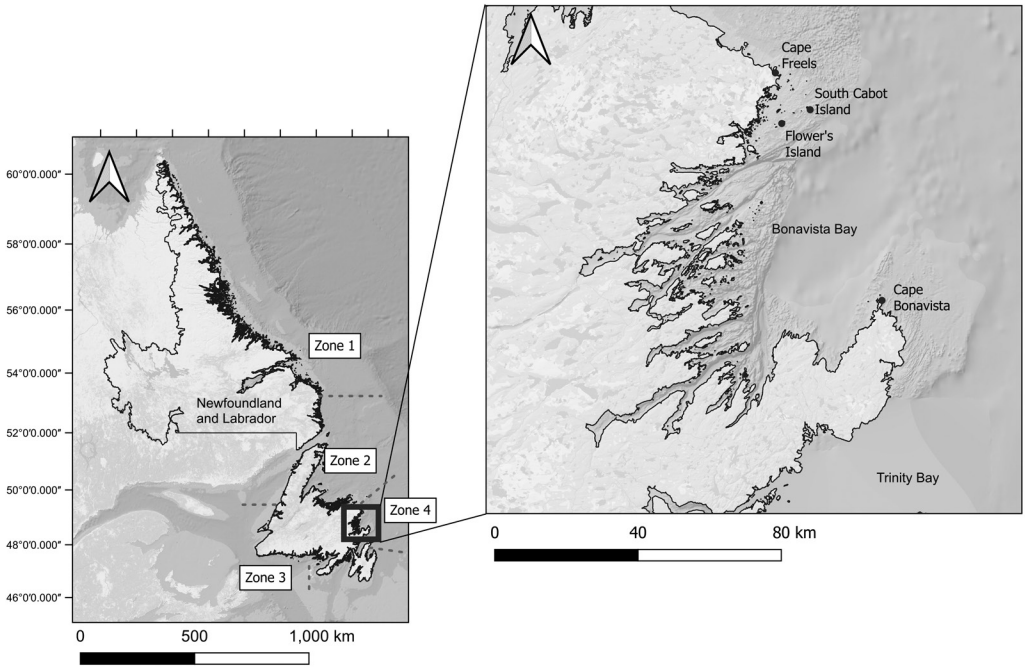

Fig. 1. The study area and murre *Uria* spp. hunting zones for Newfoundland and Labrador, Canada. Each zone has different seasonal dates: Zone 1, 01 September–16 December; Zone 2, 06 October–20 January; Zone 3, 25 November–10 March; Zone 4, 03 November–10 January and 02 February–10 March. Panel on right shows the Bonavista Bay region (study area), Canada, and some locations mentioned by hunters.

TABLE 1
Migratory Bird Conservation Act regulations on murre hunting in Newfoundland and Labrador (NL) relevant to interviewee opinions

Regulation[a]	1995–current[b]	Changes suggested by some interviewees
Zoning, Schedule 3, Part 1	Four zones (Fig. 1) Zone 1: 01 Sept–16 Dec Zone 2: 06 Oct–20 Jan Zone 3: 25 Nov–10 Mar Zone 4 (Study Area): 03 Nov–10 Jan & 02 Feb–10 Mar	Season dates changed (nine of 30 interviewees) Zone 4 changed to have same opening date as Zone 2 (seven of nine interviewees)
Daily bag & possession limit	20 per day & possession limit of 40, unlimited number of hunting trips per season	Limit annual number of murres harvested (11 out of 30 interviewees)
Gun type	Section 15 (1) (d) prohibits 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"	Questioned the three-shell restriction (14 of 30 interviewees)

[a] Migratory Bird Regulations (2020)
[b] No regulations were enforced from 1949–1994

Environment and Climate Change Canada (2022) estimated that 75% of birds harvested are Thick-billed Murres. They breed in the low and high Arctic (Greenland, Iceland, Norway, and the Canadian high Arctic; Frederiksen et al., 2019; Gaston & Hipfner, 2020; Petersen & Bakken, 2004), and birds from all of these populations may overwinter offshore NL (Frederiksen et al., 2016). Band recovery data indicate that high Arctic Thick-billed Murres move south to Newfoundland (or east of Greenland; Petersen & Bakken, 2004), with younger birds arriving in the fall and breeders arriving in the winter. They remain in Newfoundland waters until March (Gaston & Hipfner, 2020). A tracking study of post-breeding Thick-billed Murres in Labrador indicated that they move south to the northeast coast of the island of Newfoundland and then offshore in late winter (Montevecchi et al., 2012). In parts of the breeding range, population declines have resulted in an at-risk status (e.g., red-listed as Vulnerable in Greenland, Iceland, and Norway; Frederiksen et al., 2016); thus, hunting in NL could negatively impact populations outside of Canada. While populations breeding in Labrador may be relatively stable (Frederiksen et al., 2016), modelling has shown depressed population growth, primarily due to the occurrence of hunting and chronic oil pollution on wintering grounds in NL (Frederiksen et al., 2019).

