Government of Northwest Territories
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Mackenzie Mountain Non-resident and Non-resident Alien Hunter Harvest Summary 2015

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ABSTRACT

Each of the eight licenced outfitters and Renewable Resource Officers with the Sahtú and Dehcho Environment and Natural Resources (ENR) regional offices collected data on big game harvested in the Mackenzie Mountains during the 2015 hunting season. Harvest data and observations of wildlife from non-resident and non-resident alien hunters (collectively called "non-resident" for this report) were recorded. This year, big game hunting licences were bought by 447 non-resident hunters, the greatest number of licences purchased in any year from 1991-2015 (range 321-447), 10% above 2014 and 20% more than the average of 373 licences. Hunters (n=364) from outside Canada (non-resident aliens) were primarily from the USA (n=310) and comprised 69% of the outfitted hunters; 18 and 11 hunters were from Germany and Mexico respectively, with eight hunters coming from Poland. There were 83 (19%) Canadian hunters, whose residency was from outside the Northwest Territories (NWT); of these, 67 were from Alberta or British Columbia. A 5% increase in hunters from the USA over 2014 was offset by a 5% decrease in Canadian hunters. Of the 447 non-resident licence holders, 413 came to the NWT and most spent at least some time hunting.

Hunter satisfaction remains high; 98% of respondents (n=290) rated their experience as either excellent (86%) or very good (12%). The high quality hunting experience, the abundance of wildlife in the Mackenzie Mountains (both game and predators), and the

impressive management and stewardship of the land were specifically commented on. Repeat clients (21% of respondents) had returned for a 2nd to 21st hunt, and 88% of respondents indicated they would like to return in future years. We received 72% of the voluntary hunter observation forms, the second consecutive year with >70% return and fourth greatest since 1995, which is encouraging.

Two hundred and ninety-one tags were purchased for Dall's sheep, more than in any previous year. The harvest of 219 rams (including five by resident hunters), was the most in any year since records have been kept. Average annual ram harvest from 1991-2015 was 198. The mean (±SD) age of harvested rams was 10.6±1.5 years; the third highest average age since records have been kept (1967), and the 28th consecutive year the average age of harvested rams from the Mackenzie Mountains has been ≥9.5 years. The average right horn length was 88.0 cm; percent of broomed horns was higher than average. Hunters reported seeing fewer legal rams (horns at least ¾ curl) than rams with horns <¾ curl during their hunts, average seven legal rams/hunt. Based upon hunter observations we estimated 58.3 lambs and 72.1 rams per 100 ewes, respectively. Preliminary results, based upon the measurements of individual annuli from 741 rams harvested 2002-2015, revealed the presence of a cohort effect suggesting that birth year conditions impact the growth rates of Dall's sheep in the southern Mackenzie Mountains. Preliminary analysis of genotyping 405 rams harvested throughout the Mackenzie Mountains indicates that sheep from the Ogilvie and Mackenzie Mountains can be further

subdivided into four clusters largely delineated by river drainages and mountain range boundaries.

In 2015, 347 tags were purchased for northern mountain caribou, the greatest number since reporting started in 1991. The harvest of 190 bull caribou was the second highest since records have been kept and higher than the average of 162 (range 117-191) from the past 25 years. Hunters observed an estimated 43.0 caribou calves and 50.0 bulls per 100 adult female caribou, respectively.

One hundred and seventeen tags were purchased for moose this year, the fourth highest since reporting started in 1991. The harvest of 71 bull moose was lower than the average of 74 since 2005. Hunters observed an estimated 33.7 moose calves and 98.1 bulls per 100 adult female moose, respectively. This year the cow:calf ratio was >30:100 after two years below 30:100. Teeth from 133 harvested moose have voluntarily been provided for aging; the age range is 3-15 years (mean 7.7; median 7.0).

This year 71 tags were purchased for mountain goats, more than in any previous year. Seventeen goats (fifteen males, two females) were harvested, similar to the mean annual harvest 2005-2015. The mean age determined by horn annuli, was 7.2 years (range 3.5-14.5 years). Hunters observed an estimated 67.5 goat kids and 92.5 billies per 100 adult nannies.

More wolf tags were purchased in 2015 than in any other year since records started in 1991; 20 wolves were harvested from 358 tags purchased including four wolves harvested during the winter season in zone S/OT/01. The harvest of 20 is higher than the average of 15 since 1991. Hunters observed 152 wolves in 2015 (range 142-317 observed annually 1995-2014). Two wolverines were harvested from 178 tags purchased in 2015. Wolverines were observed in six of eight zones with hunters observing 23 wolverines including three pairs and a family of three. Two black bears were harvested from 20 tags purchased. Only seven black bears have been harvested in the Mackenzie Mountains since 1991. This year two black bears were observed well north of 64°N latitude. There has been no grizzly bear hunting season for non-residents since 1982. More grizzly bear adults (n=566) and adults plus cubs (n=656) were observed in 2015 than in any year since records started in 1996. 2014 was the first year when >500 adults and >600 adults plus cubs were observed. Twelve nuisance grizzly bears were killed in 2015, the most bears killed since 1993 when records started. This year saw the second hunter to be mauled by a grizzly bear; he sustained serious injuries. In 2014 there was the first fatal mauling since non-resident grizzly bear hunting was closed in 1982.

We continue to use summary meat recording forms in addition to AMMO meat forms and for the fifth year we have information about meat distribution for all eight outfitters. An estimated minimum of 23,755 kg (52,261 lbs.) of wild game meat, mostly moose and mountain caribou, was distributed locally this year. Replacement cost of meat from local

northern retailers is conservatively estimated at $593,875 using a $25/kg average replacement cost.

This was the last year outfitter zones D/OT/01, D/OT/02, and S/OT/03 were able to hunt within the expanded Nahanni National Park Reserve and the Nááts'ihch'oh National Park Reserve boundaries. Most mountain goat harvest occurs in zones D/OT/01 and D/OT/02. The loss of the expansion area will significantly reduce the area available to hunt goats. We anticipate tag purchases, goat harvest, and voluntary goat observations to be reduced starting in 2016.

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INTRODUCTION

General Background

The 140,000 km^2 (54,000 mi^2; 34.6 million acres) area of the Mackenzie Mountains in the western Northwest Territories (NWT) was first opened to non-subsistence hunters in 1965 (Simmons 1968). Since then, the Mackenzie Mountains have become world-renowned for providing a high quality wilderness hunting experience (Veitch and Simmons 1999, www.spectacularnwt.com/whattodo/hunting/themackenziemountains, www.huntingreport.com), particularly for Dall's sheep and more recently moose. In return, non-resident hunters and outfitters in the Mackenzie Mountains provide about $2.5 million annually to individuals, businesses, and governments in the NWT (Harold Grinde personal communication). The outfitted hunting industry in the Mackenzie Mountains also provides employment for 150-170 outfitters, guides, pilots, camp cooks, camp helpers, and horse wranglers (Werner Aschbacher personal communication). In addition, fresh meat from many harvested animals is provided to a number of local communities including Tulít'a, Fort Good Hope, and Norman Wells in the Sahtú and Wrigley, Nahanni Butte, Fort Liard and Fort Simpson in the Dehcho. This meat is distributed among local elders and residents and to health/long term care facilities. The estimated annual replacement value of this meat has ranged from *ca.* $60,000-$625,000.

Eight outfitters are currently licenced by the Government of the Northwest Territories (GNWT) to provide big game outfitting services within the Mackenzie Mountains (Figure 1, Appendix A). No hunting is permitted within the original boundaries of Nahanni National

Park Reserve (NNPR) (Figures 1, 2) except for subsistence harvest by NWT (GHL) holders. Harvest by clients of outfitters has been permitted within the expanded boundaries of NNPR since 2009. Under the NWT *Wildlife Act*, each licenced outfitter has the exclusive privilege of providing services within their zone, which enhances the outfitters' ability to practice sustainable harvest through annual allocation of the harvest effort.

The hunting licence year in the NWT runs from 01 July - 30 June and those who do not have Aboriginal or treaty harvesting rights and who desire to hunt big game within the NWT must annually obtain a big game hunting licence (Environment and Natural Resources 2014a). Any youth under the age of 18 must have the consent of a parent or guardian to obtain a licence. There are four classes of licenced big game hunters in the NWT:

1) *General:* subsistence harvesters, primarily Aboriginal people.
2) *NWT Resident:* Canadian citizens or landed immigrants who have been living in the NWT for at least 12 continuous months prior to application for the licence.
3) *Non-resident:* Canadian citizens or landed immigrants who live outside the NWT, or have not resided in the NWT for 12 months prior to application for the licence.
4) *Non-resident Alien:* an individual who is neither a NWT resident nor a non-resident.

Figure 1: Outfitting zones and land claim areas (dotted lines) of the Mackenzie Mountains, NWT, with NNPR original boundary, prior to 2009 expansion, indicated.

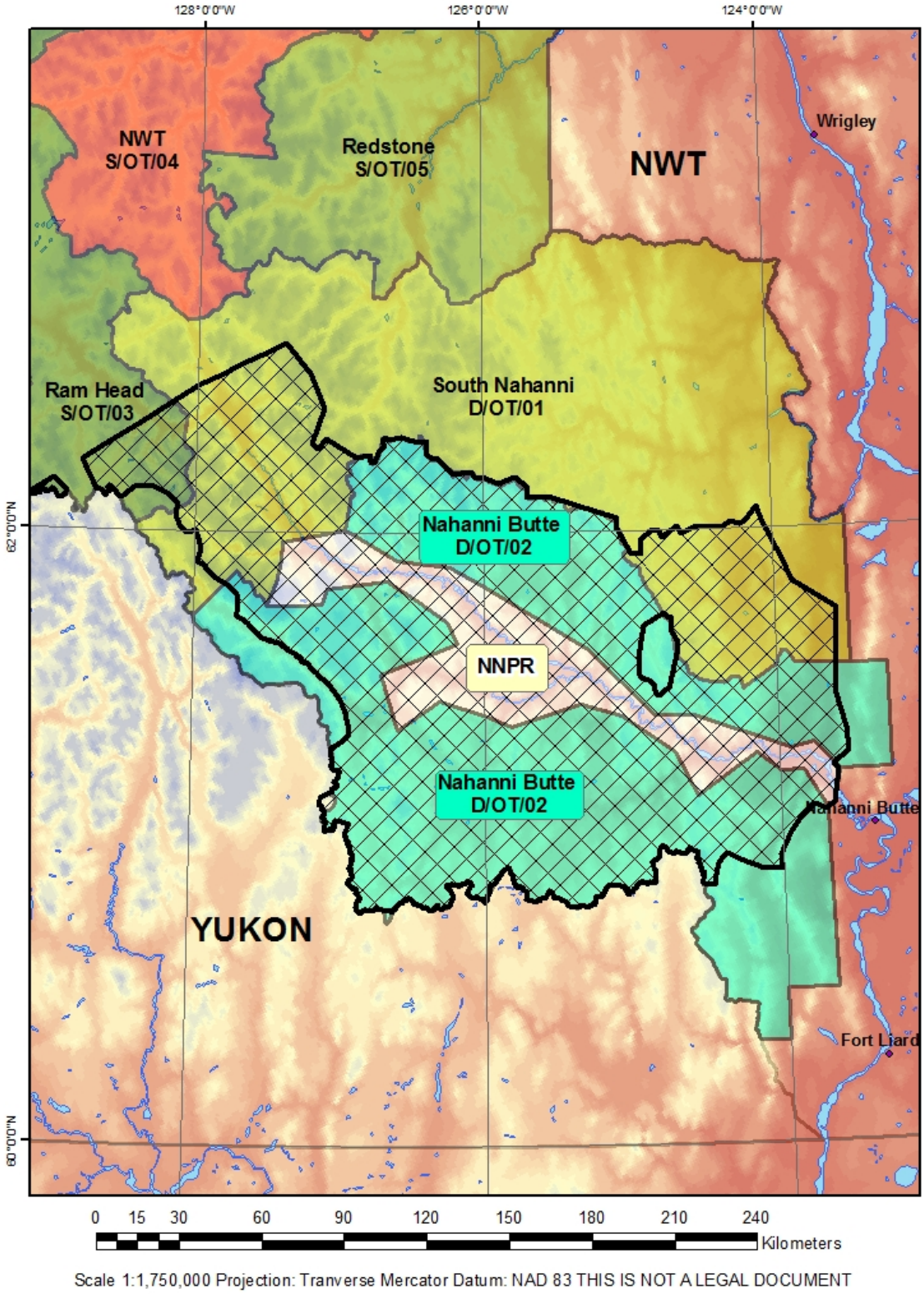

Figure 2: The original area of NNPR, in white, with the expanded boundary (9 June 2009) indicated by the checkered polygon.

Both non-resident and non-resident alien hunters must use the services of an outfitter and must be accompanied by a licenced guide at all times while hunting big game. For simplification in this report, we call both non-resident and non-resident alien hunting licence holders 'non-residents' and combine their harvest statistics. The data from five resident hunters, who harvested Dall's sheep in the Mackenzie Mountains without a guide, have been included in the number of sheep harvested and the age and horn length measurements in this report as indicated.

Individual non-resident hunters are annually restricted to one each of the following big game species (Appendix B): Dall's sheep (male with at least one ¾ curl horn), northern mountain woodland caribou (either sex), moose (either sex), mountain goat (either sex), wolf (either sex)[1], wolverine (either sex), and black bear [adult not accompanied by cub(s)]. Although non-resident hunters are allowed to hunt female moose and caribou they prefer to hunt males for their trophy antlers and the harvest is exclusively males. Non-resident hunting for grizzly bears was closed in 1982 as a result of concerns about over-harvest (Miller et al. 1982, Latour and MacLean 1994). There are currently no restrictions on the total number of each big game species that an outfitter can take within the zone for which they are licenced.

Wildlife management within the Mackenzie Mountains is the responsibility of a variety of government agencies and boards set up as a result of comprehensive land claim

[1]In the Sahtú region, non-resident hunters and non-resident alien hunters are allowed to hunt two wolves from 1 August - 15 April in S/MX/01. Only one wolf can be hunted in the Dehcho and Gwich'in areas.

agreements. The NNPR (4,766 km^2 original pre-2009 boundary) in the south Mackenzie Mountains is managed by Parks Canada – an agency of the Canadian federal government. Under the terms of the *Sahtú Dene and Métis Comprehensive Land Claim Agreement* (signed in 1993) and the *Gwich'in Comprehensive Land Claim Agreement* (signed in 1992), the main instrument of wildlife management within the two settlement areas lies with the Sahtú Renewable Resources Board (SRRB) and the Gwich'in Renewable Resources Board (GRRB), respectively. Approximately 68,000 km^2 of the central and northern Mackenzie Mountains are within the Sahtú Settlement Area and 8,300 km^2 are within the Gwich'in Settlement Area, which encompass the extreme north end of the range (Figure 1). However, the GNWT maintains ultimate jurisdiction for management of wildlife and wildlife habitat within each of the claim areas. The Department of Environment and Natural Resources (ENR) is responsible for licencing outfitters, guides, and hunters and for annually monitoring non-resident big game harvest in the Mackenzie Mountains.

Each year ENR, under the *Wildlife Act* related provisions in the *Wildlife Business Regulations*, requires outfitters to submit an outfitter return on a client hunter success form for each person that purchased an NWT non-resident big game hunting licence (Figure 3). These are known as outfitter return forms and they must be submitted whether or not a client actually hunted, and whether or not any game was harvested. The outfitter return forms allow us to quantify harvest by non-resident hunters to help biologists with the GRRB, SRRB, and ENR ensure that the harvest of each species is within sustainable limits.

In 1995, the then Department of Resources, Wildlife and Economic Development (RWED), requested that all non-resident hunters also fill out a voluntary questionnaire. The questionnaire has evolved through the years based upon suggestions from outfitters, their clients, and government staff. Different questions pertaining to wildlife observations, the quality of the hunting experience, the quality of services related to hunter travel, and specific topics for hunter comment have come and gone. However, one key component of the questionnaire that has remained constant pertains to reporting the different types and numbers of wildlife species seen during their hunts. These data have been recorded and the questionnaire forms have been referred to as hunter observation forms in this report (Figure 4). These data provide valuable time series of observations and are used in assessing mountain caribou herd status (Larter 2012a).

This is the twenty-first consecutive year that a summary of the data collected by ENR on non-resident hunters in the Mackenzie Mountains has been made. In the text of this document, data for 1995 are found in Veitch and Popko (1996), for 1996 in Veitch and Popko (1997), for 1997 in Veitch and Simmons (1998), for 1998 in Veitch et al. (2000b), for 1999 and 2000 in Veitch and Simmons (2000, 2002, respectively), for 2001 by A. Veitch and N. Simmons (unpublished data), for 2002-2014 in Larter and Allaire (2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015 respectively). Additionally, Latour and MacLean (1994) summarized data for 1979-1990. This report compiles the harvest data collected during the 2015 hunting season and compares it with available data collected since 1995, and earlier when available.

Figure 3: Example of a completed outfitter return on client hunter success form.

