From:	Kolman, Brian FLNR:EX
To:	White, Nancy N ENV:EX
Subject:	RE: Draft Project Plan for Hanna-Tintina Conservancy
Date:	Wednesday, April 1, 2015 4:00:58 PM
Attachments:	Final Nass Moose Scoping Document.pdf Skeena CAP March 31 2015.pdf image001.jpg

Hi Nancy,

Nice talking with you this afternoon. Attached are the two documents we discussed earlier this afternoon. Please do not quote or distribute the documents as they are hot off the press and remain in draft format. They have not been endorsed by RMT yet. Once they become more formalized, I'll send you the 'final' documents. On a related note, as we move forward on the subsequent phases of Nass moose management planning, you should/will be formally involved.

Regards,

Brian.

Brian Kolman
Team Lead, Regional Initiatives| Resource Management | Skeena
Ministry of Forests, Lands, & Natural Resource Operations
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From: White, Nancy N ENV:EX
Sent: Wednesday, April 1, 2015 3:10 PM
To: Kolman, Brian FLNR:EX
Subject: Draft Project Plan for Hanna-Tintina Conservancy

HI Brian,

As discussed, here is the draft project plan to develop a management plan for the Hanna-Tintina. I'm thinking that I should add you as a contact for the Nass Moose Project…

Cheers,

Nancy.

Nancy White, P.Ag.
Planning Section Head - Skeena
BC Parks and Conservation Officer Service Division
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Nass Moose Scoping Document:

Phase 1 in the Development of a Nass Moose Management Plan

March 31, 2015

Prepared for:
Ministry of Forests, Lands, and Natural Resource Operations
Skeena Region, 3726 Alfred Avenue
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Prepared by:
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McElhanney

Executive Summary

McElhanney Consulting Service Ltd. was contracted by the Ministry of Forests Lands and Natural Resource Operations to provide a Nass Moose Management Plan Scoping document, with cultural and technical input from the Gitanyow and Nisga'a First Nation, which captures the available information and the current status of moose in the Nass Population Management Unit (NPMU). For the Nisga'a and the Gitanyow moose represents a primary source of red meat available all year and, in addition to being an integral part of their food security, has cultural and ceremonial significance. In order to achieve the objectives of this project it was necessary to evaluate the current influences on moose to identify how best to recover the population before providing recommendations with a range of options from which appropriate management can be selected. A literature review of the historic research was conducted followed by interviews and open forum discussions held with the Nisga'a and Gitanyow. Information and concerns relevant to the moose population were identified under 5 categories: 1) demographics; 2) mortalities by humans and predators; 3) parasites and disease; 4) habitat capability and suitability; and 5) seasonal movement and distribution. Each topic discusses the historic research that has occurred, the current efforts that the Gitanyow, Nisga'a and province are employing, and where future research should be directed in order to rebuild the moose population of the NPMU. The report concludes that while unsustainable annual harvests may have had some initial impact on the population, the larger problem appears to be unregulated hunting and that any management action that does not address the unregulated hunt cannot achieve the goal of recovering the moose population in the NPMU. The report includes a Process Plan for the next 18 months and an annotated Table of Contents recommended for the final Nass Moose Management Plan.

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Introduction

Between 1994 and 2001, three stratified aerial surveys indicated that the moose population in the Nass Population Management Unit (NPMU) was fluctuating between 1400 and 2050 animals. However, between the 2001 count and the 2007 count, there appears to be a dramatic drop in the estimated population size in the NPMU to approximately 638 animals. At this point, several harvesting restrictions were imposed. The last population estimate in 2011 suggest that there are approximately 517 moose in the NPMU and that the restrictions have not been adequate to arrest the population decline.

Moose in the Nass Valley represent more than just a holiday photographic opportunity or challenging animal for sport hunting. For the Gitanyow and Nisga'a First Nations that live in the area, moose represent a large component of their sustenance diet. In the lower elevations of the Nass, it represents the primary source of red meat available year round. While it can have additional value as a shared meal during celebrations, primarily it constitutes a healthy and needed protein source and an integral part of their food security.

Given the importance of moose, both the Nisga'a and Gitanyow have strived to develop solutions and mitigations to arrest the population decline with the limited resources that are available. For example, both have developed regulations, limited entry lotteries, hunting closures for certain areas and sex, hunter surveys, and reduced the hunting season duration. The Nisga'a Lisims Government, as part of the Nass Wildlife Committee, have contracted LGL Ltd. to conduct research and develop recovery strategies. In addition, they have developed their own Conservation Officer and wildlife support services within their communities. The Gitanyow have capable wildlife support staff who regularly patrol the accessible roads in winter. Furthermore, they have developed an extensive communication network using social media and educational systems to ensure all results are reported by their registered hunters and that the ethic of traditional ways are encouraged. The province has supported many of these activities through expert advice, logistical support for population surveys, closures for non-aboriginal hunting, and funding. However, it became apparent to provincial staff that in order to achieve the desired results, a more cohesive and inclusive approach was required to develop a Moose Management Plan for the Nass area.

The development of a Nass Moose Management Plan (NMMP) will require several subsequent steps. The first of these steps includes the development of a scoping document. The objective of a scoping document is to use existing local knowledge and data within the literature to define the extent of existing information on the factors impacting moose or moose habitat in the NPMU. Using this information, the scoping document identifies where more rigorous management is necessary and the data gaps and other factors that should be considered in the development of a NMMP. In general, these factors can be divided into demographics associated with the moose population, human caused mortality, non-human mortality, seasonal habitat suitability, and disease. Within each of these factors it is important to document on-going efforts such that successes can be shared and built on in a more regionally applied NMMP.

The final portion of this document includes two appendices. The first is proposed work plan identifying our recommended approach towards continued developing of the NMMP. The second is an annotated table of contents for how we envision the final NMMP should be laid out.

Methods

Two research methods were employed in data gathering for this project. Initially, a literature search was conducted for sources pertaining to the population of moose and or its habitat within the NPMU and surrounding areas. Literature was obtained through in-house and internet searches, peer-reviewed journal articles and government databases.

The second method focused more on the local knowledge and technical information held by the two First Nations. Meetings were scheduled with the Gitanyow Hereditary Chiefs and technical advisors, and with Mike Demarchi, the technical advisor for the Nisga'a regarding moose management. Both groups stressed the importance of the moose within their community and their concern over the decline of the population. Meetings were structured as a directed discussion in an open forum. Semi-structured questions were posed so those present could recount personal and community experiences. Broad topics focused on the demographics of the moose in the NPMU, mortality (human and predator induced), the effects of disease, the quality and distribution of available habitat, and the movement and distribution of moose. Minutes of these minutes were confirmed by the two First Nations prior to finalizing and inclusion within the project Library (provided as an attachment).

Study Area

The Nass Population Management Unit (NPMU) is located in northwestern British Columbia and covers an area of approximately 16,100 km^2 of largely unoccupied forested land. The NPMU boundaries include portions of 4 provincial wildlife management units (WMU 6-14, 6-15, 6-16, and 6-30). This area encompasses the lower Nass River watershed and includes Nisga'a lands and many of the Gitanyow *Lax Yip* (territories). In the Nisga'a Final Agreement (1998) this area was defined as the Nass Wildlife Area (NWA) and within this document both the NWA and NPMU will be used interchangeably. Settled areas are located along two provincial highways including Highway 113 (Nisga'a Highway) and Highway 37 (Stewart-Cassiar Highway). These two highways are connected by the Nass Forest Service Road or Cranberry Connector, a highly used resource road which currently is only open in snow free seasons (Figure 1).

The Nass River basin is an area of low relief with gently rolling topography and hundreds of small lakes that drain in a southerly direction. The basin is surrounded by mountains with the Boundary Ranges to the west, the Hazelton Mountains to the south, and the Skeena Mountains in the east. Rocks underlying the basin are volcanic and the drainage pattern of the area is indicative of glacial scouring from the Pleistocene era. Approximately 300 years ago, a volcanic eruption occurred resulting in the creation of Lava Lake and a lava plain of about 7 miles long and 3 miles wide in the Tseax watershed (Holland 1976).

The NPMU includes many ecoregions with climates that range from hyper maritime in the southwest to continental in the northeast. This range in climate creates conditions for a variety of biogeoclimatic zones. Closer to the coast the mild to cool, wet winters with deep snowpack create environments for the Coastal Western Hemlock (CWH) bioclimatic zone at low to mid elevations and the Mountain Hemlock (MH) zone at higher elevations. The most common zone found in the NWA is the Interior Cedar-Hemlock (ICH), which occurs at low to mid-elevations in the Nass River drainage. While this is the most common biogeoclimatic zone, it includes two very different subzones; the very wet cold subzone (ICHvc) and the moist cool subzone (ICHmc), with the ICHmc subzone containing at least 2 variants.

