WOLVERINE CARCASS COLLECTION PROJECT

2013-2014 ANNUAL REPORT

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Yukon
Environment

February 2016

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Yukon Department of Environment
Fish and Wildlife Branch
PR-15-01

Acknowledgements

We would like to thank Jane Harms, Meghan Larivee and Linea Eby for their help during necropsies. We would also like thank Jean-Francois Robitaille at Laurentian University, and Rajnish Sharma and Kristine Luck at University of Saskatchewan for their research efforts on wolverine diet, disease and internal parasites. Special thanks go to staff in Conservation Officer Services Branch and North Yukon Renewable Resource Council for processing trapper submissions and storing wolverine carcasses in their freezers. Most of all we would like to thank all the trappers who submitted wolverine carcasses to this program—this project would not have been possible without their interest.

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Suggested citation:

KUKKA, P.M. AND T.S. JUNG. 2016. Wolverine carcass collection program: 2013-2014 annual report. Yukon Fish and Wildlife Branch Report PR-15-01. Whitehorse, Yukon, Canada.

Summary

- We collected age and sex data, along with other basic biological information and samples, from trapper-submitted wolverine carcasses from the 2013-2014 harvest. This report summarizes the data from the 2013-2014 trapping season, which is the 8th year of data collection in this carcass collection program. The payment per carcass was increased this year from $30 to $50 at the suggestion of trappers.
- The program provides a cost-effective means of monitoring wolverine populations and harvest characteristics, and can allow for a statistical population reconstruction aimed at assessing the sustainability of the harvest.

Key Findings

- Trapper submissions to the program were good; about two-thirds (67%) of the total annual harvest was received in 2013-2014.
- The wolverine harvest was male-biased, with 60% of the wolverine carcasses being males. Overall, this bias is desirable from a management perspective because it should have less impact on population dynamics than if more reproductive females were removed from the population; thus, it is more sustainable. However, the proportion of females in the harvest was the highest in the last two years of the study. The majority of harvest consisted of young animals (<2 years old). Juveniles, subadults and adults comprised 35%, 27% and 38% of the harvest, respectively. Harvest biased on young animals is typical for furbearer populations. The proportion of adults was higher for females than males. Because adult females are a crucial cohort for replenishing the population, the sex- and age-class structure of harvested females may be of concern to wildlife managers.
- 100% of harvested adult females were pregnant based on the presence of fetuses or corpora lutea. High pregnancy rates are typical for wolverines, but the actual reproductive output is typically low. None of the pregnant females were near or post parturition; however, the extension of the harvest season into wolverine denning season (mid-February to April) may be a concern that requires further investigation.

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Introduction

Wolverines (*Gulo gulo*) are a species of special management interest across their circumboreal range because they are both a species at risk and a valued furbearer. Within Canada, wolverines are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a species of *Special Concern*, and globally they are on the IUCN Red List as *Vulnerable*. Wolverines generally occur at low population densities (e.g., Golden et al. 2007), have large home ranges (Banci and Harestad 1990), and relatively low reproductive rates (Rausch and Pearson 1972, Banci and Harestad 1988). There is a concern that wolverines are sensitive to human disturbance and development, as well as overharvest (Krebs et al 2004, Ruggiero et al. 2007, Slough 2007).

Wolverines are harvested across much of their range in northern Canada and Alaska. Harvest reporting is in place in Yukon, where pelt sealing is compulsory for hides going into commercial trade (Slough 2007). Wolverines in Yukon can be harvested by hunting or trapping, with the vast majority (~ 98%) of animals harvested each year by fur trappers. In Yukon, Slough (2007) reported 2,162 wolverines harvested during the 1989–1990 to 2003–2004 trapping seasons; an average of 144 ± 40 (SD) wolverines per trapping season.