Department of Environment and Natural Resources
Pursuant to the *WILDLIFE ACT*

OUTFITTER RETURN ON CLIENT HUNTER SUCCESS

Ministère de l'Environnement et des Ressources naturelles
En vertu de la *LOI SUR LA FAUNE*

RAPPORT DU POURVOYEUR SUR LES RÉSULTATS DE CHASSE D'UN CLIENT

OR017556

INSTRUCTIONS: This form is to be completed as soon as practicable after the big game animal has been killed and is to be submitted before the 10th day of the following month to the Regional Biologist.
Ce formulaire doit être rempli aussitôt que possible après l'abattage du gros gibier et d

OUTFITTER/CLIENT HUNTER - POURVOYEUR/CLIENT CHASSEUR

Outfitter Name - Nom du pourvoyeur	Client Hunter Last Name - Nom de famille du client chasseur	First Name - Prénom	Init.	Hunting Lic. No. - N° du permis de chasse
Gana River Outfitters Ltd	[redacted]			[redacted]

RETURN FOR THE PERIOD OF - RAPPORT MENSUEL POUR
Month: Mois : August 2009

BIG GAME HUNTED - GROS GIBIER CHASSÉ (If none killed, complete "No. of Days Hunted" for each species hunted - Si aucun animal n'a été abattu, remplir la partie «Nombre de jours à la chasse» pour chaque espèce chassée)

Species - Espèce	Tag No. N° de l'étiquette	No. of Days Hunted Nombre de jours à la chasse	Guide	Guide Lic. No. N° de licence du guide	Kill Date Date de l'abattage D-J M-M	Latitude D M	Longitude D M	Miscellaneous - Divers.
Woodland Caribou Caribou des bois	[redacted]							Right Antler Length: Longueur du bois droit : cm / Left Antler Length: Longueur du bois gauche : cm
Moose Orignal								Widest Antler Spread: Largeur du panache (au plus large) : cm
Moutain Goat Chèvre de montagne								Right Horn Length: Longueur de la corne droit : cm / Left Horn Length: Longueur de la corne gauche : cm / Sex - Sexe
Polar Bear Ours polaire								Hide Length: Longueur de la peau : cm / Population / Sex - Sexe
Barren-Ground Caribou Caribou de la toundra								Species - Espèce/No. Seen - Quantité aperçue/Sex - Sexe
Other, specify - Autre préciser Wolf	[redacted]							
Other, specify - Autre préciser Wolverine	[redacted]							
Other, specify - Autre préciser								
Other, specify - Autre préciser								
Dall's Sheep Mouflon de Dall	[redacted] Plug No. - N°ce poinçon	8 Cert. No. - N° de cert.	[redacted] Disc. No. - N° de disque	[redacted] Right Horn Base: Corne droit à la base : cm / Left Horn Base: Corne gauche à la base : cm	19 08	64 37	129 41	Right Horn Length: Longueur de la corne droit : cm / Left Horn Length: Longueur de la corne gauche : cm / Spread - Largeur entre les cornes / Broomed - Corne abîmée Right Droit Left Gauche / Age

COMMENTS - COMMENTAIRES

We are interested in your observations of quantity and quality of wildlife observed, their location, condition, age, sex, species, etc. In addition, please comment on any unusual conditions (i.e. scars, behaviour, etc.) on the harvested animals.

Nous sommes intéressés par les observations que vous avez faites sur la quantité et la qualité de la faune, sa localisation, sa condition, l'âge, le sexe, les espèces, etc. De plus, vous pouvez faire des commentaires sur les conditions inhabituelles observées sur des animaux abattus (cicatrices, comportement, etc.)

OFFICE USE ONLY - RÉSERVÉ AU BUREAU

Export Permit No. - N° du permis d'exportation	Export Permit No. - N° du permis d'exportation	Cites Permit No. N° du permis CITES
Checked By - Vérifié par	Date 20	Entered By - Inscrit par / Date 20

NWT4430305

NOTE: This form must be kept up to date and all records relating to the Outfitter Return are subject to inspection by a Wildlife Officer. It is an offence to give false or misleading information in this return.

NOTE: Cette formule doit être à jour. Un agent de la faune a le plein pouvoir de vérifier la justesse de tout ce qui est inscrit sur le rapport du pourvoyeur. Inscrire des renseignements faux ou trompeurs sur ce formulaire constitue une infraction.

[redacted]
Outfitter - Signature - Pourvoyeur

Date 04092009

Headquaters – Administration Centrale

MACKENZIE MOUTAINS, NORTHWEST TERRITORIES
HUNTER WILDLIFE OBSERVATION REPORT – 2007

Dear Hunter: The Department of Environment and Natural Resources request your kind assistance with completing this questionnaire about your NWT hunting experience, in order to assist us with the management of Mackenzie Mountain big game populations. All the requested information is completely voluntary, but your providing it to us is most appreciated.

HUNTER INFORMATION

First Name	Last Name	
Address – number and street, box number	Town, City	Province, State, Country

Hunting License # Outfitter Zone: 6|0T|01 Outfitter: ARCTIC RED RIVER

Start Date of Hunt 7/15 2007 End Date of Hunt 7/24 2007 Observations Made Over 10 Days

ESTIMATED NUMBER OF DALL'S SHEEP SEEN			
¾ and Full Curl Rams	Less than ¾ Curl Rams	Ewes	Lambs
25	46	24	17

ESTIMATED NUMBER OF WOODLAND CARIBOU SEEN		
Bulls	Cows	Calves
2	1	Ø

ESTIMATED NUMBER OF MOOSE SEEN		
Bulls	Cows	Calves
Ø	Ø	Ø

ESTIMATED NUMBER OF MOUNTAIN GOAT SEEN			
Billys	Nannys	Kids	Unknown Age
Ø	Ø	Ø	Ø

Other Species						
	Wolf	Wolverine	Black Bear		Grizzly Bear	
			Adult	Cub	Adult	Cub
Number(s) Seen	3	Ø	Ø	Ø	1	Ø

How would you rate your overall hunting experience in the Mackenzie Mountains?
Excellent X Very Good _____ Good _____ Fair _____ Poor _____

How many times have you hunted in the Mackenzie Mountains, **including** this year's hunt? 2

Do you plan to return to hunt in the Mackenzie Mountains again? Yes X No _____

COMMENTS: Excellent Area / outfitter.

Thank You! Please give this form to the Officer or Clerk when you are exporting your trophies, or to the guide/outfitter with whom you hunted. We would appreciate receiving this form whether of not you harvested an animal(s).

Figure 4: Example of a fully completed hunter observation report form.

Nahanni National Park Reserve Expansion

NNPR, encompassing an area of 4,766 km^2 in the southern Mackenzie Mountains, was originally established in 1972, after Prime Minister Pierre Elliot Trudeau canoed down the Nahanni River. The Park was in "reserve" status pending settlement of outstanding Aboriginal land claims in the region, which remain ongoing. On 9 June, 2009, the Canadian government, with Dehcho First Nations, announced legislation increasing the area of NNPR to *ca.* 30,000 km^2 (11,583 mi^2). This newly enlarged boundary includes 91% of the greater Nahanni ecosystem and most of the South Nahanni River watershed in the Dehcho region (www.pc.gc.ca/pn-np/nahanni/ne/ne2-ep.asp).

The enlarged boundary also overlaps three of the eight outfitting areas which were established in the Mackenzie Mountains in 1965: Ram Head Outfitters (S/OT/03), South Nahanni Outfitters (D/OT/01) and Nahanni Butte Outfitters (D/OT/02). Of the total area of their outfitting areas, 4.7% of Ram Head, 27.2% of South Nahanni and 79.4% of Nahanni Butte fall within the newly expanded NNPR boundary (Table 1). Since 2009, these three outfitters have been allowed to harvest within the expanded boundary, while Parks Canada was negotiating with them to end sport hunting in the Nahanni area. By the end of 2015 Parks Canada had made monetary settlements with two outfitters: Ram Head and Nahanni Butte Outfitters (Dehcho Drum, January 21, 2016), and according to Parks Canada, four commercial outfitters were compensated due to the expansion (www.cbc.ca/news/canada/north/parks-canada-settlements-nwt-1.3391646).

Subsequently, starting in 2016, guided hunting by outfitters will be restricted to those areas outside of the expanded NNPR boundary. ENR will continue to issue licences, tags,

and export permits for harvesting by these three outfitters in the reduced area of their outfitting areas.

Table 1: The area (km^2) and % of the outfitting area that lie within the 2009 expanded boundary of NNPR.

Outfitter	Outfitting Area (km^2)	Outfitting Area within New NNPR	% of Area within New NNPR
Ram Head Outfitters	19,734.82 km^2	921.27 km^2	4.7 %
South Nahanni Outfitters	25,024.16 km^2	6,811.10 km^2	27.2 %
Nahanni Butte Outfitters	21,962.30 km^2	17,450.66 km^2	79.4 %

The Prairie Creek mine, established in 1966, now falls completely within the newly expanded boundary of NNPR. However, the mine and an area of *ca*. 300 km^2 surrounding the site were specifically excluded from NNPR so that the mine owned by Canadian Zinc was assured of its third party rights to operate and access the mine site. A new bill amending the National Parks Act solely for NNPR was required to assure these third party rights (www.canadianzinc.com).

METHODS

Prior to the start of the 2015 hunting season, each outfitter in the Mackenzie Mountains received sufficient copies of the outfitter return and hunter observation forms for all their clients for the year. The *Wildlife Business Regulations* requires outfitter return forms to be returned by the tenth day of the month following the month of the hunt – e.g. for a hunter that was in the field in July, a form must be submitted by the tenth of August. Those forms were submitted to an ENR office in the Dehcho or Sahtú region, whether or not a client actually hunted and whether or not harvest occurred. In co-operation with ENR Renewable Resource Officers and the outfitters, persistent attempts were made to obtain outfitter return forms for every non-resident that held a big game hunting licence through a Mackenzie Mountain outfitter in 2015.

Data from both the outfitter return forms and hunter observation forms were entered into Microsoft Excel (Microsoft Corporation 2010) spreadsheets. Data were cross-checked with the records of sequentially numbered, unique identifier plugs inserted in the horns of legally harvested rams found in the Licence Information System-Intranet (LISIN) data management system maintained by ENR offices across the NWT, and also with GNWT wildlife export permit forms, to ensure that all data were verified and the spreadsheets contained all appropriate available data required for analyses.

We distributed new hunter observation forms in 2015 for consistency and recorded all observations directly from these hunter observation forms. If we did not receive a hunter

observation form, but wildlife observation data were recorded on the outfitter return form, we used these wildlife observation data. If observation information differed between the hunter observation form and the outfitter return form for the same client, we used the data from the hunter observation form. Occasionally we received identical observation data from forms of different hunters. These hunters had the same guides and lengths of hunts, and obviously had hunted together. We recorded forms with data that had been provided, but for the wildlife observation analyses only one set of observations was used.

All descriptive statistical analyses were performed using Microsoft Excel. We present means ± standard deviation (SD). Some additional statistical analyses were performed using Minitab 7.2 software (Minitab Inc. 1989).

Larter et al. (2016) provides a more detailed and comprehensive account of various element levels found in tissues from Dall's sheep, mountain caribou, moose, and mountain goat that were presented in the 2014 harvest study.

RESULTS AND DISCUSSION

Hunters

In 2015, big game hunting licences for the Mackenzie Mountains were bought by 447 non-resident hunters from 14 countries (Table 2). This is the greatest number of licences purchased in any year from 1991-2015 (range 321-447), 10% more than last year and 20% greater than the average of 373 licences for the same period (Figure 5, Appendix F). Of those 447 hunters, 413 came to the NWT and spent some time hunting. The remaining 34 either cancelled their hunts, decided not to hunt for themselves but participated with other hunters they knew, or decided not to hunt due to unforeseen complications after arriving in the NWT. Seventeen of these 34 were guides. Guides often purchase licences every year but rarely have the opportunity to hunt themselves.

In 2015, licence sales to residents of countries other than Canada and the United States (n=54) represented 12% of sales, a 5% decrease since 2013. Non-resident Canadians purchased 19% (n=83) of licences, a 5% decrease over 2014. Licence sales to hunters from the United States represented 69% of the total (Table 2, Figure 6). This is an almost 5% increase over 2014 and a 10% increase over 2013. Licence sales from 2006-2013 had been consistent at about 61% hunters from the United States, 24% Canadian hunters and 15% hunters from countries other than Canada and USA. The rapid decline in strength of the Canadian dollar and continued strength of the American dollar may have been a factor in the recent decline of Canadian and foreign hunters as guided hunts are marketed in American dollars.

Table 2: Province, state and/or country of origin of the 447 non-residents who purchased licences for hunting in the Mackenzie Mountains, 2015.

Canada		United States		W. Europe		Other	
Yukon	**3**	Eastern States[1]	**123**	Germany	**18**	Mexico	**11**
British Columbia	**33**			Spain	**1**	Russia	**1**
Alberta	**34**	Western States[2]	**187**	Belgium	**2**	Chile	**2**
Saskatchewan	**6**			Austria	**3**	Poland	**8**
Manitoba	**1**			France	**2**		
Ontario/Quebec	**5**			Switzerland	**1**		
Newfoundland and Labrador	**1**			Czech Republic	**3**		
				Latvia	**2**		
Total	**83**		**310**		**32**		**22**

[1]AL, AR, CT, DE, FL, GA, IL, IN, IA, KY, LA, ME, MD, MA, MI, MN, MS, MO, NH, NJ, NY, NC, OH, PA, RI, SC, TN, VT, VA, WV, WI
[2]AK, AZ, CA, CO, HI, ID, KS, MT, NE, NV, NM, ND, OK, OR, SD, TX, UT, WA, WY

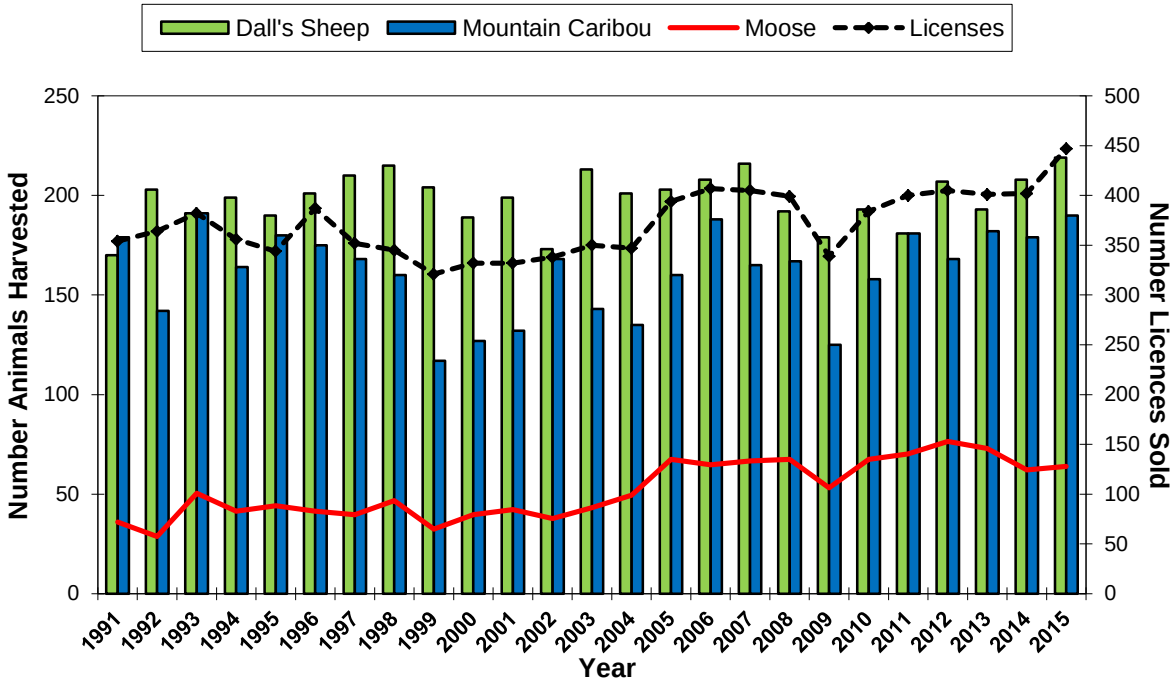

Figure 5: The number of Dall's sheep, mountain caribou, and moose harvested in the Mackenzie Mountains by non-resident hunters, and the number of non-resident licences sold during 1991-2015.

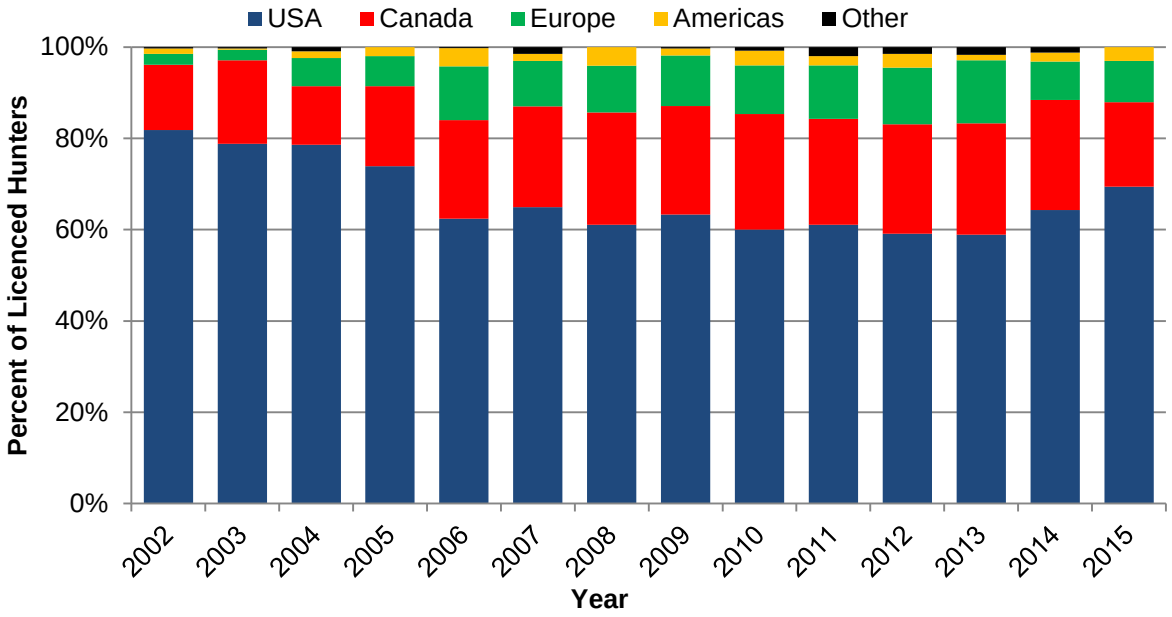

Figure 6: The geographical areas of origin of hunters purchasing licences (in %) to hunt in the Mackenzie Mountains from 2002-2015.

In general guided hunting in the Mackenzie Mountains occurs from July to October; however successful guided hunting for wolves also occurs during winter in area S/OT/01. Wolves were harvested during winter 2015/16 in area S/OT/01 for the seventh consecutive year; four wolves were harvested in April 2016.