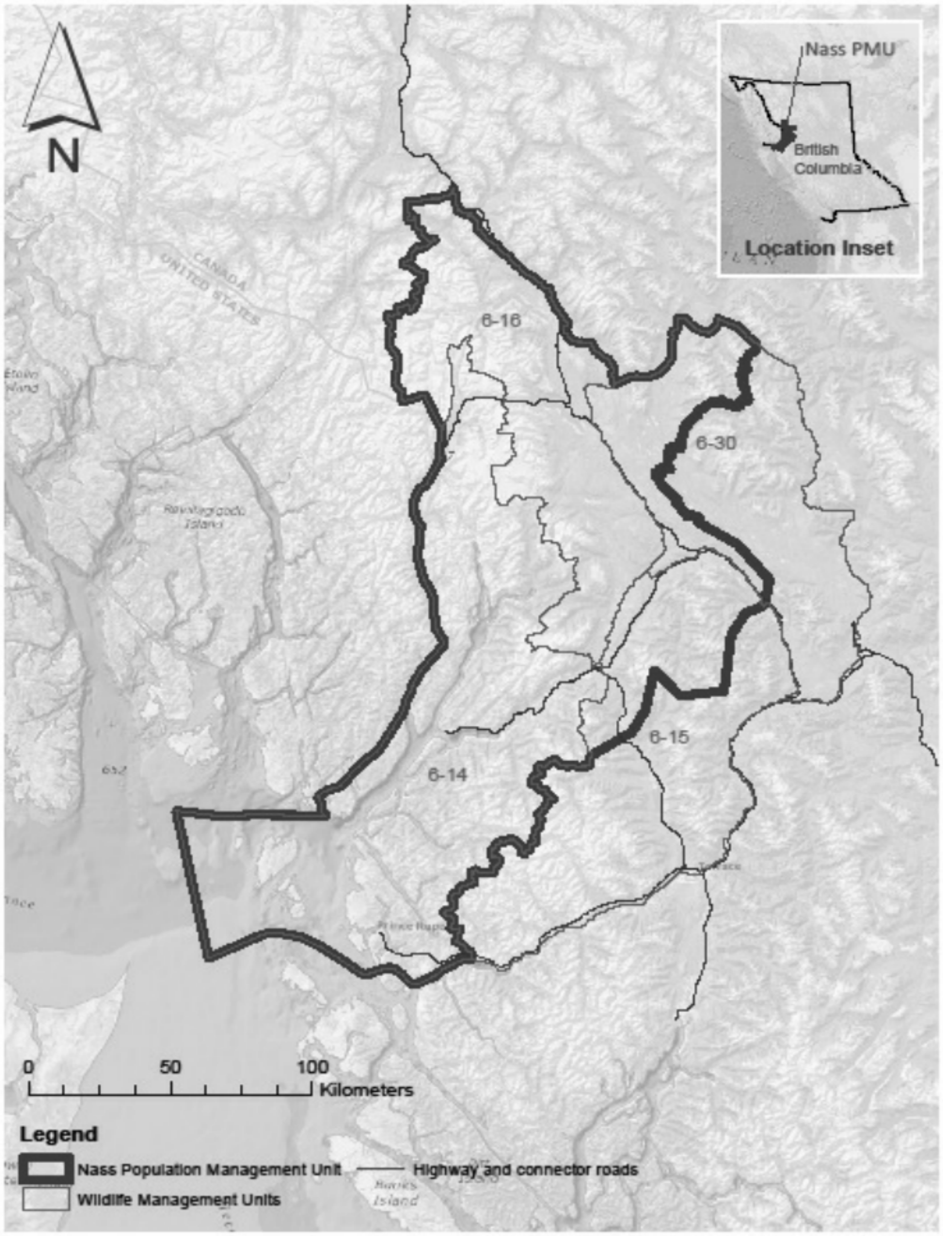

***Figure 1**: Map identifying the boundary of the Nass Population Management Unit (red), the Provincial Wildlife Management Units within the Skeena Region (yellow) and the major roads that bisect the NPMU (black).*

Above the ICH is the Engelmann Spruce-Subalpine Fir (ESSF) zone. Both are characterized as having long, cold, and snowy winters and are important moose habitat in summer. The Boreal Alpine Fescue Alpine (BAFA) and the Coastal Mountain-heather Alpine (CMHA) zone are above the MH or ESSF, respectively and have the shortest growing season with harshest climates (Banner et al. 1993).

Conifers are the dominant overstory canopy of forested stands in the NPMU. These stands include species such as western hemlock (*Tsuga heterophylla*), Roche spruce (*Picea lutzii*), western redcedar (*Thuja plicata*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*). Sites along riparian habitats or in areas that have been disturbed by forest harvesting and fire, contain common deciduous species such as black cottonwood (*Populus trichocarpa*), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), red-osier dogwood (*Cornus stolonifera*) and willow species (*Salix* sp.).

Disturbance in the NPMU has occurred over a variety of time scales. Approximately 300 years prior, a volcanic eruption occurred which created a lava plain. This disturbance reverted the landscape to the earliest successional stage. To-date, very little vegetation has become reestablished besides a few succulent vascular plants, highly specialized mosses and lichen (Holland 1976 and B .Pollard pers. observ.).

On a shorter time scale, the results of both natural and human caused fires are still evident on the landscape. Large fires in the Kiteen watershed and in the Cranberry are likely the result of lightning strikes during a dry summer in the late 1950's. At lower elevations, the Gitanyow would often initiate fires as a management tool. These low intensity fires in the spring would help increase the available forage for rabbits and other prey animals as well as revitalizing berry producing areas (K. Koch pers. comm.).

Since the middle of the 20th century, forest-harvesting has been the largest source of disturbance in the NPMU. Harvesting was initiated in the lower floodplains of the Nass River in the 1950's, and within the Cranberry area in the 1970's. Harvesting progressed across the Lower Nass with large areas of the Kinskuch, Kwinatahl, Brown Bear, and the Highway 37 corridor in the mid to late 1980's. Harvesting continues throughout the area today, although at a much reduced rate with the majority of high-value wood now difficult to economically develop. The largest relevant legacy of this harvesting is the retention of 1000's of km of road segments leaving large areas of the NPMU accessible year round to ATV, 4-wheel drive trucks and snowmobiles in the winter.

Most recently BC Hydro installed the Northwest Transmission Line that largely splits the NWA. This resulted in a linear corridor from Terrace to Bob Quinn substation. In addition, the electrification of Highway 37 suggests that multiple mining operations are now more likely to be viable. Avanti's Kitsault Mine near Alice Arm will start using Highway 37 and the Cranberry Connector this year and will result in year round maintenance.

Results

Communications with the Nisga'a and Gitanyow identified each groups' interest and the importance of rebuilding the moose population in the NPMU. Each of the broad topics discusses the historic research, inventory and monitoring that has occurred, the current efforts that the Gitanyow, Nisga'a and province are employing, and where future efforts should be directed in order to rebuild the moose population of the NPMU.

First Nation Interest

Both the Nisga'a and the Gitanyow describe the importance of moose as a food source and for its cultural and ceremonial significance. For example, the Nisga'a consider it tradition to have moose during winter ceremonies that honor those that have passed away. Additionally, many within the Nisga'a community rely on moose as a source of organic meat for home use (H. Nyce Sr., Talking Stick Interview). The Gitanyow consider moose meat as…

> *'a larger part of the Gitanyow'* as *'90% of people still eat traditional food 1-2 times a week'* (J. Starlund pers. comm.).

The moose is not just for ceremonial purposes, but provides an important addition to a healthy diet and life style for the people within the community. Additionally, it is seen as an opportunity for elders to pass knowledge of hunting and their *Wilp* (house territories) to the youth (GHC 2014).

The main concerns expressed by both First Nations is the rate at which the moose population declined in the last 16 years, the current population estimates, and the restrictions to their rights to harvest. Both groups agree that the population decline is a direct result of overharvesting and even with harvest restrictions in place, both groups recognize that the lack of enforcement of the existing regulations continues to exacerbate the problem. The Gitanyow Chiefs specified that excessive animal harvesting in the lower Cranberry winter range is the primary factor driving populations down although there is some concern that a commercial poaching operation may also be occurring (GHC 2015 Interview; Demarchi 2015). Continued reduction of moose populations is a significant concern as it is a threat to both First Nations' food security. The Nisga'a and Gitanyow are strong supporters of implementing a Nass Moose Management Plan that will increase the population of moose and allow for greater food security. However, to have the highest chance of success, both also understand that it will require short-term sacrifices and a coordinated approach.

Demographics

Demographics refers to the numeration of an animal population and includes items like total population size, sex and age ratios, and a variety of other metrics that are often used to assess the health of the population or its capability to sustain harvesting. The following outlines some of the demographic sampling done over the last 20 years, current efforts, and the limiting factors or data gaps in existing information regarding the population of moose in the NWA.