Given their global conservation concern, coupled with naturally low densities and relatively high harvest numbers, assessing the sustainability of wolverine is of particular interest to wildlife managers across the species range (e.g., Sæther et al. 2005, Lofroth and Ott 2007, Dalerum et al. 2008). Such assessments, however, are difficult in many areas because the density or abundance of wolverine is often unknown. Methods to determine wolverine density or abundance include aerial survey (Golden et al. 2007, Magoun et al. 2007), mark-recapture studies using DNA obtained from hair-snagging grids (Mulders et al. 2007), and remotely-deployed camera traps (Magoun et al. 2011). However, wolverine are elusive and particularly difficulty to census. Consequently, currently available inventory methods are time-consuming and expensive, particularly for remote areas with limited access, such as Yukon.

In 2005, we initiated a program to assess the possibility of using readily available carcasses from fur trappers to monitor wolverine population status in Yukon, and evaluate the sustainability of the harvest. We reasoned that examination of readily available carcasses may provide a suitable means to gather demographic and population trend data in a cost-effective manner.

Similar wolverine carcass collection programs have been conducted in Nunavut and Northwest Territories (e.g., Lee 1994), and for other furbearers in other jurisdictions (e.g., Fryxell et al. 2001; Larivière et al. 2010). The program has 4 goals:

- **Examine the population characteristics of harvested wolverine.** Understanding the population composition of harvested animals and how that may change with time is essential for wildlife managers, as these data can be used to

inform population modeling initiatives and wildlife management recommendations (e.g., Coe et al. 1980, Taylor et al. 1987, Larivière et al. 2010, Nilsen et al. 2011). We were primarily interested in obtaining the following key pieces of information from the carcasses: 1) sex and age-class of harvested animals, and 2) reproductive characteristics of females (pregnancy rate and timing, and litter size).

- **Assess the sustainability of the harvest.** Here, we were interested in determining the feasibility of using age-at-harvest data to assess if the harvest was sustainable. Analyses of age-at-catch data have been commonplace in marine fisheries, but have not been widely applied for terrestrial mammals despite their potential as a cost-effective means of assessing harvest sustainability (e.g. Solberg et al. 1999, Fryxell et al. 2001, Nilsen et al. 2011). However, we recognized that a relatively long time series of harvest data (12–13 years) would be needed to conduct such analyses.
- **Explore aspects of the health of wolverine.** There is little information on the health of wolverine. Submitted carcasses provided an opportunity to examine them for health issues and collect select tissues for disease sampling. Testing of readily available carcasses of wolverine can provide a window into the presence and prevalence of select diseases in the assemblage of carnivores in Yukon (e.g. Reichard et al. 2008a, 2008b).
- **Enable research on wolverine biology.** Wolverines are one of the least studied carnivores in northern regions. Consequently, there is much still to learn about their basic biology. Rausch and Pearson (1972), and Banci (1987) provided the only biological studies of wolverine in Yukon. Given our access to a relatively large number of carcasses, we were interested in collecting biological samples that could be used to learn more about the biology of wolverine. For example, DNA samples can be used to explore population genetics questions at regional (e.g. Wilson et al. 2000) or continental scales (e.g. Kyle and Strobeck 2001, 2002). Stomach contents and fat samples can be collected to examine seasonal diets (e.g. Magoun 1987, Lofroth et al. 2007). At the root of good wildlife management is knowledge of the biology of the species; a better understanding of wolverine biology will ultimately lead to better management.

Here, we provide a progress report on the winter season 2013-2014, which is the 8th year of data collection for the carcass collection program. This report compliments the more comprehensive report (Jung and Kukka 2013) that summarized the findings and recommendations based on the first 7 years of the program.

Appendix A provides additional information on the scientific papers prepared from the wolverine carcass data.

Methods

In Yukon, Canada, wolverine may be legally harvested during the winter (November 1 to March 10) by licensed fur trappers. We solicited licensed Yukon fur trappers to voluntarily submit the skinned carcasses of wolverine. In return, trappers were compensated $50 per wolverine carcass. Animals were harvested with industry-standard trap sets for wolverine. Carcasses were kept frozen at -20°C for 6 – 10 months prior to necropsy.

