Detecting Furbearer Population Trends in Alberta using Trapper Logbooks, 2018–2024

Interim Report

Alberta Conservation Association

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EXECUTIVE SUMMARY

Detecting furbearer population trends is a difficult task when relying on harvest records alone. Alberta Conservation Association (ACA) has been working with Alberta Trappers Association (ATA) to develop an approach that uses trapping effort to better understand furbearer trends. Since 2018, a subset of trappers within Alberta has voluntarily provided detailed harvest and effort information recorded in personal logbooks submitted annually. We synthesized these logbook data to estimate furbearer trends over large spatial scales. These logs are cast to gain a measure of catch-per-unit effort (CPUE), and over time a change in CPUE can indicate whether harvest is sustainable. We learned that many trappers were already keeping detailed personal records of their effort before using standardized logbooks. By using a standardized approach, we assess if the harvest and effort data provided by trappers enables us to detect CPUE for a given furbearer species, as well as detect population metrics at meaningful spatial scales.

ACA began the annual collection of trapper logbooks with a focus on marten (*Martes americana*) beginning in winter of 2017/18. Two years later (2019/20), we added four additional furbearer species to logbook entries including lynx (*Lynx canadensis)*, fisher (*Martes pennanti)*, otter (*Lontra canadensis)*, and wolverine (*Gulo gulo*). Four years after this study began (2021/22), we also added wolf (*Canis lupus*) trapping effort and harvest to the logbook data collection.

Harvest records in the form of export sales and registrations have historically been used for speculating about changes in population trends for furbearer species. We began to see evidence emerge from the winter of 2019/20 that harvest records alone may be unreliable for detecting population trends for marten without also factoring in the effort associated with that harvest. The record of provincial exports for marten pelts displayed a year-to-year decline from 2017/18 through to 2019/20 although CPUE showed an increase during that same timeframe. This suggests that other factors beyond the apparent abundance of marten may have influenced the decline of exported marten pelts between 2017/18 and 2019/20, and that annual harvest alone may be an unreliable indicator of population change.

On average, it took 118 trap nights to harvest one marten based on the seven-year mean of CPUE among all reporting traplines (2018 to 2024). This is equivalent to setting 17 traps for a week and catching one marten. On average and among years, trappers in the Boreal Forest Natural Region had lower marten catch rates when compared to those in the Foothills and Rocky Mountains regions. In comparison, it took 200 trap nights to harvest one fisher and 139 trap nights to take one lynx when averaged over five years (2020 to 2024).

We trialled an analytical approach that made use of harvest and effort data and used estimated survival metrics to predict marten abundance across Fur Management Zones (FMZ). For this population reconstruction model (PopRecon), we used seven years of logbook data from 2018 to 2024 and ran models that explored scenarios that assumed an annual harvest represented by high (30%) versus low (10%) portions of the population. We examined marten abundance in five spatial areas (FMZs 1, 2, 3, 4, and 5 & 6) and found that it varied yearly within each FMZ. Regardless of which harvest level we assumed for population reconstruction modelling, trends in abundance were generally stable to possibly increasing, similar to trends based on CPUE. Statistical population reconstruction offers several advantages over traditional index-based monitoring; however, we lack Alberta-specific auxiliary data, including harvest probability. We will therefore treat these results with caution and will refine our approach as new information becomes available. We will also continue to explore population reconstruction models such as PopRecon as we receive additional years of marten harvest and effort data to better understand the reliability of these outputs over time.

Trappers have submitted logbooks from 389 individual RFMAs up to 2024, although the consistency of submissions on an annual basis from individual traplines is well below this number. Logbook submissions have varied from year to year ranging from 126 in the first year, to a high of 207 in year three, and then dipped well below 200 for years four through seven. This decline in logbook submissions is a concern if this trend continues. To gain robust estimates of marten abundance among all FMZs we predict that at least 300 logbooks are needed annually.

Keywords: Alberta, furbearer, logbook, marten trapping, population trend.

ACKNOWLEDGEMENTS

We thank Bill Abercrombie of the Alberta Trappers Association (ATA) and Dave Kay of the Government of Alberta for their insight and assistance with project development. Anne Coles, previous president of the ATA, was instrumental in logbook development. We greatly appreciate the hundreds of ATA members who volunteered their trapping and fur harvest data by submitting logbooks. They have been a pleasure to collaborate with. We also thank the many trapping locals and presidents for promoting the logbook initiative as well as Donna Moore and Darnell McCurdy, ATA executive for their assistance ensuring logbooks were entered online. Andrea Morehouse (Winisk Research and Consulting) conducted PopRecon population modelling for marten and provided text for the associated sections in this report.

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1.0 INTRODUCTION

Estimating the abundance and population trend of harvested furbearer populations contributes to effective management (Hiller et al. 2023). While furbearer populations in the province are managed similarly to fish and hunted wildlife populations in some respects, data on furbearer abundance have been largely lacking. Harvestable fish and wildlife populations are typically surveyed, and harvest regulations are set accordingly (Connelly et al. 2020). However, furbearer population data in Alberta have primarily been limited to trapper affidavits and fur registrations. Harvest data provide information on how many furbearers are trapped year to year, but they do not provide any indication of the level of effort involved or the age class of the harvest from one year to the next. Several variables can impact total harvest of a given species. For example, a trapper may set fewer traps or trap fewer days for a species, simply due to personal obligations or they may choose to not target a species based on fur price that year. The resulting harvest data will show a decrease in harvest of that species, but that decrease may not be associated with its abundance on the landscape.

In 2014, in collaboration with the Government of Alberta (GoA), Alberta Trappers Association (ATA) developed a detailed logbook for volunteer trappers to record trapping activities and species harvest. In 2017, Alberta Conservation Association (ACA) was invited to work alongside ATA to help continually improve their data collection as well as analyze and interpret the results.

Recording trapper effort associated with harvest provides a common measure of sampling effort that, when combined with harvest, provides greater resolution for making population inferences when compared to fur sales or exports alone. When we became involved, we predicted that individual trapper logbook entries held promise for tracking furbearer trends over broad spatial scales but would require revision to estimate the catch-per-unit effort (CPUE) associated with harvest. Estimates of CPUE can provide an index of species abundance, and over time, a change in CPUE can indicate whether harvest is sustainable.

Marten occur across much of the forested portion of Alberta and are widely trapped throughout their range. Beginning with the winter 2017/18 season, we narrowed the focus of logbook entries to that for marten (*Martes americana*) given their universality, widespread distribution, and a harvest pattern that is not restricted by an imposed harvest quota (e.g., allowable catch per year per trapline). The age class of harvested animals, when combined with harvest effort information, provides additional information that is valuable for estimating population change over time (Skalski et al. 2011, Clawson et al. 2016). As such, we adopted a common method to determine the age class of harvested marten based on temporal muscle development of the skull (Magoun et al. 1988, Flynn and Schumacher 2016), and provided training to improve consistency among traplines.

We also wanted to assess if logbook data could be effective for predicting trends for species other than marten. Beginning in winter 2019/20, we added lynx (*Lynx canadensis*), fisher (*Martes pennanti*), otter (*Lontra canadensis*), and wolverine (*Gulo gulo*) to the logbook program. These four species were subject to harvest quotas during the entire study. In 2021, wolf (*Canis lupus*) was included with logbook entries and helped to facilitate ATA's involvement in the province’s wolf management program. This report summarizes furbearer harvest and trapping effort data collected over seven years beginning in 2017/18 and ending with the 2023/24 trapping season.

We predicted that our ability to estimate CPUE and detect species population trends would be limited by the number and geographic distribution of logbooks submitted each year. With the widespread abundance of marten across the province, we expected this species would have the greatest opportunity for detecting meaningful population trends. As such, this report introduces a preliminary population reconstruction model for marten.

2.0 STUDY AREA

2.1 Definition of trapping zones, areas, and area holders

Alberta is divided into eight Fur Management Zones (FMZs) in which trapping seasons (timing and length) are set for furbearer species (Figure 1). The province is further divided into Registered Fur Management Areas (RFMAs; colloquially referred to as “traplines”), where a portion of public land is delineated by a boundary. There are approximately 1,632 RFMAs in the province. Each RFMA has a senior licence holder who has exclusive authority to trap and manage fur within the RFMA. Senior holders often acquire a junior partner to share trapping opportunity, and some licence holders have authority over multiple RFMAs, typically located in the same region. Some RFMAs can be several townships (one township = 93 km^2), and certain species harvest limits can vary when an RFMA is greater than two townships in size. In addition, some seasons are extended in certain Wildlife Management Units (WMUs) (GoA 2024a).

Marten trapping occurs in six of the eight zones (i.e., FMZ 1–6, Figure 1) (GoA 2024b). Provincially, the trapping season for marten runs from November 1 through January 31 in areas where it is allowed (GoA 2024b). In select WMUs, the season for marten is extended until February 15 (GoA 2024b). There are no limits on the number of marten that may be harvested per annum (GoA 2024b).