Razorbills *Alca torda* are alcids that breed and overwinter in NL in relatively low abundance (Chapdelaine et al., 2001). Owing to the similarity of their plumages to those of murres, Razorbills are incidentally killed during the murre hunt (Elliot et al., 1991; Wilhelm et al. 2008). Lavers et al. (2009) estimated that 8,131 Razorbills are killed per year in the NL hunt. They recommended educating hunters, as well as modifying quotas and the timing of hunts, in areas where the species clusters and overlaps with murres.

In this work, we used interviews with hunters to gather their perspectives on harvest management and the conservation of murres from one area off the northeast coast of the island of Newfoundland. The interviews were centered around hunters' perspective on hunting rights and hunters' opinions of the harvest regulations. Given NL's history of joining the Canadian Federation, exploring whether hunters view hunting as a personal right—regardless of regulations—may help clarify how likely they are to follow hunting laws, as well as the extent to which they rely on murres for subsistence. Hunter opinions of the regulations may also inform management. For example, if hunters are unlikely to follow regulations, estimates based on legal quotas may underestimate the actual harvest (Cox et al., 2024). Finally, hunters' perspectives on the current state of the hunt, such as whether the bag limit is too easy or difficult to reach, could inform the setting of annual harvest quotas (see Smith et al., 2022). Ultimately, this study aimed to capture recent hunter perspectives on murre harvest management and explore how these insights can contribute to future management strategies.

METHODS

Study area

Bonavista Bay (approximately 3,200 km^2) is located on the northeast coast of the island portion of NL. It is populated by approximately 45 small communities, many with small fishing harbors, coves and inlets, numerous shoals, and small islands (Fig. 1). Bonavista Bay has water depths ranging from shoals exposed at low tide to channels and areas reaching depths up to 200 m. A small colony of approximately 10,000 nesting pairs of Common Murres breeds on South Cabot Island, Bonavista Bay (49°10′N, 53°21.5′W; Wilhelm et al., 2015). Funk Island, a globally significant breeding Common Murre colony (~500,000 nesting pairs), is 65 km north of Bonavista Bay (Montevecchi et al., 2012; Wilhelm et al., 2015). The Bonavista Bay murre hunt occurs predominantly in a portion of Zone 4, where the season runs from 03 November–10 January and 02 February–10 March (Migratory Bird Regulations, 2020; Fig. 1, Table 1).

Data collection

We conducted interviews within a defined area extending from approximately 10 km northeast of Cape Freels (northern Bonavista Bay) to 10 km east of Cape Bonavista (southern boundary) (Fig. 1). 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. Two candidates were

initially selected based on the lead author's prior connections, and subsequent participants were recruited via the snowball sampling method (Etikan et al., 2016; Noy, 2008). Hunters were interviewed at their homes. We used a semi-structured questionnaire to guide the interviews (Table 2), covering topics such as interviewee demographics, hunter knowledge of murres, harvesting practices, and conservation and enforcement (Human Participant Ethics Review, #STU 2021-058, York University).

Interviewees were shown a detailed oceanographic navigation chart of Bonavista Bay and presented with six 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 were asked to identify the birds using the names they most often use to identify them (Montevecchi & Tuck, 1987). Birds of varying ages and molting stages live in NL waters (see Ainley et al., 2021; Gaston & Hipfner, 2020). When hunting, interviewees would primarily see non-breeding plumage for Thick-billed Murres (Gaston & Hipfner, 2020) and Common Murres in December, and breeding plumages in March (Ainley et al., 2021).

The interviews ranged from approximately 55 minutes to two hours and 50 minutes, were audio-recorded, and were manually transcribed on the basis of the dialects and local terminology. Following Cresswell & Poth (2018), a case study analysis was used to code major points and comments to identify key themes for interpreting hunters' perspectives.

RESULTS

Thirty hunters were interviewed: 27 resided and hunted within the study area, two resided outside the study area in Notre Dame Bay (the adjacent bay to the north), and one resided and hunted in Trinity Bay (the adjacent bay to the south) (Fig. 1). All interviewees continued to hunt murres (annually, n = 25; intermittently, n = 3) or had hunted murres in the past (n = 2). All the hunters were male (n = 30), with an average age of 56 years (range: 31–72). Their hunting experience ranged from 15 to 56 years, spanning the period from 1965 to 2021. Seventeen hunters had more than 40 years of hunting experience, and 22 out of the 30 hunters had hunted consistently before the regulatory changes that were introduced in 1995 (see Appendix 1). Twenty-eight interviewees were active hunters during the 2020–2021 hunting season and also hunted other marine and terrestrial species. All current and prior murre hunters identified themselves as hunters of other bird species (e.g., Common Eider *Somateria molissima* and King Eider *S. spectabilis*; Ruffed Grouse *Bonasa umbellus* and Spruce Grouse *Falcipennis canadensis*) and mammals (e.g., Snowshoe Hare *Lepus americanus* and Moose *Alces alces*), all of which are subject to regulated, annual hunting seasons.