We received all but three mandatory outfitter return forms for the 447 people that purchased non-resident licences. We received 298 (72%) of the possible 413 voluntary hunter observation forms from hunters in 2015 (Table 3). This is an encouraging sign as it is the second consecutive year we have received at least a 70% return and the fourth highest return since we initiated voluntary reporting in 1995. The need for returning voluntary observation forms has been emphasized at Association of Mackenzie Mountain Outfitters (AMMO) general meetings. Some of the recent increase may be attributed to a change in ownership of S/OT/04 for the 2014 hunting season; the majority of hunters from

this zone returned hunter observation forms which had not been the norm previously. Although most outfitters endeavour to have clients complete and submit these forms, we received only 31% of the 71 forms from G/OT/01, 52% of the 64 forms from S/OT/02, and 9% of the 35 forms from S/OT/03. The limited returns, from outfitting areas with fairly large clientele, remain a concern because it precludes the ability to generalize observations over the entire Mackenzie Mountains. Two areas with low returns cover the greatest range in latitude in the Mackenzie Mountains (Figure 1). See Figure 4 as an example of a fully completed hunter observation form.

Table 3: Percent of Mackenzie Mountain outfitter and non-resident hunter forms submitted, 1995-2015.

Form Type	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Outfitter Return (mandatory)	99	99	98	99	99	98	99	99	98	99
Hunter Observation (voluntary)	72	75	56[1]	60	62	60	62	71	65	64

Form Type	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995
Outfitter Return (mandatory)	100	99	98	95	92	96	96	97	98	100	98
Hunter Observation (voluntary)	65	74	60	59	57	53	51	60	50	71	80

[1] 5% of forms were lost after being completed but prior to submission.

It is obvious that non-resident hunters immensely enjoy their hunting experience in the Mackenzie Mountains (Table 4). In 2015, 98% of respondents rated their experience as either excellent (86%) or very good (12%). Not only do voluntary client comments make specific mention of the high quality of hunts (56%; n=95), and the abundance/quality of

animals (27%; n=45; Appendices C, D), many comments make reference to (1) the professional and world class experience with their chosen guides, (2) the abundance of a wide variety of game species and predators, (3) the apparent health and condition of the game animals, (4) the pristine and scenic environment of the Mackenzie Mountains, and (5) compliments on the management and stewardship of the land.

Table 4: Satisfaction ratings for non-resident hunters (including non-hunting guides) in the Mackenzie Mountains, 1996-2015.

Rating	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Number of Hunters Reporting	290	262	207	212	210	193	191	239	239	230
Excellent (%)	86	88	86	93	90	88	86	85	81	80
Very Good (%)	12	10	11	5	6	10	12	10	12	16
Good (%)	2	2	2	2	4	1	2	4	5	3
Fair (%)	0	0	1	0	0	1	0	1	2	1
Poor (%)	0	0	0	0	0	0	0	0	0	0
Rating	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**
Number of Hunters Reporting	256	229	191	193	191	158	157	202	144	224
Excellent (%)	90	84	82	82	75	76	73	80	78	77
Very Good (%)	7	10	15	15	16	17	20	17	17	17
Good (%)	2	5	3	3	6	6	5	2	3	2
Fair (%)	1	0	0	0	1	0	1	1	1	3
Poor (%)	0	1	0	0	1	1	2	0	1	1

Comments about grizzly bears have been common since the start of the voluntary hunter observation forms in 1995; their abundance, problems created around camps and kills, and the lack of, and need for, a grizzly hunting season being consistent themes. This year was no different (Appendices C, D). In 2000 we started getting comments about high wolf

numbers. This year was only the second year since 2000 that there were no comments about wolf numbers. We continue to get comments about the expansion of NNPR mostly about lost hunting opportunities, six years after the expansion. The 2015 season was the last year for outfitted hunting in the expanded NNPR boundaries (see Figure 2).

It was the first time hunting in the Mackenzie Mountains for 228 of 290 (79%) respondents (including non-hunting guides). The 62 repeat hunters had hunted from two to 21 times previously. Of 290 respondents (including non-hunting guides) 88% indicated they would like to return to the Mackenzie Mountains to hunt in the future.

ENR continues to provide outfitters with summary meat record forms which can be used in conjunction with AMMO meat forms to provide better reporting of harvested meat. Both forms record the amount of meat (Dall's sheep, northern mountain caribou, moose, and mountain goat) taken from harvested animals and how the meat was used and/or distributed. This year we received summary forms from all eight outfitters, an additional 135 AMMO meat forms were also submitted. This is the fifth consecutive year we received records of meat distribution from all eight outfitters.

The distribution of wild game meat by outfitters is an important and greatly appreciated local benefit but can often be a topic of heated local debate. Meat is used in outfitter camps by guides and clients, is taken out with clients, and is provided to local communities. We believe that the information from summary meat record forms provides a better overall picture of the amount of wild game meat being distributed by the outfitters. Generally the

majority of meat from harvested Dall's sheep and mountain goats is used in outfitter camps. Nevertheless, at least 2,123 kg (4,670 lbs.) from 217 harvested Dall's sheep and 342 kg (752 lbs.) from 17 harvested mountain goats was distributed locally. Northern mountain caribou and moose meat is also used in outfitter camps, but harvested mountain caribou and moose make up a large portion of the wild game meat that is distributed locally: at least 8,127 kg (17,879 lbs.) from 190 northern mountain caribou and at least 13,164 kg (28,960 lbs.) from 71 moose. If we use a relatively conservative $25/kg as the replacement cost for meat from local northern retailers, then some $593,875 of meat was distributed locally in 2015.

Dall's Sheep (*Ovis dalli*)

Dall's sheep is one of the most desired species sought by non-resident hunters in the Mackenzie Mountains. Tags to hunt Dall's sheep were purchased by 291 (65%) non-resident hunters in 2015. This is the greatest number of tags purchased in the past 21 years (Table 5). At least 75% of sheep tag holders (including five resident hunters) pursued Dall's sheep, harvesting 219 rams; the most since records have been kept (Figure 5, Appendix F). The mean (±SD) length of a sheep hunt was 4.0±3.0 days, similar to hunt lengths from 1997-2015 (Table 6), but less than the 5.3 day average from 1979-1990 (Latour and MacLean 1994). Outfitted hunts in the Mackenzie Mountains are generally booked for ten days; when hunters fill their sheep tag, any remaining time is typically spent in pursuit of other big game species for which tags are held, or in hunting small game. The number of hunters taking multispecies hunts has increased in recent years (Jim Lancaster personal communication and Werner Aschbacher personal communication).

Table 5: Tags for big game species purchased by non-resident hunters with outfitters in the Mackenzie Mountains, 1995-2015.

Species	2015 447 hunters		2014 402 hunters		2013 401 hunters		2012 396 hunters		2011 400 hunters		2010 384 hunters		2009 339 hunters		2008 391 hunters		2007 399 hunters		2006 407 hunters	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Dall's Sheep	291	65	264	66	264	66	270	68	251	63	253	66	215	63	261	67	266	67	276	68
Mountain Caribou	347	78	327	81	296	74	300	76	314	79	295	77	252	74	275	70	272	68	274	67
Moose	117	26	123	31	131	33	115	29	121	30	116	30	96	28	109	28	108	27	112	28
Mountain Goat	71	16	57	14	58	14	42	11	55	14	45	12	45	13	45	12	50	13	21	5
Wolf	358	80	298	74	299	75	292	74	285	71	294	77	252	74	228	58	227	57	201	49
Wolverine	179	40	154	38	155	39	153	39	163	41	171	45	133	39	111	28	150	38	108	27
Black Bear	20	4	19	6	34	8	16	4	32	8	28	7	22	6	2	1	7	2	3	1

Species	2005 394 hunters		2004 337 hunters		2003 347 hunters		2002 329 hunters		2001 339 hunters		2000 332 hunters		1999 321 hunters		1998 345 hunters		1997 352 hunters		1996 387 hunters		1995 343 hunters	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Dall's Sheep	246	62	229	68	257	74	218	66	220	65	231	70	227	71	246	71	252	72	252	65	218	64
Mountain Caribou	285	72	243	72	247	71	229	69	201	59	206	62	181	56	223	65	260	74	274	71	233	68
Moose	101	26	84	25	85	24	68	21	65	19	69	21	63	20	69	20	73	21	74	18	70	20
Mountain Goat	40	10	24	7	18	5	18	5	12	4	12	4	6	2	23	7	30	8	14	4	16	5
Wolf	214	51	166	49	207	60	159	48	137	40	155	47	89	28	165	48	209	59	193	50	72	21
Wolverine	154	39	89	26	141	40	97	29	83	25	85	26	65	20	99	29	135	38	114	30	35	10
Black Bear	40	10	8	2	9	3	3	1	0	0	6	2	2	<1	2	<1	8	2	0	0	0	0

Table 6: Mean length, SD, and range (in days) of Dall's sheep hunts where at least one day was spent hunting from 1997-2015.

		2015	2014	2013	2012	2011	2010	2009	2008	2007
Number of Reports		213	206	193	207	173	179	179	192	216
Mean Hunt Length		4.0	3.8	4.0	4.0	4.0	4.0	3.9	3.7	4.1
SD		3.0	2.9	3.0	3.0	3.0	3.0	2.6	2.6	2.6
Range		1-15	1-14	1-13	1-14	1-11	1-13	1-10	1-14	1-13
	2006	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**
Number of Reports	214	190	167	189	174	176	198	201	224	216
Mean Hunt Length	4.1	4.1	4.0	3.8	4.7	4.8	4.6	4.7	4.4	4.3
SD	2.7	2.6	2.9	2.9	2.7	3.0	2.7	3.1	2.8	2.6
Range	1-12	1-14	1-17	1-12	1-15	1-15	1-15	1-16	1-15	1-12

Harvest by non-residents comprises at least 90% of the total annual harvest of Dall's sheep in the Mackenzie Mountains and takes only 0.9-1.6% of the estimated 14,000-26,000 Dall's sheep in the Mackenzie Mountains (Veitch et al. 2000a). Therefore, the current non-resident harvest level appears well within sustainable limits, provided that hunting pressure is geographically distributed across each of the zones. The 2015 harvest of 219 rams is *ca.* 1.6% of 14,000. In the Yukon (YT) - where harvest is managed by a full curl rule – Dall's sheep managers have set the sustainable harvest at 4% of the non-lamb population (YT Renewable Resources 1996). In those areas of the YT where the management objective is to increase population size, harvest is limited to 2% of the total population.

There has been remarkable consistency in the mean outside contour length of the right horns from rams harvested by non-residents for the past 44 years (1972-2015), mean 89.0±1.6 cm (SD) (Appendix E, Table 7), which is surprising given the increase in average age of harvested sheep during that same period. We expected to see more broomed or broken horn tips on older animals, since horn breakage generally occurs as a result of fights between rival males (Geist 1993).

The maximum left and right horn lengths reported in 2015 were 104.5 and 104.0 cm respectively (Table 7). The maximum horn length recorded by Boone and Crockett for Dall's sheep in North America is 110.5 cm (43.5 in.) for a sheep taken from the Mackenzie Mountains in 2005. Two of the top 50 Dall's sheep recorded in the 13th edition of the Boone and Crockett Club record book are from the Mackenzie Mountains; the highest scoring horns hold 31st place (Boone and Crockett Club on-line trophy database accessed 2016).

Table 7: Measurements of Dall's sheep ram horns from sheep harvested by non-resident hunters in the Mackenzie Mountains, 2015.

	Left Horn Contour Length		Right Horn Contour Length		Left Horn Base Circumference		Right Horn Base Circumference		Tip to Tip Spread	
	cm	in	cm	in	cm	in	cm	in	cm	in
Mean	87.8	34.6	88.0	34.6	32.6	12.8	32.5	12.8	57.4	22.6
SD	7.9	3.1	9.5	3.7	1.6	0.6	2.8	1.1	9.4	3.7
Maximum	104.5	41.1	104.0	40.9	37.0	14.6	36.5	14.4	87.0	34.3
Minimum	61.0	24.0	59.5	23.4	27.3	10.7	27.0	10.6	22.5	8.8

This year we aged all 219 harvested rams; 148 (68%) were ≥10-years-old. The mean age (±SD) of harvested rams was 10.6±1.5 years (range 6.5-15.5 years, Figure 7). This is the

third highest average age of harvested rams recorded in the Mackenzie Mountains since records have been kept (1967) and the 28th consecutive year where the reported mean age of harvested rams was 9.5 years or older (Appendix E). This year we report a higher percent broomed horns than the 19 year average, 34% left and 35% right versus 31% left and 32% right. This is not unexpected as more older rams were harvested this year than most.

The continued high age of harvested trophy sheep may be a result of harvest being spread out in time and space within hunting areas. Exclusivity of non-resident big game harvesting within each area provides the opportunity for outfitters to harvest in different parts of their area on a rotational basis and forgo hunting in some areas for two or three seasons. In recent years some outfitters have used helicopters to gain access into areas not accessible by horseback. These areas have not been exposed to hunting previously, and spread out the harvest in space, likely contributing to the continued high average age of harvested rams.

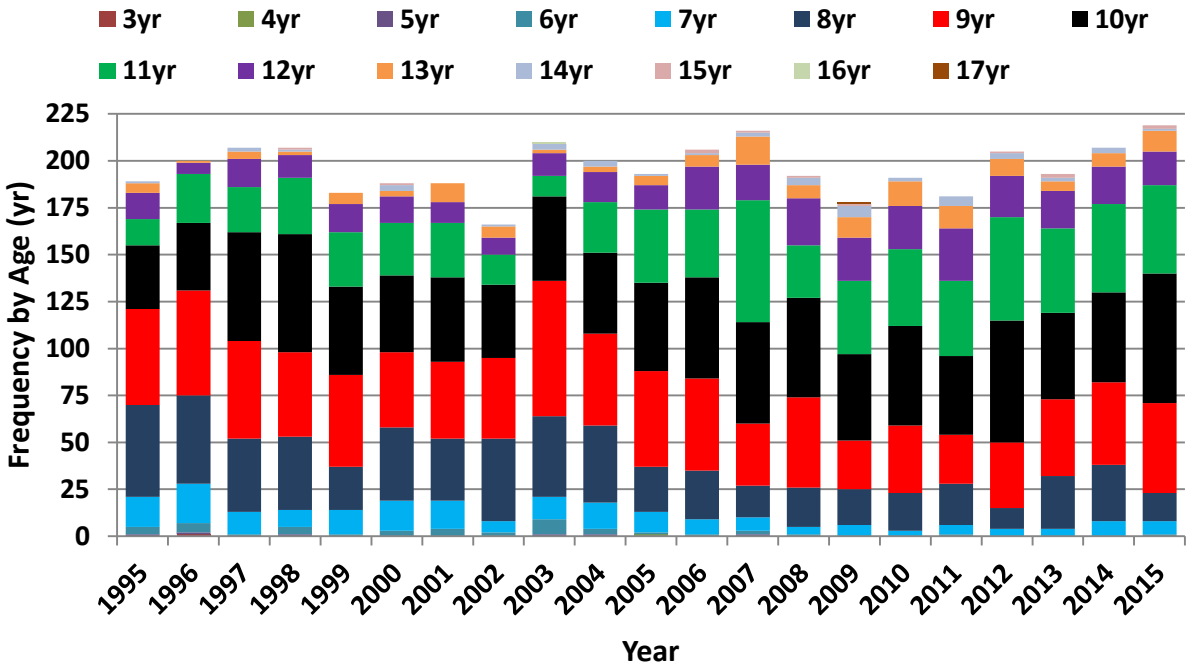

Figure 7: Age-structure of Dall's sheep ram harvest by non-resident and resident hunters in the Mackenzie Mountains, 1995-2015, based upon counting horn annuli.

Horns are not shed annually and provide detailed records of growth history in the form of discernable annual growth segments, or annuli. Annuli are evident in the keratin sheath of the horn, and form as the result of a stop-start pattern of growth in the winter and spring seasons, respectively. Horn growth can be limited by resource availability which is regulated by regional climatic conditions (Hik and Carey 2000). Examining horn growth patterns over time can reveal years of high and low environmental productivity. Since 2002 ENR has tried to measure the annuli from as many harvested Dall's sheep rams as possible using a flexible tape to measure the length and basal circumference of each segment. From 2002-2015, 741 Dall's sheep horns were measured.

Preliminary results showed that horn growth patterns were influenced by year of birth and demonstrated both statistically and biologically significant variation in volume acquisition as a function of age. This reveals the presence of a cohort effect, which suggests that birth year conditions impact the growth rates of Dall's sheep in the southern Mackenzie Mountains (K. Eykelboom unpublished data). Although the underlying cause of this variation is not clear, similar trends were seen in neighbouring populations of Dall's sheep in the YT. It is likely that climate plays a role in horn growth variation, and correlations in the YT have been found between horn growth periodicity and inter-decadal climate variability (Hik and Carey 2000). Further analysis of these patterns is underway.

We calculated an estimated 58.3 lambs per 100 ewes based upon hunter classifications of sheep observed during their hunts in 2015 (Table 8); the average ratio reported since 1995 is 55 lambs:100 ewes (Appendix G). Ground-based surveys were conducted in July in two study areas of the northern Sahtú region of the Mackenzie Mountains on an annual or semi-annual basis from 1997-2014. Average ratios of 62.8 (range 36.7-83.0) and 55.1 (range 17.3-94.1) lambs:100 ewes were reported (A. Veitch unpublished data, Heather Sayine-Crawford personal communication). For the Richardson Mountains of the northern YT and NWT, Nagy and Carey (2013) suggest an August ratio of 43 lambs:100 ewes would have allowed for their observed 10.5% average annual rate of increase from 1986-1991. Subsequent to a decline in this unhunted population from 1997-2003, J. Nagy et al. (unpublished data) reported 28 lambs per 100 'nursery sheep' in August 2003. Surveys in the southwestern YT conducted during late June-mid-July 2015 classified 5,460 sheep, reporting a ratio 37 lambs per 100 nursery sheep; the actual recruitment in lambs:100

ewes would be higher (Troy Hegel personal communication). Jorgenson (1992) summarized 17 years of lamb:ewe classification data for a population of bighorn sheep in west-central Alberta and found a mean ratio of 43 lambs:100 ewes in September (range 25-54).

Table 8: Observations of Dall's sheep reported by non-resident hunters in the Mackenzie Mountains, 2015.

	Number of Hunters Reporting	Number Observed	Mean Number Observed/Hunter	% of Sheep Classified
Rams	237	3,407	14.0	31.3
Ewes[1]	221	4,723	21.0	43.4
Lambs	207	2,753	13.0	25.3

[1] includes females >1-year-old, yearlings, and younger rams; also called nursery sheep.