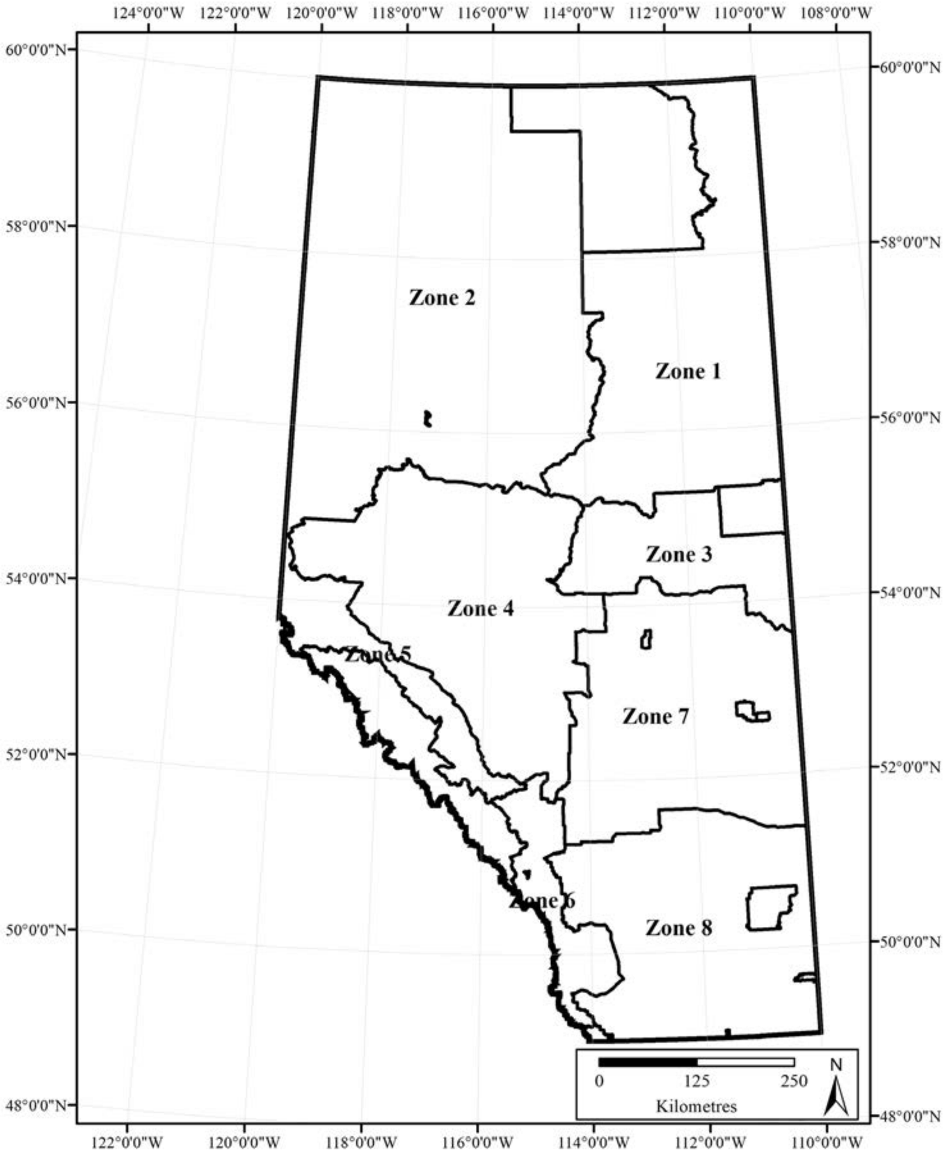


Figure 1. Fur Management Zones (FMZs) of Alberta.

3.0 MATERIALS AND METHODS

3.1 Logbook revision

Initially, ATA developed a logbook that was approximately 50 paper pages in length for registered fur management trappers to complete. ATA submitted all logbook responses received over three winters (2014/15–2016/17) to ACA. Our role was to analyze data from the initial batch of logbooks collected prior to our involvement and summarize the utility of the data and determine whether any changes to the logbook process were needed. We found that the logbook concept held promise for producing information on trends that could be tracked over time, as well as age and sex ratio data. However, it was apparent that a much larger sample size of participating trappers would be needed and the addition of trapping effort by species would allow for calculation of a CPUE index, which is commonly used to inform furbearer management decisions (Hiller et al. 2023). Collectively, we decided to create a more concise and simpler logbook to encourage trapper participation and to focus primarily on marten. Data from 2014–2017 logbooks suggested that marten were most widely available throughout the province. The logbook is currently a total of five pages with the addition of quota species and wolves. It has also been used opportunistically to gather information on non-furbearer species that are routinely observed by trappers during time spent on their RFMAs.

3.2 Logbook data

One logbook was submitted per trapline each year for those RFMA holders who chose to volunteer their time and effort. Logbooks were submitted following the end of each licence year and covered the period from the previous July through to the following June. For each RFMA, trappers provided an account of hours spent conducting trapline-related activities each month. They documented their harvested marten by gender (male/female) and age (juvenile/adult) using the skull muscle method (Magoun et al. 1988, Flynn and Schumacher 2016) (Appendix 1). We used this information to calculate ratios of juveniles to adult females and, males to females in the harvest. To calculate trapping effort, trappers estimated the average number of traps or snares set for each species at any given time and multiplied that by the average length of time (number of days) that those traps would remain set. We chose to have trappers estimate these values as not all trappers record the details of when each trap is set and removed. This approach trades off some level of precision for simplicity and we assumed this may encourage greater participation levels for this volunteer program. We have found through doing trapline visits that most trappers have a good sense of how many traps they have out for each species and for how long.

During the time covered by this report, harvest limits were in place for lynx, fisher, otter, and wolverine. These four quota species were added to the logbook in 2019/20, and in 2021/22 wolf trapping information was also included. The ATA wolf management program is part of an agreement between the GoA and the ATA, providing trappers an opportunity to help reduce wolf predation on *Threatened* caribou populations. If an RFMA falls within specified caribou range and the trapper meets requirements, the province will provide compensation to the trapper if they set baits and snares for wolves and submit an ATA logbook that year.

Trappers could count a single trap more than once on the same day if that trap had the ability to catch more than one species. Some examples of this include a Belisle Super X 120 or 160, both of which are certified traps for harvesting marten and fisher in Alberta, although a 120 is more commonly used for marten. Trappers also noted when a catch was unintentional (e.g., bycatch): when a harvest occurred using a trap that was not specifically set for the species harvested.

Trappers were asked to include their perception of population abundance and trend in logbook submissions. There is also a general comments section that offered trappers an opportunity to share a multitude of observations of interest. The layout and question details have evolved over time, and an example of the 2023/24 logbook version is provided in Appendix 2.

In 2020/21, the logbook included a one-time forest grouse questionnaire where trappers provided forest grouse information based on their respective RFMA. Since trappers spend a significant amount of time on their traplines, we asked for their opinion on forest grouse (spruce [*Falcipennis canadensis*] and ruffed [*Bonasa umbellus*]) population trends and habitat associations. And lastly, in 2022/23, we incorporated a local knowledge question to the logbook asking trappers at what stage they feel the snowshoe hare (*Lepus americanus*) cycle is in on their RFMA.

3.3 Database management

In addition to a hardcopy PDF version of the logbook, we developed an online version of the logbook using Microsoft Forms. A web page link was made available on the ATA website that would direct a trapper to the online logbook form. Having the trapper enter their own data online eliminated the need for data entry at the end of each season, saving ACA time and resources. Submitting the online form initiated an automated reply that would go to each trapper through Microsoft Flow. The automated reply allowed the trapper to review their response and provide an opportunity to inform us of any data entry errors. The logbook data were retrieved by Microsoft SQL server, which linked the data to a Microsoft Access database where we would store, manage, and query the data. Queries were developed to provide data quality assurance and quality control. When outliers were identified we contacted individual trappers to resolve any potential data errors.

3.4 Logbook analysis

From the marten harvest reports and estimates of trap nights (number of traps set multiplied by number of days set), we calculated a trapping-season CPUE (number of marten caught per 100 trap nights) for each RFMA. We combined these data and summarized the results at the provincial, natural region (Figure 2), and FMZ levels by calculating annual averages when a minimum sample size of ten logbooks had been met. Natural regions or FMZs that did not meet this minimum were not plotted onto corresponding figures. Confidence intervals (CI) for annual averages were estimated using a bootstrapping method to account for the distribution of the data (many low catch rates and few high catch rates). We used a 90% CI in our analyses as it is standard practice for monitoring wildlife populations for management purposes (e.g., Czaplewski et al. 1983, Becker et al. 2022). The Grassland, Parkland, and Canadian Shield regions were not included in the natural region comparisons. However, one Canadian Shield and one Parkland

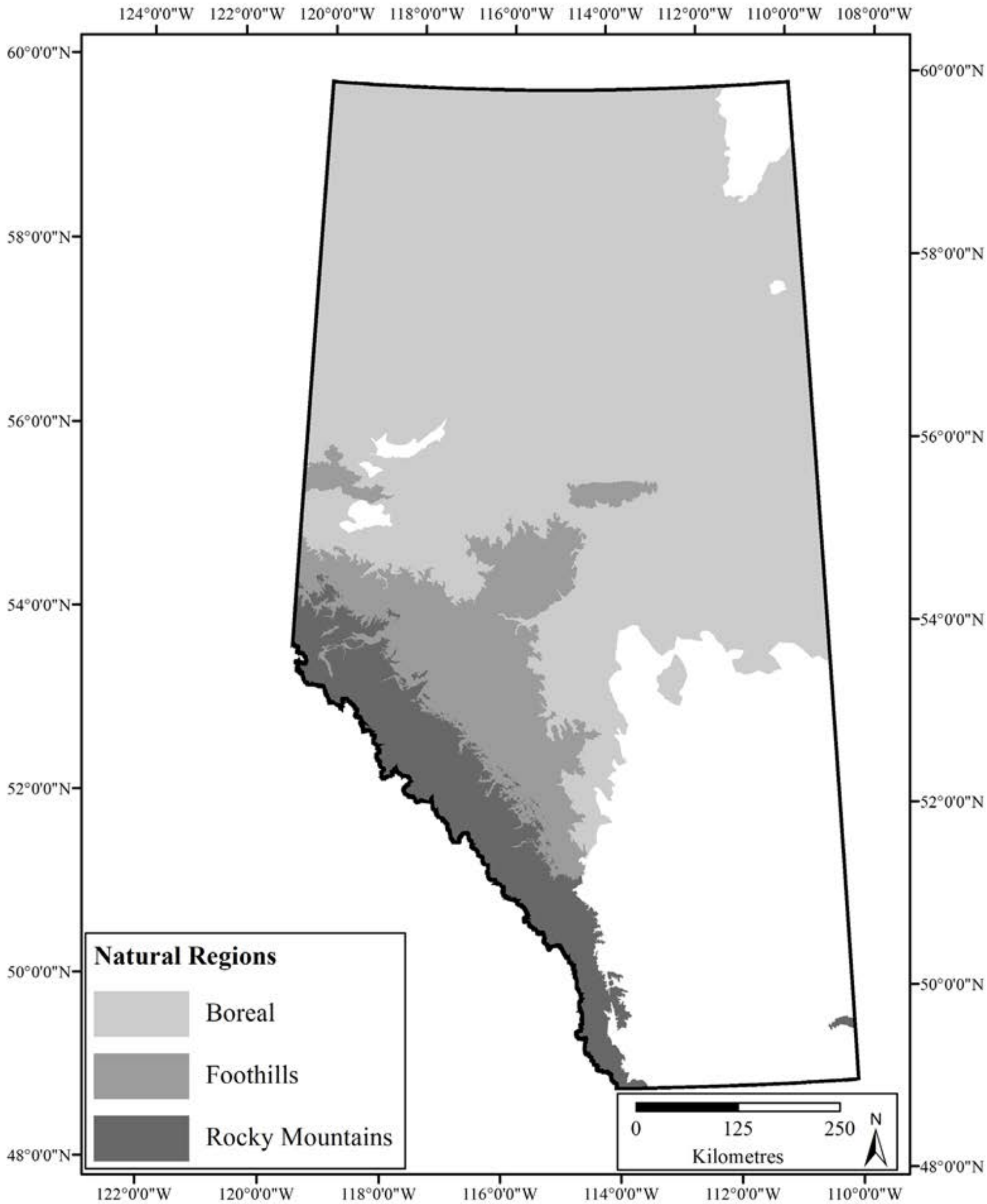


Figure 2. Three of six natural regions of Alberta incorporated in our trapper logbook analyses.

RFMA provided logbook data, and those data were used outside of the association to natural region. We similarly calculated trapping-season ratios of juveniles to adult female marten and, males to females in the harvest.