We organized the interview results into five thematic areas: (1) perspectives on hunting rights; (2) species identification; (3) hunters' opinions of, and experiences with, harvest regulations; (4) hunters' recommendations for changes to harvest regulations; and (5) perspectives on changes in hunting efforts.

Perspectives on hunting rights

Most interviewees (n = 27, 90%) felt that they had a historical right to hunt murres, but few (n = 6, 20%) connected this right to NL joining Canada. Of those that did, one hunter stated, "When we joined Canada, it was a part of the deal Joey [Smallwood, NL's first Premier] signed"; another said it was "a God given right under Confederation." Most hunters thought that murre hunting rights were ancestral: "Back in our grandfather and their father's time it was a source of protein that got their families through the winter."

Although many hunters said that murres were not the primary source of protein, they remained an important part of the annual diet. Reflecting the sentiment of most interviewees, one 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." 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."

Species identification

Thick-billed Murres were identified by most hunters as their preferred species to hunt (n = 22, 73.3%). However, only four hunters (13.3%) knew where the species breeds. Many hunters referred to Thick-billed Murres as "young" birds and Common Murres as "old" birds. Almost all interviewees (n = 28, 93.3%) speculated that Thick-billed Murres migrate from somewhere in the north, traveling along Cape Freels and Cape Bonavista to reach the southern coast of Newfoundland (see Fig. 1). While most hunters (n = 23, 76.7%) knew where Common Murres nested in Bonavista Bay, and knew the general migratory patterns in and out of Bonavista Bay, they had no knowledge of breeding locations beyond Bonavista Bay (n = 26, 86.7%) and speculated that Common Murres moved out of the bay to the Grand Banks (n = 27, 90%).

Fifty percent (n = 15) of hunters reported they could readily distinguish Thick-billed Murres from Common Murres while hunting. However, when shown pictures of murres in various seasonal plumages, most hunters either confused the species or indicated that they had not seen them before; only two hunters were able to correctly identify all murres across various seasonal plumages (Fig. 2). All hunters (n = 30, 100%) knew that it is illegal to shoot Razorbills, yet most (n = 28, 93.3%) admitted to occasionally doing so by accident, though in small numbers. When shown close-up pictures of Razorbills, most hunters (n = 24, 80%) were able to identify them by bill shape and size. However, only nine hunters (30%) stated that they could identify Razorbills in flight or on the water. All the interviewees noted that if they were able to recognize Razorbills among a flock of murres—whether swimming in the water or flying—they would avoid shooting them.

Most hunters (n = 19, 63.3%) expressed interest in learning more about the species they hunt. Several noted that improved knowledge of murre biology would help them understand the rationale for certain regulatory decisions. All hunters (n = 30, 100%) used local names to identify murres and many (n = 19, 63%) hunters were not aware that all "turrs" were murre species. One interviewee commented, "Some people don't know what type of birds they are hunting, not even basic information."

Hunters provided detailed knowledge of their local ecosystem and reported the ability to predict the likelihood of a successful

TABLE 2
A sample of the semi-structured interview questions relevant to the study[a]