During necropsy, we took morphometric measurements, determined the sex and collected various biological samples. Morphological measurements included total body length, neck circumference, and body mass. Biological samples included a premolar tooth for aging, female reproductive tracts for determining productivity, muscle tissue for DNA analyses, and stomach contents and subcutaneous fat for diet analyses. We also collected parasitological samples to study the prevalence of *Trichinella* and *Toxoplasma*, as well as the overall diversity of intestinal parasites, in northern wolverines. The parasitological samples included blood, tongue, diaphragm, heart, brain, intestines and feces.

Age was determined via cementum analysis of a premolar tooth at a commercial laboratory (Matson's Laboratory LLC, Milltown, Montana). Wolverine <1 year old were classified as juveniles, those that were 1-2 years old were subadults, and >2 years old were considered adults.

Pregnancy was determined from the presence of a fetus, or in the case of animals harvested while early in pregnancy, the presence of corpora lutea (Banci and Harestad 1988). Corpora lutea (a mass of cells that forms after the release of a mature egg) were determined via the dissection of ovaries. Where available, we obtained crown-rump length and mass of fetuses.

Results and Discussion

Yukon trappers submitted 86 wolverine carcasses from the 2013-2014 trapping season, which comprised 67% of the harvest in that season. This is similar to the rate of submissions in previous years (Jung and Kukka 2013). The increased payment from $30 to $50 per carcass did not appear to increase the number of submissions.

Wolverines were harvested throughout Yukon (Fig. 1). The majority of submissions originated from the southwestern and south central Yukon, in Ruby Ranges (27%) and Yukon Southern Lakes (16%) ecoregions, respectively. We observed a similar spatial pattern in previous years (Jung and Kukka 2013). The larger harvest in these areas compared to other regions in Yukon may be explained by higher trapping activity or wolverine abundance, or likely a combination of both. Further investigation on the spatial patterns of wolverine harvest is underway.