For CPUE and ratio calculations, we determined combined seven-year averages by averaging the group of seven annual values to account for variable trapper participation among years (i.e., some RFMAs submitting data each year, while others did not; Hurlbert 1984).

Quota species (lynx, fisher, otter, and wolverine) and wolf data collection and analysis followed a similar method to marten; however, we did not collect age class information for quota species until 2022/23. Trappers primarily classify lynx (Marti and Ryser-Degiorgis 2018) and fisher age (Giuliano et al. 1989) using body size. Our goal in adding this information is to conduct population modelling for lynx and fisher in the future, similar to the approach taken for marten (see 3.5 Statistical Population Reconstruction). Therefore, age class ratios are only included for lynx and fisher. Like marten, we placed a minimum requirement of ten RFMAs per year for each natural region or FMZ to calculate indices for lynx and fisher. We only provide provincial-scale estimates of CPUE for otter and wolverine due to smaller sample sizes.

To test which factor(s) influenced marten harvest rates, we ran a linear mixed model with the log of the number of marten harvested per 100 nights (CPUE) as our response variable, with natural region and year (i.e., trapping season) as our explanatory covariates, and RFMA as our random effect. When taking the log of our CPUE/100 nights, we added a small value (0.1) to the CPUE to retain data where the CPUE was zero (i.e., a trapper put in effort but did not harvest). We ran the null model with just the random term, plus four additional models that included the two covariates: one for each covariate separately, another model with both covariates included, and finally a model with an interactive term between the two covariates. We selected the top model(s) as those that had an Akaike Information Criterion (ΔAIC) less than 2.0. As our two explanatory covariates were both categorical, if either were in the top model(s) we completed a multiple comparison using the emmeans function (Lenth 2024) to see which categories were different from each other.

All analyses and graphics were run or produced in RStudio version 2024.04.2 (RStudio Team 2024) and R version 4.4.1 (2024-06-14). For simplicity in labelling, we refer to the trapping season as the latter year of the two years in a given trapping season. For example, year one of the project included the trapping season beginning in November 2017 and extending through either January or February 2018 depending on the FMZ; we refer to this year in the following tables and graphs as 2018. Similarly, the 2023–2024 trapping season is referred to as 2024.

3.5 Statistical population reconstruction for marten

We used marten harvest data voluntarily reported by Alberta trappers to estimate marten abundance within Alberta's FMZs using statistical population reconstruction (SPR). SPR is a form of an integrated population model. It integrates multiple sources of data, which allows for improved precision of estimated parameters. SPR models usually consist of at least three likelihood components: age-at-harvest likelihood, aging likelihood, and auxiliary likelihood (Clawson et al. 2017a). The auxiliary likelihood uses data that are independent of age-at-harvest data, while the aging likelihood accounts for incomplete aging or reporting of harvest (Clawson et al. 2017a).

We chose FMZs as the SPR modeling region because it best supported SPR model assumptions (Clawson et al. 2017a). SPR models assume that harvest vulnerability and natural survival probability are homogenous across the modelling region within age and sex classes (Clawson et al. 2017b). Further, harvest regulations must be the same across the entire SPR modelling region. Clawson et al. (2017a) also recommend that SPR modelling regions be as large as possible without violating assumptions of demographic homogeneity. Trapping season timing and length in Alberta is established based on FMZs and reflects differences in trapping pressure and seasonal pelt quality (GoA 2024b). Thus, given these assumptions and considerations, we chose FMZs as the SPR modelling region.

We used the PopRecon version 2.0.26 software (Clawson et al. 2017b) to estimate marten abundance within Alberta's FMZs. The program PopRecon2 is a software program that facilitates the analysis of SPR models (Clawson et al. 2017a). The program output includes estimates of abundance, natural survival, harvest probability, and recruitment. Trappers provided marten harvest data at the RFMA scale from 2017/18 through 2023/24 trapping seasons (Figure 1), including (when possible) an estimate of marten age at harvest. Age was classified as either juvenile (i.e., under one year old) or adult (i.e., over one year old). We also included unaged marten in the model as year-specific ratios of the number of aged marten to the total number of harvested marten. PopRecon does not currently have the ability to estimate sex-specific models, and we did not separate marten by sex in our models due to sample sizes. Thus, our marten model included annual marten harvest, harvest effort (i.e., number of trap nights scaled to a mean of 1 as recommended in Berg et al. 2017), and two sources of auxiliary data. Auxiliary data can be estimates of harvest probability, survival, and/or abundance either from separate studies or estimated from the literature (Clawson et al. 2017a, 2017b).

Because empirical auxiliary data were not available for Alberta, we used estimates of harvest probability and survival based on the literature as well as our knowledge of the system. From our experience working with trappers and spending time on their traplines, we know that a very small percentage of the trapline area is effectively trapped for marten. At the RFMA scale, access is typically limited to seismic lines and industrial roadways. A trapper will maintain (i.e., brush clear) a small percentage of those linear features within their trapline area and use them for travel and trap setting. Only certain segments of those maintained trails will be used to target marten. Therefore, the level of harvest occurring at the RFMA (and subsequently FMZ) scale is limited to the maintained trails with traps and a buffer surrounding that area. Harvest rates in the literature varied widely (e.g., Fryxell et al. 1999, Helldin 2000, Fortin and Cantin 2004). For example, Thompson (1994) reported harvest mortality rates in Ontario ranging from 0.029 to 0.393, depending on food availability and habitat. Based on the published literature and the small effectively trapped area, we chose a harvest level of 0.10 to represent a low harvest rate and 0.30 to represent a high harvest rate. Harvest auxiliary data provide a model starting point, which then varies over time using a maximum likelihood framework to estimate yearly harvest rate in conjunction with abundance.

Based on the published literature, we chose an annual survival rate of 0.60 across both sexes and age classes. Similar to harvest rates, marten survival rates vary in the literature. For example, Bull and Heater (2001) reported survival rates of 0.55 for juveniles and 0.63 for adults, while Martin et al. (2022) reported survival rates of 0.81 for female marten and 0.68 for males. Hodgeman et al. (1994) reported survival rates as low as 0.11 for juvenile males during the trapping season, but as high as 0.93 for adults during other times of the year. Thus, we believe our estimated survival rate of 0.60 represents a realistic and moderate rate of survival.

To assess the use of SPR with Alberta data, we ran both low and high harvest scenarios while holding survival rate constant at 0.60 to estimate marten abundance within each FMZ where marten are trapped in Alberta. Each RFMA was assigned to the FMZ in which it (or most of it) fell.

4.0 RESULTS

4.1 Trapper participation

Between 2017/18 and 2023/24, a total of 1,170 logbooks was submitted (Table 1). Across all years, we received logbooks from 389 of Alberta's 1,632 RFMAs (Figure 3). Approximately 6% of these RFMA holders have submitted a logbook each year, while 22%submitted logbooks for the past five or more years. On average, participating traplines were 228 km^2 (approximately 2.5 townships) in size.

Table 1. Number of trapper logbooks submitted in Alberta by year, 2018 to 2024. Year refers to the latter of the two years covered by a trapping season.

Year	Logbooks Submitted
2018	126
2019	199
2020	207
2021	148
2022	168
2023	159
2024	163

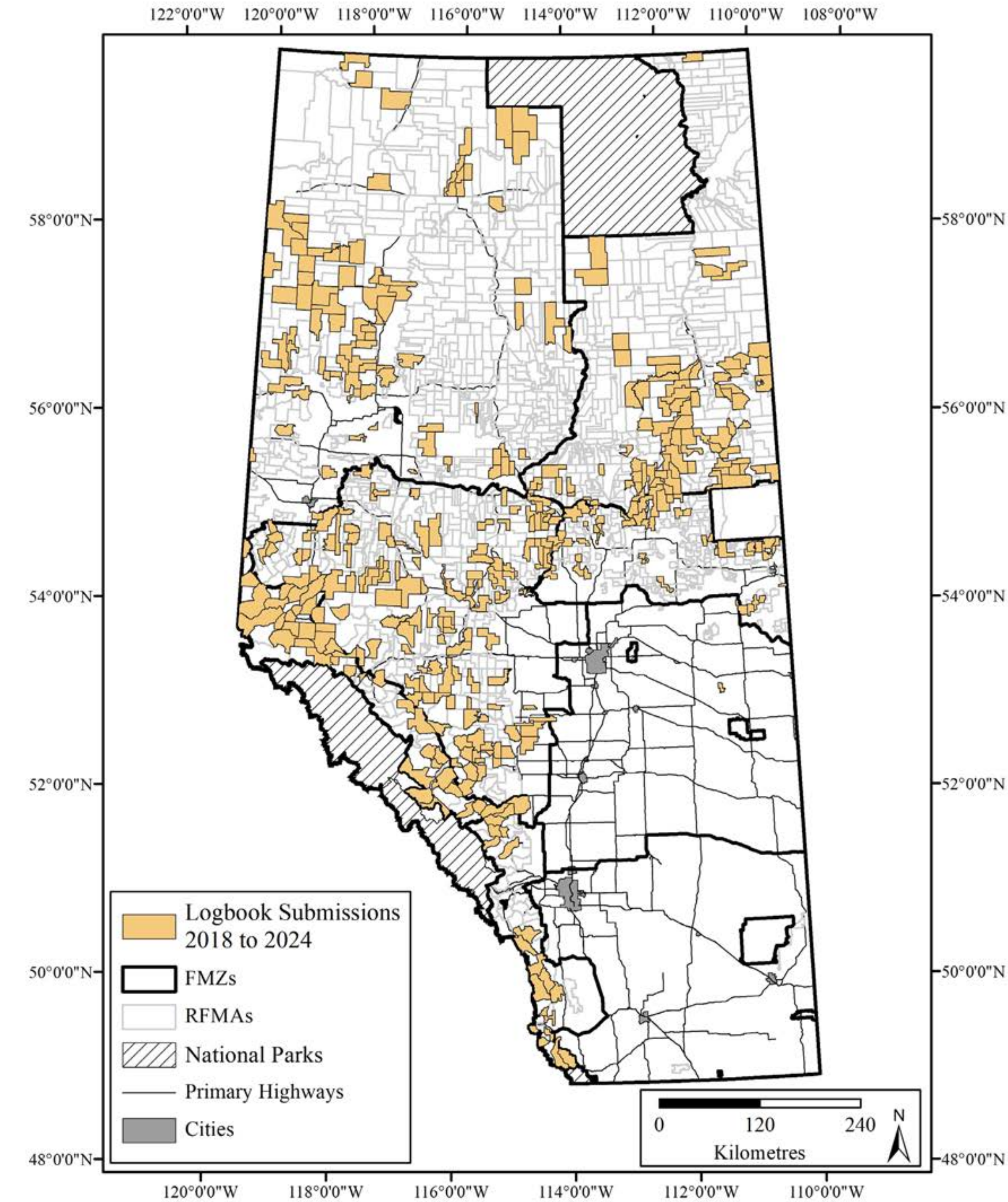


Figure 3. Geographic distribution of Alberta logbook submissions (n = 389 Registered Fur Management Areas [RFMA]) received from trappers, 2018 to 2024.