Hunter demographics	Name, Age, Occupation, Education Did you hunt for murres in the 2020–20211 season? Do you still hunt murres and, if not, why did you stop? How old were you when you first started hunting murres? Do you hunt other birds, animals, and, if so, what are they? Do you hunt murres in bays other than the one you live in? If so, which ones have you hunted in?
Hunter knowledge	How many types of murres can you hunt? What are their local names? Can you tell the difference between the different species when they are: Sitting on the water? When flying? How? Can you identify a Razorbill? When flying? How? When on the water? Do you know where Common Murres breed? Do you know where Thick-billed Murres breed? How many eggs does each species produce in a breeding season?
Harvesting	Do you normally get your daily limit when you hunt? (Y/N) How many times did you hunt in the last season that you hunted? Is that more or less than other seasons you have hunted? How many murres do you usually get when you hunt/average per trip? On average, do you get more of one type than the other type? What type of weapon do you use? Do you feel you are an average, above average, or less than average hunter in terms of the number of birds harvested? How many people go hunting with you per trip? Are you expecting your children, if any, will take up murre hunting? (Y/N) What kind of boat are you now using to hunt from? How have the boats changed over time? 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? Do you think it is easier now to get your daily limit than in previous years? (Y/N) Is there any time of day that is best for hunting? Are you seeing more hunters on the water now than before? Why do you think the reason is for that? How many murres do you think you would harvest in a season now? Have you ever seen or reported a banded bird?
Conservation & enforcement	How many murres are you allowed: To shoot? Is that per trip or per day? To have in your possession? What does "in your possession" mean? Are you okay with a daily bag limit of 20 murres? (Y/N) Do you think it should be reduced or increased? (Y/N) Do you agree with a possession limit of 40 murres? (Y/N) Are you in agreement with the timing of the season now? If not, why not? Do you think the hunt should be opened to other species? Have you ever been checked by an enforcement officer? If so, how many times? Which ones (e.g., RCMP, Fisheries, CWS)? Here are some common problems (interviewees were provided a list) you hear in the media with murre hunting? Tell me which you think are the most common if any are, at all? Do you think that hunters are consulted enough on murre hunting? What do you think is the best way for murre hunters to be involved in making conservation decisions? Some people say that murre hunting is a historic right and should never be taken away from hunters? Do you agree? (Y/N) If you heard that the murre population was in danger of collapsing, would you support a complete ban on murre hunting? (Y/N) Would you be willing to submit annual harvest data? (Y/N) How do you hear about season opening times, regulation changes, etc.? What is the total # of murres killed where you feel you have had a hunting season that has met your minimum needs (total birds harvested for period fall through winter)?

[a] Additional questions on observations of murre distribution and abundance were also asked.

hunt. They identified a variety of predictive factors, such as wind direction, ice coverage, ice movement, and time of day and season. Based on their previous hunting success, all the interviewees stated they knew the most favorable conditions for a successful hunt, such as early mornings, northerly wind conditions, and instances when ice was pushed southward around Cape Freels.

Hunter opinions of, and experiences with, harvest regulations

All the hunters interviewed (n = 30, 100%) expressed support of the intent of the harvest regulations, even though some acknowledged having violated them. Due to Human Participant Review Ethics protocols, interviewees were not directly asked whether they had violated regulations, so we cannot report the

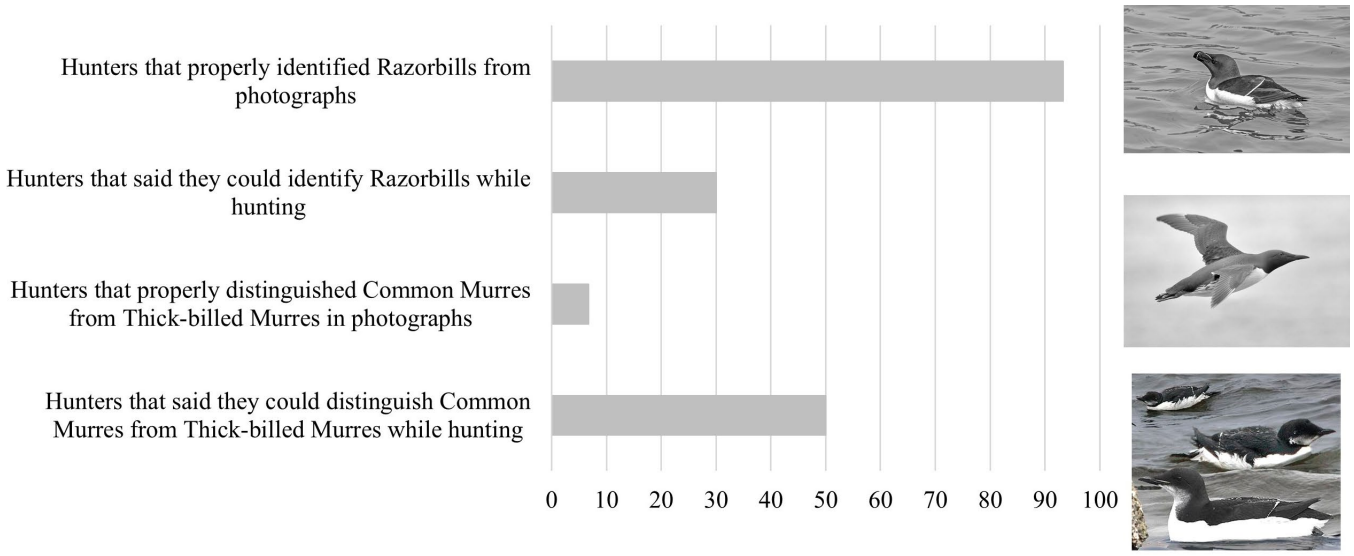

Fig. 2. Murre *Uria* spp. hunter responses (n = 30) to species identification questions. Razorbill *Alca torda* photo credit (top right): https://commons.wikimedia.org/wiki/File:Razorbill_%28Alca_torda%29_on_water.jpg). Thick-billed *Uria lomvia* (middle right) and Common murre *Uria aalge* (bottom right). Photo credits: Ian L. Jones.

proportion of those who did. When hunters voluntarily disclosed violations, we clarified that they were not obliged to do so. Many hunters felt that the restrictions introduced in the 1990s were necessary to prevent severe declines in the murre population(s). One hunter noted, "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." While some hunters questioned the purpose of specific regulations and proposed modifications (see below and Table 1), they expressed strong overall support for the current regulatory framework.