Differences in adult sex ratios among populations may result from differences in hunting pressure, differences in survival of males and females from birth to adulthood, or both (Nichols and Bunnell 1999). However, since the ratio of rams to ewes is almost never equal in wild populations of mountain sheep, even where they are unhunted, it is clear that there is a different natural mortality rate for the two sexes. This difference was believed to be a result of injuries and stress accumulated by males during the breeding season (Geist 1971).

The 72 ram:100 ewe ratio estimated from hunter observations in 2015 is well below the 87 ram:100 ewe average reported from 1995-2015 (Appendix G). Ground-based surveys were conducted in July in two areas of the northern Sahtú region of the Mackenzie Mountains on an annual or semi-annual basis from 1997-2011. Average ratios of 63.4 and 58.1 rams:100 ewes were reported (A. Veitch unpublished data).

In the YT, mid- to late June annual aerial surveys to count and classify sheep from 1973-1998 reported a mean of 48 rams (range 28-74) per 100 'nursery sheep' (J. Carey unpublished data). More recently, a similar survey of 5,460 sheep, in late June-mid-July 2015, reported 43 rams per 100 'nursery sheep' (Troy Hegel personal communication). For the unhunted Richardson Mountains herd (YT-NWT), J. Nagy et al. (unpublished data) reported 41 rams per 100 'nursery sheep' in 2003 following a decline from peak population size in 1997. In Alaska, ram:ewe ratio for two unhunted herds in Denali and Gates of the Arctic National Parks typically averaged 60-67:100 (Nichols and Bunnell 1999). In more heavily hunted Alaskan herds, ram:ewe ratio ranged from 33:100 (heavily hunted) to 87:100 (lightly hunted). The ram:ewe ratios reported for the Mackenzie Mountains since 1995 (Appendix G) suggest that the harvest of rams in the Mackenzie Mountains is sustainable at current levels.

More rams were classified by curl in 2015 than since 2008 (Table 9). This may be a reflection of the greater number of observation forms returned this year. This year, hunters observed fewer legal (>¾ curl) rams (n=1,406) than rams with <¾ curl (n=1,693). The mean number of legal rams observed per hunt was 7.0 (Table 9). In most years hunters have observed fewer legal rams than rams <¾ curl (Table 9).

As one of the collaborators in a landscape genetics study on thinhorn sheep, ENR Fort Simpson has been contributing horn core samples taken from Dall's sheep harvested in the Mackenzie Mountains. In order to insert a permanent numbered plug in ram horns, it is necessary to drill a hole in the horn. These drill shavings represent DNA samples of

individual sheep. Previous work indicated that sheep from the NWT belonged to a lineage that survived the last ice-age in the major Beringian refugia alongside sheep that now inhabit Alaska, YT and northwestern British Columbia (Sim et al. 2016 In Prep.). Samples from 405 rams harvested in the Mackenzie Mountains (G/OT/01=45, S/OT/01=51, S/OT/02=52, S/OT/03=44, S/OT/04=39, S/OT/05=56, D/OT/01=59, D/OT/02=59) were genotyped using 153 single nucleotide polymorphisms (SNPs). Preliminary analysis indicates that sheep from the Ogilvie and Mackenzie Mountains can be further subdivided into four clusters largely delineated by river drainages and mountain range boundaries (Sim et al. 2016 In Prep.).

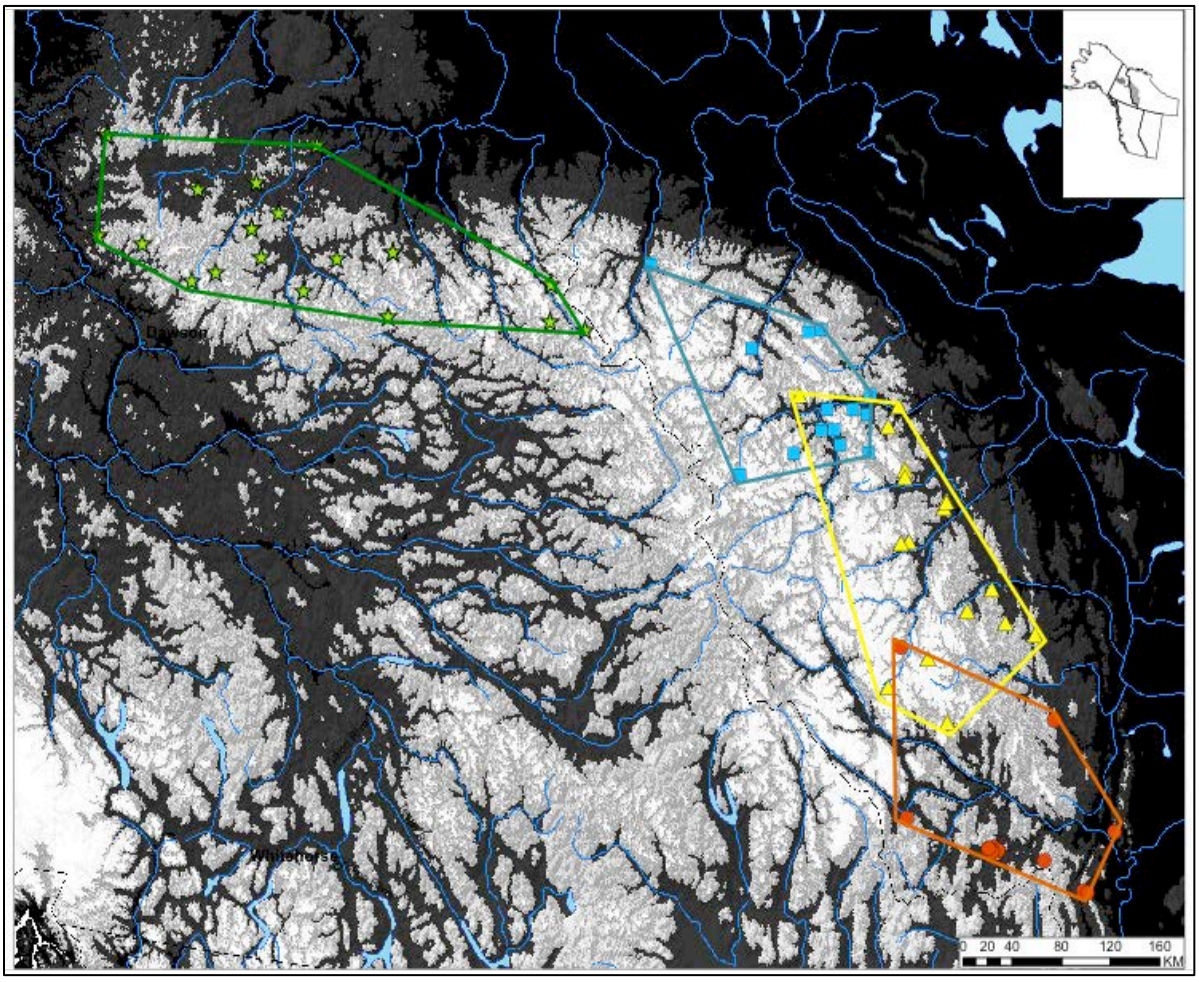

Figure 8. Four clusters of Dall's sheep in the Ogilvie and Mackenzie Mountains. (from Sim et al. 2016 In Prep.).

Table 9: Classification of Dall's sheep rams observed by non-resident hunters in the Mackenzie Mountains, 1995-2015.

Ram Class	2015		2014		2013		2012		2011		2010		2009		2008		2007		2006	
	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl
Number of hunters reporting	215	202	208	186	156	149	140	124	149	133	158	142	139	132	184	174	150	168	108	171
Number of rams classified	1406	1693	1372	1484	1006	1230	1117	987	1234	1168	1314	1620	1040	1093	1520	1698	1902	2266	1769	2019
% of rams classified	45.4	54.6	48.0	52.0	45.0	55.0	53.0	47.0	51.4	48.6	48.8	55.2	48.8	51.2	47.2	52.8	45.6	54.4	46.7	53.3
Mean number of rams observed/hunt	7.0	8.0	7.0	8.0	6.0	8.0	8.0	8.0	8.0	9.0	8.3	11.4	7.5	8.3	8.3	9.8	11.0	13.5	9.9	12.0

Ram Class	2005		2004		2003		2002		2001		2000		1999		1998		1997		1996		1995	
	Horn > ¾ curl	Horn <¾ curl	Horn > ¾ curl	Horn <¾ curl	Horn > ¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl	Horn >¾ curl	Horn <¾ curl
Number of hunters reporting	186	182	188	183	127	121	148	133	186	174	151	147	144	138	177	177	205	205	172	174	181	180
Number of rams classified	1787	1899	2185	2324	1662	1654	1720	1720	1812	1765	1351	1717	1579	1756	1848	1924	1538	1586	1713	1699	2070	1645
% of rams classified	48.5	51.5	48.5	51.5	50.1	49.9	50.0	50.0	50.7	49.3	44.0	56.0	47.3	52.7	49.0	51.0	49.2	50.8	50.2	49.8	55.7	44.3
Mean number of rams observed/hunt	9.6	10.4	11.6	12.7	11.9	11.9	11.6	12.9	9.7	10.1	8.9	11.7	11.0	12.7	10.4	11.3	7.5	7.7	10.0	9.8	11.4	9.1

Northern Mountain Caribou (*Rangifer tarandus caribou*)

In their 2002 assessment, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the boreal population of woodland caribou as Threatened and the northern mountain population of woodland caribou as Special Concern. These two populations of woodland caribou were subsequently listed under the federal *Species at Risk Act* (SARA) in 2004 and 2007 respectively. Caribou of the Mackenzie Mountains are part of the northern mountain population of woodland caribou. In order to be more specific and to avoid confusion this report will use "northern mountain caribou" when referring to caribou from the Mackenzie Mountains.

Northern mountain caribou are another of the more desired species sought by non-resident hunters. Tags were purchased by 347 (78%) non-resident hunters (Table 5), the greatest number of tags purchased since reporting started in 1995 (average 264, range 181-347). At least 55% of tag holders hunted caribou, harvesting 190 males. This was higher than the annual average harvest of 162 (range 117-191) and the second highest harvest from 1991-2015 (Figure 5, Appendix F). The mean (±SD) length of a caribou hunt, determined from the 206 reports where hunters spent at least one day hunting, was 4.0±3.0 days (range 1-18 days), comparable to that of previous years (Table 10).

Over a period of three hunting seasons (2011-2013) ENR collected front incisor teeth from caribou harvested in the southern portion of the Mackenzie Mountains, on a voluntary

basis. Teeth were aged by counting cementum annuli. The ages from the 32 caribou ranged from two to 11 years (mean 6.5 years, median 6.3 years).

Table 10: Mean length, SD, and range (in days) of northern mountain caribou hunts where at least one day was spent hunting from 2000-2015.

	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
Number Reports	206	190	196	180	187	175	155	190	172	171	191	120
Mean Hunt Length	4.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0	4.3	3.7	4.9
SD	3.0	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.2	3.1	3.8	3.9
Range	1-18	1-14	1-13	1-17	1-16	1-14	1-14	1-15	1-16	1-14	1-32	1-34

	2003	2002	2001	2000
Number Reports	172	181	178	141
Mean Hunt Length	3.8	3.6	4.3	4.0
SD	2.8	2.7	3.2	2.7
Range	1-14	1-12	1-15	1-12

We calculated ratios of 43.0 calves and 50.0 bulls (males) per 100 adult females (cows) based upon hunter classifications of northern mountain caribou observed during hunts. Bulls comprised 25.9% of all caribou classified (Table 11). The calf:cow ratio was similar to the average of 43:100 (range 35-59:100) calculated since 1995; interestingly the bull:cow ratio was the second highest reported since 1995, substantially higher than the average 39:100 (range 21-61:100; Appendix G).

Table 11: Observations of northern mountain caribou reported by non-resident hunters in the Mackenzie Mountains, 2015.

Sex/Age Class	Number of Hunters Reporting	Number Observed	Mean Number Observed/Hunter	% of Total Classified
Bulls	246	4,323	17.6	25.9
Cows	238	8,641	36.3	51.8
Calves	204	3,716	18.2	22.3

Although antler measurement information sometimes goes unreported on outfitter forms, we received antler lengths from 132 (69%) successful hunters. This year, as in other years, there was substantial variation in antler lengths, range 43.5-145.0 cm (17.1-57.1 in.). The maximum left and right antler lengths reported were 145.0 and 143.0 cm respectively (Table 12). The maximum antler length recorded by Boone and Crockett for northern mountain woodland caribou in North America is 158.5 cm (62.4 in.) for a caribou taken from the Mackenzie Mountains in 1978. Twelve of the top 50 mountain woodland caribou recorded in the 13th edition of the Boone and Crockett Club record book are from the Mackenzie Mountains; the highest scoring antlers hold 8th place (Boone and Crockett Club on-line trophy database accessed 2016). Another measuring system for antlered animals is from Safari Club International (SCI), which has a unique all-inclusive record keeping system for measuring trophies, the most used system in the world. Unlike Boone and Crockett this system has no deductions or penalizing for asymmetry and provides points for all tines which are important for caribou (Jim Lancaster personal communication). Eight of the top 20 mountain woodland caribou recorded in the SCI record book are from

the Mackenzie Mountains, with a caribou harvested in 2006 holding second place in scoring (SCI on-line trophy database accessed 2015).

Table 12: Antler measurements of northern mountain caribou bulls harvested by non-resident hunters in the Mackenzie Mountains, 2015. All measurements are in cm (in.).

	Contour Length	
	Left Antler	**Right Antler**
Number Measured	132	132
Mean (cm)	116.7 (45.9 in.)	116.9 (46.0 in.)
SD (cm)	55.3 (21.8 in.)	55.4 (21.8 in.)
Maximum (cm)	145.0 (57.1 in.)	143.0 (56.3 in.)
Minimum (cm)	46.5 (18.3 in.)	43.5 (17.1 in.)

Since 1991 the percentage of bulls observed by clients in the Mackenzie Mountains has never been greater than 28%. This is a lower percentage than the cumulative 39% average adult bull component reported by Bergerud (1978) in his summary of eight North American caribou populations that were either non-hunted or hunted non-selectively (i.e., both males and females included in the harvest). Veitch et al. (2000c) classified 2,659 of an estimated 5,000 caribou in the central Mackenzie Mountains in August 1999 and reported only 25% of those animals as males. Surveys done on the presumed rutting grounds of the South Nahanni caribou population in 1995, 1996, and 1997 reported 24, 28, and 20% of animals classified as males ≥1-year-old (Gullickson and Manseau 2000) and in 2001 reported 27% bulls (Gunn et al. 2002). A 2007 survey during the rut estimated 33.7 bulls:100 adult cows (R. Farnell and K. Egli unpublished data). A 2008 composition count

during the rut in the same general area estimated a slightly higher ratio of 35.5 bulls:100 adult cows (Troy Hegel personal communication).

Nagy (2011) determined ten activity periods for northern mountain caribou in the Sahtú using movement data from satellite collared caribou (Olsen 2000, 2001). The breeding period, or rut, was defined as 9-25 October. This period was also the activity period with the greatest daily movement rate (Nagy 2011). Hunter observation data are collected and the 1999 survey was carried out prior to the breeding period (Veitch et al. 2000c). Surveys conducted well before the rut or breeding period may underestimate the male component of the population. The surveys in 2007 and 2008 were conducted in late September and early October, just prior to the defined breeding period, and findings were more comparable to what Bergerud (1978) reported. Based upon hunter observations there is some evidence that the proportion of males differs between populations, with male:female lower in Redstone than in Bonnet Plume; this difference has been consistent over the past 20 years (Larter 2012a). Further investigation is required to explore demographic attributes of northern mountain caribou in the Mackenzie Mountains.

Northern mountain caribou in the Mackenzie Mountains are estimated to number between 15,000 and 20,000 from at least three separate populations shared between the YT and NWT (Figure 9). Currently, estimated population sizes (excluding calves) are *ca.* 4,200 for the Bonnet Plume, a minimum of 7,300 for the Redstone, and *ca.* 2,700 for the greater Nahanni (South Nahanni, Coal River and Labiche pooled) population (COSEWIC 2014).

They are subjected to an annual bull-selective non-resident harvest averaging 162 males per year (1991-2015). The resident harvest of northern mountain caribou in the Mackenzie Mountains also tends to be bull-selective (but not restricted to bulls) and is generally light (*ca.* 30 animals/year); subsistence harvest includes both males and females, with the proportion of each dependent on the time of year that animals are harvested (J. Snortland unpublished data, ENR unpublished data). Subsistence harvesters in the Mackenzie Mountains include residents of both the NWT and YT; harvest is not generally reported.

Studies on the Redstone population of northern mountain caribou were initiated in March 2002, with ten female caribou being equipped with satellite radio collars as part of a study of caribou in the central and north-central Mackenzie Mountains initiated by the SRRB (Creighton 2006, Olsen 2000, 2001, Olsen et al. 2001). A recent analysis of these location data indicates that some of the collared animals in the range of the Redstone population are relatively sedentary year round, while others show the more typical seasonal migratory movements (John Nagy personal communication).