The mean monthly time that logbook participants spent on trapping activities ranged from eight hours in June to 80 hours in December, with a combined seven-year annual average of 423 hours spent per trapline on all trapping-related activities. This includes various trapline activities, from trail and cabin maintenance to finishing furs. For the trappers participating in the logbook initiative, the total hours spent conducting trapping-related activities has remained relatively consistent among years (Figure 4), with the greatest deviation from the seven-year average (approximately 14% higher) occurring during 2020/21, which was the first full trapping season to take place during the COVID-19 pandemic.

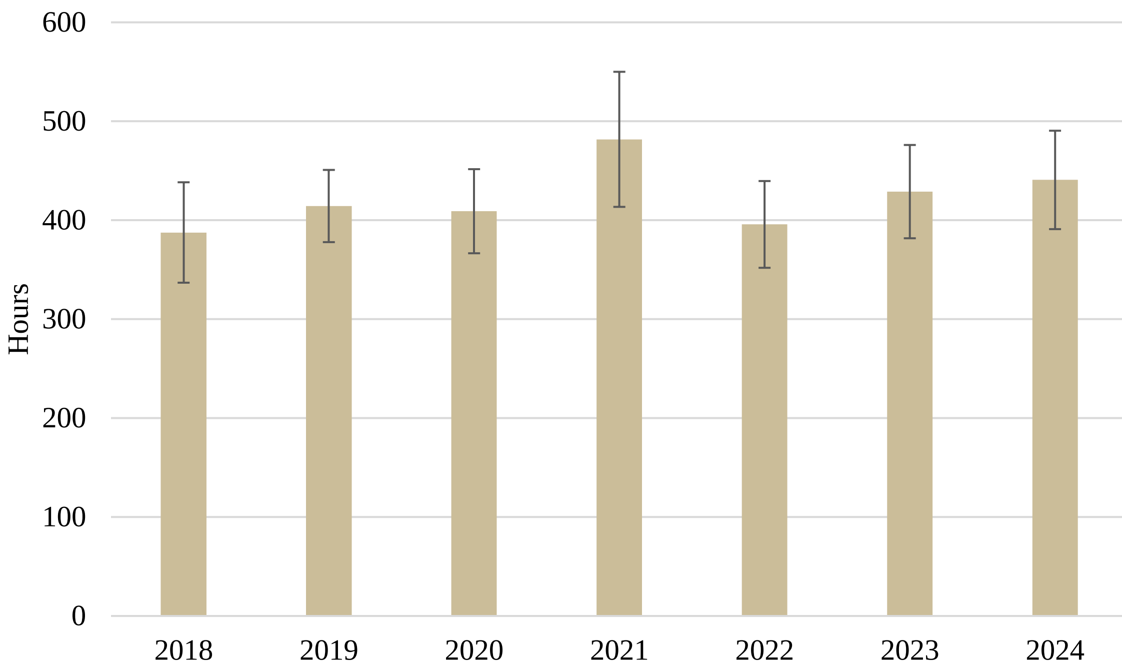


Figure 4. Average total number of hours (+/- 90% CI) spent on trapping-related activities based on data from Alberta's trapper logbooks each year, 2018 to 2024.

The greatest number of marten logbook submissions came from the Boreal Natural Region (n = 570, pooled annually), followed by the Foothills (pooled n = 270) and Rocky Mountains (pooled n = 100) natural regions. Fur Management Zone 4 had the greatest number of logbooks (n = 309, pooled annually) followed by FMZs 1 & 3 combined (pooled n = 302), and FMZ 2 (pooled n = 203) (Table 2). FMZs 5 & 6 contribution levels were lower (pooled n = 126) and were lacking in the minimum sample size of ten RFMAs some years.

Table 2. Number of Registered Fur Management Areas (RFMA) setting traps for marten and submitting logbooks by year within each Fur Management Zone (FMZ).

Year	Number of Participating RFMAs					
	FMZ Number					
	1	2	3	4	5	6
2018	29	13	7	45	11	6
2019	25	35	16	65	18	12
2020	32	37	15	50	14	12
2021	23	25	13	35	14	7
2022	36	34	17	36	9	4
2023	27	28	11	40	7	4
2024	38	31	13	38	5	3

4.2 Marten population trend

Based on the seven years of logbook data, trappers set an average of 30 marten traps for an average of 45 days each year, and the marten catch rate across the province for an equivalent amount of effort (i.e., CPUE) showed a stable-to-possibly-increasing trend (Figure 5; however, see results below regarding the lack of a year effect). We were satisfied during the first five years with the level of precision at the provincial scale to meet wildlife monitoring objectives (+/- 20% at 90% CI). We like to see the error bars be within 20% of the mean. However, the provincial values were less precise than desired during the final two years. Due to sample size limitations, the variation associated with dividing the data into natural regions and FMZs produced a lower level of precision. The boreal marten data were close to meeting precision targets in all but the final year. At current levels of logbook entries, we cannot reliably detect changes over time for all natural regions or FMZs.

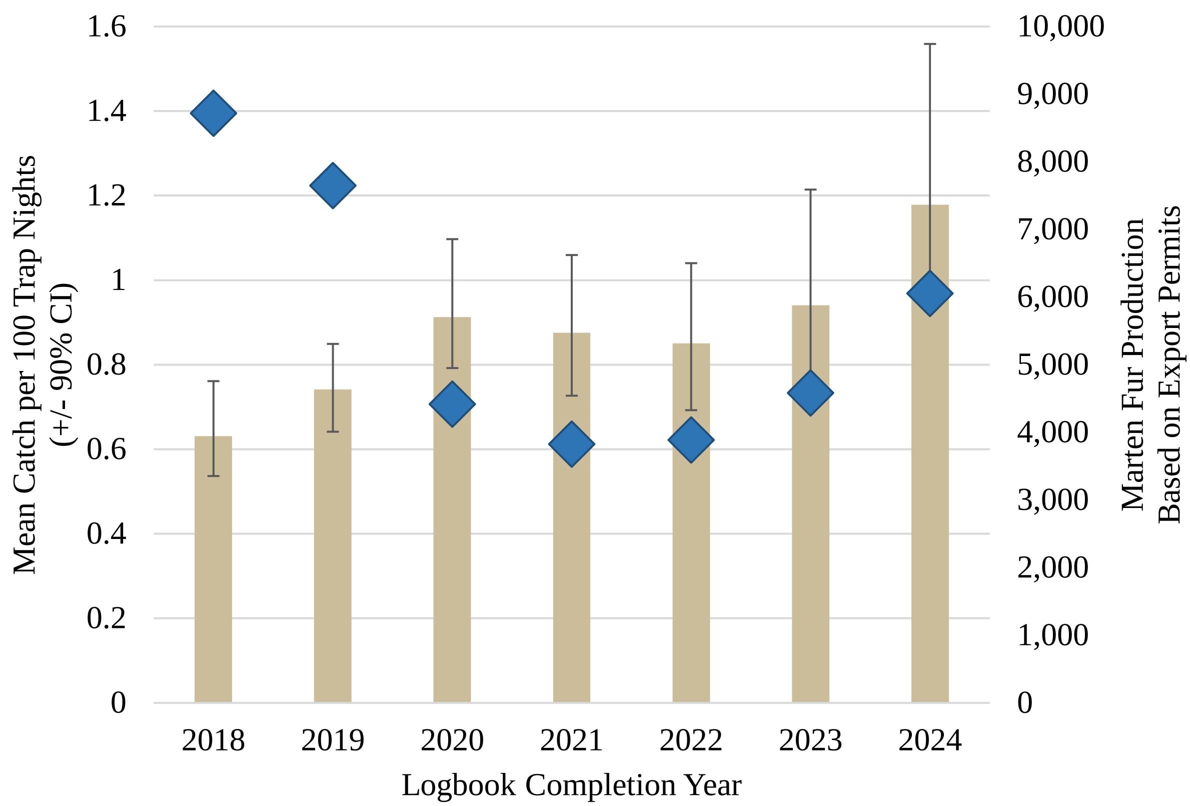


Figure 5. Marten fur production in Alberta (blue diamonds; GoA 2024b) declined from 2018 to 2022, but the catch rate for an equivalent amount of trapping effort (i.e., CPUE; beige bars, +/- 90% CI) did not significantly change.

On average, it took 114 trap nights per marten harvest (mean CPUE of 0.88 marten per 100 trap nights, standard error [SE] = 0.06) over the seven-year period. For comparison, this would be equivalent to setting 16 traps for a week and catching one marten. Over the seven-year period, 115 logbooks (12%) reported setting marten traps but not catching a marten, while the remainder harvested at least one marten (range 1–98 marten, n = 823). Based on all logbooks received over the seven years, an average of ten (SE = 0.48) marten were harvested per RFMA, per year. One percent of the total marten catch was unintentional.

RFMAs within the Foothills Natural Region had higher average marten CPUEs than the Boreal, particularly in 2021, 2022, and 2023 (Figure 6). The Rocky Mountains and Foothills natural regions had the most uncertainty associated with their averages, however, and the Foothills failed to meet precision targets. The Rocky Mountains Natural Region failed to meet the ten RFMA minimum after 2021.