Historic Research

The population of moose in the NWA has had 5 surveys over the last 20 years. Stratified random block samplings (see Demarchi 2000 for detailed account of the method) conducted across the entire Nass survey area identified a population of 1697 ± 41% animals in 1997. However, values exceeded the Resource Inventory Committee (RIC) standards of ± 25% so an additional assessment was proposed once sightability issues had been corrected (Demarchi 2000). In 2001, the moose population was again assessed and estimated to contain 1595 ± 19% moose once corrected for sightability (Demarchi 2000). This estimate was used by the Nisga'a Wildlife Committee (NWC) to quantify the Total Allowable Harvest (TAH) for moose within the NWA beginning in 2001. The TAH from 2001 to 2007 remained at 225 individuals each year with 45-55 being cows and 25-40 being calves. Hatter (1998) suggests that populations should be reassessed at a minimum of 5 years to manage for sustainable harvesting. By 2007, the population had decreased substantially and was estimated at 638 ± 33% moose within the NWA (Figure 2). This significant decline resulted in hunting restrictions such as a Limited Entry Harvest (LEH) for resident and non-resident hunters and a reduced TAH to only 70 bulls. These restrictions were kept in place over the next 5 years (2007-2011). The most recent 5-year assessment estimated for the population of moose within the NWA at 517 ± 28%. These restrictions appear to have slowed the population decline, but not assisted in the rebuilding of the population.

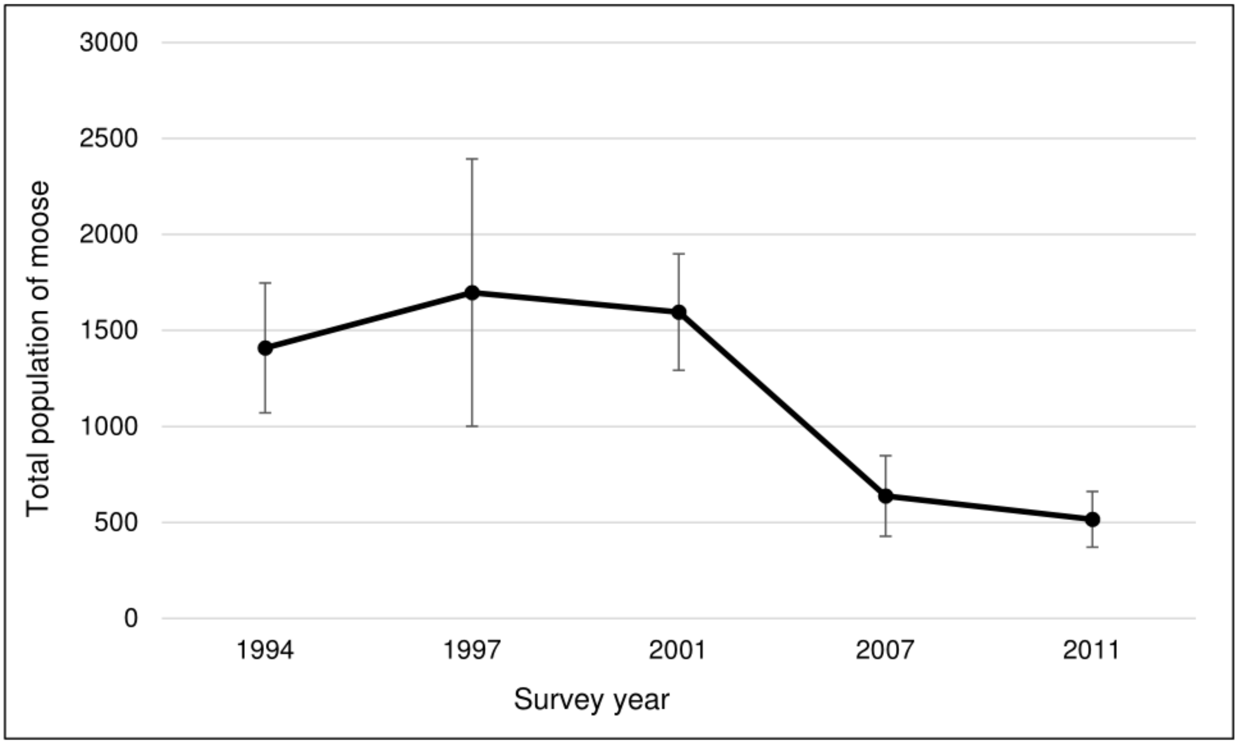

Figure 2*: The total population of moose in the NWA based on 5 aerial surveys using a stratified random block sampling method (Demarchi 2000). Assessments were conducted from 1994 to 2011. In 1994 and 1997, surveys were conducted for the entire Nass survey area of which the NWA is a subarea and from 2001-2011, survey results are for the NWA (reproduced from Table 1 in Demarchi 2013).*

When considering factors that may be influencing these population numbers, it is often easiest to look at it from the perspective of what things add to the population versus which things are subtracted. When it comes to adding, there is really only the number of animals moving into the area or the number of juveniles born. The possibility of additional animals entering the population has been examined before with collared moose in the NPMU. Demarchi (2000) determined that the potential for a significant number of moose to immigrate into the study area was low. This is supported by traditional knowledge (GHC 2015 Interview).

Determining the number of calves born per cow is a significant variable in predicting the growth rate of a population. However, this statistic is difficult to measure because of the observation conditions during birthing times (mid to late May). Often calving moose will find isolated areas with good lateral sight lines and at least one direction with no risk of surprise such as the edge of a lake or clearing. As such, it is often difficult to see calves even when the cow is radio-collared. The best approach is to sedate moose and take blood samples or taking reproductive tracks from females accidentally killed or harvested in the spring. This can be used to determine the rate of pregnancy and, in the case of harvested cows, how many are carrying twins. For example, work completed by Demarchi (2000), used blood tests and radio-telemetry work to provide a minimum estimate of 89 calves for every 100 cows. This number is consistent with moose in many populations and is not considered problematic or possibly resulting in population declines (Ballenberge and Ballard *in* Franzmann and Schwartz 1998).

The calf:cow ratio is a comparison of calves and cows in mid-winter, but this does not reflect the actual number born, only those juveniles that survived to their first winter. The calf:cow ratio provides managers some idea about calf survival and the potential for individual animals to enter the breeding pool. In order to have a sustainable harvest, a population must maintain a certain number of calves being born and surviving to adulthood. For example, a population with no growth (i.e. stable) could sustain a calf:cow ratio as low as 25:100 (Bergerud 1992 cited in Hatter 1998). However, if a 5-10% annual harvest is occurring then the calf:cow ratio should be maintained around 30-45 calves per 100 cows. Within the NWA over the 16 years of monitoring, the calf:cow ratio has fluctuated between 44-55 calves for every 100 cows. This number is fairly consistent with other studies in the Kispiox and in the Kitwanga-Cranberry (Marshall 2001 and Hamelin 2003). This would suggest the population over the last 16 years should have been sustainable at a 10% harvest (Demarchi 2013).

The bull:cow ratio is also used as a surrogate for the number of females that can be impregnated in the fall rut. Moose are polygamous breeders meaning that one male will fertilize multiple females. In populations that do not have harvesting, the ratio is often close to one, although higher risk behaviour often keeps the bull population slightly lower (Schwartz *in* Franzmann and Schwartz 1998). At parity, many of the bulls will not successfully reproduce because they will be kept away from females by another dominant male. In harvested populations, the ratio can be highly influenced by the target of the hunt. When it is a bull only harvest, the ratio can often change to 30 bulls per 100 cows (30:100).

Over 16 years, the bull:cow ratio has fluctuated from 38:100 (1997) up to 85:100 (2007) and dropped back to 63:100 (2011; Demarchi 2013). Considering these ratios, it is highly unlikely that there would be a problem ensuring that all receptive females were impregnated and that the population could have maintained a 5-10% annual harvest. However, the literature indicates that there are no clear correlation between bull:cow ratios and pregnancy rates (Thompson 1991 cited in Schwartz 1998). These ratios are only significant when considering absolute numbers such that higher female numbers in a fixed population size will produce more juveniles.

While the bull:cow ratios are not significant for predicting pregnancy rates, they do highlight an interesting phenomenon. During the large drop in population between 2001 and 2007, there is similarly a large shift in bull:cow ratio from 45:100 to 85:100. Using the total population bull:cow and calf:cow ratios as a basis to develop absolute numbers, it appears that cows were reduced from approximately 800 animals in 2001 to 270 in 2007, while the bull population dropped from 360 to 130. This means that for every bull harvested, 2.3 females were harvested. While these numbers are based on estimates, it appears that the moose hunt in those ten years had a significant bias toward cows or that there was some type of habitat selection by cow moose that placed them at higher risk.