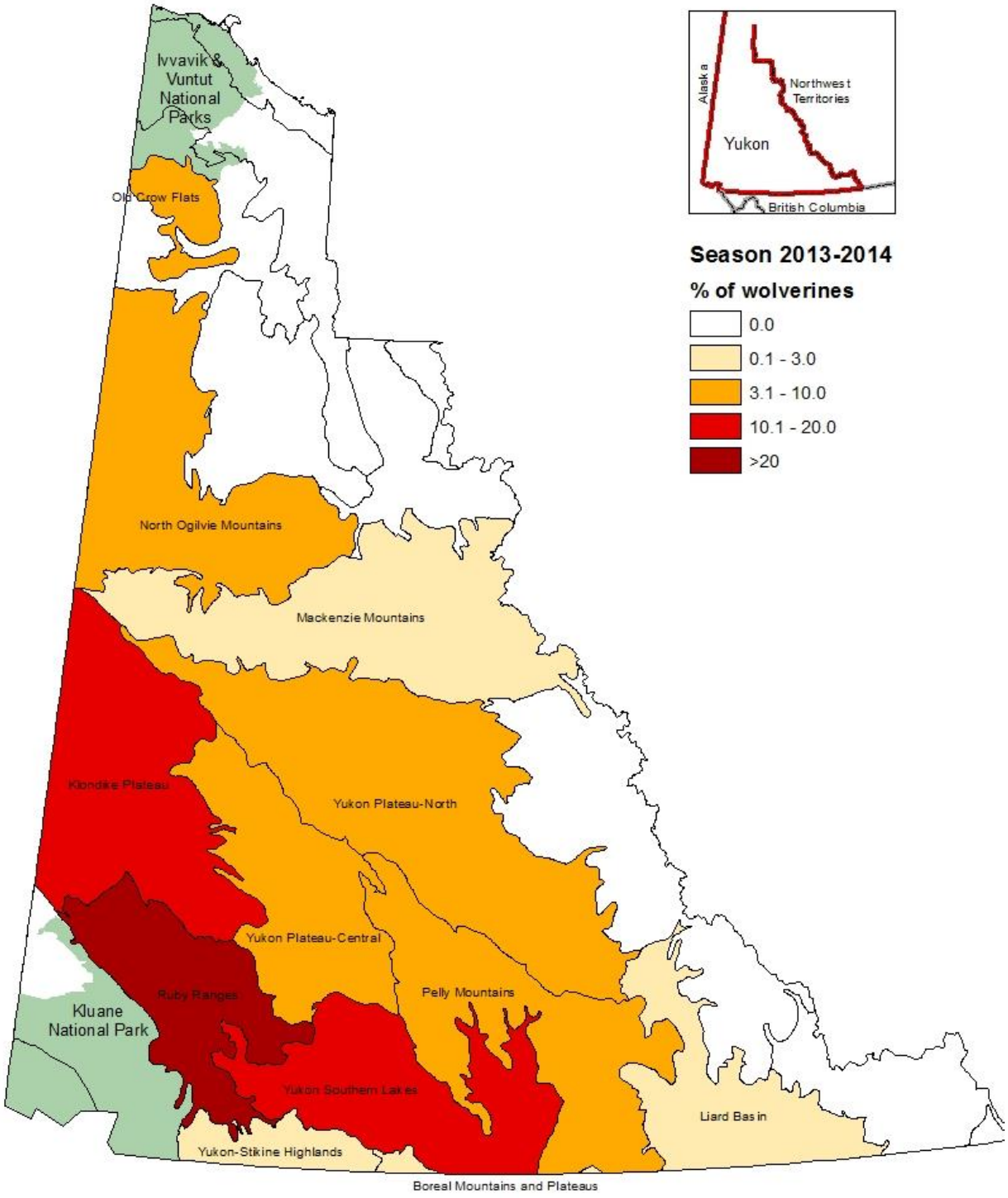

Figure 1. Location of wolverine carcass submissions during 2013-2014 trapping season in Yukon.

Wolverines were harvested during all months of the 2013–2014 trapping season, with the majority of wolverine being harvested in December (34%), followed by January (30%), February (22%), March (10%) and November (4%; Fig. 2). December to February is the primary harvest season for wolverine in Yukon, with the largest number of wolverines typically harvested in January and February. Poor early winter conditions (e.g. warm temperatures and lack of snow) may limit the trapping effort in November. The trapping season closes on March 10, which limits the number of trap nights during that month.

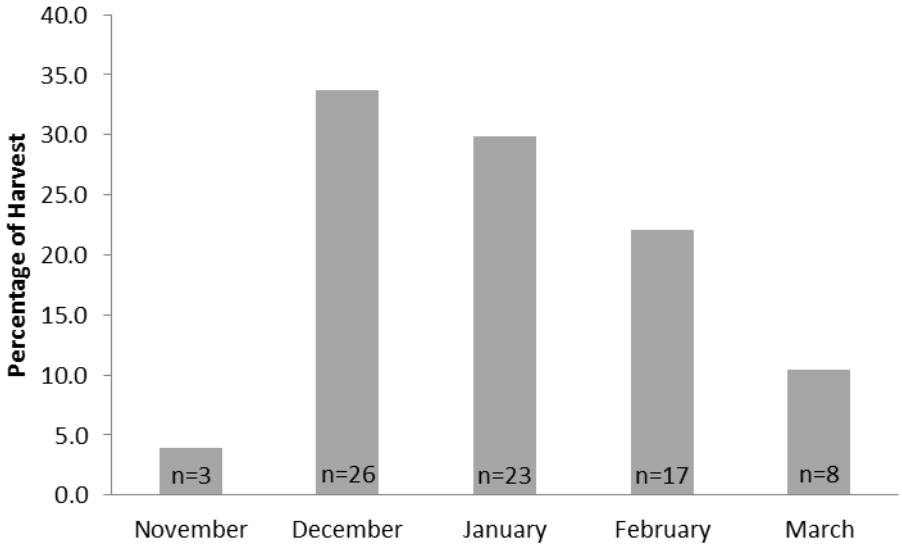

Figure 2. The percentage of wolverines harvested each month during the trapping season 2013-2014 (1 November to 10 March) in Yukon.