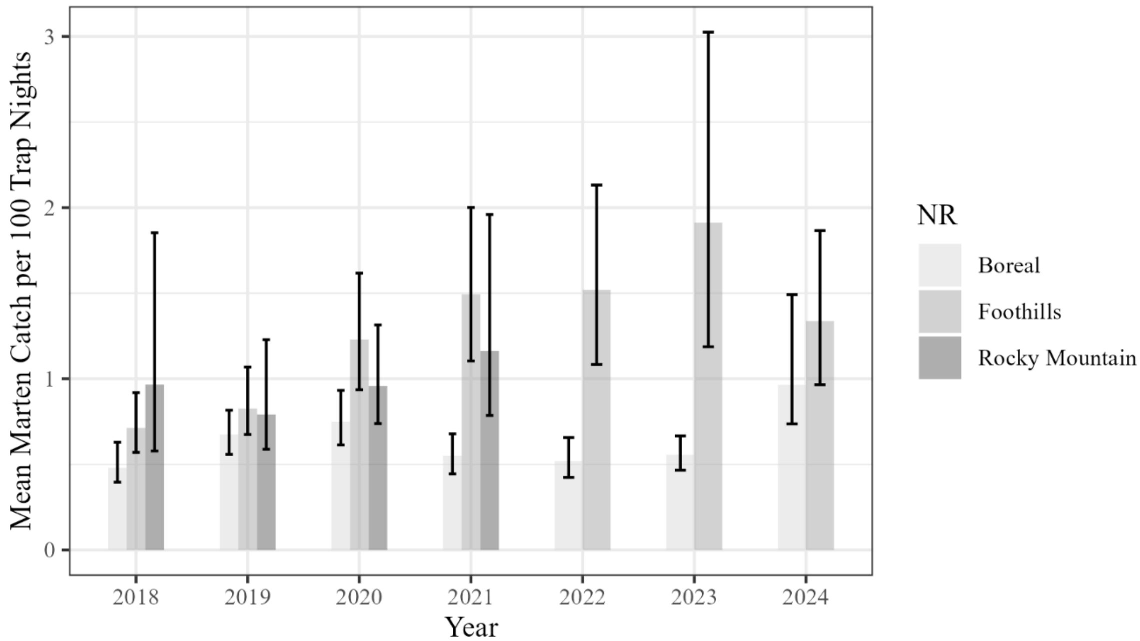
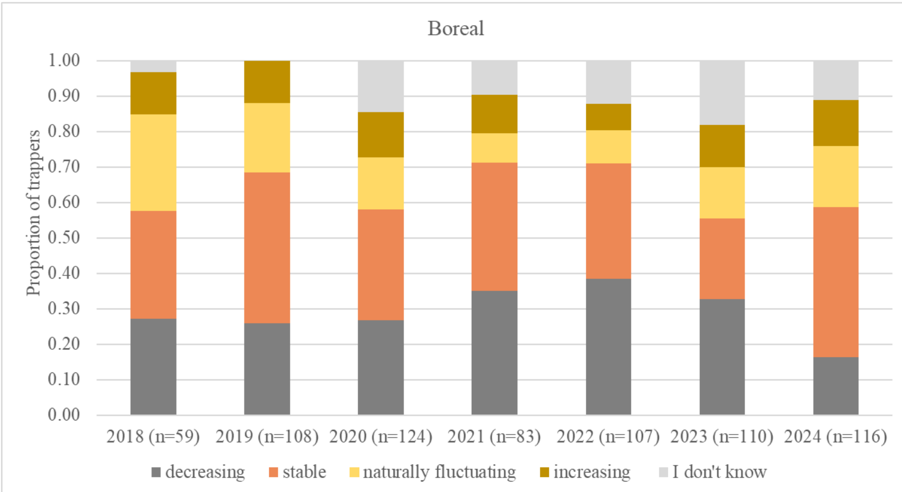


Figure 6. Average marten catch-per-unit effort (CPUE; mean +/- 90% CI) in natural regions (NR) of Alberta from 2018 to 2024. We used a minimum of ten Registered Fur Management Areas (RFMA) per NR to display a bar value for a given year/NR.

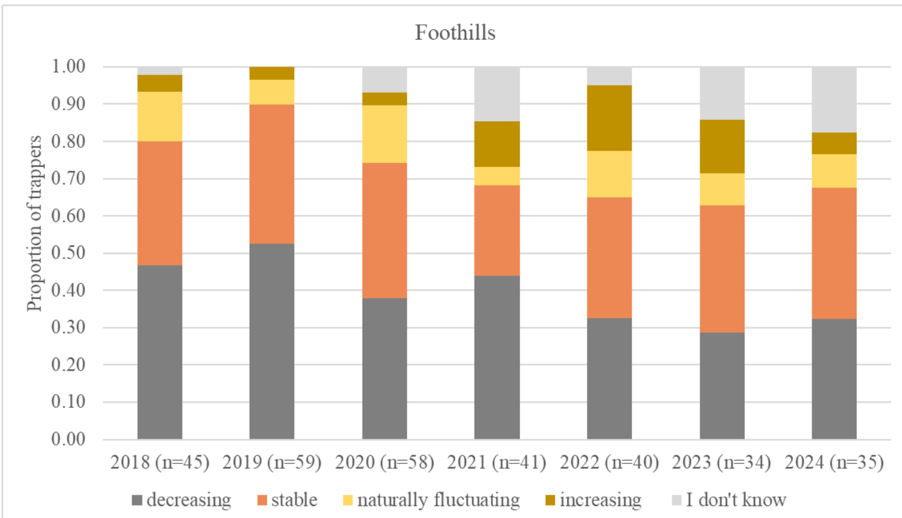
When we tested if year or natural region was associated with differences in marten CPUE in the overall data set (Appendix 3), we found no effect of year by itself (i.e., no significant change over time). Natural region alone did the best job of explaining the pattern in the data, with marten CPUE significantly lower in the Boreal than in the Foothills Natural Region (Appendix 3). Marten CPUE in the Rocky Mountains Natural Region was not significantly different from the Boreal or Foothills natural regions. However, the lack of adequate sample size from the Rocky Mountains Natural Region created a high degree of uncertainty, resulting in no significant difference from either.

Over the seven-year period, marten CPUE in the Boreal Natural Region showed slight changes but remained relatively stable (Figure 6). Trapper perceptions from the boreal matched this harvest-based indicator, with “stable” or “naturally fluctuating” being the dominant sentiment until 2021/22, when nearly an equal proportion of trappers felt the population had been decreasing. Logbooks from 2022/23 had the greatest proportion of trappers reporting that they were unsure about the population trend (Figure 7a); and by 2023/24, a high proportion of trappers from the boreal region felt marten populations were once again “stable.”

Throughout the seven years, CPUE in the Foothills Natural Region showed a general increasing trend until 2023/24 (Figure 6); however, there is high uncertainty around some of those estimates, suggesting that there may have been substantial variability among traplines. At the beginning of the seven-year period, nearly half of the foothills trappers reported that the population had declined in recent years. This negative sentiment generally declined over time, however, while the proportion of trappers who felt unsure tended to grow (Figure 7b). Trappers in the Rocky Mountains Natural Region largely felt the marten population was stable or naturally fluctuating (Figure 7c).



a)



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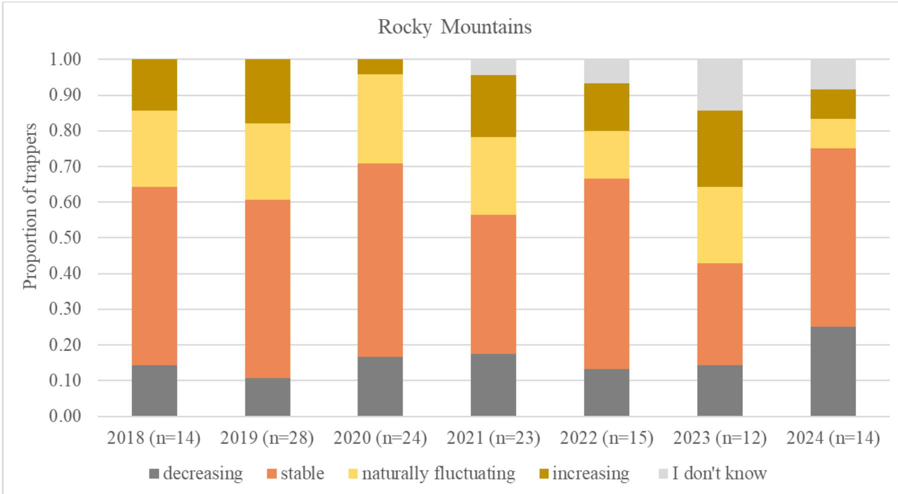


c)

Figure 7. Trapper perception of marten population trend in Alberta's Boreal (a), Foothills (b), and Rocky Mountains (c) natural regions, based on logbook questionnaires between 2018 and 2024.

Subdividing the data further into FMZs reduced our sample sizes and produced less certain results for marten (Figure 8). We combined FMZs 1 & 3 (n = 468 and n = 257 RFMAs in total per FMZ, respectively) and 5 & 6 (n = 101 and n = 57 RFMAs in total per FMZ, respectively) as these are adjacent but smaller zones with fewer RFMAs when compared to FMZ 2 (n = 618 RFMAs in total) and FMZ 4 (n = 514 RFMAs in total). Grouping FMZs 1 & 3 provides representation from the northeastern portion of the Boreal Natural Region, while grouping FMZs 5 & 6 (largely Upper Foothills Subregion) capture Alberta's mountainous areas bordering the National Parks and Continental Divide.

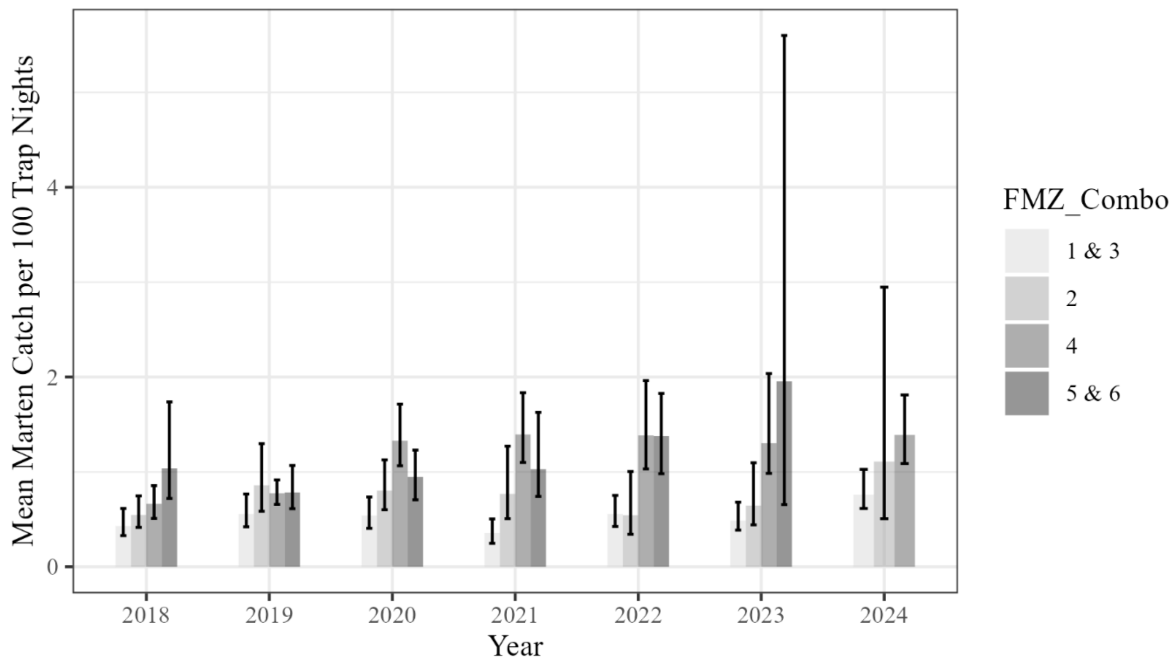


Figure 8. Average marten catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta's Fur Management Zones (FMZ; 1 & 3 and 5 & 6 combined) between 2018 and 2024.