Demarchi (2013) suggests that the initial decline in the population is likely attributable to the overharvesting that resulted from inaccurate initial population and demographic estimates such as mortality rates and the twinning rates (M. Demarchi, pers. comm.). While this may be accurate for the initial declines to 2007, it does not explain the continued decline after 2007. Both regulated overharvesting and unregulated harvesting have been identified by the Gitanyow Hereditary Chiefs as the primary issue in driving the population down (GHC 2015 Interview) and Demarchi (2007) suggested that the high cow mortality may be limiting population recovery. See Figure 3 for a graphic depicting the impact of harvesting a fall/winter cow versus harvesting a bull at the same time (from Koch 2014).

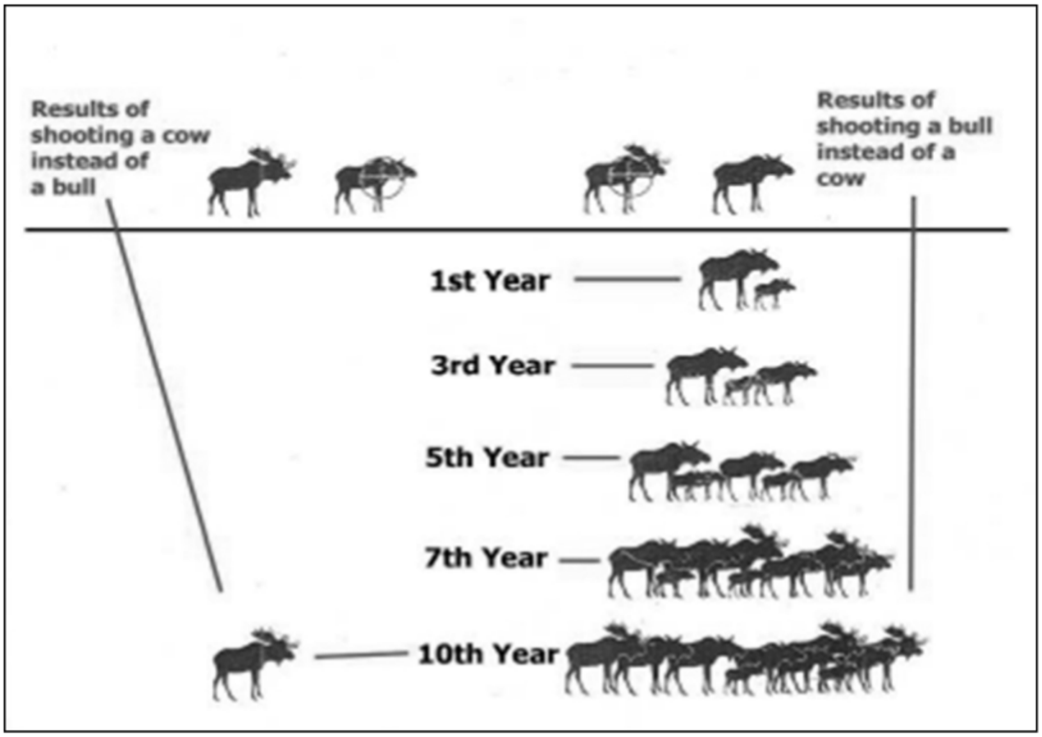

Figure 3: *Recreated from Koch 2014 that demonstrates the result of removing a bull from the population versus removing a cow. Over the long term, by retaining the cow moose in the population a greater likelihood of a population rebuild could occur.*

Current Efforts

In an effort to manage the declining population of moose, the Nisga'a have a regulated Limited Entry Harvest (LEH) for moose in the NWA commencing in the 2007/08 hunting season. After the hunting season, all individuals that received permits are requested to submit to a post-harvest interview. This survey gathers information on the harvested moose including the location and date of harvest and the amount of hunter effort that was required. In addition, hunters are asked to provide a tooth or jaw from the harvested moose. However, not all hunters that receive a permit submit to the post-harvest interview (~80% compliance; M. Demarchi pers. comm.).

In the early 2000's (winters of 2000/2001 and 2001/2002) and again in the winter of 2011/2012, the GHC council initiated a permitting system for their LEH harvest of moose on the Gitanyow *Lax Yip*. In 2014-15, 34 permits were issued that resulted in 14 moose being harvested by Gitanyow *Wilp* members (Koch 2015). In addition to the permitting system, the Gitanyow have established hunting regulations based on the Gitanyow *Ayookxw* (traditional law). These regulations state that hunters are allowed to harvest on their respective *Wilp* territory without permission from the Chief of that *Wilp*. However, if they desire to harvest from another *Wilp* territory, permission from the Chief of that *Wilp* must be obtained. If a hunter is successful, then they must offer a portion of the animal to the Chief of that *Wilp* (Koch 2014). Restrictions for hunting seasons were also implemented in the *Wilps*. For example, during the 2013/14, the Gitanyow closed harvesting of moose in the *Gwinuu* and *Haitsimsxw* territories and placed season restrictions in the remaining 6 *Wilp* territories.

In order to slow the population decline, both the Nisga'a and the Gitanyow have implemented a bull only harvest since the 2007/08 hunting season. After the implementation of a bull only harvest, no data on cow mortality resulting from harvesting was recorded. The next NWA moose population assessment is scheduled for the spring of 2016.

Data Gaps

While substantial efforts have been made to study the moose population in the Nass, there remains some gaps in our knowledge that would greatly assist in improving management including:

- Better population estimates with respect to provincial standards (± 25%) for the TAH allocation,
- Improved consistency and information gathering from regulated hunters,
- Enhanced assessment of unregulated hunter impacts,
- Correlation of more costly population estimates (i.e. aerial surveys) scheduled for 2016 with multiple economic alternatives (i.e. ground transects tabulating tracks and browse intensity) that can be used to track populations more often than every 5 years even if at a lower level of accuracy,
- Improved knowledge of mortality rates, calf and winter predation rates, recruitment and twinning rates, and other demographics to enhance the confidence in the TAH,
- Improve the access to and use of information from hunter surveys and or highway mortalities to quantify the mortality and fecundity rates, and
- Investigate the cumulative effects associated with specific drivers and how they affect the moose (i.e. high predation and low fecundity).

Human Related Mortalities

Historic Research

The consensus for the greatest source of moose mortality in the NPMU is directly human related, primarily from overharvesting and unregulated hunting (Demarchi 2013), but now simply from unregulated hunting and potentially commercial poaching (Demarchi 2015). Demarchi (2000) reported that during three years of monitoring 38 collard moose (1997-2000), a total of seven were reportedly killed by hunters. Of these, three were potentially poached as the collars were cut and not returned. This study only reflects a small portion of what was occurring, but expanded proportionally, suggests that 8% of the population he was studying was harvested outside of the regulations. After the 2001 population estimate and until LEH restrictions were implemented for First Nations, the only form of monitoring that occurred in the NWA was from restrictions to resident and non-resident hunter harvest in the WMUs.

In 2001, based on the population estimates from Demarchi (2000), the Nass Wildlife Committee (NWC) created a TAH of 225 individuals including cows and calves. It was believed that this would result in a sustainable harvest and allow the population to increase by 10% over the next 5 years (Demarchi 2013). However, this resulted in a 40% population decrease in 6 years suggesting parameters used in modeling the TAH were in err. The specific factors considered problematic within the TAH model were initial population estimates, mortality rates, and rate of twinning in the population (Demarchi 2015, pers. comm.). In order to curtail the decline and initiate population recovery, the TAH in 2007 was reduced to 70 bulls for Nisga'a and Gitanyow Nations and hunting was closed to resident and non-resident. The enforced restrictions slowed the decline, but did not initiate a significant recovery detected in the 2011 population estimate. This may have been attributable to continued unregulated hunting activities, traffic mortalities reported in the Wildlife Accident Reporting System by the Ministry of Transportation and Infrastructure, predation, or it may be that historic cow harvests are limiting the population's potential to recover quickly.

Current Efforts

Reducing the TAH is not the only way members of the Nisga'a and Gitanyow attempted to decrease harvesting impacts on the moose population. For example, the Nisga'a created a LEH and employed a Conservation Officer responsible for enforcing the regulations. However, the Nisga'a Conservation Officer (CO) does not have full authority to enforce federal, provincial or Nisga'a laws and regulations (M. Demarchi pers. comm.).

The Gitanyow and provincial COs serving the NPMU from Smithers and Terrace work together to enforce hunting regulations within the Gitanyow territory. The Gitanyow Hereditary Chiefs have asked the CO to enforce their permitting restrictions within their territories as…

> *'they [Gitanyow] are trying to create a good image for responsible harvest management but the CO presence within this area is stretched too thin.''*

As a result of limited resources the Gitanyow feel that proper compliance monitoring of the yearly harvest is not occurring.