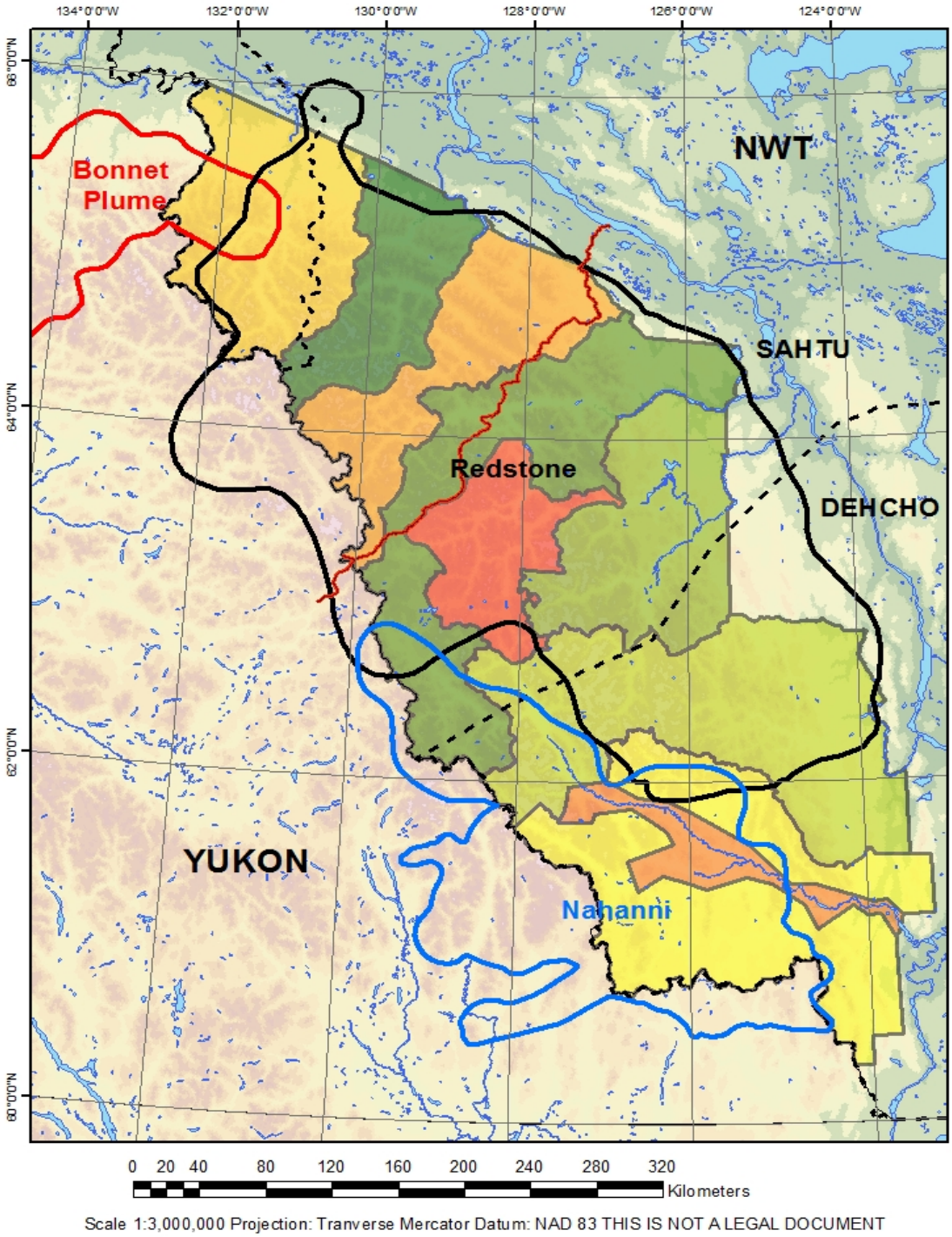

Figure 9: Distribution of Bonnet Plume (in red), Redstone (in black), and greater Nahanni (in blue) caribou populations following COSEWIC (2014) population polygons. Map: GNWT/B. Fournier, ENR (2013)

Satellite radio collars were deployed on nine adult female caribou during March 2000 and October 2001 by the YT Department of the Environment (Jan Adamczewski personal communication). These animals were believed to be part of the greater Nahanni population. In October 2004, 18 female caribou were equipped with satellite collars along the YT-NWT border. These caribou were also believed to be from the greater Nahanni population, but three animals were determined to be from the Finlayson population. This was a co-operative study between YT Territorial Government, Parks Canada (NNPR) and the Wildlife Conservation Society (Weaver 2006). In October 2008, 30 female caribou were equipped with satellite collars along the YT-NWT border in order to assess spatial distribution, habitat use, and population characteristics of the South Nahanni and Coal River herds of the greater Nahanni population. Collared animals permitted herd estimates based upon mark-recapture methodology and indicated stability to a slightly increasing trend for the South Nahanni herd (Hegel et al. 2016).

Tulít'a regularly conducts community hunts in the Caribou Flats. Biological samples were collected from 43 mountain woodland caribou harvested during hunts in 2013 and 2014. Blood and fecal samples were screened for pathogens, parasites and exposure to diseases. Body condition scoring was made using depth of back fat, the kidney fat index, percent bone marrow fat, and a pre-defined four score qualitative index. Preliminary results documented pathogens, diseases, and parasites that have been reported in caribou elsewhere (e.g. Johnson et al. 2010), but some were the first reported for mountain woodland caribou. No animals tested positive for *Brucella* (Carlsson et al. 2015).

Moose (Alces americanus)

Tags to hunt moose were purchased by 26% (n=117) of non-resident hunters in 2015, slightly above the average purchased from 2005-2015 (Table 5). At least 61% of tag holders hunted moose and harvested 71 bulls. The 2015 harvest was higher than the average 58 moose (range 32-85) harvested annually since 1991, but slightly lower than the average from 2005-2015 (Figure 10). Since 2005, the number of moose tags purchased has increased (Table 5, Appendix F). Success rates for moose hunts have remained relatively stable, but the increased number of tag sales in recent years has resulted in an increased overall harvest (Figure 10). The mean (±SD) length of a moose hunt, determined from the 73 reports where hunters spent at least one day hunting, was 3.0±3.0 days (range 1-13 days), similar to reports from previous years (Table 13).

In 2005 there was a noticeable increase in moose harvest relative to pre-2005 levels. The consistently higher post-2004 harvest levels are likely in part related to the change in ownership of outfitting zone D/OT/01 (Figure 10). This zone is one of the largest, with an abundance of good moose habitat. From 1991-2004 the average harvest was <4 moose/year because most clients wanted to hunt Dall's sheep. The new owner has many European clients who are specifically looking for trophy moose for European mounts. He has also been utilizing previously unhunted areas of the area. From 2005-2015 the average annual harvest has been ~20 moose from this area. Moose in the Mackenzie Mountains are considered to be of the Alaska-YT subspecies, physically the largest subspecies of moose with large males attaining *ca.* 725 kg. (www.adfg.alaska.gov/index.cfm?adfg=moose.main).

Recently, the Mackenzie Mountains have emerged as one of the top destinations to have success in taking these large moose (Jim Lancaster personal communication).

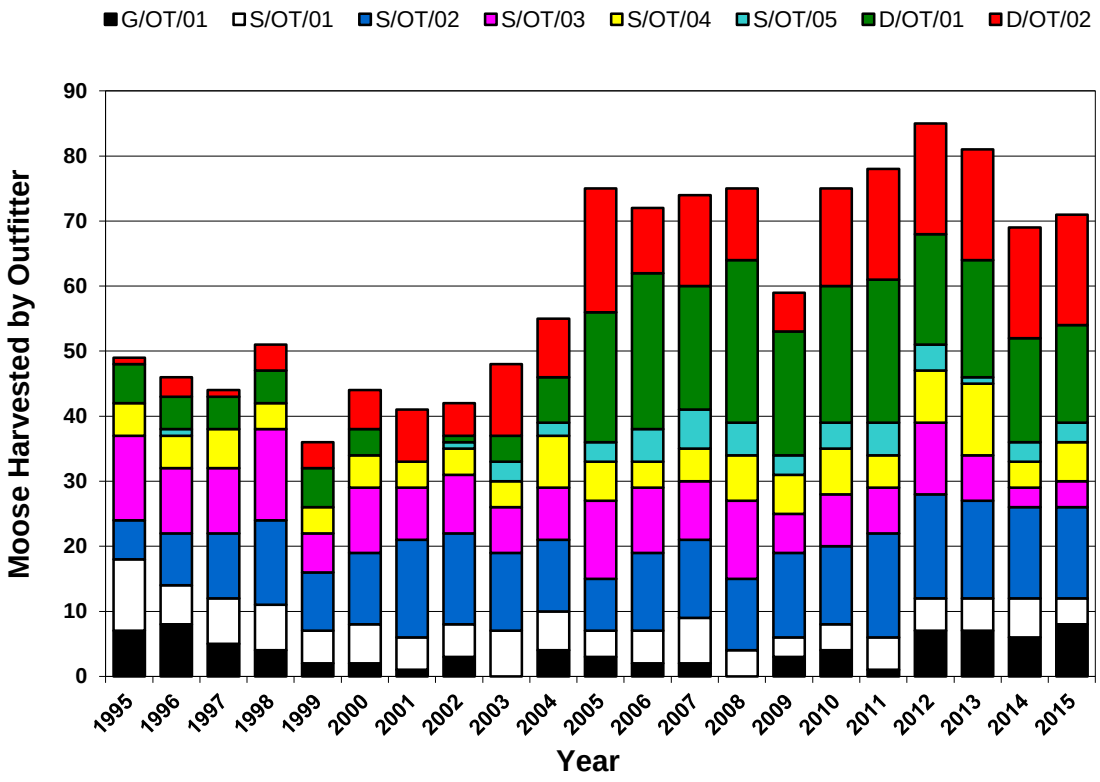

Figure 10: Moose harvested by individual Mackenzie Mountain outfitters from 1995-2015.

Table 13: Mean length, SD, and range (in days) of moose hunts where at least one day was spent hunting from 2000-2015.

	2015	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**
Number Reports	73	71	91	85	86	86	68	82
Mean Hunt Length	3.0	4.0	4.1	4.2	4.1	4.5	4.2	3.6
SD	3.0	3.0	3.1	3.1	2.8	4.0	3.4	2.9
Range	1-13	1-14	1-15	1-15	1-14	1-18	1-14	1-16
	2007	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Number Reports	80	72	85	49	60	46	42	48
Mean Hunt Length	4.0	3.6	4.4	4.8	3.9	3.6	3.7	4.4
SD	2.5	2.7	3.1	3.3	2.8	2.6	2.9	2.7
Range	1-9	1-11	1-14	1-12	1-14	1-12	1-12	1-12

Since 2003 ENR has collected front incisor teeth from moose harvested by hunters in the southern portion of the Mackenzie Mountains on a voluntary basis. Teeth are forwarded to Matson's Laboratory for aging. Age is determined by counting the cementum annuli much like the growth rings of a tree. June 1 is used as the birth date for moose (Matson 1981). We currently have ages from 133 harvested moose; ages range from three to 15 years (mean 7.7 years, median 7.0 years; Figure 11).

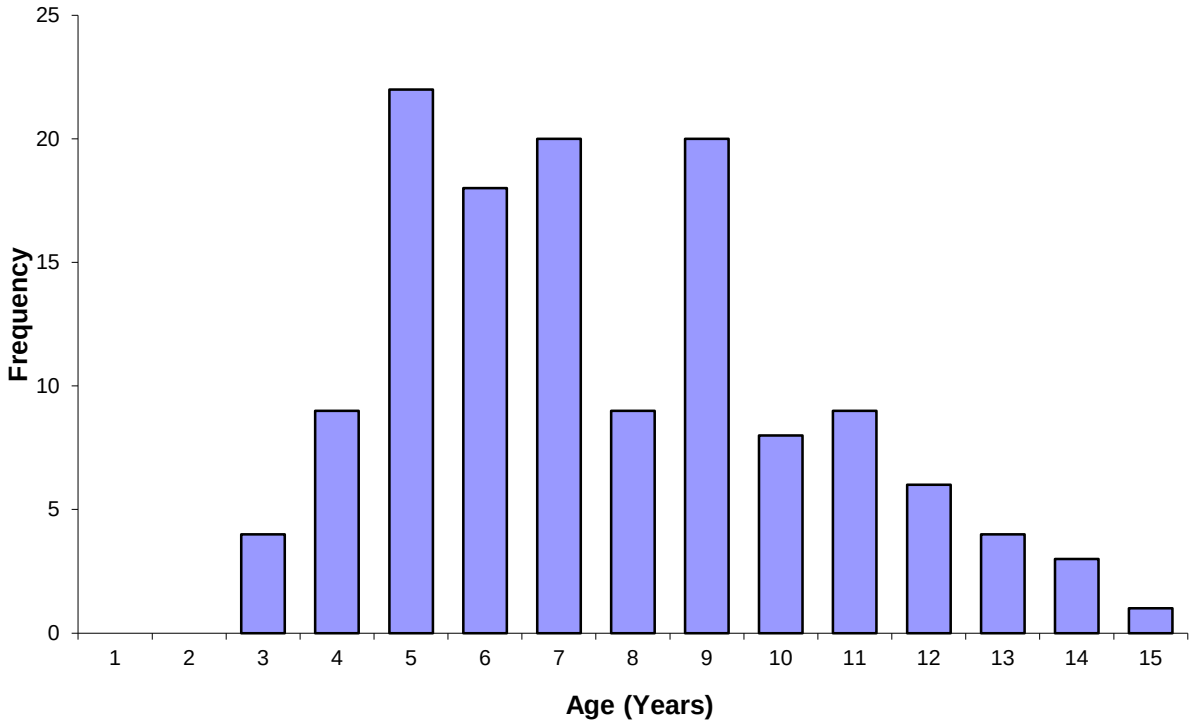

Figure 11: Ages of 133 moose teeth voluntary provided by southern Mackenzie Mountain outfitters from 2003-2015.

The mean (±SD) tip-to-tip spread of measured antlers (n=59) from bull moose harvested in 2015 was 145.0±57.1 cm (56.7±22.3 in.) similar to other years (Table 14). The maximum recorded antler spread of 185.0 cm (72.8 in.) this year was less than the record spread of 196.9 cm (77.5 in.) for a moose harvested 1982. One moose taken from the Mackenzie Mountains is in the top 25 moose recorded in the record book of the 13th edition of the Boone and Crockett Club and currently holds 19th place (Boone and Crockett Club on-line trophy database accessed 2016). A moose harvested in the NWT Mackenzie Mountains in 2008 was accepted in May 2009 and holds 27th place. A moose harvested during the 2010 season ranks second as a Pope and Young World Record moose with a score of 241 5/8.

Table 14: The yearly mean and range of measured bull moose tip-to-tip antler spread in cm (in.).

	2015	2014	2013	2012	2011	2010	2009	2008
Measured (n)	59	61	69	67	69	65	53	63
Mean Spread	145.0 (57.1)	144.1 (56.7)	144.9 (57.1)	142.0 (56.3)	144.0 (56.7)	143.5 (56.5)	143.5 (56.5)	145.5 (57.3)
Range	94-185 (37.0-72.8)	89-185 (35.0-72.6)	97-170 (38.3-67.0)	98-161 (38.6-63.4)	113-168 (44.5-66.1)	106-174 (41.7-68.5)	92-175 (36.2-68.9)	101-174 (39.8-68.5)

	2007	2006	2005	2004	2003	2002	2001	2000	1999
Measured (n)	62	56	53	38	34	32	32	34	26
Mean Spread	141.1 (55.6)	141.3 (55.6)	144.9 (57.0)	150.3 (59.2)	150.0 (59.1)	149.3 (58.8)	144.3 (56.8)	147.0 (57.9)	144.2 (56.8)
Range	102-179 (40.2-70.5)	107-170 (42.1-66.9)	122-165 (48.0-65.0)	127-174 (50.0-68.5)	107-165 (42.1-65.0)	103-178 (40.6-65.0)	113-165 (44.5-65.0)	127-179 (50.0-70.5)	109-166 (42.9-65.4)

Table 15: Observations of moose reported by non-resident hunters in the Mackenzie Mountains, 2015.

Age/Sex Class	Number of Hunters Reporting	Number Observed	Mean Number Observed/Hunter	% of Total Classified
Bulls	134	515	3.8	42.3
Cows	121	525	4.3	43.1
Calves	71	177	2.5	14.6

We calculated ratios of 33.7 calves:100 adult females (cows) and 98.1 bulls:100 cows based upon hunter observations of moose during hunts (Table 15, Appendix G). The calves:100 cows in 2015 is the third highest ratio recorded and is higher than the average 30:100 (range 20-36:100) calf:cow ratio recorded since 1995. The calf:cow ratio reported for the fall remains lower than the 40-60:100 that is generally documented during early to mid-

winter aerial surveys for moose along the Mackenzie River in the vicinity of the communities of Fort Good Hope (MacLean 1994a), Norman Wells (Veitch et al. 1996) and Tulíť a (MacLean 1994b) (Appendix G). However, these surveys were conducted after the major fall subsistence harvest and variable female harvest can certainly impact the interpretation of calf:cow ratios. As no research has been done on moose in the Mackenzie Mountains, we have no explanation for the apparent discrepancy in calf production, survival, or both between the mountains and the river valley. A survey of moose in the Norman Wells study area in January 2001 estimated a calf:cow ratio of 18:100 (ENR Norman Wells unpublished data), and an aerial survey of the Mackenzie River Valley and vicinity in the Dehcho region south from the Blackwater River to Jean Marie River conducted in November 2003 estimated 32:100 (Larter 2009). These studies indicate that low calf:cow ratios may not be restricted to the Mackenzie Mountains and that further studies are required to determine the cause(s). A program was established to document calf:cow ratios annually in November in designated areas of the Mackenzie and Liard River Valleys of the Dehcho through 2010 (Larter 2009). A large-scale aerial survey of the Mackenzie River Valley and vicinity south from the Blackwater River to Jean Marie River, conducted in November 2011, estimated a calf:cow ratio of 54:100 (N. Larter and D. Allaire unpublished data).

The bull:cow ratio of 98:100 reported for 2015 is similar to the 104:100 average from 1995-2015 (Appendix G). Bull:cow ratios from the Mackenzie Mountains continue to be generally higher than the range of 27-105:100 reported in the YT (R. Ward cited *in*

Schwartz 1997) and 16:100 from heavily harvested populations in Alaska (Schwartz et al. 1992), and average of 46:100 from Norway, range (25-69:100) (Solberg et al. 2002). There has been concern that low bull:cow ratios could influence conception dates, pregnancy rates and newborn sex ratios (Bishop and Rausch 1974, Crête et al. 1981, Solberg et al. 2002) and that management strategies should maintain a high bull:cow ratio (Bubenik 1972).

Studies on tundra moose in Alaska have not found evidence that moose populations with low bull:cow ratios have reduced reproductive rates (Schwartz et al. 1992); populations with a more skewed sex ratio had a relative rate of population increase greater than populations without a skewed sex ratio (Van Ballenberghe 1983). However, a recent study of eight heavily harvested moose populations in Norway indicated a relationship between declining recruitment rate and skewed adult sex ratio (Solberg et al. 2002). Based upon hunter observations since 1995, there is no indication of any decreasing trend in the bull:cow ratio of moose in the Mackenzie Mountains, hence the adult sex ratios are an unlikely factor in the low calf:cow ratios reported. The reported sex ratios may have an inherent bias towards a greater number of bulls if harvesters consistently spend more time searching for moose in areas frequented more by large males than females.