Over the seven-year period, we were not able to achieve an adequate sample size to reach our precision target at the FMZ level; however, some general patterns did emerge. Marten catch in the northeast Boreal (FMZs 1 & 3) remained generally consistent at approximately 0.5 marten per 100 trap nights. CPUE was generally higher in FMZ 2 than FMZ 1 & 3, though not significantly. Likewise, FMZ 4 was typically higher than FMZ 2. The confidence interval for FMZ 4 did not overlap FMZ 1 & 3 from 2020 onward (i.e. CPUE was higher in FMZ 4). The confidence interval surrounding FMZs 5 & 6 was higher than FMZs 1 & 3 in five years, including 2023, which was exceptionally large due to low sample size (n = 11) and one RFMA that experienced a high catch rate with minimal effort. Prior to 2023, this same RFMA resulted in marten CPUEs that aligned with other traplines. Additionally, FMZs 5 & 6 lacked the ten RFMA minimum in 2024.

4.3 Marten gender and age class ratios

Based on trapper identification of harvest age, the seven-year provincial average ratio of juveniles to adult females was 3.0:1 (SE = 0.12). When we separated these ratio data by natural region (Figure 9), the multi-year averages had tight confidence intervals, but the annual data only met our precision target in one instance (boreal traplines in 2019).

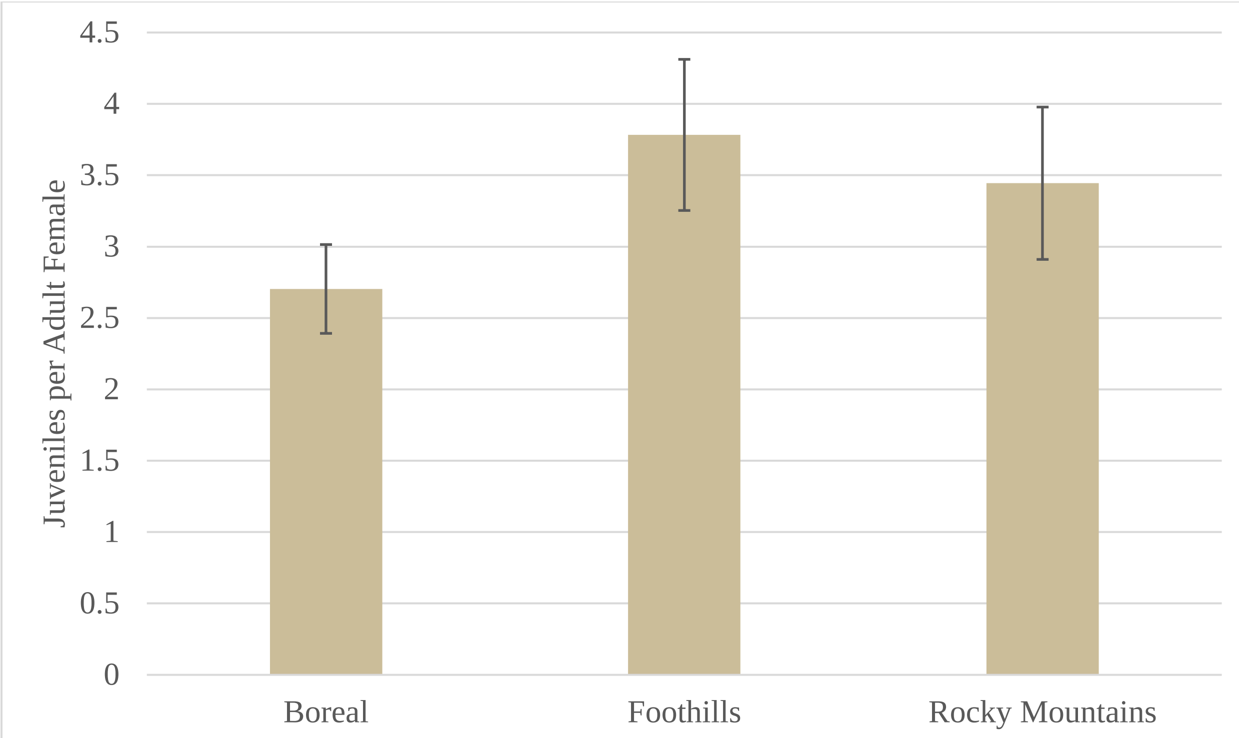


Figure 9. Average number of juvenile marten harvested per adult female in Alberta's natural regions (+/- 90% CI), based on trapper logbook reports between 2018 to 2024.

The Boreal and Foothills natural region ratios in Figure 9 were averaged across seven years; however, the Rocky Mountains ratio was averaged across four, since 2022, 2023, and 2024 were lacking in sample size.

Similarly, the seven-year average number of juvenile marten harvested per one adult female ranged from 2.9 to 3.4 by FMZ and FMZ combination (Figure 10).

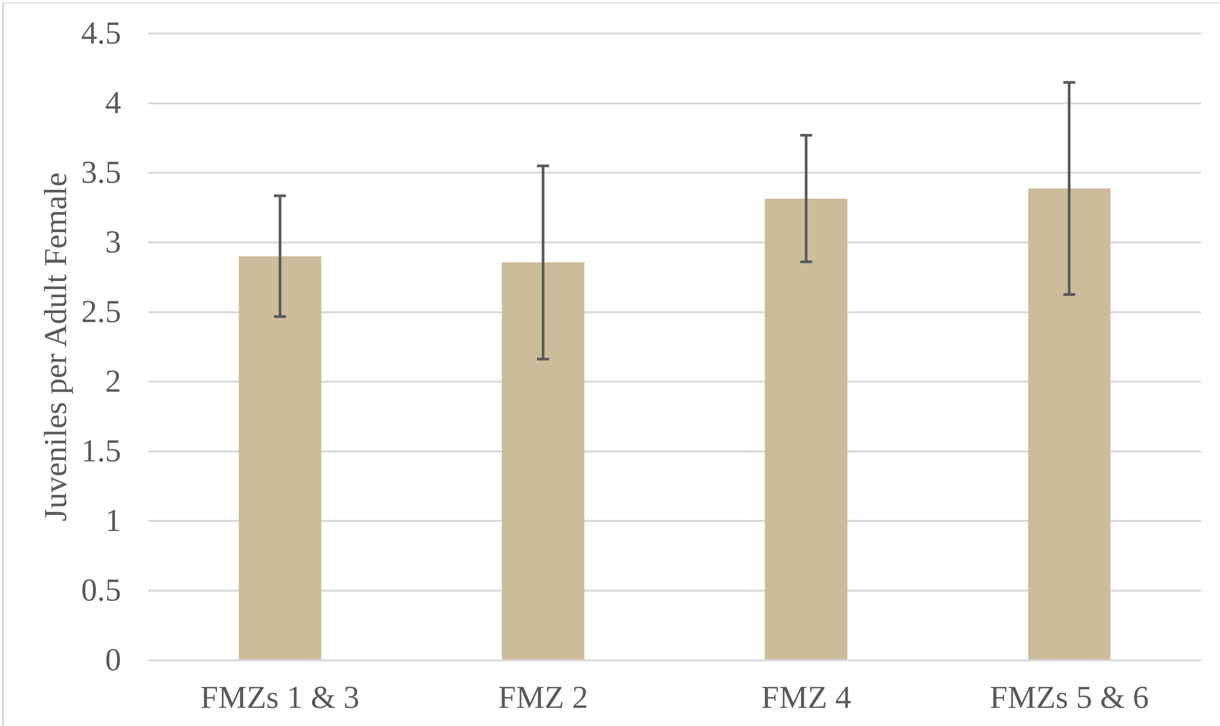


Figure 10. Average number of juvenile marten harvested per adult female in Alberta's Fur Management Zones (FMZ) or FMZ combination (+/- 90% CI), based on trapper logbook reports between 2018 to 2024.

Sixty-four percent of the total marten harvest (all RFMAs and years combined) was male. Averaging yearly ratios pooled across RFMAs and age classes produced a provincial ratio of 1.8 males harvested per 1 female (SE = 0.07). When we divided the harvest into natural region, the male to female ratio was 1.6 (SE = 0.06) for the Boreal Natural Region, 2.0 (SE = 0.11) for the Foothills, and 2.0 (SE = 0.12) for Rocky Mountains. Similarly, the average number of males harvested per female ranged from 1.6 to 2.1 by FMZ: FMZs 1 & 3 (mean=1.7; SE = 0.09), FMZ 2 (mean=1.6; SE = 0.13), FMZ 4 (mean=1.9; SE = 0.08), and FMZs 5 & 6 (mean=2.1; SE = 0.12). Annual Fur Management Zone values generally met precision targets for FMZ 4 and FMZ combination 1 & 3; however, this was inconsistently achieved for FMZ 2 and FMZ combination 5 & 6. Overall, adult male was the most abundant gender/age category (38%) harvested, followed by juvenile male (27%), juvenile female (20%), and adult female (16%), as determined by trapper logbooks.

4.4 Statistical population reconstruction for marten

The number of participating RFMAs varied by zone and year (Table 2) and ranged from a low of three in 2024 (eight when FMZs 5 & 6 were combined) to a high of 65 in 2019. As a result of low sample sizes in FMZs 5 & 6 (Table 2), we combined data from these zones for SPR. FMZs 5 & 6 are adjacent (Figure 11) and host similar habitat on the east slopes of the Rocky Mountains.

Modelled estimates of annual marten abundance varied widely among FMZs in any given year, with higher annual harvest predicting lower annual abundance. Under both the low (harvest rate = 0.10) and high (harvest rate = 0.30) harvest scenarios, estimated marten abundance was highest in FMZ 4, peaking in 2021 at almost double the estimated abundance under the low harvest scenario versus the high harvest scenario for the same year. Fur Management Zone 3 had the lowest estimated marten abundance, and the low harvest scenario consistently had almost triple the estimated abundance using the high harvest scenario.

Estimated marten abundance trends between 2018 and 2024 increased most notably in FMZs 4 and 5 & 6 under both the low and high harvest scenarios (Figure 12). Trends in the other three FMZs were generally more stable under both the low and high harvest scenarios, with FMZs 2 and 3 declining in 2019 and then stabilizing.

Similarly, under both low and high harvest scenarios, estimated harvest rates varied across years and FMZs, with the highest rates in 2019 in all FMZs except FMZ 1. Under the low harvest scenario, the highest harvest rate occurred in 2019 in the combined zone FMZs 5 & 6 while the lowest rates also occurred in that same zone in 2024. Under the high harvest scenario, harvest rates were highest in 2019 in FMZ 2 and lowest in 2024 in the combined zone FMZs 5 & 6.