In order to increase presence during the busy hunting season, the GHC have employed community members as wildlife monitors to patrol the territories from November to January. However,…

> *'monitoring only occurs on the highway or areas with road access because there is no access to backcountry and monitoring is also limited to provincial hunting seasons and not Gitanyow extended hunting season.'*

Additionally, to increase community awareness of the declining moose population, the GHC are implementing forms of community outreach such as advertisements posted in central locations and in the newspaper and creating a Facebook page for hunters to report in an open forum. With this approach, they are creating a community of hunters that are more vigilant about ensuring others are following the existing regulations. The intent is to instill the hunter ethic and reinforce the Gitanyow *Ayookxw* and preliminary results are positive (Koch 2015 pers. comm.).

The Gitanyow feel that there should be more open communication about hunting rates and the effort required to harvest moose. Access to a provincial database which identifies the number of hunters (First Nations, resident and non-resident), the number of hunting days and the total number of moose harvested could lend insight into local moose populations as well as regulation adjustments that reduce impacts. Furthermore, recommendations that were outlined in the NFA (1999) and by Demarchi (2011) for the collection of teeth and reproductive tracts of cow moose should transpire. This data has been collected by the Nisga'a during post-harvest interviews with hunters (Demarchi 2015), but is not made publically available. The data related to harvest is required; whether it is the Ministry that collects these data, the Chief for the respective territories where hunting occurs or an independent 3rd party.

Both groups expressed interest for an increased presence on roads or within areas where incidences of unregulated hunting are high. Whether this occurs through an increase in funding that supports increased wildlife monitor presence with greater authority or government funds are increased for CO presence within the First Nations hunting season. Gitanyow Chiefs expressed…

> *'the need for monitors to have the authority to take action for any illegal or inappropriate harvesting.'*

Finally, both groups indicated that there was a necessity to educate their members and others about hunting in the NWA, the negative impacts of reducing the cow population, and the demand for a moose harvest that will preserve the population for future generations. A good example is the educational posters that are found in Demarchi (2013) that demonstrates the impact of taking a cow over a calf and Koch (2014) which demonstrates the impact of removing a bull over a cow.

Data Gaps

Mortality caused by harvesting moose has some of the most important gaps from the perspective of both the Nisga'a and the Gitanyow. In addition to gaps in knowledge, there are issues associated with sharing information that make it difficult to determine the difference between regulated and unregulated kills and makes enforcement nearly impossible. Gaps include:

- Incomplete and inadequate hunter reporting in regulated hunt,
- Little or no information on unregulated hunting impacts, and
- Lack of data sharing agreements or coordinated compliance monitoring resulting in very limited compliance enforcement.

Road Mortalities

Historic Research

The low elevation and gentle topography of Highway 37 contains both winter habitat and movement corridors for this species. Traffic data is lacking for roads in the NWA. Between 1988 and 2007, the Bulkley-Stikine District (Highways 16, 37 and 37A) reported 1,022 collisions with vehicles and moose (Rescan 2013). Road mortalities along the eastern portion of the NWA are reported in the provincial Wildlife Accident Reporting System (WARS); however, these data are limited as less than 35% of road mortalities are actually reported or the location accurately identified (Sielecki 2010 in Rescan 2013). This has led to requests for independent studies be conducted which have resulted in conflicting observations.

Rescan (2013) reported that from 2000 to 2008, traffic was reduced from 500 to 200 average annual daily trips (AADT) and suggest that the impact of increasing traffic from the Kerr-Sulphurets-Mitchell (KSM) project would not have a negative influence on the moose population. Conversely, the GHC staff conducted surveys at the Meziadin junction of Highway 37 and 37A in order to create a baseline for traffic effects analysis within their territory. They used the proposed methods similar to traffic assessments carried out by the Ministry of Transportation and observed an increase in the AADT compared to what was reported by Rescan (2013). The Gitanyow feel that this increased traffic would negatively impact the moose population (GHC 2014).

Traffic induced mortalities are a growing concern with respect to a population rebuild for moose. Approximately 65% of road mortalities reported to the province through WARS were cows located in valley bottoms (Koch 2015). With intensification of vehicular traffic anticipated with increasing industry access on Highway 37, greater moose-vehicle interactions can be anticipated, further taxing population recovery. Additionally, concerns have been raised about road mortalities along active Forest Service Roads (FSRs) that traverse the NWA such as the Nass FSR. Once industrial activity is occurring year round, the accessibility to hunters is increased which allows for easier harvesting and poaching. The Gitanyow indicated that…

> *'the Nass FSR was closed during this winter [2014-15] because there was no activity up at the Kitsault Mine that required the road to remain open. Monitors traveled the Nass FSR on snowmobile and observed lots of moose tracks and moose beds. If this road is kept open then this creates access to moose much longer.'*

On the contrary, the Nisga'a feel that this road is an important access route to areas further to the north. In addition, they feel that increased, speed controlled traffic may actually reduce unregulated hunting as it provides a much higher probability that those hunting will be seen and reported.

Current efforts

The Gitanyow and a Highway 37 advisory group are looking for a more aggressive management to moose-vehicle interactions. The main solution agreed upon is increased signage especially in high-moose areas and implement diversionary trails from the highway (Koch 2015).

Data Gaps

There remains several areas where traffic impacts on moose are not well understood including the impact of speed, increased traffic and the type of traffic. For instance, assessments on the CN rail near Smithers indicated that collision rates with moose did not collate with traffic rates (McElhanney 2013). In addition, mitigation measures should be explored to determine low cost and effective treatments to improve visibility, increase driver awareness, and provide options for moose to leave the road in deep snow conditions. Additional efforts by Ministry of Transportation and Infrastructure (MoTI) could improve the data collection within the WARS reporting system (i.e. identifying the sex of mortalities) which could have significant implications on population recovery. Alternatively, highway maintenance contractors could report mortalities to local wildlife monitors in order to collect relevant data such as pregnancy and twinning rate in spring cows.

Predation

Historic Research

The key predators of moose within the NPMU are the grey wolf (*Canis lupus*), the grizzly bear (*Ursus arctos*) and the black bear (*U. americanus*). Currently, little detailed information is available for these species within the NPMU. For example, in the BC management plan for the grey wolf no population estimates are given for the Skeena Region. It is assumed that wolf density will be high if the population of moose is high (BC MFLNRO 2014).

In addition, data on predation rates for moose in the NPMU are scarce. Only two studies have reported predation by wolves in the NPMU. Demarchi (2000) reported that of the 38 collared moose, possibly 2-4 individuals were killed by wolves. Additionally, a 1-year radio telemetry study on 15 adult moose in the Kitwanga Watershed reported two individuals were predated by wolves (Hamelin 2003).

During the 2011 population assessment, Demarchi and Shultz (2011) observed 37 wolves, which was the highest seen during the aerial surveys since they started in 1994. Methods used in aerial surveys target important moose wintering habitat; therefore, an increased presence of predators in these habitats may suggest that predator density could be restricting population growth. When asked about the presence of predators like the wolf within the NPMU, the understanding is that the population has increased. Packs of 4-7 individuals have been observed along roads and hunters are reporting that…

> *'more wolf tracks and more lone wolves are being seen'* and *'lots of howling is heard.'* (GHC 2015 Interview).

Demarchi has suggested that the current state of the moose population in the NPMU may be in a "predator pit" or a low-density dynamic equilibrium. This occurs when predators are able to kill a sufficient number of moose that the population is unable to naturally rebuild (Demarchi 2013). The current low estimates of moose necessitates the importance of understanding predator density and their affect in restricting a natural population growth (i.e. reproduction). When predatory density is understood, it may become apparent that predator numbers will reduce naturally or if management is required. If this is indeed the situation, a predator cull may be the only solution to allowing the moose population to recover. This Nisga'a have identified this as a possible response to reduced moose numbers and the Gitanyow have agreed that some form of predator control may be necessary. However, the Gitanyow suggest that predator control should not be the only method or the first approach to rebuilding the moose population.

While wolves are the primary predator in winter, both grizzly bears and black bears can take calves early in the season (Gasaway et al. 1992). Documenting the percentage of calves that succumb to bear predation is very difficult; however, local experience suggests that bear populations are not changing significantly over the last few years (M. Demarchi pers. comm. and pers. observ.) such that the rate of bear predation is likely unchanged as well.

Current Efforts

Currently, there are no known efforts being completed to identify the density of predators within the NPMU with the exception of incidental sightings.

Data Gaps

Given that predator density and their impact on moose populations may be the current limiting factorin restricting population growth, developing detailed data on local predation is a high priority. Data gaps include:

- Identifying predator density and the distribution of wolves and bears in the NPMU,
- Investigate the predator-prey dynamics within the NPMU, and
- If predator management is required, identifying alternative methods and possible scenarios that could be best applied in the NWA.