Mountain Goat (Oreamnos americanus)

There is a wide range in the number of mountain goat tags sold annually since 1995 (6-71), but tag sales were consistently higher from 2005 than during 1995-2004 (Table 5). The use of rotary aircraft in recent years has permitted outfitters to get into some more

remote and rugged areas of their areas where they have never been before, areas where goats are resident. More hunting packages include a mountain goat and since 2005 10-16% of hunters purchasing licences buy a mountain goat tag. Increased accessibility to areas of untouched goat range has likely had some effect on the increased number of goat hunters and success in goat harvest. This year, mountain goat tags were purchased by 71 (16%) non-resident hunters, more than in any previous year (Table 5.). Seventeen goats (15 males, two females) were harvested similar to the mean annual harvest 2005-2015 (Appendix F). The mean (±SD) length of a goat hunt, determined from the 19 reports where hunters spent at least one day hunting, was 3.0±2.0 days (range 1-8 days), similar to that reported in previous years (Table 16).

Table 16: Mean length, SD, and range (in days) of goat hunts where at least one day was spent hunting from 2000-2015.

	2015	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**
Number Reports	19	15	13	17	20	13	22	21
Mean Hunt Length	3.0	2.0	2.3	2.8	2.3	3.2	2.5	3.0
SD	2.0	2.0	1.3	1.7	1.2	1.9	2.0	1.8
Range	1-8	1-8	1-5	1-7	1-5	1-7	1-8	1-8

	2007	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Number Reports	27	12	18	8	6	4	2	1
Mean Hunt Length	2.7	2.8	3.8	3.9	3.0	2.8	1.5	3.0
SD	1.7	1.5	2.8	1.6	2.6	1.9	0.7	n/a
Range	1-6	2-6	1-14	2-6	1-8	1-5	1-2	3

Mountain goats are known to inhabit five of the eight outfitting zones in the Mackenzie Mountains, occurring almost exclusively below 63°00'N (Veitch et al. 2002). They are most

numerous in high relief terrain along the YT-NWT border between 61°00’ and 62°00’N. However, since 1995 we have received hunter observations or harvest reports of goats from only four of those outfitter areas - D/OT/01, D/OT/02, S/OT/03, and S/OT/04 (Figure 1). In 2015, observations came from three areas, D/OT/01 (n=55), D/OT/02 (n=156), and S/OT/03 (n=1); harvest occurred in D/OT/01 and D/OT/02. We estimated 67.5 goat kids and 92.5 billies per 100 nannies based upon hunter observations. Both ratios were higher than the average 63.6 kids and 67.3 billies per 100 nannies from 2002-2015 (Appendix H).

In 2005, we began estimating the age of harvested goats by counting horn annuli; we try to age as many harvested goats as possible. The average age of 157 harvested goats (141 billies and 16 nannies) is 7.8 years (range 2.5-16.5). Eighty-eight goats were <8 years old, 69 were >8 years old and 37 were >10 years old (Figure 12). Three of the 17 goats harvested in 2015 were aged >10 years, with one aged at >14 years old. The longest horns from a mountain goat taken in 2015 were 25.5 cm (left) and 24.0 cm (right). No mountain goats from the NWT are listed in the top 50 in the 13th edition of the Boone and Crockett Club record book (Boone and Crockett Club on-line trophy database accessed 2016). Based upon age and horn length data over the past ten years there may be a somewhat linear relationship between age and horn length from 4.5-13.5 years, but for ages outside of that range there is almost no relationship. Large horned animals are found over a wide range in animal ages (Figure 13).

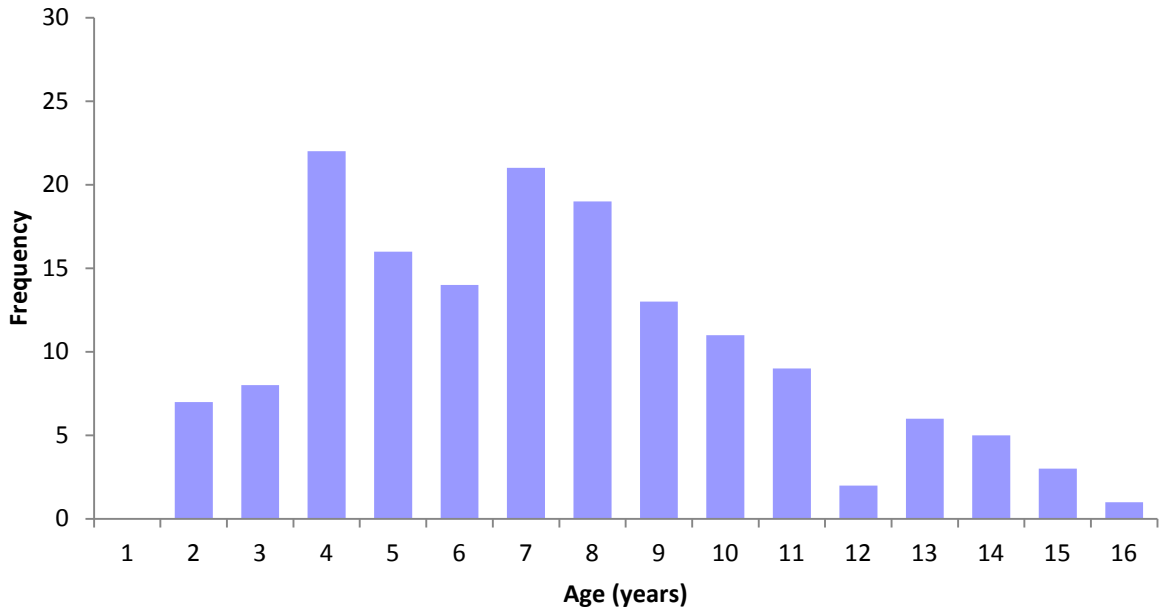

Figure 12: Ages of 157 mountain goats harvested in the southern Mackenzie Mountain based upon counting horn annuli 2005-2015.

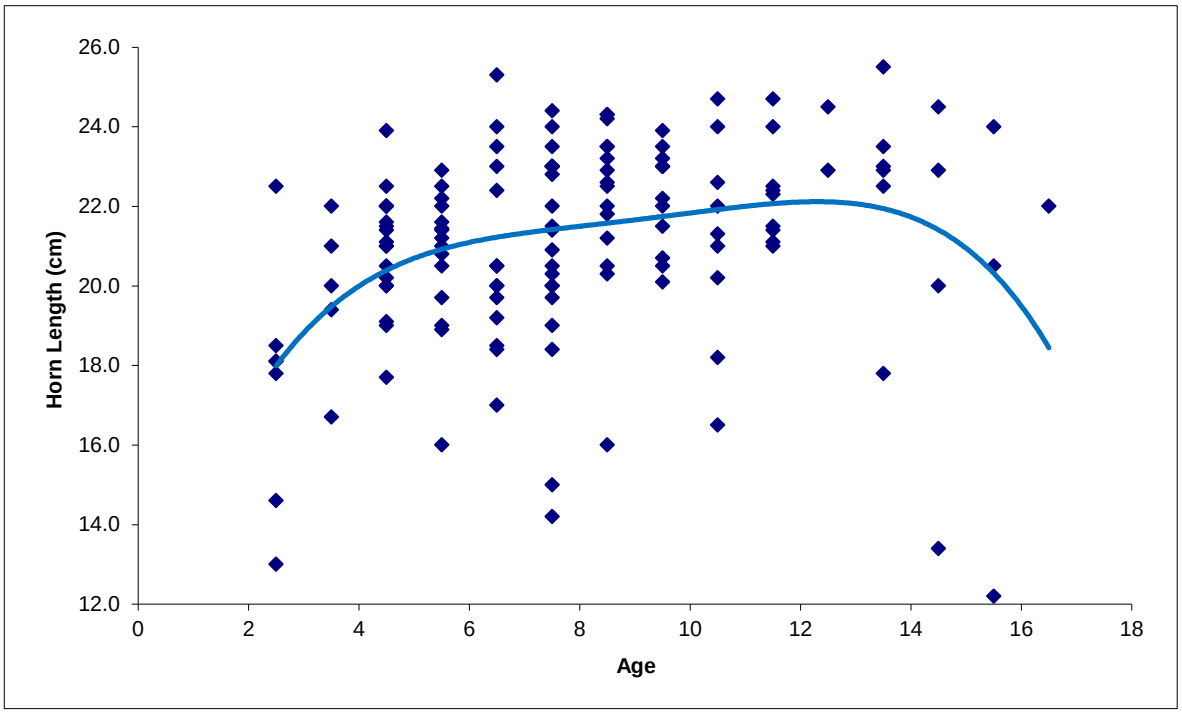

Figure 13: The relationship between the horn length (cm) and age (based upon horn annuli) of 157 mountain goats harvested in the Mackenzie Mountains 2005-2015. Line of best fit is a 4th order polynomial.

There is some evidence that goat numbers and distribution have been increasing in both areas D/OT/01 and D/OT/02 in the southern Mackenzie Mountains (Larter 2004, 2012b, Jim and Clay Lancaster and Werner Aschbacher personal communication). The total number of goats observed has been increasing in recent years and billies have been observed in places they had not been seen previously in these areas (Clay Lancaster and Werner Aschbacher personal communication, Appendix H).

In a 2.5 hr. rotary-winged survey of zone D/OT/02 on 11 September 2006, 88 goats were observed (38 billies, 27 nannies, 19 goat kids, and four yearlings), producing estimates of 140.8 billies and 70.4 goat kids per 100 nannies (N. Larter unpublished data). This survey was conducted in an area that could not be surveyed during a 2004 aerial survey and provided similar numbers of goats and ratio estimates as the 110.7 billies and 71.4 kids per 100 nannies from that 2004 survey (Larter 2004). A rotary-wing survey was conducted 22-24 August 2011 in the Ragged Range area of D/OT/01. 278 goats were observed (124 billies, 80 nannies, 50 goat kids, six yearlings; 18 goats were unclassified), producing estimates of 155.0 billies and 62.5 goat kids per 100 nannies (Larter 2012b). These survey results could be used to support the contention of increasing goat numbers and distribution but we acknowledge there was seven years between surveys. ENR will continue to work with outfitters in areas D/OT/01 and D/OT/02 to better assess the current status of mountain goats in the Mackenzie Mountains.

Much of the areas surveyed for goats in 2004, 2006, and 2011 fall within the expansion area of NNPR. This was the last year for guided hunts to occur within the expansion area. Most goat harvest occurs in areas D/OT/01 and D/OT/02. With the significant reduction of areas to hunt goat in these areas as a result of NNPR expansion we anticipate future reductions in tag purchases and in goat harvest. Voluntary hunter observations of mountain goats starting in 2016 will likely be reduced and will be restricted to limited parts of mountain goat range and be less representative of the mountain goat population of the Mackenzie Mountains as a whole.

Wolf (Canis lupus)

Wolf tags were purchased by 80% (n=358) of non-resident hunters in 2015 (Table 5). This is the greatest number of tags and highest proportion of hunters purchasing tags in any year since reporting began in 1995 (Table 17). At least 18% (n=64) of tag holders actively hunted wolves, harvesting 20 wolves (seven males, three females and ten with undocumented gender) (Appendix F). An average of 15 wolves/year has been harvested annually since reporting started in 1991. Hunters reported spending one to 12 days actively hunting wolves (mean ±SD of 3.7±2.4 days). For the seventh year wolves were hunted during the winter season in area S/OT/01; four wolves (two females and two males) were harvested in April 2016.

Hunters observed 152 wolves during 2015, the lower end of the 142-317 range from previous years (1995-2014). There is no relationship between the number of wolves observed/year and annual harvest nor does the number of tags purchased/year explain

annual differences in wolf observations (Table 17). The number of hunters reporting since 2001 has been consistently higher than in previous years, which is attributed to a change in how we defined hunter reporting. For data collected after 2001, we assumed that all returned observation forms where there was a blank, a zero, or a dash in the box indicating the number of wolves observed was a report of no wolves being observed. When looking at the forms this seemed like a reasonable assumption. This assumption may well be invalid for previous years' data and would bias the post 2001 values to be higher than the previous years.

Table 17: Observations of wolves reported by non-resident hunters in the Mackenzie Mountains, the number of wolves harvested and the number of wolf tags purchased, 1995-2015.

	2015[1]	**2014[1]**	**2013[1]**	**2012[1]**	**2011[1]**	**2010[1]**	**2009[1]**	**2008[1]**	**2007[1]**	**2006[1]**
# Hunters Reporting	294	216	242	215	218	203	194	244	244	239
# Wolves Observed	152	275	155	253	184	203	167	260	262	202
# Hunters Seeing ≥1	26	42	36	45	74	61	65	76	88	84
Number Harvested	20	23	16	24	21	19	20	17	12	23
Number Wolf Tags	358	298	299	292	285	294	252	228	227	201

	2005[1]	2004[1]	2003[1]	2002[1]	2001	2000	1999	1998	1997	1996	1995
# Hunters Reporting	254	244	203	197	142	116	103	148	141	76	119
# Wolves Observed	245	317	200	249	215	228	142	148	200	186	269
# Hunters Seeing ≥1	76	81	74	69	65	61	40	57	76	26	26
Number Harvested	19	18	12	11	15	14	11	9	17	11	14
Number Wolf Tags	204	166	207	159	137	145	89	165	209	194	72

[1]Change in reporting since 2002 may have resulted in the number of hunters reporting for 1995-2001 being artificially low, see text.

Starting in 1999 we received hunter comments on our voluntary observation forms that wolf numbers were high. In subsequent years the number of hunters commenting about high wolf numbers has increased. Interestingly, this year none of the responding hunters indicated that they thought wolf numbers were high.

Wolverine (*Gulo gulo*)

Over the past ten years averages of about 37% of hunters purchase wolverine tags. This year was no exception; 40% (n=179) of non-resident hunters purchased tags. Prior to 2005 fewer wolverine tags were purchased (Tables 5, 18). At least 16% (n=28) of tag holders actively hunted wolverine; two were harvested. Hunters spent from one to ten days actively hunting wolverine (mean ±SD of 4.2±2.6 days). Wolverines were observed in six areas, most observations were in areas G/OT/01 and S/OT/01. In only 1997 and 2014 have wolverines been observed in all areas (Figure. 8). The majority of observations were of solitary individuals (n=14); three observations were of groups of two and one observation was a family of three. Historically, wolverine observations have been mostly of solitary animals with few family groups being observed. One could argue that the number of

wolverines observed annually from 1995-2015 has somewhat of a cyclical pattern (Table 18, Figure 14), however a trend line through the data is essentially flat. Wolverine numbers are believed to be declining in some other parts of their range in the NWT (SARC 2014); however, our observations from the Mackenzie Mountains since 1995 do not show a declining trend and the Species at Risk Committee assessed wolverine as "not as risk" in 2014.

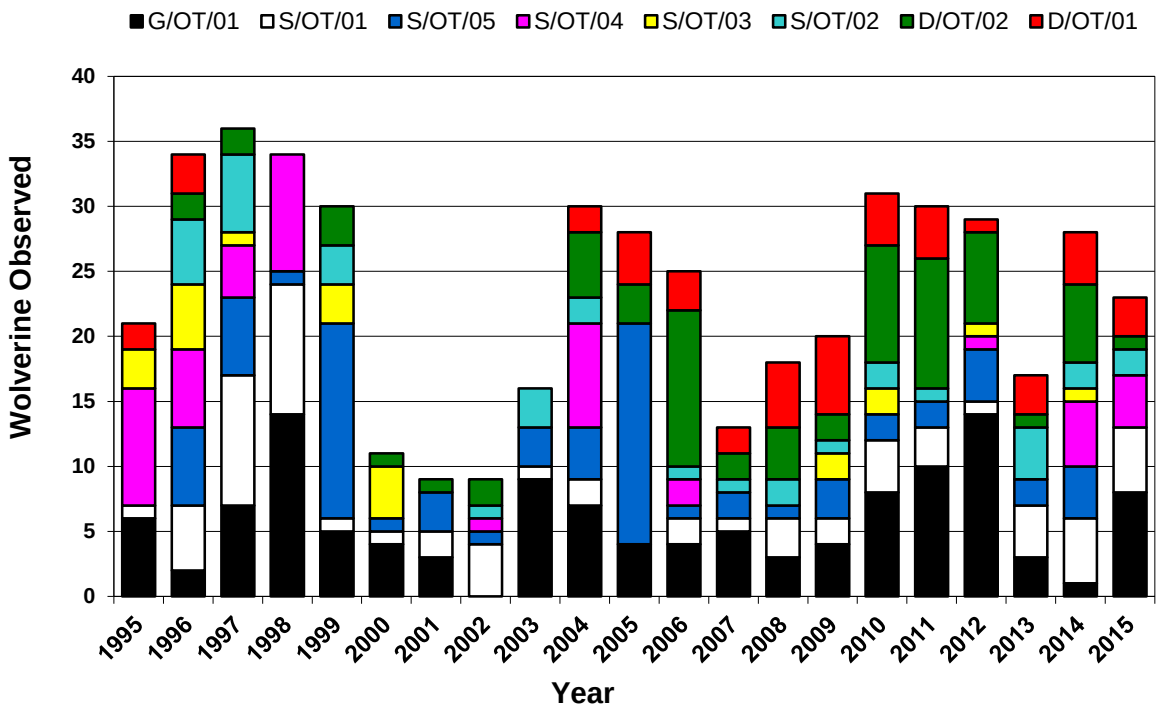

Figure 14: The number of wolverine observed by hunters from 1995-2015 and the outfitter zones where the observations occurred. Data are based upon voluntary hunter observation forms.

Table 18: The number of reported observations of wolverine, the number of wolverine harvested, the number of hunters with wolverine tags, the percentage of total hunters with wolverine tags, and the total number of hunting licences purchased for 1995-2015.