The harvest was male-biased (60% males), which is typical for harvested mustelid populations (Buskirk and Lindstedt 1989). Over the 8 years of study, males comprised 65% of the annual harvest (range 55–73%). The number of females (40%) was slightly higher in 2013–2014 than the overall mean of 34% (range = 27–44%). The highest proportion of female harvest over the 8 years of study occurred during the last two years. Harvest of too many females is a potential management concern, because it will limit the population's ability to replenish itself. Wolverines occur in naturally low density and have a very low reproductive rate (Banci and Proulx 1999); thus, over-harvest of females can be particularly detrimental to harvest sustainability. Continued monitoring of the harvest sex ratio is recommended.

The majority of harvest was young animals (<2 years old). Juveniles, subadults and adults comprised 35%, 27% and 38% of the harvest, respectively. Young animals also comprised the majority of harvest in previous years. A harvest skewed towards young animals is typical for exploited mustelid populations, probably due to their dispersal behavior and naiveté with traps.

Population bias towards young animals likely does not occur in unexploited populations, because there is little turnover in resident animals and the natural mortality of juveniles is high (Garant and Crete 1997). Thus, harvest mortality of juveniles may be largely compensatory for some furbearers. However, for a species such as wolverine that has a naturally low resiliency to exploitation (Banci and Proulx 1999), any harvest may introduce additive, rather than compensatory mortality (Dalerum et al. 2008; Krebs et al. 2004).

The proportion of adults was higher for females than males (Fig. 3); 42% of females (n=33) were adults, whereas 35% of males (n=51) were adults. The harvest of female wolverines as adults has ranged from 25 to 67% over the years, whereas the harvest of males has ranged more moderately from 25% to 49%. Harvest of young males may be higher than young females, because they may disperse further than females (Vangen et al. 2001); thus, encountering more traps. However, whether young males disperse further from their natal range than young females is inconclusive (Dalerum et al. 2007).

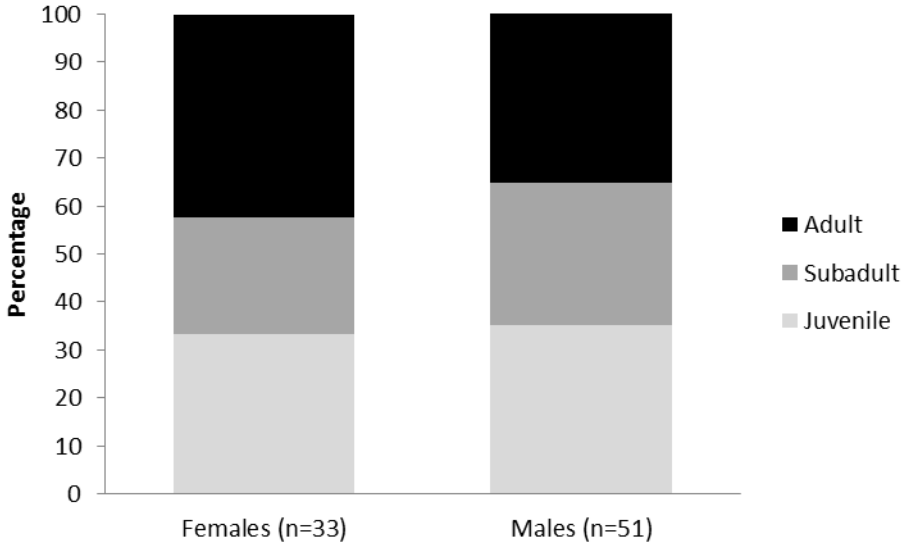

Figure 3. The sex specific age structure of harvested wolverines during the trapping season 2013-2014 in Yukon. Males comprised 60% and females 40% of the submitted carcasses.