Parasite and Disease

Historic Research

There are 3 types of disease agents that can affect the survivorship of moose thereby affecting the population. Brainworms (*Parelaphostrongylus tenuis*) are considered to be the most fatal to moose, but have not been detected within BC (Demarchi 2013). Both the winter tick (*Dermacentor albipictus*) and liver flukes (*Fascioloides magna*) have been reported in BC.

Research on moose in Alberta, the western Rockies, and the Yukon have reported individuals with hair loss attributed to the winter tick. This tick causes a premature loss of winter hair also known as alopecia. Samuel (1989) surveyed 220 trappers in northeastern BC requesting information pertaining to hair loss seen in moose during late winter. Of the 84 trappers that responded, 54% reported seeing moose with alopecia; 29% reported seeing it yearly and 33% had found dead or dying moose with ticks and alopecia.

Research on the giant liver fluke suggests that this parasite is an unlikely factor in causing moose declines. This parasite can cause considerable liver damage; however, infections are generally undetected until slaughter as it does not appear to compromise the health of an individual. Additionally, moose are considered a dead-end host as few worms reach maturity or leave the host (Lankester and Foreyt 2011).

Historically, hunters in the NPMU have not reported moose with visible affects caused by parasites and or disease. However, both ticks and liver flukes have been noted by the Gitanyow. For example, a liver from a harvested moose was offered to a Chief as part of the Gitanyow *Ayookxw*. He noted that there were lumps present and when poked a fluid poured out, suggesting the presence of liver flukes. He was unsure if it was safe to eat and disposed of the liver. Additionally, during interviews with the Gitanyow Chiefs it was stated that ticks were not commonly noted on hunted moose; however, when they were evident it was…

> *'when the weather warms fast'* and some moose looked *'really loaded and appeared scraggly and skinny'* (GHC 2015 Interview).

Current Efforts

Recently, the province of BC is distributing surveys to wildlife professionals and the general public asking for reported observations of hair loss resulting from tick infestation. The purpose of these surveys is to identify the prevalence of winter ticks and the distribution of the parasite in BC (Mike Bridger pers. comm.).

To increase the awareness of diseases that are transferable to humans and pets from wildlife, a document has been created to inform hunters, trappers, anglers, and biologists about safe practices (Stitt undated). This document identifies the possible disease present in wildlife, how to properly use and store the meat, and if it is safe to feed to pets.

Data Gaps

Currently, very little is known about parasite loading and potential disease in local moose populations. However, it is unlikely that these had a significant impact in creating the decline of moose as there are no reports on large die-offs that would have been evident it the population was effected. However, the following gaps still exist:

- Collect data from animals observed and those harvested to quantify parasite loads in the NPMU and
- Educate the importance of proper handling of meat and what is safely edible. The Gitanyow have expressed the interest of a vet to come and talk to the community.

Movement and Seasonal Distribution

Historic Research

There are three types of migratory behavior exhibited by moose. Individuals that are considered non-migratory are found in habitats that contain resources associated with winter and non-winter ranges. Conversely, migratory behavior in moose can happen across the landscape or latitudinal (elevation) in response to snowpack accumulation (Hundertmark in Franzmann and Schwartz 1998). Within the NPMU, all examples of migratory behavior have been observed.

Over a 3-year study (1997-2000) on 38 moose in the NWA, the majority (71%) were observed to demonstrate migratory behavior while 24% were considered non-migratory. Migrant moose either moved long-distances across the landscape to access habitats associated with seasonal demands or moved to lower elevations to occupy winter range. However, both types of migratory behavior was in response to snow pack accumulation. Conversely, the non-migratory moose were observed occupying habitat at lower elevations than moose considered migratory.

Similarly, Hamelin (2003) conducted a study on 15 adult moose over one year within the Kitwanga Watershed. Unlike the results in Demarchi (2003), the moose in Hamelin (2003) were reported to migrate latitudinal to avoid areas of increased snow accumulation. For example, when snow pack began to increase, moose were observed moving to lower elevations that provided greater access to browse, reduce the effects of colder climates and snow, and increase the availability of thermal cover.

Based on both studies (Demarchi 2003; Hamelin 2003), it can be surmised that the distribution of moose reflects both snow accumulation and the availability of food resources. Demarchi (2000) observed that elevations less than 800 m and in the vicinity of the Nass River, the Cranberry River, and the White River were used intensively by moose. Hamelin (2003) reported that two main areas were considered to be of high use; north of Kitwancool Lake and east of Kitwanga. Furthermore, both studies reported that all moose that were radio-collared remained within the study areas, implying that the available habitat where these studies took place supported moose during both the winter and non-winter seasons (Demarchi 2003).

The conclusions by Demarchi (2003) and Hamelin (2003) on the distribution of moose are two-fold: 1) moose are located in areas that reflect habitat suitability and 2) an increase in snowpack results in moose migrating to areas lower in elevation or adjacent to habitat that limits the accumulation of snow. However, over the last two population estimates (2007 and 2011), the demographics have changed and regeneration of the secondary moose winter ranges has likely occurred. Because winter range can limit moose distribution within the NPMU, understanding the historic distribution of intensively used areas could prioritize locations where habitat enhancement should be focused or where predator management would have the highest probability of assisting with the growth of the population.

Current Efforts

As part of the Nisga'a Lisims Government permitting system, the location of each harvested moose is recorded. This information is supplied to the NWC and to Ministry of Forests, Lands, and Natural Resource Operations (FLNRO).

Within the Gitanyow, various methods are in place with the permitting system to identify the distribution of moose within their territory. For example, once 5 bull moose are harvested within a *Wilp* territory, then the hunting season is closed for that territory. Additionally, a hunter who receives a permit is responsible for filling out a Gitanyow Wildlife Harvest Survey and submit to the GHC office regardless if a moose was harvested.

Data Gaps

Moose distribution is of vital interest for both protecting the highest density winter sites, but also for managing hunting activities in specific areas. If area closures are required in the future, these will be the areas closed initially. Much of this is known (See Habitat Suitability/Capability), but not in formats that are effective for management. Some areas where gaps still exist are:

- Correlation with other administrative boundaries such as management units and *Wilps*, such that harvest management and or compliance and enforcement can be managed effectively,
- Defining specific winter range units and capturing specific stand management regimes for either harvesting or stand restoration, and
- Increase the confidence in movement and distribution of moose within the NPMU and potentially identify the driver for this distribution (i.e. food resources, calving grounds, snowpack, etc.).

Habitat Capability/Suitability

Historic Research

Moose require large amounts of quality forage on a daily basis. Winter food sources vary depending on region, but contain primarily woody vegetation associated with plants commonly found or accessible in early successional habitats. These early successional habitats are typically created by fire, forest harvesting, land-clearing or active floodplains (Franzmann 1981). In the study area, winter forage production can be divided into primary and secondary winter habitats. Primary winter habitats are those area that are self-perpetuating, such as active floodplains. Secondary winter forage habitats include areas where browse is plentiful during one specific seral stage and natural seral progression limits its productivity through time (Pollard, 2002). The primary winter range in the NWA are found in low elevation riparian communities along the Lower Nass, Dragon Lake wetlands, the Kiteen, Kinskuch and Cranberry River, and in isolated areas of the Nass main stem between canyons (Pollard 2007). The majority of secondary winter range are associated with forest harvesting in low elevation receiving sites. Given that harvesting started at the lowest elevations and moved up slope, many of these secondary winter ranges have passed or are passing out of their highest productivity seral stage. Later harvesting is generally located at higher elevations at more mesic sites with a decreased ability to produce forage species.

One of the first comprehensive habitat assessment of the NWA was completed by Yazvenko et al. (2002). They conducted a 1:20,000 habitat suitability assessment for three target species including grizzly bear, mountain goat, and moose. Conclusions drawn suggest there was an abundant source of moose non-winter range available; however, no high-suitability moose winter range was present and the moderate-high habitat exists only at low elevations along riparian areas. This suggests that key areas of the NPMU may be significant for rebuilding the population.

A suitability model was then developed for Cranberry and Kitwanga drainages as part of the larger Kispiox Forest District (Mahon et al. 2005 and Fillier et al. 2007). This model was required to meet the Kispiox LRMP requirements of providing high value moose winter range at a landscape-level planning that exceeded the existing 1:250,000 biophysical mapping. The model used existing forest cover information, TRIM stream, aspect, and elevation information to assign a 4-class suitability rating. In southern portions of their study area, major floodplains and areas with greater than 60% deciduous cover were given the Class 1 or highest rating for suitability. Several other criteria were then used to evaluate the rating based on forest cover before ratings were adjusted due to elevation. The underlying concept was that forage suitability would be determined from the vegetation information and that elevation and topographic information would be used to predict snow accumulation.