When queried about encounters with enforcement officers, 17 hunters (56.7%) reported having been checked at some point, while 13 (43.3%) said they had never been checked during all their years of hunting murres. One hunter had received a fine for hunting Eiders out of season more than 10 years before the interview, and another hunter had received a fine for selling murres 30 years prior. Four hunters had been checked multiple times, three of whom were checked upon landing at a public wharf near the Department of Fisheries and Oceans Office. One hunter had been checked almost annually at various locations via 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 30 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."

There were no specific interview questions on hunters' views of various enforcement measures; however, hunters frequently commented on the topic. Some interviewees openly admitted to violating regulations, including harvesting other species, selling or bartering murres, and modifying guns to increase their shell capacity beyond regulation limits. While most interviewees emphasized that they did not condone breaking the law and were aware of the associated risks, they also stated that they would never report others for such violations. As one hunter commented, "We live in a small community, and one day I might need their help sometime." Another participant reflected, "It goes on sometimes, but it doesn't happen much anymore, and there are only a very small number that do it."

Some hunters (n = 14, 46.7%) questioned the merits of the shotgun capacity restriction regulation (Table 1) and described how they bypass it. One stated, "Most fellows throw away the manufacturer's 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 they cannot get any more than the three shells, check our license and the number of birds on board, and then leave." Another commented, "You are not able to find many people around here with the proper plug in it."

Several interviewees noted that, in most cases, there are three hunters per boat, each legally permitted to carry a gun. This allows for a total of nine shots per flock of murres. They argued that using guns without plugs is irrelevant as long as they do not exceed their daily limit of 20 murres per person. Their rationale was that removing the plug allows hunters to spend less time on the water, lowers costs, improves safety for the hunters, and minimizes disturbance to murres.

Some hunters (n = 17, 56.7%) raised concerns about others exceeding the bag and possession limits but noted that such violations are currently far less common than in the past. They attributed this decline to several factors: (1) many hunters are now older and less motivated to hunt; (2) there is less need to harvest large numbers of murres; and (3) there is a risk of facing significant penalties if caught (see Environment Climate Change Canada, 2020). Four hunters (13.3%) expressed concern about non-compliance with regulations in areas outside of Bonavista Bay (Placentia and Notre Dame Bays). Nine hunters (30%) expressed concerns about hunting pressure in Placentia Bay and had given up hunting there because of the substantial number of hunters in this area.

In recent years, no hunters had submitted harvest data or responded to any volunteer data questionnaires. However, all hunters indicated they would submit annual harvest data if it were a mandatory requirement for obtaining a license.

As reported by hunters, hunting practices and relative success, as measured by the number of murres harvested, have changed over the years in response to hunting technology and environmental conditions (e.g., wind, ice conditions, and the presence of bait fish; Appendix 2). One hunter stated, "Before we only had a 20 (horsepower [hp] engine) or less and couldn't get out into the squatch holes [areas of open water in slob ice where large numbers of murres congregate and were easy to harvest], then we had the 40 [hp] and we had it made because we would get into the squatch holes. Now there are 100 hp." Another 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." Most interviewees now own fiberglass boats with larger, more fuel-efficient engines (n = 26), use GPS units, and use communication tools such as cellular phones and very high frequency (VHF) radios to communicate with each other while hunting. Contemporary hunters can travel through thin ice, travel longer distances, and cover more hunting territory faster. As one hunter stated, "When we started birding, we had a six horsepower, then a 15 took us to Shag Rock, then a 25 to Flower's Island, then a 30 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 Bonavista Bay is committing suicide."

Hunter recommendations for changes to harvest regulations

Twenty-three hunters (76.7%) expressed a desire for more consultation with the Canadian Wildlife Service and recommended mandatory annual harvest surveys and community meetings. One 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."

Despite overwhelming support from hunters for the MBCA and regulations, some (n = 9, 30%) recommended changes to the season opening dates. Among those recommending changes, opinions varied; however, seven of nine respondents favored aligning the opening date with that of Zone 2 (north of Bonavista Bay; Fig. 1, Table 1). Rationales included: better timing with murre presence; calmer winds earlier in the season, allowing for safer and more frequent hunting trips; and the advantage held by hunters from Cape Freels, who can access both Bonavista Bay and areas to the north from their community.