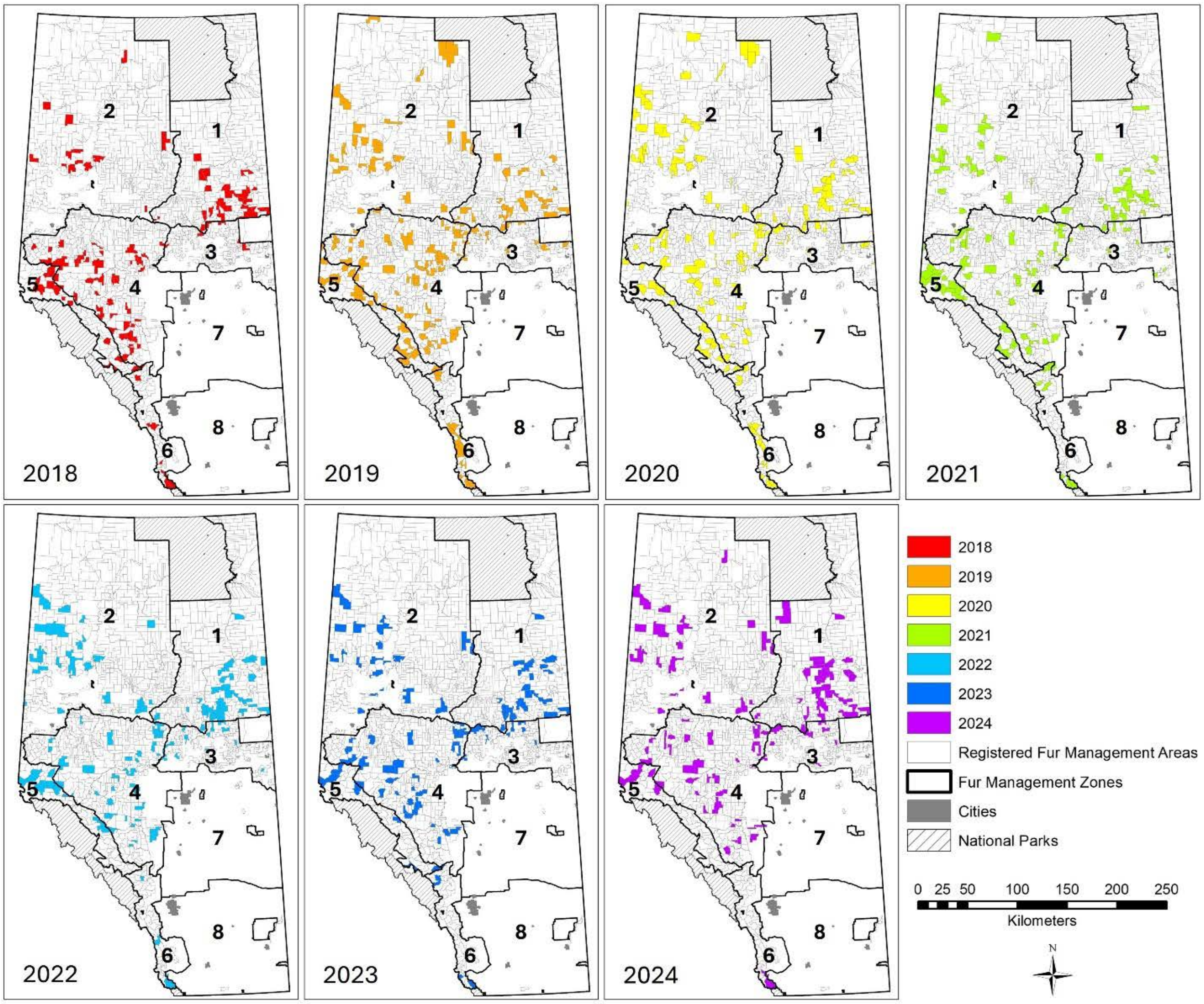
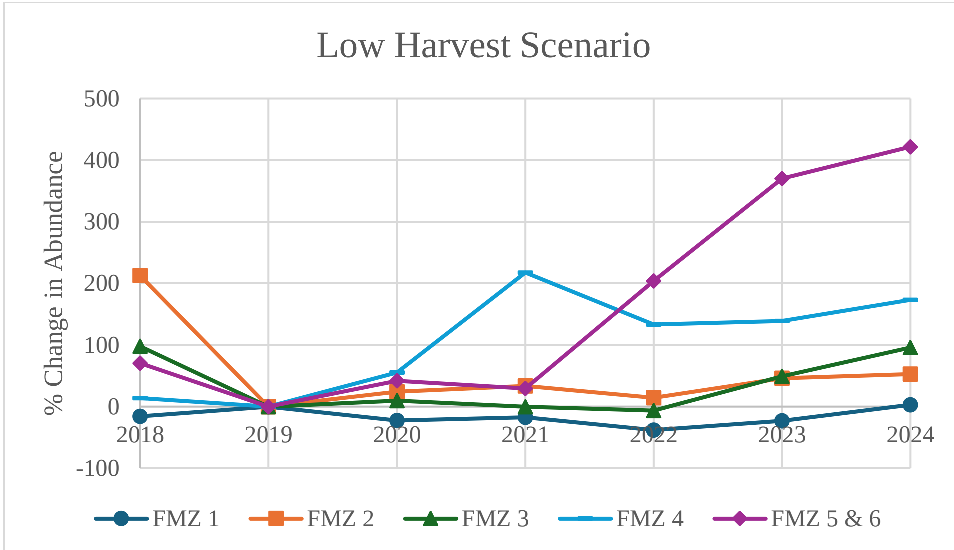
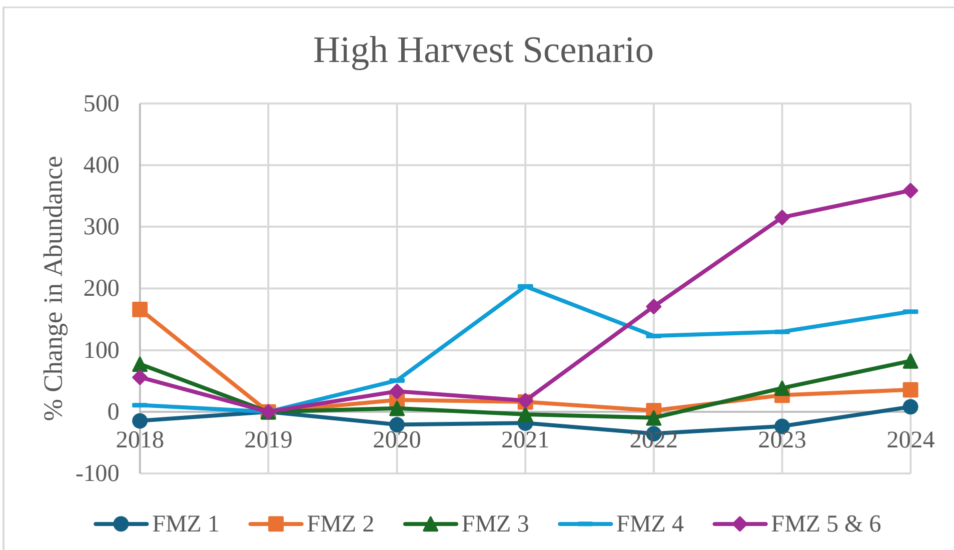


Figure 11. Registered Fur Management Areas submitting trapper logbooks with marten data across Alberta by year. Fur Management Zones (FMZs) and associated numbers are displayed in bold. See Table 2 for sample sizes by year and FMZ.



a)



b)

Figure 12. Percent change in the statistical population reconstruction modelled marten abundance in Alberta Fur Management Zones (FMZ) under the low (0.1) (a) and high (0.3) (b) harvest scenarios. The reference year was set to 2019, which had the largest overall sample size.

4.5 Quota species

Through logbook comments and follow-up meetings, trappers expressed their interest in providing multi-species information; therefore, from 2019/20 onward, the information collected within logbooks also included lynx, fisher, otter, and wolverine in addition to marten.

4.5.1 Lynx

Naturally, lynx are not as abundant or widespread as marten and we predicted it would be a challenge to attain a sample size large enough to gain robust estimates of CPUE within each FMZ. Nonetheless, the number of annual logbooks that contained lynx data was encouraging (5-yr average, n = 112). Of the 564 RFMAs that set traps for lynx over the five years, 440 reported harvesting at least one lynx, with an average of four lynx per trapline. Many RFMAs were repeat participants each year for all quota species. The lynx quota (during the timeframe of this study) is variable among RFMAs ranging from three to 12 lynx per RFMA. While large traplines, those in excess of two townships in size, can harvest an additional one to five lynx for each added township. The 5-year average number of lynx traps set was 21 traps for 43 days. On average, trappers reported that approximately 2% of the total lynx catch was unintentional. Based on logbook data, CPUE has gradually declined since 2020 (Figure 13).

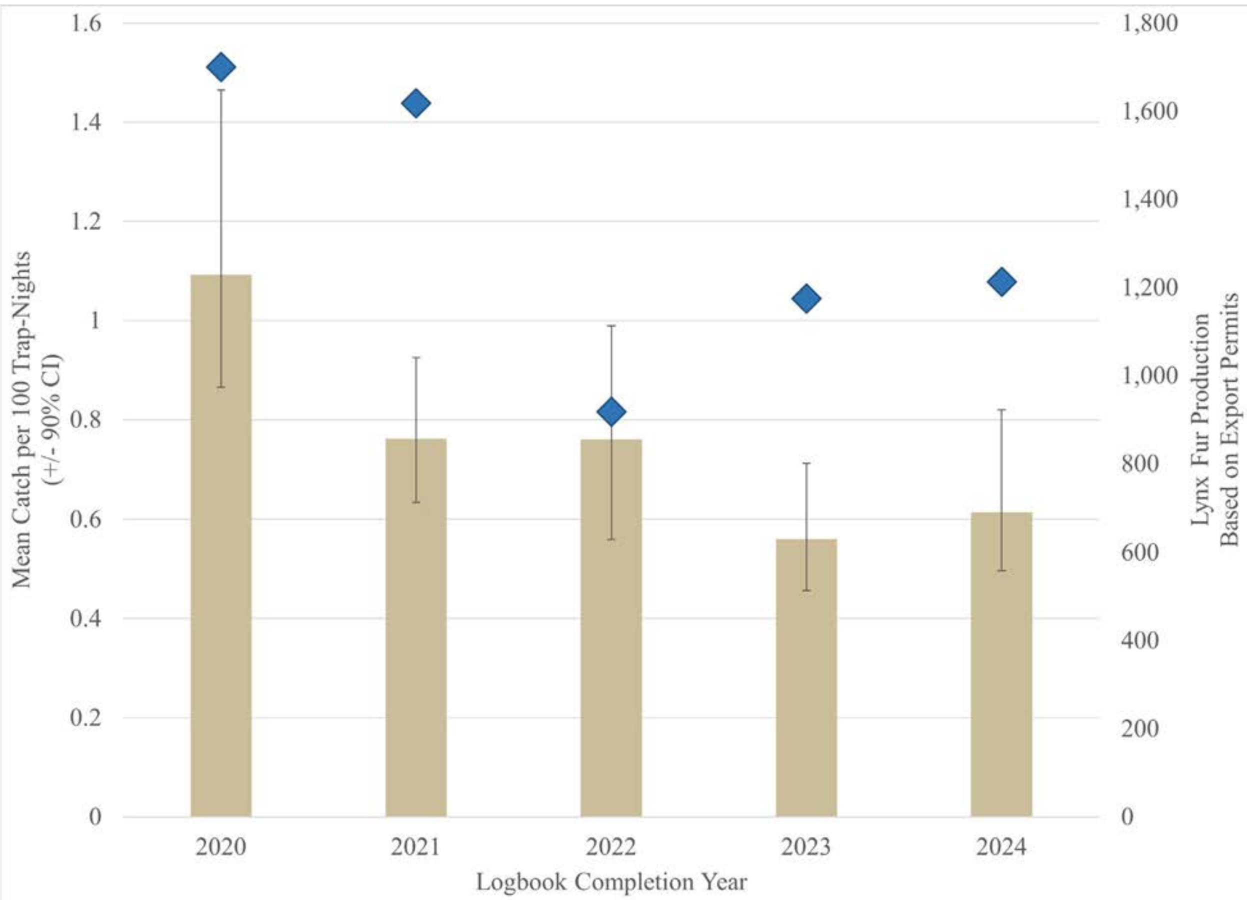


Figure 13. Lynx fur production in Alberta (blue diamonds; GoA 2024b) has fluctuated while trapping catch-per-unit effort (CPUE; beige bars, +/- 90% CI) has declined between 2020 and 2024.