We examined the reproductive status of 33 females; eighteen females (53%) were pregnant, with a 100% pregnancy rate for adult females. From the pregnant animals, 15% had discernible fetuses. The mean litter size for these animals was 3.2 (range 3-4). High pregnancy rates are typical for adult wolverines; however, their actual reproductive output is typically low (Persson et al. 2006). The study of reproductive tracts may overestimate wolverine productivity; young are likely lost during pregnancy, after parturition, or both. The onset of reproduction for female wolverines is late (average age of first reproduction is 3.4 years; Persson et al. 2006). In

our sample, the mean age of pregnant females was 3.3 years.

None of the females in our sample were post-partum or in advanced stages of pregnancy. The denning period for wolverine occurs typically from February to April, and there appears to be considerable variation in the timing of birth (Inman et al. 2012). We have encountered a few cases in other years of females that were either post-partum or very close to giving birth. These animals were harvested in late February or early March. The harvest of denning females is a concern, because it inevitably results in the loss of the whole litter.

Outreach and Scientific Communications

We provided media interviews on our wolverine carcass project to CBC television in December 2014 and Up Here magazine in January 2015. We gave a wolverine necropsy demonstration to students in Yukon College's Renewable Resource program and the University of Alberta's Northern Environmental and Conservation Sciences program in June 2014.

We prepared scientific papers based on the different aspects of this project (see the abstracts in Appendix A): 1) the prevalence of porcupine quills in wolverine (Kukka and Jung); 2) the prevalence of kidney stones in wolverine (Oakley et al.); and 3) the population characteristics of harvested wolverines (Kukka et al.).

We gave oral and poster presentations in the following public and scientific forums:

- Robitaille, J-F. (July 2014) Functional specializations in the Martes complex: Morphology and diet of American marten, Martes americana, fisher, M. pennanti, and wolverine, Gulo gulo in Canada. Presented at the 6th annual Martes symposium in Krakow, Poland.
- Luck, K., B. Wagner, J. Schurer, J. Harms, B. Elkin, T. Jung, R. Mulders, and E. Jenkins. (September 2014) Intestinal parasites in wolverines (Gulo gulo) from the Northwest and Yukon Territories, Canada. Presented at the Western College of Veterinarian Medicine, University of Saskatchewan, Saskatoon, Saskatchewan.
- Robitaille, J.-F., T. S. Jung and P.M. Kukka. (November 2014, April 2015) The winter diet of wolverines (Gulo gulo) in Yukon. Presented at the annual Biodiversity Forum in Whitehorse, Yukon, and the Northern Furbearer Conference in Juneau, Alaska.
- Kukka, P.M. and T.S. Jung. (November 2014, April 2015) The characteristics of wolverine (Gulo gulo) harvest in Yukon. Presented at the annual Biodiversity Forum in Whitehorse, Yukon, and the Northern Furbearer Conference in Juneau, Alaska.

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APPENDIX 1 PEER REVIEWED PUBLICATIONS

1) The cost of a prickly diet: incidents of porcupine (Erethizon dorsatum) quills embedded in wolverine (Gulo gulo)

Piia M. Kukka, Thomas S. Jung
Published: Canadian Field-Naturalist, Volume 129 (2015)

Abstract: The occurrence of North American Porcupine (*Erethizon dorsatum*) quills embedded in wild carnivores and domestic dogs is not rare; however, the prevalence of this occurrence and its consequences in wildlife are largely unknown. We examined 569 trapper-submitted Wolverine (*Gulo gulo*) carcasses for embedded porcupine quills. We observed quills in 4.6% of the wolverines, including all sex and age classes. We found quills throughout the body, and, in most cases, injury was not apparent. Observed complications, however, included bone proliferation and tissue damage to internal organs. Our data show that the occurrence of porcupine quills in Wolverine is not rare and demonstrate that, in a few cases, serious injuries may result from migrating quills.