All hunters were aware of the bag and possession limits, and although they agreed with these restrictions, 11 (36.7%) recommended implementing annual limits instead of daily quotas. Sixteen hunters (53.3%) reported harvesting more than 100 murres annually. The primary reasons cited were personal consumption throughout the season and giving murres to family members. Several hunters reported hearing about murres being bartered or sold and were aware of local prices. One hunter openly admitted to bartering for murres, unaware that it was illegal.

When asked what constitutes a successful hunting season, most hunters responded that 40 murres were more than enough for the winter season. One hunter commented, "We only make three or four trips a year now, and if I have 30 turrs in the fridge, I know I got enough." Another hunter responded, "For a family, if you have 60 turrs, you have had a good year. Thirty to give away and 30 for yourself." Just under half of interviewees suggested an annual limit on the lower end of the range—between 30 to 80 murres—while 16 individuals (53%) proposed a higher range over 100. One hunter remarked, "The number of turrs we are allowed to kill must be large enough to make it worth our while to go out." However, concerns were also raised about waste. Reflecting on uneaten murres, one hunter admitted bluntly, "One time, I wanted a fridge full. If you want to see a turr now, go into the dump in the spring." The observation of (uneaten) murres at the dump (i.e., wasted) was noted by four interviewees (13.3%).

While only three hunters (10%) thought there was overhunting in Bonavista Bay and made comments such as, "Any turr coming down from St. Anthony is running a gauntlet," 24 hunters (80%) felt that murres were not currently overhunted. Twelve hunters (40%) commented that despite the larger number of boats and hunters on the water in Bonavista Bay, fewer murres were taken than in the past. One stated, "We would kill more in a week when we were younger than we do now in a full season."

Six recommendations for change were identified, each receiving varying degrees of support: (1) remove the three-shell restriction in shotguns; (2) amend the hunting season opening date in Bonavista Bay to align with that in Zone 2; (3) establish a mechanism for increased hunter consultation at the community level; (4) establish a program to educate hunters on murre biology; (5) implement a tag system to cap the annual number of murres harvested; and (6) introduce a mandatory hunter harvest survey as a part of the license system (Fig. 3). When asked whether they would support a complete ban on murre hunting—and under what conditions—hunters were divided. Some supported a quota reduction (n = 12, 40%), while others favored a temporary closure (n = 18, 60%) on hunting if the population required time to recover. Those in support of a closure expressed caution, citing concerns about the potential impact on future harvest opportunities.

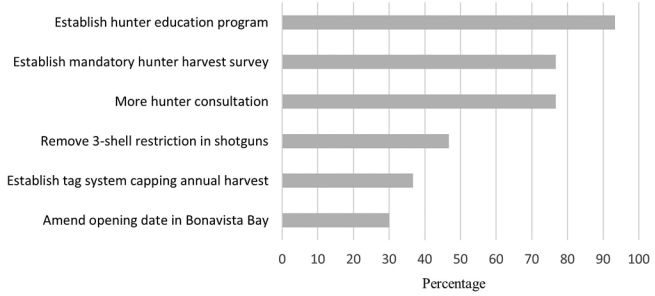

Fig. 3. Recommendations to change hunting regulations by murre *Uria* spp. hunters in Bonavista Bay, Newfoundland and Labrador, Canada.

Perspectives about changes in hunting effort

Many hunters raised the issue of the aging hunting population during discussions. One elderly hunter remarked, "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 reported spending less time hunting and harvesting only enough for winter, compared to when they were younger. Hunters aged 60 years and older (n = 13) made up the largest age group in the study and typically took fewer than five murre hunting trips per season. Only seven hunters mentioned younger family members expressing an interest in hunting murres. As one hunter commented, "The young ones coming up, I don't know if they will ever shoot a turr or not." However, the declines in future hunters may not necessarily lead to reduced 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, two weeks on and off, who go out when they are here." Another added, "There are more boats at it now than before, and if it is a good day, you may see as many as 28 to 30 boats, but a lot of times you might only see a half a dozen."