Year	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Reported Observations	23	28	17	29	30	31	20	18	13	25
Number Harvested	2	1	2	0	2	3	3	1	0	1
No. Wolverine Tags	179	154	155	153	163	171	133	111	150	108
% Wolverine Tags	40	38	39	39	41	45	39	28	37	27
Total Hunting Licences	447	402	401	396	400	384	339	399	405	407

Year	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995
Reported Observations	28	30	12	9	9	11	30	34	36	34	21
Number Harvested	1	0	0	1	2	0	3	0	1	4	1
No. Wolverine Tags	154	89	141	97	83	78	65	99	135	114	35
% Wolverine Tags	39	26	40	29	26	23	20	29	38	29	11
Total Hunting Licences	394	337	347	338	332	332	321	345	352	387	344

There is no relationship between the number of wolverine observed/year and annual harvest nor do the number of tags purchased/year explain annual differences in wolverine observations (Table 18). Wolverines occur throughout the Mackenzie Mountains, but sightings are considered rare. Most wolverine observations are made in hunting zones G/OT/01, S/OT/01, S/OT/05 and D/OT/02.

Black Bear (Ursus americanus)

This year 20 tags were purchased by non-resident hunters for black bears (Table 5); two bears were harvested. Only seven black bears have been harvested in the past 25 years.

Black bears are relatively rare in the Mackenzie Mountains and when seen are mostly south of 63°00'N. In 2015, 16 black bears (14 adults and two cubs) were reported; this is the fewest observations from 2003-2015 (Table 19). This year bears were observed in five outfitter areas D/OT/01, D/OT/02, S/OT/01, S/OT/02 and S/OT/04. One adult black bear was observed in each of the latter two areas, each well north of 64°00'N. As with the other post-2001 carnivore data, we assumed that all returned observation forms where blanks, zeroes, or dashes occurred in the boxes indicating the number of carnivores observed was a report of no carnivores being observed. This assumption is likely invalid for previous years' data and likely somewhat inflates the post-2001 values relative to 1996-2001 values.

Table 19: Observations of black bears reported by non-resident hunters (including non-hunting guides) in the Mackenzie Mountains, 1995-2015.

	2015[1]		2014[1]		2013[1]		2012[1]		2011[1]		2010[1]		2009[1]		2008[1]		2007[1]		2006[1]	
	Cub	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**
Total # Observed	2	14	5	27	12	18	3	34	2	27	0	29	3	14	8	48	4	34	2	27
% of Total Observed	13	87	16	84	40	60	8	92	7	93	0	100	18	82	14	86	11	89	7	93
No. Hunters Reporting	298	298	262	262	212	212	216	216	218	218	203	203	194	194	244	244	244	244	239	239
No. Hunters Saw at Least 1	1	11	4	22	4	13	1	7	2	19	0	8	3	10	3	10	2	17	1	14
Maximum # Observed	2	3	2	2	4	3	2	3	1	8	0	2	1	3	3	4	2	8	2	11

	2005[1]		2004[1]		2003[1]		2002[1]		2001		2000		1999		1998		1997		1996		1995 [2]
	Cub	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**All Bears**
Total # Observed	4	21	1	23	3	34	3	17	0	7	2	15	4	7	0	15	2	3	1	10	11
% of Total Observed	16	84	4	96	8	92	15	85	0	100	12	88	36	64	0	100	40	60	9	99	nil
No. Hunters Reporting	256	256	229	229	191	191	199	199	127	130	88	93	87	89	121	124	96	96	6	14	44
No. Hunters Saw at Least 1	3	18	1	19	2	21	2	14	1	7	1	10	2	6	0	8	2	3	1	9	9
Maximum # Observed	2	2	1	3	2	7	2	3	0	1	2	3	2	2	0	3	1	1	1	2	2

[1] Change in reporting for 2002 may have resulted in artificially lower numbers of hunters reporting for 1995-2001.

[2] All bears not separated out by cubs and adults.

Grizzly Bear (*Ursus arctos*)

The Mackenzie Mountains have been closed to non-residents for hunting grizzly bears since 1982 and resident hunters have been restricted to one bear per lifetime since the same year (Veitch 1999). It is clear from hunter comments on voluntary observation forms that, despite the lack of hunting opportunities, grizzly bears in the Mackenzie Mountains remain a subject of considerable interest for non-resident hunters and their guides (Appendices C, D). For the past 17 years there have been a variety of comments about grizzly bears and 2015 was no exception. This year hunters reported the loss of meat, capes and food to grizzly bears, and commented that there were too many grizzly bears and a hunt should be considered. Outfitters also continue to mention camp and equipment damage by grizzly bears both during and after the season. To minimize human-grizzly bear interactions electric fences have been used at main camps, temporary camp use has been reduced, clean camp policy has become standard for most camps, and some known high-use grizzly bear areas have been avoided.

Even though moose calf numbers, based upon hunter observations, are generally lower in the Mackenzie Mountains than those reported in the Mackenzie Valley, and predation by grizzly bears could be a potential cause (Ballard 1992), there were few hunter comments indicating low moose or caribou calf numbers.

From 1996-2013, the number of adult grizzly bears observed annually has fluctuated around a mean of 305 (range 218-402) with no discernable trend over time. Similarly the number of cubs observed annually fluctuated around a mean of 76 (range 40-115) with no trend over time (Figure 15, Table 20). This year more adult (n=566), and adult plus cubs (n=656), were observed than in any year since 1996 when observations were first recorded. This is the second consecutive year that >500 adults and >600 total bears have been observed and for those hunters that reported observing bears that >3 bears/hunter were reported (Figure 15, Table 20). If the observations from 2014 and 2015 are included in the time series, there is a positive trend in grizzly bear observations from 1996-2015.

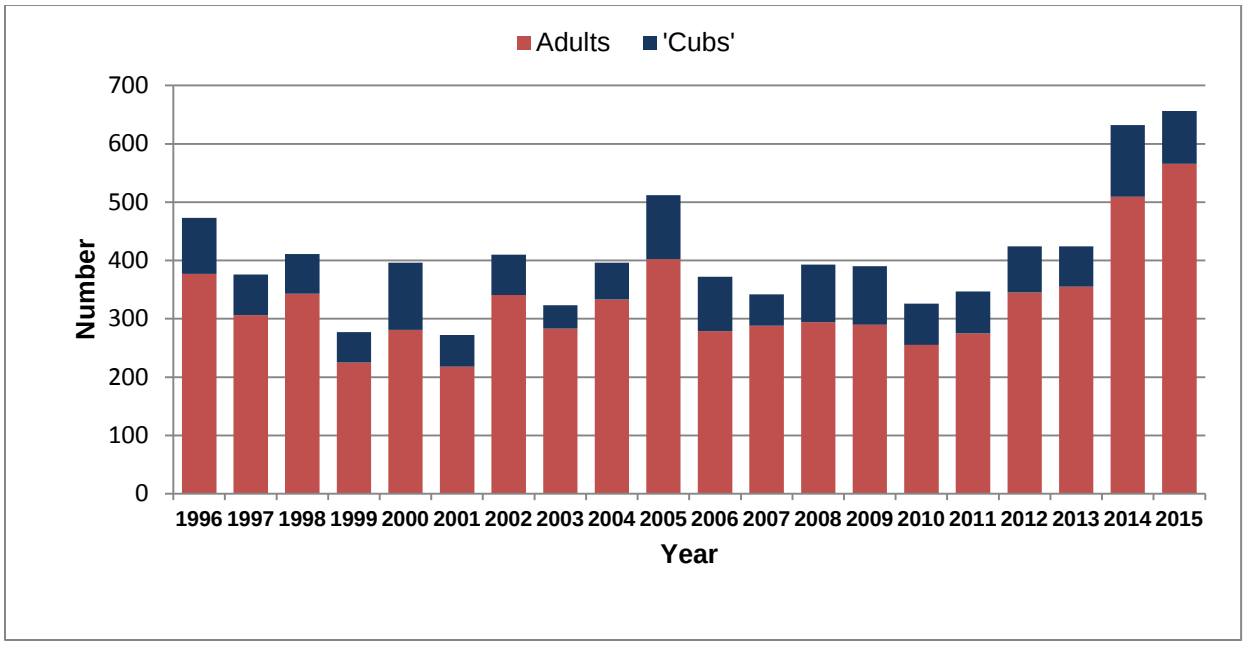

Figure 15: The number of adult and 'cub' grizzly bears observed by hunters from 1996-2015. Data are based upon returned voluntary hunter observation forms. 'Cubs' likely refer to cubs-of-the-year, yearlings, and possibly two-year olds.

Because cub grizzlies in the Mackenzie Mountains tend to stay with their mothers for three years (Miller et al. 1982), reported observations of 'cubs' likely refers to cubs-of-the-year,

yearlings, and possibly two-year-old bears. This may account for some of the variability in our cub observations (Figure 15). The percent 'cubs' reported from 1996-2015 ranges from 12.4-29.0 (mean 19.6). Miller et al. (1982) estimated that cubs and yearlings made up 14.3 and 10.4%, respectively of the grizzly population during 1973-1977. If yearlings were reported as cubs this could explain the high range we report for observed 'cubs'.

Since 1993, 78 nuisance grizzly bears have been killed, the majority in the Sahtú (n=47), with 19 and 12 for the Gwich'in and Dehcho regions, respectively (ENR unpublished data). The Sahtú covers the largest area of the Mackenzie Mountains at *ca.* 68,000 km^2. This year more nuisance grizzly bears were killed than in any year from 1993; 12 in total. Bears were killed in all regions: Sahtú (n=7), Gwich'in (n=3) and Dehcho (n=2).

Most instances of grizzly-human conflict used to come at night when grizzlies took the meat, and left without incident. However, more recently there have been increasing reports of grizzlies claiming either meat or hides from kills while guides were in the vicinity or while they were at camp (Carl Lafferty personal communication). A frequent comment of guided hunters is that bears have lost their fear of humans because of a lack of hunting and they are concerned that this has become a human safety issue. Prior to 2014 there were no documented incidences of injuries to humans caused by grizzly bear attacks (Veitch 1999). Unfortunately, last year a hunter was fatally injured in a grizzly bear attack while he and his guide were butchering a moose; the first documented hunter fatality in the Mackenzie Mountains. This year we had a second mauling. It also occurred while a moose was being

butchered in the same outfitter area (S/OT/02) as the 2014 incident. The hunter was seriously injured but survived. In this case a hunter was attacked while sitting on a ridge scoping for moose.

There have been no demographic studies on grizzly bears in the Mackenzie Mountains since field research conducted in 1973-1977 in a remote area of just 3,000 km^2 near the YT border (Miller et al. 1982). Miller et al. (1982) documented a low reproductive rate for female grizzly bears. No sows less than eight-years-old produced cubs, the average inter-litter interval was 3.8 years, and there was a mean litter size of 1.8. From 1996-2015 we used voluntary hunter observation forms and estimated litter size from only those observations where cubs were present with a single adult bear. We report a mean litter size of 1.7 based on annual estimates (range 1.3-2.1). Comparisons of our results with Miller et al. (1982) must take into account that we do not have a large sample size of observations annually and that these observations are potentially from all areas of the Mackenzie Mountains, not a small area. Also, in the 1970s grizzly bears were hunted by non-residents; non-resident hunting ceased in the Mackenzie Mountains in 1982. Although resident hunting still occurs, it is extremely limited. Therefore grizzly bears observed during 1996-2015 and the current grizzly bear population have really not been exposed to human harvest for at least one generation.

In a recent summary of grizzly bear harvest in the Gwich'in Settlement Area, the population for the Mackenzie Mountains zone was 110 bears (≥2 years old) (Environment and Natural

Resources 2014b). This zone overlaps about 75% of area G/OT/01 and a small portion of area S/OT/01 (see Figure 1). At the 2015 AMMO annual general meeting, ENR and AMMO members agreed that there was a need to get a better idea of grizzly bear numbers throughout the Mackenzie Mountains. Studies employing the used of hair snagging and DNA analyses, similar to those used by Paetkau et al. (1998) and Weaver (2006) were discussed at length. Some hair samples collected opportunistically by AMMO members during summer 2015 were provided to ENR at that meeting. Six samples from zone S/OT/01 and two samples from zone S/OT/05 were forwarded to Wildlife Genetics International, in Nelson, BC, for analyses. The remaining three samples were identified as coming from three different individual bears. ENR committed to designing an appropriate hair-snagging study to better assess bear numbers.

Table 20: Observations of grizzly bear reported by non-resident hunters in the Mackenzie Mountains, 1995-2015; total number of bears observed, % of cubs/adults, number of hunters reporting grizzly observations, number of hunters seeing at least one cub/adult, the mean and maximum number of cub/adults observed.

	2015		2014		2013		2012		2011		2010		2009		2008		2007		2006	
	Cub	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**
Total # Observed	90	566	123	509	69	355	79	345	72	275	71	255	100	290	99	294	54	288	93	279
% of Total #	14	86	19	81	16	84	19	81	21	79	22	78	26	74	25	75	16	84	25	75
# Hunters Reporting	37	177	56	155	29	123	46	138	38	123	33	104	47	109	48	139	28	127	50	122
# Hunters Saw ≥1	24	111	39	103	20	74	24	71	28	65	25	53	36	64	31	64	17	56	32	70
Mean # Observed	2.4	3.2	2.2	3.3	2.4	2.9	1.7	2.5	1.9	2.2	2.2	2.5	2.1	2.7	2.1	2.1	1.9	2.3	1.9	2.3
Maximum # Observed	10	19	9	14	6	15	5	14	4	10	5	11	6	20	6	12	5	15	5	12

	2005		2004		2003		2002		2001		2000		1999		1998		1997		1996		1995
	Cub	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**Cub**	**Ad**	**All Bears[1]**
Total # Observed	110	402	63	333	40	283	69	341	59	222	113	281	52	225	68	343	70	306	96	377	389
% of Total #	21	79	16	84	12	88	17	83	21	79	29	71	19	81	17	83	19	81	20	80	nil
# Hunters Reporting	49	150	34	131	19	120	34	128	136	171	108	131	98	117	139	177	110	170	49	132	138
# Hunters Saw ≥1	10	65	15	57	9	53	11	48	28	104	51	97	28	81	31	105	32	129	46	129	123
Mean # Observed	2.0	2.3	1.9	2.5	2.1	2.4	2.0	2.7	0.4	1.3	1.1	2.1	0.5	1.9	0.5	1.9	0.6	1.8	2.0	2.9	2.8
Maximum # Observed	10	16	4	15	12	7	8	20	5	10	8	12	4	12	6	16	12	17	5	15	16

[1] All bears not separated out by cubs and adults.

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APPENDIX A

Outfitters licenced to provide services to non-resident hunters in the Mackenzie Mountains, NWT – 2015.

D/0T/01 – SOUTH NAHANNI OUTFITTERS LTD.
Werner Aschbacher and Sunny Petersen
PO Box 31119
Whitehorse, YT Y1A 5P7
(P) (867)399-3194
(F) (867)399-3194
(E) info@huntnahanni.com
(Web) www.huntnahanni.com

D/0T/02 – NAHANNI BUTTE OUTFITTERS
Jim Lancaster
PO Box 3854
Smithers, BC VOJ 2N0
(P) (250)846-5309 or (250)263-9197
(E) jladventures@xplornet.com
(Web) www.lancasterfamilyhunting.com

G/0T/01 – ARCTIC RED RIVER OUTFITTERS
Tavis Molnar
PO Box 1
Whitehorse, YT Y1A 5X9
(P) (867)633-4934
(F) (867)633-4934
(E) info@arcticred-nwt.com
(Web) www.arcticred-nwt.com

S/0T/01 – GANA RIVER OUTFITTERS
Harold Grinde
P.O. Box 528
Rimbey, AB T0C 2J0
(P) (403)357-8414
(E) ganariver@pentnet.net
(Web) www.ganariver.com

S/0T/02-MACKENZIE MOUNTAIN OUTFITTERS
Stan and Helen Stevens
P.O. Box 175
Dawson Creek, BC V1G 4G3
(P) (250)786-5118
(F) (250)786-5404
(E) mmostanstevens@gmail.com
(Web) www.mmo-stanstevens.com

S/0T/03 – RAM HEAD OUTFITTERS
Stan Simpson
P.O. Box 5551
High River, AB T1V 1M6
(P) (780)446-8774
(E) ramheadoutfitters@hotmail.com
(Web) www.ramheadoutfitters.com

S/0T/04 - NWT OUTFITTERS
Clay Lancaster
PO Box 653
Hudson Hope, BC V0C 1V0
(P) (250)263-7778
(E) jladventuresxplornet.com
(Web) www.lancasterfamilyhunting.com

S/0T/05 - REDSTONE TROPHY HUNTS
Dave Dutchik
P.O. Box 1172
Cochrane, AB T4C 1B2
Cell: (250)261-9962
(P/F) (403)975-8862
(E) redstonehunts@yahoo.ca
(Web) www.redstonehunts.com

APPENDIX B

Summary of fees, bag limits, and seasons for big game species available to non-resident hunters in the Mackenzie Mountains, NWT - 2015. (Note: all prices are in Canadian funds.)

Species	Status	Tag Fee	Trophy Fee	Bag Limit	Season
Black Bear	Non-resident	$40.00	$200.00	1 adult bear not accompanied by a cub	15 Aug - 31 Oct
	Non-resident alien	$100.00	$200.00		15 Aug – 30 June
Woodland Caribou	Non-resident	$40.00	$400.00	1	25 Jul - 31 Oct
	Non-resident alien	$100.00	$400.00		
Mountain Goat	Non-resident	$40.00	$400.00	1	15 Jul - 31 Oct
	Non-resident alien	$100.00	$400.00		
Moose	Non-resident	$40.00	$400.00	1	1 Sep - 31 Oct
	Non-resident alien	$100.00	$400.00		
Dall's Sheep	Non-resident	$40.00	$400.00	1 adult male with min. ¾ curl	15 Jul - 31 Oct
	Non-resident alien	$100.00	$400.00		
Wolf	Non-resident	$40.00	$200.00	1 or 2[2]	25 Jul - 10 Oct
	Non-resident alien	$100.00	$200.00	2	1 Aug - 15 Apr
Wolverine	Non-resident	$40.00	$200.00	1	25 July - 10 Oct
	Non-resident alien	$100.00	$200.00	1[3]	1 Aug – 15 Apr

Source: Environment and Natural Resources. 2015. Northwest Territories Summary of Hunting Regulations. Yellowknife, NT. 40pp.