More recently, moose winter range assessments were completed for both the North (Pollard 2007) and South (Pollard 2008) Nass Timber Supply Areas (TSA). In the North Nass TSA, moderate to high winter range for moose was primarily associated in riparian habitats. This approach was based on 1:10,000 orthophotgraphic interpretation and identification of ecosystems known to provide high-moose winter characteristics, regardless of the current seral stage. Recommendations from Pollard (2007) suggested that five moose winter range areas be created within the North Nass TSA. Within the South Nass TSA, moderate to high value habitat was largely associated with wetlands and rich nutrient receiving sites along riparian areas. The South Nass TSA had abundant habitat available for moose winter range and it was recommended that 12 areas be created specifically for moose winter range. These areas focused on large complexes of low elevation wetlands and hygric habitats as well as adjacent to active flood plains.

In 2014, Pollard completed moose winter browse capability mapping in Gitanyow's traditional territory in much the same way as it was completed in the Nass South and Nass North TSA. The intent of this project was to ensure the basis for winter browse capability was the same between this areas and adjacent areas such that the same general management instructions could be used with the Ungulate Winter Range Order. This project resulted in a mosaic of habitats colored by winter browse production value using a 6-class rating scheme. These base maps were intended to provide the Gitanyow and FLNRO with adequate data to assign winter ranges to the study area which has now been completed (Koch, pers. comm.).

Current Efforts

These assessments have highlighted the best quality winter range in the NWA. A total of 17 locations were recommended for consideration during land use planning that would protect moose winter range. The majority (12) are situated in the south-eastern section of the NWA.

As of April 2014, the majority of moose winter range in the NWA have become legally recognized and protected under the Old Growth Management Areas (GCH 2014).

Data Gaps

Given the intensity and level of detail of habitat mapping and habitat suitability and capability available for the NWA, there are relatively few gaps. One area where the ecosystem based mapping has not been completed is on the north side of the Nass downstream from the Kinskuch and areas along the lower Nass to its estuary. However, in most of those areas the winter habitat is very well understood to be within or adjacent to the Nass and large tributary's floodplains. Only very limited effort would be required to bring these areas up to the same standard as the rest of the NWA.

While this mapping is not Terrestrial Ecosystem Mapping (TEM) or Predictive Ecosystem Mapping (PEM), only minor modifications would be required to use the spatial data to calculate landscape capability. In turn, the landscape capability could be used to as part of a calculation to establish carrying capacity for moose. However, this may not be of high priority as the landscape is currently under-utilized.

One option would be to use existing maps to identify areas that have a high suitability, but are currently at a seral stage of low suitability. This would produce a list of sites where stand management or ecosystem restoration may be particularly effective in improving habitat quality. Demarchi (2013) noted that given the rate and timing of forest harvesting, much of the optimal stands created by past harvesting are entering a seral stage where little or no winter forage is being produced. While this mapping was never intended for this purpose and some slight modifications would be required, this mapping could also be used to predict the rate of suitability change through time.

Conclusion and Recommendations

The population of moose in the NPMU has been well studied over the last 25 years. Initially, early work focused on moose demographics, movement, and habitat selection using radio-collared individuals. These studies have provided a great deal of information on population fluctuations, the bull:cow and calf:cow ratios important for managing moose populations, and establishing an appropriate harvest policy. Starting in 1994, population estimates for the area have been completed five times until most recently in 2011. In the last 10 years, much of the work has focused on the identification of winter range using a variety of information sources.

While these studies have identified a range of factors that are key in managing the population, there still remains several gaps in our knowledge that would assist in managing the population toward recovery. Firstly, several elements are used to predict population growth, such as twinning rates, predation rates, and other mortality rates. However, our knowledge on these rates is preliminary. Until this information can be determined, any establishment of a TAH is based on conjecture.

s.13,s.16

s.13,s.16

The harvest of cows at this unprecedented rate was obviously outside of the Gitanyow's, the Nisga'a's, and the provincial government's moose management policy which suggests that the cow mortality was largely within the unregulated hunting category. Given our current understanding about the influence of unregulated hunting, calculating a new TAH is not recommended without an accurate estimate of mortality resulting from unregulated harvesting. Furthermore, developing management strategies to address a moose population recovery is futile without first controlling the unregulated harvest.

Given the importance of understanding and controlling the unregulated harvest, the recommendation of highest priority is to explore a variety of options to increase our understanding and the best approach to address this issue. This will likely include one or more of the following options:

- Education of hunters (as condition of permit) and/or general public,
- Use of social media for reporting successful hunts to encourage a social ethic and identify unregulated hunters,
- Increase compliance enforcement such as irregular road stops, increased CO presence, increased use of trained local monitors to run regular patrols, or the use of remote cameras along high risk roads,
- Increase hunting restrictions such as a gear restriction, closing areas of high risk such as deserted roads within winter range or restriction of legal hunts to age and sex specific animals,
- Continue the bull only hunt until data supports a cow hunt under the assumption that all cow harvest is unregulated making the monitoring of harvest systematic, and
- Coordinate and share hunter or post-harvest data from all hunters within the NWA.

Some of the approaches may have an immediate impact. However, others will require changing social behavior and habits which may take several years before results are recognizable. During that time it may be necessary to severely limit harvest rates to ensure only those that are fully willing to comply with the regulations benefit. Locally relevant penalties outside the provincial regulation system should be considered by the Nisga'a and Gitanyow given the importance of moose to their local food security.

The second highest priority is associated with data collection regarding population counts. While it will likely take more than five years for populations in the Nass to recover, a five-year hiatus is too long to determine if management actions are having the desired impact. A detailed population count is scheduled for the spring of 2016. This is a good opportunity to initiate surrogate, lower cost monitoring techniques that will provide interim information between intensive larger counts. As such, if these surrogate population counts determine that declines are continuing, adjustments to the management regime can be made immediately.

Exploring techniques suitable for lower cost surrogates are outside the scope of this project; however, on a preliminary basis it could include two additional approaches. On a monthly basis in the winter, wildlife monitors could complete transects through winter range designated high-value and tabulate transect intersections with moose tracks. For more accuracy, helicopter-based direct counts may be used. For example, Demarchi's (2007) exploration of population changes in high-rated strata indicated that population declines were consistent across the strata. As such, the selection of one or two strata for detailed counts may provide an understanding of how the entire population is reacting to management strategy. This approach would have a higher level of accuracy compared to the linear transects, but not as accurate as the five-year aerial surveys. These surveys would also provide some indication of predator density or signs of unregulated hunting. Over time, using these two lower cost approaches in concert with the full counts would allow for correlations such that a more timely method could be developed to recognize population change.

Due to the history of forest harvesting within the study area, most of the lowland habitats have some type of road access. Many of the main roads (Cranberry, Kinskuch, Little Paw, White River Niska Lakes, Brown Bear, and Orenda Main) are part of circle routes meaning that users do not have to return the way they entered. While these circle roads have benefits to resource extraction, it creates access points that are exceptionally hard for CO's to monitor. In addition to these mainlines, there remains a legacy of roads from the initial harvest of the lowlands in most areas except where erosion and vegetation have reclaimed them or bridges have been pulled.

The only way to address these access issues is to develop an access management plan in concert with the Ministry of Forests and the multitude of other resource licensees. An access management plan can be a large process complicated by the current extent of roads, the wants, needs, and legal requirements of the resource licensees, and requirements for long-term planning. However, it can also be a relatively simple process negotiated among users based on a limited number of explicate statements such as:

1. all circle roads will contain a portable bridge that when removed, will limit road access,
2. circle road bridges (above) will be removed when export of resources is not required,
3. tertiary access roads (block level) will be completely de-activated within three years of harvesting unless stand management is indicated in the site prescription, and
4. road-side vegetation management within moose winter range should incorporate measures to reduce the production of winter browse.

Additional area-specific rules can be established such as immediate removal of access structures within or adjacent to winter range. For roads like the Cranberry or Highway 37 where winter access will be maintained indefinitely, additional responsibility for monitoring and reporting should be discussed with the MoTI and their maintenance contractors. For industry operating on these roads, additional responsibility tracking moose related incidents should be incorporated into their BC Environmental Assessment table of conditions.

As indicated, a great deal of research has been completed in the NWA and it has resulted in a good understanding of some of the key components required to manage moose. However, there remains some components that require further exploration including impact of predators on moose mortality, impact of the unregulated harvest, and reliable estimates affecting population growth such as twinning rates. Understanding these components will not only improve population monitoring and predictions, but assess if predator management is required. Demarchi (2013) makes a case for the use of predator culls to reduce predation and increase moose populations. The moose population in the NWA may have entered a predator pit resulting in the need for a predator cull. However, it is difficult to make this recommendation prior to having adequate evidence. At this stage, the potential for a predator pit situation is based on anecdotal evidence and circumstantial observations. In order to determine the validity of a long-term predator management plan, additional research is required that would focus primarily on the direct cause of moose mortality in the NWA. This would provide quantitative data that could identify if predator management is required.