DISCUSSION

The biology of North Atlantic alcid populations has been extensively studied, including assessments of the impacts of harvesting, oiling, and fisheries bycatch (e.g., Cox et al., 2024; Frederickson et al., 2019; Frederickson et al., 2021; Gaston & Robertson, 2010; Piatt et al., 1984; Piatt & Nettleship, 1987; Regular et al., 2013; Robertson et al., 2014; Wiese & Ryan, 1999; Wiese et al., 2004; Wiese & Robertson, 2004). Once source of mortality—hunting—is not caused by industrial-scale activities (excluding egg collection or hunting in the Arctic; see Montevecchi et al., 2007), and its management can be adjusted annually based on population health. Implementing such management actions requires collaboration with hunters, making it essential to understand their perspectives on regulations to assess the effectiveness of these measures. In this study, interviewees noted the need for hunter consultation and educational outreach. These approaches, when implemented across jurisdictions, have been shown to improve compliance with regulations (Chardine, 1994; Chase et al., 2002). Although hunters in one region of NL discussed a wide range of topics related to murre harvesting, our focus was on (1) species identification and (2) perspectives and recommendations on harvest regulations, including calls for increased engagement with harvest management agencies.

Species identification

The Canadian Wildlife Service has a single hunt for two species: the Thick-billed Murre, which migrates into the area, and the Common Murre, which breeds locally (see also Cox et al., 2024; McFarlane Tranquilla et al., 2015). The maximum sustainable harvest identified collectively for both species was 250,000 in 2019, although an estimated 72,000 murres were killed in 2018 (Environment and Climate Change Canada, 2019). Based on hunting licenses and fresh wings submitted by hunters for species and age identification (Species Composition Survey; Frederiksen et al., 2019), Cox et al. (2024) estimated the annual legal harvest in NL to be 19,500–37,000 Common Murres and 40,000–89,000 Thick-billed Murres. They also concluded that neither species could sustain the combined mortality from licensed hunting, high levels of illegal take, and/or incidental capture in fisheries.

If one species was to show a rapid decline, could narrowing the hunt to the other species be considered? Our study revealed that hunters had mixed abilities in species identification (see also Lavers et al., 2009). They used local and overlapping vernaculars for the two murre species but had only one local name for non-target Razorbills, although most could correctly identify Razorbills in photographs. The two murre species were not easily distinguished (Fig. 2); paradoxically, however, hunters reported a preference for Thick-billed Murres. Challenges with species identification and unintended harvest could be mitigated, to some extent, through hunter education (Naves, 2018), which may reduce the degree of divergence between science-based species identification and local ethno-taxonomies (Ng'weno, 2010). We recommend conducting more surveys across NL to identify what factors hunters use to identify birds (e.g., timing within the season or time needed to process birds based on the degree of pin feathers). Such surveys could help determine the feasibility of narrowing the hunt to one murre species, if required. Training hunters in species identification under realistic, on-the-water hunting conditions—where all three species may be present in mixed flocks—will reduce non-target take (Lavers et al., 2009), though it will not completely eliminate the issue and should be part of a broader suite of management approaches (see below).

Perspectives and recommendations on harvest regulations

Current hunting regulations are structured to provide hunting opportunities while conserving murre populations (see Frederiksen et al., 2019; Merkel et al., 2016). The interviewees provided opinions and suggestions on current murre harvest regulations, including gun requirements, seasonal dates, and an annual cap on total take (Table 1). Although the three-shell shotgun limit is intended to improve retrieval rates of shot birds by reducing crippling loss (Van Den Akker & Wilson, 1951), most interviewees reported disregarding this regulation. Notably, none of the interviewees mentioned crippling loss; however, there is a long-standing data gap in mortality estimates from hunting (Chardine et al., 1999; Frederiksen et al., 2019). The three-shell limit is also meant to slow harvest rates in any given area, irrespective of the number of hunters (Van Den Akker & Wilson, 1951). More research is needed to determine how frequently the three-shell limit is disregarded and to understand the potential implications for murre harvest estimates.

Seasonal hunting dates are set not only to overlap hunting with the presence of the target species, but also to establish regulatory limits. In NL, these dates were developed through extensive consultation with the hunting community—albeit three decades ago (Chardine, 1994). Some hunters suggested starting the season one month earlier to maximize harvests in fewer trips, which may coincide with the peak presence of Thick-billed Murres (see Hedd et al., 2015; Montevecchi et al., 2012; Table 1). As noted by the interviewees, while the cultural context of murre hunting is shifting from subsistence to recreational harvesting (see also Montevecchi, 2007), most hunters still measure their success by the effort required and the size of their kill. Further consultation with murre hunters across NL on seasonal dates may help identify periods of peak murre abundance and allow managers to evaluate whether changes to the hunting season are warranted.