[2] One wolf limit from D/OT/01-02 and G/OT/01, and two wolves limit from S/OT/01-05.

[3] One wolverine limit from S/OT/01-05, D/OT/01-02 and G/OT/01, could hunt wolverine in S/OT/05 1 August - 15 April.

APPENDIX C

Comments provided from non-resident hunters in the Mackenzie Mountains, NWT on voluntary Hunter Wildlife Observation Report forms, 2015. We have not printed actual names of outfitters or their guides (XXX).

We saw a porcupine below the glacier. Poor weather the whole time.
Beautiful wilderness!! High quality animals available… will recommend to others.
Fannin
Very well managed area. Lots of game in the small area that we hunted.
Overall I had a wonderful time. One of my favorite hunts I've done. The work was hard but in the end worth it. This will be an event that I will never forget. Thank you so very much for the wonderful time.
Awesome hunt, beautiful country. Dark Fannin.
Absolutely my best hunting experience. Wonderful country!!
Excellent hunt, accommodations, service. Beautiful location. Looking forward to returning.
XXX - a very fine organization, run in professional manner. Very friendly atmosphere.
I have been on many hunts across North America and XXX is top rate in organization, safety and most importantly, hunting ethics and integrity!
Excellent trip and well run outfit. Had an incredible time.
Animals harvested 1 - ram, 1 billy were very fat and healthy.
Excellent outfitters - well organized, great hospitality, fully accommodating, great guides.
Hunted together with son XXX.
It was a very good hunting with professional people! Living and food was excellent!
The area would be unforgettable! At last I would say we had a great time by wonderful people! Thanks for all!
Nice hunt and people. Nice landscape.
It was a very nice time for me!
XXX + my guide were great. Not just well organized + professional but very conservation minded. Heard zero footprint often.
Very well organized and professional hunting with nice people in the camp!
Very well organized and professional hunting with nice people all over the camp!
It was an absolute fair chase hunt! Thank you very much!!
Great experience! Great country super host.
Excellent experience.
Poor weather
Will like to bow hunt more areas, keep open XXX.
Outstanding outfitter + guide - fantastic experience
Excellent operation and hunting experience!
Excellent hunt & outfitter. Professional & First Class.
Archery!
Lots of rain/fog. Only had 1 full day hunting. Lots of sheep! Great outfitter, very professional.

Archery Ram.
Archery - ram was colored with many dark hairs throughout!
Beautiful - rugged country - Really enjoyed myself, will do again.
Lots of rain and fog.
All guides and staff very professional and worked together great. Awesome experience and beautiful country! Will recommend.
Rain, fog, rain, fog - spectacular scenery - great hunt.
Great outfitter, guides, beautiful country!
It is unfortunate that XXX will expand to preclude XXX from hunting in the new boundary, they are excellent conservationists and this change … accessing of this area to future generations.
Very nice place, nice people, awesome guide. A real family, hard hunt, good for mental and experience of a lifetime.
Great hunt
Seen a lot of grizzly sign on rub trees and tracks along rivers. Territory very well managed by outfitter. Another great experience in the NWT.
Awesome experience, great outfitter.
I saw lots of grizzly bear and very big ones, should open a grizzly hunt. Don't think it's a good idea making that park, it's a great place this Mackenzie Mountains to come and hunt.
Very well run. First class experience!
Maybe next time. Bad weather, client had health issues.
Archery! Client had to leave business.
Had an excellent trip couldn't ask for a better experience, awesome job thanks!
Had a very good time "Good job", thanks.
Very good.
I had the most wonderful time. I have dreamed of hunting the XXX since I was a child. Thank you.
What a great crowd, great guide, great food and most of all… a great packer!
Excellent hunting experience.
You need people to seriously look into a method to control the grizzly bear population.
Had fun
Bad weather, client had restricted mobility.
Excellent hunt. Poor weather, older client with restricted mobility.
Extremely poor weather, hunted 1 day of 8 the rest of the time in the tent.
Extreme weather
Porcupine
Great hunt with my boys! NWT needs to start hunting grizzlies. They were completely unafraid and a gunshot seems to be the lunch bell.
Sheep seen where low down on mountains for this time of year.
My horseback hunt exceeded my expectations.
Lots of game on the river, got unlucky in a few stocks but that's hunting, great client.
Amazing country never gets old love XXX.
Animals in good shape, found 8 ticks on sheep cape, 11 year old ram, skinny.
Healthy animals, beaver making good moose country.

Lots of sheep, good shape, lots of griz.
Sheep was 11 year old ram, skin and bones, no teeth left.
I had so much fun! This was totally a trip I will recommend!! My guides were incredible! The food was delicious & I had the time of my life! Thanks so much!
Outfitters were awesome. Our guides are amazing. XXX and XXX are family now.
Wonderful country.
Amazing hunt. Too many bears, amazing bears, too many.
Lots of sheep, hill's too big, went donkey hunting, rams lived another year, moose are too big!
Very good cow/calf ratio on moose also seen lots of moose this year better than ever before throughout the year guiding.
Grizzly bears all roaming the tops of the highest mountains.
6 days in tent, bad weather hunter looking for big rams.
First class hunt!!!
Had a great time.
XXX at XXX runs an awesome outfit, would highly recommend him.
Great hunt, super outfitter, great guide, good equipment. Overall first class experience.
XXX runs a very professional operation. Beautiful country and a great experience.
My NWT experience was fantastic and I will be back. I believe there is too many grizzlies and the territory is wasting a resource by not issuing a regulated amount of permits. Thanks.
Excellent experience, once again!
XXX were professional in every way and are a major influence on return trips to the Mackenzie Mountains.
XXX had great guides/ wranglers and cooks.
Excellent hunt, will return.
Excellent outfitter & hunt.
Fabulous country - prestine. Kill some Grizzly's.
Lots of mature bears, tracks over ours heading away from camp and back each day.
Nothing could have made this hunt better other than being able to stay longer. *We had 2 very close encounters with bears?
The guide service is first class. They take care of the land and wildlife. The NWT is lucky to have outfitters and guides who take care of the land.
Always a pleasure.
Please be sure to maintain the beauty + wilderness of this magnificent part of the world.
Excellent trip outstanding outfit and crew.
First class operation! Great to have outfitter's that take pride in what they do, will recommend to every sheep, moose hunter.
Excellent experience, camp and facility. Great comrades between guides, hunters and staff. Awesome meals.
Thanks for the opportunity to hunt these beautiful mountains.
Open grizzly bear hunting.
Enjoyed an excellent hunt. Bagged sheep and caribou with bow. Game numbers observed were outstanding. Would definitely hunt here again.

Excellent camp and facilities; experienced & knowledgeable guides, excellent habitat, phenomenal "chef" and cooks, and a warm water bath!
Excellent guiding, the cooking was even better!! Very professional crew!! Great trip.
Grizzly bear hunting should be allowed to help manage the resource.
Beautiful country - wild & pristine - I loved it.
Great hunt!
Would be nice to see a grizzly tag. Seems to be a bear in every valley.
Fantastic adventure!!
Black powder hunter.
14 year old archery hunter.
Great time, great outfitter, great guides and crew. Incredible experience!
Awesome
Great hunt. Very old extremely broomed ram 3 years broomed left 2 on right.
Outstanding outfitter + crew. The country and game is a privilege to see.
Past on rams, returning next year.
I hunted both moose and woodland caribou successfully. The quality of the hunting, the accommodations, the food, the supervision, and especially the guiding was superb. It could not have been any better.
Saw way too many grizzly bears and only one moose calf. Great place to hunt I will be back, thank you.
Way to many grizzly bears. Great outfitter/great people/great hunt.
Hunted with son XXX.
Seen a lot of rams, good age class lots of ewes and lambs.
Good time. Awesome country, couldn't be happier.
Taking all of sheep meat home.
Great experience.
Lots of sheep + caribou seen during the trip. Animals were all healthy.
Plenty of sheep on the mountains, but we did spend a lot of time in the air…
We saw lots of sheep, caribou and bears on our trip. All seemed to be in good health.
Saw tons of game! I will be coming back in the future to hunt the Northwest Territories again.
XXX and XXX were excellent guides - wouldn't have changed a thing! Thanks.
Hunting trip was great as we had anticipated! Weather was a bit tough for the start.
Enjoyed our trip.
Did not observe any unusual "animals". Everything looked normal.
The hunt was fun. My guide XXX was top notch. Did everything right was very patient.
XXX was very professional. XXX + XXX very polite and pleasant to be around, food was good. Overall a great hunt and would recommend XXX for future hunts. On my hunt observed numerous wildlife. Bear, wolf, caribou, sheep all looked amazing and healthy.
Large abundance of game! Game management in this area was incredible. XXX knows the area well and how to hunt it. We saw a lot of game on out trip. As expected we saw a lot more ewes and lambs than rams. Caribou were up high due to the bugs at lower elevations.
Great hunt. Lots of game, great shape, very healthy.
All game appeared healthy and in good condition.

Awesome accommodations + guides, I shared the woods w/ several exp. Guides Great horses, obviously well provided for. Base camp was great environment could be some better plans for the outpost camps. XXX was an awesome experience. The fauna was diverse + enjoyed the animals were plentiful with a good mix of sexes - all appeared to be in great health + not pressured - seem to be an overabundance of bears as I experienced 2 encounters
Tough hunt, tough country, beautiful scenery.
Too many bears, caribou appeared healthy.
I enjoyed hunting with XXX. He walked hard and was knowledgeable about the game and area. The camp was better than I expected, food was good and plentiful. The caribou I saw were in very good condition, I didn't see as many large bulls as I expected. However the ones I did see were trophy quality. The bull moose I saw were very nice. The harvest looked pristine and sustainable.
Had to be very aware of grizzly bears and made the hunt an uneasy experience. I hunted 2 days and game was adequate. The bull I shot had a bite under the left ham about 3" x4". Condition of the caribou seemed good, the bull I shot had a lot of fat on it, so that was good.
We saw a lot of game during the hunt - all animals appeared to be healthy and in good condition. The area seemed to have a large population of grizzly bears. Bears entered camp and created problems, we saw bears daily during the hunt.
The caribou that were observed seemed healthy, alert and remote. One day of hunting resulted in approximately 20-25 caribou seen.
Lots of game, too many bears!
Very good time. Lots of game in the area, but too many bears.
The game was plentiful and active. I was able to harvest a nice bull caribou on the first day of the hunt. Bear took some meat.
This hunting experience was outstanding. All wildlife appeared healthy and the habitat had plentiful food supply.
Game was abundant and herds extremely healthy.
Game all appeared healthy.
Saw lots of caribou + they appeared healthy + in good shape.
Game was in good health.
Bear took all meat at hook lake camp. All game is healthy and lots of caribou, food looked to be in good supply.
All game was large + healthy. Not a lot of movement.
Had an enjoyable experience. Saw lots of game. Did not get a chance at a mature ram.
Saw lots of game. Didn't get on any mature rams.
Saw a healthy abundance of moose which was the species I was hunting. Moose looked strong + healthy and appropriately active for this time of year. Very good bull to cow ratio.
Good service, hard working. Beautiful country, lots of game.
Spotted approximately 50-60 caribou. Numerous bulls. All game looked healthy, travelling.
Plenty of animals, all healthy.
Animals seen seem to be healthy, lots of animals. Great location.

APPENDIX D

A summary of the 2015 voluntary hunter comments broken down into specific topics.

No. of Hunters Reporting	No. of Hunters Mentioning Good Quality Hunts	No. of Hunters Mentioning Abundance /Quality of Animals	No. of Hunters Mentioning Grizzlies	No. of Hunters Mentioning Wolves	No. of Hunters Mentioning Park Expansion	No. of Hunters Mentioning Bad Weather
169	95	45	25	0	3	12

APPENDIX E

Number, age, and horn length measurements of Dall's sheep rams harvested by non-resident hunters in the Mackenzie Mountains, 1967-2015. Number harvested includes 10[1], 2[2], 6[3], 8[4], 7[5], 9[6], 4[7], 11[8], and 5[9] harvested by resident hunters.

Year	Number of Sheep Harvested	Age (Years)		Length of Right Horn	
		Mean	Sample Size	Mean (cm)	Sample Size
1967-1968	223	8.4	Unknown	86.4	168
1969	110	-	-	-	-
1970	94	-	-	-	-
1971	88	-	-	-	-
1972	110	8.5	96	86.2	90
1973	89	8.9	86	84.4	88
1974	93	9.2	85	88.6	91
1975	129	7.6	67	84.6	127
1976	144	7.8	46	88.0	144
1977	132	5.7	69	86.8	132
1978	187	8.5	115	88.9	165
1979	200	8.7	108	90.8	154
1980	188	-	-	90.1	127
1981	183	8.1	101	92.7	157
1982	126	8.7	98	89.7	124
1983	100	9.0	80	90.9	94
1984	102	8.4	98	91.2	99
1985	123	8.1	115	89.7	112
1986	154	8.8	132	88.4	153
1987	148	8.9	148	89.4	148
1988	177	9.8	166	91.7	161
1989	207	9.9	199	90.4	203
1990	219	9.8	200	90.2	218
1991	170	9.7	161	89.1	170
1992	203	9.7	199	88.0	202
1993	191	9.7	181	87.6	190
1994	199	9.5	191	89.8	196
1995	189	9.6	189	88.9	189

Year	Number of Sheep Harvested	Age (Years)		Length of Right Horn	
		Mean	Sample Size	Mean (cm)	Sample Size
1996	201	9.5	200	88.7	201
1997	210	10.0	206	89.9	203
1998	215	10.0	207	90.0	209
1999	204	10.2	183	88.8	184
2000	194	10.0	188	88.9	188
2001	199	10.1	183	87.7	184
2002	173 [6]	9.9	166	89.2	166
2003	213 [3]	9.7	210	89.8	212
2004	201 [1]	10.0	199	89.3	200
2005	203 [7]	10.2	196	89.4	199
2006	208 [8]	10.4	206	88.4	207
2007	216 [3]	10.8	216	88.3	216
2008	192 [4]	10.6	192	88.8	192
2009	179 [5]	10.9	178	88.2	178
2010	193 [6]	10.8	191	88.7	192
2011	181 [7]	10.8	181	90.5	181
2012	207 [6]	10.9	205	89.9	206
2013	193 [4]	10.5	193	87.5	193
2014	208 [7]	10.5	207	88.4	208
2015	219 [9]	10.6	219	88.0	218
Mean 1972-2015	**177**	**10**	**159**	**89.0**	**170**

APPENDIX F

Outfitted non-resident hunter harvests in the Mackenzie Mountains, 1991-2015. Number harvested includes 10[1], 2[2], 6[3], 8[4], 7[5], 9[6], 4[7], 11[8] and 5[9] harvested by resident hunters.

Year	Number of Licences Sold	Number of Animals Harvested						
		Dall's Sheep	Mountain Caribou	Moose	Mountain Goat	Wolf	Wolverine	Black Bear
1991	354	170	179	40	6	14	3	1
1992	364	203	142	32	4	7	0	0
1993	382	191	191	56	9	7	3	0
1994	356	199	164	46	5	15	2	0
1995	344	189	180	49	6	14	1	0
1996	387	201	175	46	4	9	4	0
1997	352	210	168	44	2	17	1	0
1998	345	215	160	52	5	9	0	0
1999	321	204	117	36	1	11	3	0
2000	332	194	127	44	1	14	0	0
2001	332	199	128	41	2	15	2	0
2002	338	173 [6]	168	42	5	11	1	0
2003	350	213 [3]	143	48	6	12	0	0
2004	347	201 [1]	135	55	6	18	0	0
2005	398	203 [7]	160	75	18	19	1	0
2006	418	208 [8]	188	72	12	23	1	0
2007	405	216 [3]	165	74	21	12	0	0
2008	399	192 [4]	167	75	21	17	1	2
2009	339	179 [5]	125	59	20	20	3	1
2010	384	193 [6]	158	75	13	19	3	0
2011	400	181 [7]	181	78	20	21	2	1
2012	405	207 [6]	168	85	12	24	0	0
2013	409	193 [4]	182	81	11	16	2	0
2014	407	208 [7]	179	69	14	23	1	0
2015	447	219 [9]	190	71	17	20	2	2
Mean 1991-2015	**373**	**198**	**162**	**58**	**10**	**15**	**1**	**0**

APPENDIX G

Summary of age and sex ratios calculated from non-resident hunter observation reports in the Mackenzie Mountains, 1995-2015.

Year	Dall's Sheep		Mountain Caribou		Moose	
	Lambs: 100 Ewes	Rams: 100 Ewes	Calves: 100 Cows	Bulls: 100 Cows	Calves: 100 Cows	Bulls: 100 Cows
1995	67	82	36	34	30	95
1996	44	82	45	40	26	76
1997	57	55	36	21	30	107
1998	60	84	35	34	30	95
1999	58	90	43	25	20	100
2000	47	90	41	39	26	89
2001	59	89	56	61	28	120
2002	58	89	59	31	29	96
2003	50	83	39	36	25	129
2004	53	93	42	38	30	101
2005	51	98	42	42	33	110
2006	53	96	43	37	33	137
2007	64	83	52	37	36	101
2008	49	98	41	40	31	115
2009	55	94	45	39	31	90
2010	49	93	45	46	35	101
2011	56	91	44	35	33	123
2012	53	86	40	46	33	88
2013	52	92	36	43	29	106
2014	55	93	36	41	29	103
2015	58	72	43	50	34	98
Mean 1995-2015	**55**	**87**	**43**	**39**	**30**	**104**

APPENDIX H

Summary of age and sex ratios calculated from non-resident hunter observation reports of mountain goats, 2002-2015.

Year	Kids:100 Nannies	Billies:100 Nannies	Total Animals
2002	55.2	75.9	69
2003	61.5	70.5	182
2004	57.1	77.1	84
2005	66.0	50.4	306
2006	61.5	51.4	245
2007	71.2	57.7	393
2008	54.3	97.1	264
2009	64.6	59.0	327
2010	78.3	46.2	239
2011	64.0	59.0	243
2012	51.8	71.9	257
2013	69.6	75.0	144
2014	67.8	58.5	277
2015	67.5	92.5	212
Mean 2002-2015	**63.6**	**67.3**	**231.6**