The final recommendation is to use the existing suitability and capability mapping that would initially identify areas that require stand management or ecological restoration. Once identified the carrying capacity for the NPMU can be determined. At this stage, evidence suggests that winter habitat for moose is not limiting to the existing population. However, once the population begins to increase, it may be possible to accelerate population growth with some selective stand management treatments in very specific areas. Moreover, the existing mapped habitat could determine the capacity of the landscape to support moose during the winter and identify how fast this capacity may decline as a result of natural seral progression of secondary winter range. Using this information, a landscape model can be developed to manage secondary range by targeting harvest or stand treatments such as burning, thinning, or pruning.

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Appendix I - Nass Moose Management Process Plan Recommendations

The preceding scoping document was designed to provide some background on what information is available, current efforts, as well as gaps in our knowledge base. It also represents the first step in the development of the Nass Moose Management Plan (NMMP). It concludes with a list of recommendations toward rebuilding the moose population. This appendix provides some direction on immediate actions that can be employed over the following short and medium term to ensure appropriate actions are in place before they are required.

It should be said explicitly that the optimal solution would be to have an immediate meeting where the Gitanyow, Nisga'a and provincial government could openly discuss and debate the advantages and disadvantages of alternative management options. While currently there appears to be an appetite for all groups to work toward this common goal, it appears that we are still months away from those direct discussions. As such, the following work plan makes the assumption that while those discussions will ultimately take place, in the meantime these recommendations provide an interim direction only to ensure positive action is in place before the 2015/16 hunting season begins.

Process Plan

-On completion of this document, circulate to Gitanyow and Nisga'a for comments.

-Adjust scoping document so that information adequately reflects the Gitanyow, Nisga'a, and Provincial perspectives.

-After adjustments to the document are completed, a facilitator (FLNRO or other) should be used to promote an open discussion to identify the greatest priorities of each group to move forward with a population rebuild of the moose in the NPMU. Once the priorities are listed, FLNRO can identify where overlap occurs and suggest that these be addressed first while non overlapping priorities will be determined at subsequent discussions.

-Priority actions will then be initiated. Specific actions at this stage will depend on the priority selected but should include some aspect of target setting, methodology discussions to establish accuracy and or duration, information sharing, and ultimately project planning and logistics. For example, if the provincial government, Nisga'a and Gitanyow identify more closely monitoring the population demographics as the highest priority, the following steps could be the resulting project plan:

1) request and catalogue harvest data from both Nisga'a and Gitanyow beginning 2007/08 into a central database,
2) collect and catalogue the 2014/15 harvest data from the Nisga'a and Gitanyow harvests and post-harvest/season surveys,
3) create a systematic post-harvest survey with both the Nisga'a's and Gitanyow's input to be completed and submitted after 2015/16 harvest season,
4) promote an open forum discussion/educational meeting to stress the importance of a bull only harvest and the impact to the population of removing a cow; additionally identify individuals who would like to assist with Wildlife Monitoring,

5) implement social media and advertisement similar to what the Gitanyow are currently practicing,
6) initiate the development of yearly low cost monitoring programs to run in parallel with 5 year aerial surveys.
7) identify the fall 2015/16 LEH for each group based on 2014/15 harvest data and where hunting restrictions will be in place, keep a bull only harvest, and create a contractual caveat that post-season/harvest survey must be completed or else future entry will be rejected,
8) initiate discussions with Ministry of Transportation and Highways maintenance provider to acquire all female moose carcasses between January 15 and May 1 for necropsies to determine pregnancy and twinning rates,
9) setup a five-year radio telemetry study to collar animals, specifically females to monitor predation, mortality and twinning rates,
10) coordinate aerial survey for the 2015/16 population estimate and identify specific parameters that will be collected (predator numbers, kill sites and potentially high-density moose winter range for ground transects),
11) run pilot test for ground transects to identify potential problems or concerns,
12) conduct post-harvest surveys within 2-weeks after 2015/16 hunting season is closed, and
13) delineate problematic areas and issues to be addressed in future

As each priority is explored and actions implemented, the results of the priority setting and further discussions should be integrated into the Nass Moose Management Plan.

It is anticipated that these priority setting exercise and the Nass Moose Management Plan will be completed prior to the hunting season in 2015/2016. However, project management and coordination will continue through the first hunting season with opportunities to adjust approaches and re-evaluate priorities in the spring of 2016. Results of assessment work could potentially be available for presentation and sharing in late spring. Perhaps a regional forum can be coordinated to ensure information is shared and knowledge gained is used effectively.

Appendix II - Nass Moose Management Plan (Annotated)

1.0 Introduction

1.1 Background of process:

- Explanation the process of developing the management plan
- Strictly summarized to avoid repetitive information
- Reference to preceding documents for more in depth information
- Ecology and status of the moose within BC and NPMU
- Ecological and Social context of moose within NPMU

1.2 Objectives for moose management in the Nass:

- Documenting and controlling the unregulated hunt
  -Why this issue has to be the first addressed before population recovery can occur
- Monitoring and managing population for sustainable harvest:
  -Importance of this, why it has to be set up now, and how, and who should conduct
- Access management planning and or coordination
  -Why important and what level of detail required
- Additional research requirements including predator-prey relationships
  -Preparation of long-term management through identification of outstanding mortality and natality metrics
- Use of Suitability/Capability mapping
  -Use existing mapping to highlight priority restoration areas and to support population targets considering declining suitability through time

1.3 Scope:

- Limitations on Nass Moose Management Plan (NMMP) such as temporal and geographic bounds, limits of legislative authority, other limitations as they become apparent

2.0 Project Partners, Goals and Milestones

- Describe the interest of the government, Nisga'a and Gitanyow and their commitment to the process including the importance of this projects success
- Clearly identify targets and the justification
- Establish Milestones for working towards that target
- Establish a communication structure for future distribution of information
- Construct protocol for redirecting project priorities due to new information and or differing objectives

3.0 Existing Knowledge of Moose in the NPMU and the Data Gaps:

3.1 Demographics

- Discussion of the historic population changes
- Identify the current efforts and any data gaps that may exist

3.2 Movement and distribution

- Discussion of past radio-telemetry studies identifying the seasonal movement and distribution of moose within the Nass Wildlife Area (NWA)
- Establish the knowledge gaps relating to population distribution and identify if movement by moose is restricted to the NWA

3.3 Factors that can affect a population rebuild:

- Understanding the reproductive ability of this population and the rate at which calves are being introduced including factors effecting rates
- Exploration for mortality factors affecting the population including the regulated harvest, predation, road mortalities, and the unregulated harvest
- Understanding the available habitat's distribution and quality towards habitat enhancement if it is required
- Addressing the existing knowledge about local diseases and parasites

4.0 Prioritizing Efforts to Reduce Depopulation and Initiate Repopulation:

4.1 Reducing unregulated mortality

- Establish regulations that exclude cow and calf hunts and limiting bull hunting. This may require gear, area, or seasonal restrictions
- Coordinated the distribution of hunting permits and hunter survey and share information freely between all regulating bodies
- Initiate appropriate educational programme to build on the traditional ethic using posters, word of mouth, school programs, and social media
- Increase enforcement of post-harvest interview as per permit compliance and have tiered penalties culminating in ineligibility to receive future permits
- Increase partnered enforcement with Conservation Officers and attempt alternative approaches such as remote sensing, monitoring of areas at risk, and local knowledge within communities
- Coordinated record keeping and information sharing
- Increase community awareness through education on the importance of retaining cow moose in the NPMU

4.2 Monitoring and managing populations

- Establish the level of accuracy required at specific intervals
- Consider multiple alternatives to monitor population within a range of costs and initial correlation studies to interpret results
- Comparative studies must be conducted to improve the accuracy of the correction factor applied to the sightability of moose within the aerial searches
- Establish studies to determine accuracy/improvement of TAH and population modelling parameters
- Implement some form to monitor birth and death rates of the population and calf survivorship to adulthood (see 3.5 Additional Research)

4.3 Access management planning

- Access Management Plan approach (consistent with goals and resources)

- Government ministries, licensees and their legal obligations
- Initiate planning process attempting to create limited set of guidelines to restrict circle routes and limit access into known winter range where possible

4.4 Additional research

- Establish the preferred data outcomes such as: twinning rates, predator-prey relationships, habitat selection, traffic related mortality
- Design study to explore the target outcomes
- Implement, monitor and reassess yearly
- Note that the outcome will likely drive additional studies

4.5 Habitat capability/suitability

- Determine the feasibility of development of study area suitability-based restoration mapping and landscape capability for estimation of maximum population target
- Likely low priority until current landscape capacity reached

5.0 Budget and Timelines

- Provide work plan with detail of how first 12 months will be organized as well as less specific plans out to a five-year time horizon
- Establish milestones for each aspect including re-assessment periods to encourage adaptive management approach
- Funding sources and limits explicitly identified as well as any contribution in kind
- Planning should include budget management protocol including target burn rates during different periods of the project