Annual limits, illegal bartering, and the requirement for annual harvest reporting also came up in the interviews. Under the current regulations, hunters are permitted to make frequent trips during the season, provided they do not exceed the daily bag limit (the number of birds harvested per day) or the possession limit (the total number of birds both preserved and unpreserved in their possession at any given time). The possession limits may be confounded by whether a hunter is engaged in illegal bartering. For example, a hunter at the possession limit may barter some murres and then harvest additional murres. Interviewees described legally harvesting many more murres on a consolidated annual basis than what is set by the daily bag and possession limits. Additionally, some hunters (< 40%) suggested replacing these limits with an annual harvest limit (Table 1). However, implementing an annual limit imposes law enforcement challenges, as it may require frequent monitoring of hunters during the season. Although further research using both sociological and economic frameworks is needed to better understand the motivations of murre hunters in NL (see Smith et al., 2022; Wam et al., 2012), it is clear that hunters are strongly committed to maintaining sustainable murre populations.

The incorporation of local knowledge into environmental governance is an important part of conservation efforts (e.g., Byrd et al., 2017). This strategy was used in NL in the late 1980s–mid 1990s, when resource managers were successful in introducing regulatory changes to ensure the maintenance of healthy murre populations, in part owing to community and hunter consultations and education (Chardine, 1994). Our study suggests that Bonavista Bay hunters supported conservation measures, even though some violated regulations. However, there was an underlying mistrust of conservation managers in NL, often rooted in hunters' experiences with, or perceptions of, offshore fisheries mismanagement (see Milich, 1999). Despite this mistrust, the interviewees requested education programs and more interaction with wildlife managers, suggesting an opportunity to improve relations.

Further engagement with hunting communities could improve data collection on hunting practices and views as they change over time (Benham, 2017; Byrd et al., 2017), and hunter education is known to be an effective tool in seabird conservation (Blanchard & Nettleship, 1992; Chardine et al., 1999). Hunting community engagement can take various forms—such as surveys, public in-person consultations, workshops, and advisory committees—depending on the goals of the regulatory body (Chase et al., 2002). In the past, NL hunters responded well to mail-in surveys regarding proposed murre harvest regulations, with a 31% response rate (1,847 respondents; Chardine, 1994). Although wildlife managers may prefer modern tools like online surveys, the hunters interviewed in our study reported limited internet use, which is likely typical of rural coastal communities in NL. The results from our study clearly suggested that making responses to the National Hunting Survey mandatory could improve data quality. Smith et al. (2022) also emphasized the need for higher response rates in certain zones in NL to strengthen their estimates for murre harvests using both ecological and sociological data.

Public meetings and workshops are effective approaches to community engagement (Chess & Purcell, 1999). Public meetings could be used to gather information similar to those obtained from questionnaires (e.g., Chardine, 1994), while workshops could be used to focus on topics such as species identification and murre biology. Holmgaard et al. (2018) successfully implemented an adaptive management plan for Pink-footed Geese that included workshops and surveys for hunter organizations in Norway. The hunters in our study had a deep understanding of their region. They knew when and where to hunt and were usually the first to report anomalies in Bonavista Bay (e.g., mortality events). However, the interviewees identified a significant gap in hunter knowledge of murre biology. This gap was also identified in the 1990s during MBCA consultation processes (B. Turner, personal communication, January 20, 2022), yet hunters have had few opportunities since then to engage with resource managers in ways that might improve their understanding. Workshops can provide an opportunity for resource managers to educate murre hunters, facilitate dialogue, and receive valuable feedback. Hunter participation in workshops can assist in breaking down barriers between resource managers and hunters, fostering strong engagement in murre management and conservation. For example, in an effort to reduce Whooping Crane *Grus americana* mortality, the state of Texas produced a video that was presented at hunter workshops, and the authors recommended similar outreach to hunters in areas with migratory bird hunting programs (Linam et al., 2008).

The goal of the MBCA hunting regulations is to ensure the conservation of hunted species. The current management regulations for the murre harvest are based on the best available data; however, data gaps remain (Smith et al., 2022). In rural NL, enforcement is limited, the populace is spread along vast stretches of coastline, and most violations are not reported. These factors make it challenging to ensure hunter compliance, which may compromise the quality of the data used to manage the hunt (see Cox et al., 2024; Frederiksen et al., 2019; Merkel et al., 2016; Smith et al. 2022).

This paper focused on hunters' perspectives in one region in NL. While their views may reflect broader perspectives across the province, more in-person research in various hunting zones is needed. The successful implementation of wildlife management regulations relies strongly on stakeholder support (e.g., Chase et al., 2002). The community engagement efforts initiated in the 1990s must be reinvigorated. Doing so could help the Canadian Wildlife Service build greater support for regulatory compliance and ensure future decisions about the hunt are informed by more robust and higher quality data (see Chase et al., 2002).

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AUTHOR CONTRIBUTIONS

CWH: Conceptualization, investigation, methodology, formal analysis, writing—original draft, writing—review & editing. GRWH: Conceptualization, methodology, writing—review & editing, visualization. AMCR: Conceptualization, methodology. GSF: Conceptualization, methodology, writing—original draft, writing—review & editing, visualization, supervision.

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