2) Prevalence of renal calculi in wolverine (Gulo gulo) from northwestern Canada

Michelle P Oakley; Thomas S. Jung; Piia M Kukka; Jean-Francois Robitaille
Publishing pending: Mammalian Biology (Accepted 30 November 2015)

Abstract: Renal calculi (kidney stones) are often reported in domestic animals and occasionally wildlife; however, prevalence is rarely reported for free-ranging wildlife. Our aim was to determine the prevalence of renal calculi in a large sample of free-ranging wolverine (Gulo gulo) from a harvested population in Yukon, Canada. We tested for an effect of sex, age, and body condition, on the presence of renal calculi. Macroscopic examination revealed renal calculi in 48 of 537 (8.9%) wolverine. Bilateralism was low, with only 6 of 48 (12.5%) affected wolverine having calculi in both kidneys. Calculi were found in similar prevalence between the sexes. A significantly higher percentage of adults (≥2 years old) had renal calculi than sub-adults (<2 years old). When considering adults alone, prevalence was 12.7% for males and 17.8% for females. The mean age of affected females was not statistically different than the sample population, but the mean age of affected adult males was 2 years older than unaffected adult males. Mean body condition scores for wolverine with and without calculi were not statistically different for females or males. Mineral composition was determined for calculi from 29 wolverines. Calculi from most wolverine (90%) were composed of 95-100% ammonium acid urate, with magnesium ammonium phosphate (struvite) and calcium phosphate (apatite) as minor (≤5%) constituents. Our study is one of the first to document renal

calculi in a free-ranging population of wildlife. Prevalence of renal calculi in adult wolverine from northwestern Canada was substantial; however, the pathogenesis and clinical significance of nephrolithiasis in wolverine is unknown.

3) Population characteristics of harvested wolverine (Gulo gulo) in Yukon, Canada

Piia M. Kukka; Thomas S. Jung; Jean-Francois Robitaille; Fiona K.A. Schmiegelow
Under revision: Wildlife Biology

Abstract: Across much of their North American range, wolverine (Gulo gulo) are harvested for their fur, but little is known about the potential impact of harvest on their population viability. To help understand wolverine harvest dynamics, we tested for differences in the sex and age composition of the harvest within and among years, and examined reproductive output and timing, using a sample of 655 wolverine carcasses collected from fur trappers over eight years (2006–2014), from Yukon, Canada. The harvest was skewed toward adult males and individuals in the younger age-classes (i.e., juveniles and sub-adults). However, while the sex ratio of harvested animals did not fluctuate significantly during our study, we observed significant variation in the age structure of the harvested population among years, which may indicate changes in reproductive output and survival, or differential vulnerability to harvest, possibly due to fluctuating food availability. The age structure also varied within the harvest season (November to March), with a greater proportion of adults harvested in late winter, potentially indicating a decreased availability of juveniles and increased harvest of resident animals. Most (81%) adult females were reproductive, but the timing of gestation was variable, with expected parturition ranging from late February to April, based on fetal weight. We observed two cases of post-partum females in the harvest. For trapped populations where harvest sustainability is the goal, managers strive for a harvest skewed toward juveniles and adult males, with the protection of reproductive females from harvest as the management priority. Our data demonstrate that adult females were under-represented in the harvest. However, we also demonstrate that reproductive females are more susceptible to harvest in late winter, and we suggest that consideration be given to a harvest regime that reduces the impact on adult females, in order to ensure the sustainability of the harvest.