On average, it took about 132 trap nights to harvest one lynx over the 5-year period (5-year mean CPUE of 0.76, SE 0.09). Our aim of achieving a 90% CI was not consistently met for lynx at any of the scales examined; however, we did approach our target for the Boreal Natural Region from 2021 onward (Figure 14).

Most trappers perceived lynx as being common (53%, 5-year average) on their RFMAs, while 42% felt the population was stable. However, over the five years, the number of trappers perceiving a decline in the population increased. In the Boreal region, 7, 12, 25, 26, and 25% of trappers sensed the lynx population was decreasing from 2020 to 2024, respectively. Similarly, over the same period, an increasing proportion of trappers in the Foothills expressed the opinion that lynx were on the decline until 2023 (5, 27, 36, 21, and 11%, respectively).

Similar to trapper opinion in the Boreal, there was a pattern of decreasing lynx CPUE for the Boreal Natural Region between 2020 and 2024; however, contrary to trapper opinion, there has been no detected change in CPUE in the Foothills Natural Region (Figure 14). We were not able to parse out and compare lynx CPUE for the Rocky Mountains Natural Region due to the low number of logbooks returned four out of five years (minimum requirement of ten RFMAs).

Lynx catch rate in the northeast Boreal (FMZs 1 & 3) showed a generally declining pattern between 2021 and 2024, while northwest Boreal (FMZ 2) showed a more substantial decrease between 2020 and 2024 (Figure 15). In contrast, CPUE in FMZ 4 (Lower Foothills) remained relatively consistent among years, but with considerable uncertainty around the estimate. We struggled to maintain adequate sample size for FMZs 5 & 6 (Upper Foothills) after 2020.

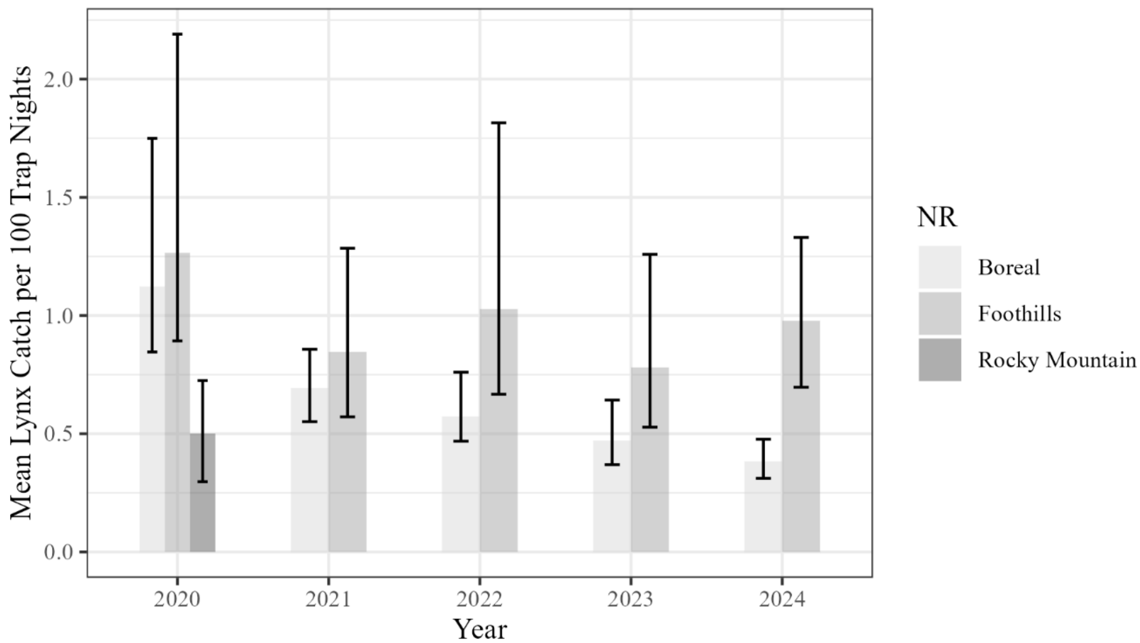


Figure 14. Average lynx catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta's Natural Regions (NR) between 2020 and 2024. We set a minimum of ten Registered Fur Management Areas (RFMAs) per NR to display a bar value for a given year/NR.

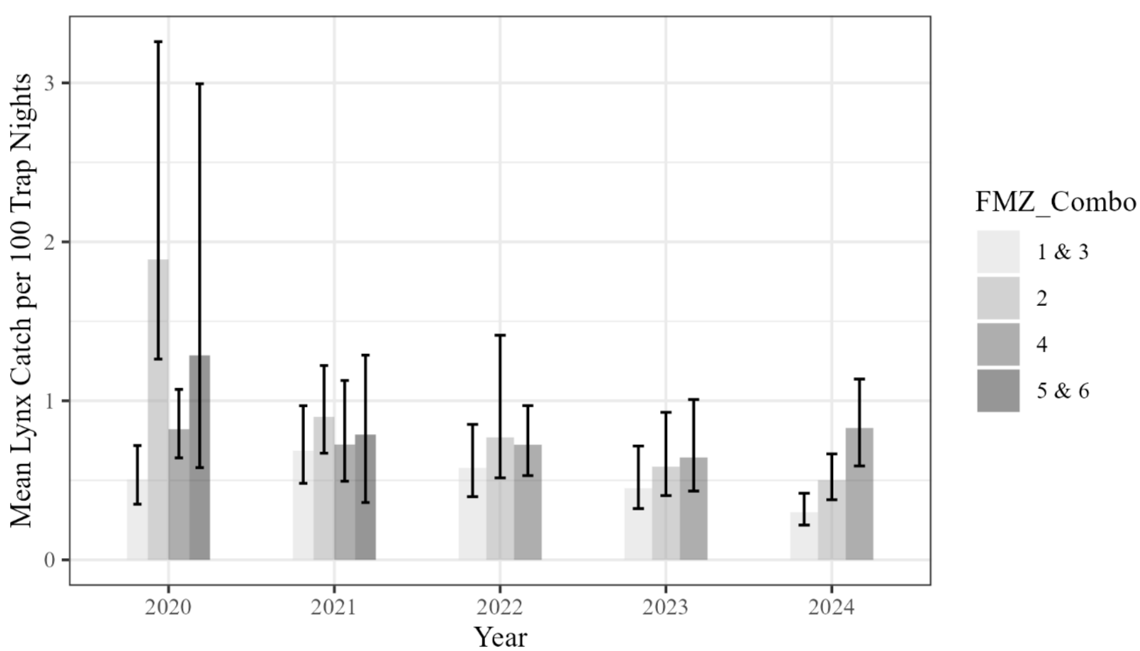


Figure 15. Average lynx catch-per-unit effort (CPUE; mean +/- 90% CI) in each Fur Management Zone (FMZ; 1 & 3, and 5 & 6 combined) between 2020 to 2024. FMZs 5 & 6 did not have the minimum ten Registered Fur Management Areas (RFMAs) 2022 to 2024.

Classifying lynx harvest into age class was initiated in 2022/23 and carried on annually thereafter. The two-year provincial average juvenile lynx to adult female ratio produced 1.4 juveniles per 1 female (SE = 0.09); however, the within-year uncertainty was substantial (approx. +/- 30%). When we separated the data by natural region or FMZ, within-year uncertainty in the estimate increased even further to between +/- 40% and +/- 80%. As such, we have not reported those values here but will do so if the sample of annual logbook submissions per region increases.

Fifty-nine percent of the total lynx harvest (all RFMAs and years combined) was male. Averaging yearly ratios that pooled across RFMAs and age classes produced a provincial ratio of 1.5 males harvested per 1 female (SE = 0.05). When we divided the harvest into natural region, annual estimates had good precision in the Boreal Natural Region, where the average male to female lynx ratio was 1.5 (SE = 0.07) over the five years. Annual estimates for the Foothills Natural Region were less precise (approx. +/- 33%) and produced a five-year average of 1.4 males per female (SE = 0.08). The Rocky Mountains Natural Region only met the ten RFMA minimum requirement in one year, producing a highly uncertain estimate (+/- 94%). Fur Management Zone 2 met the precision target in 2020 and came close in 2021 and 2022 (+/- 22%); estimates were less precise in 2023 and 2024 (approx.+/- 35%). The five-year average male to female ratio for FMZ 2 was 1.5 (SE = 0.18). Annual estimates for FMZs 1 & 3 were less precise overall (+/- 26% to +/- 32%) but also produced an average of 1.5 (SE = 0.05). Even less precise were the estimates for FMZ 4 (approx. +/- 31%), producing a multi-year mean of 1.4 (SE = 0.09). FMZs 5 & 6 were lacking in sample size.

4.5.2 Fisher

Of the 455 logbooks that reported setting traps for fisher over the 5-years, 331 reported harvesting at least one fisher, with an average of two fisher harvested per trapline within a given year. Harvest quotas range from one to ten fisher per RFMA and large traplines can harvest an additional one to four fisher for each added township. The 5-year average of those trappers targeting fisher set 23 traps for 51 days, with 7% of the total fisher catch being unintentional. Fisher CPUE and fur production have fluctuated since 2020 (Figure 16). However, at no point did the annual CPUE estimates reach our precision target, making it difficult to interpret year-to-year variation.

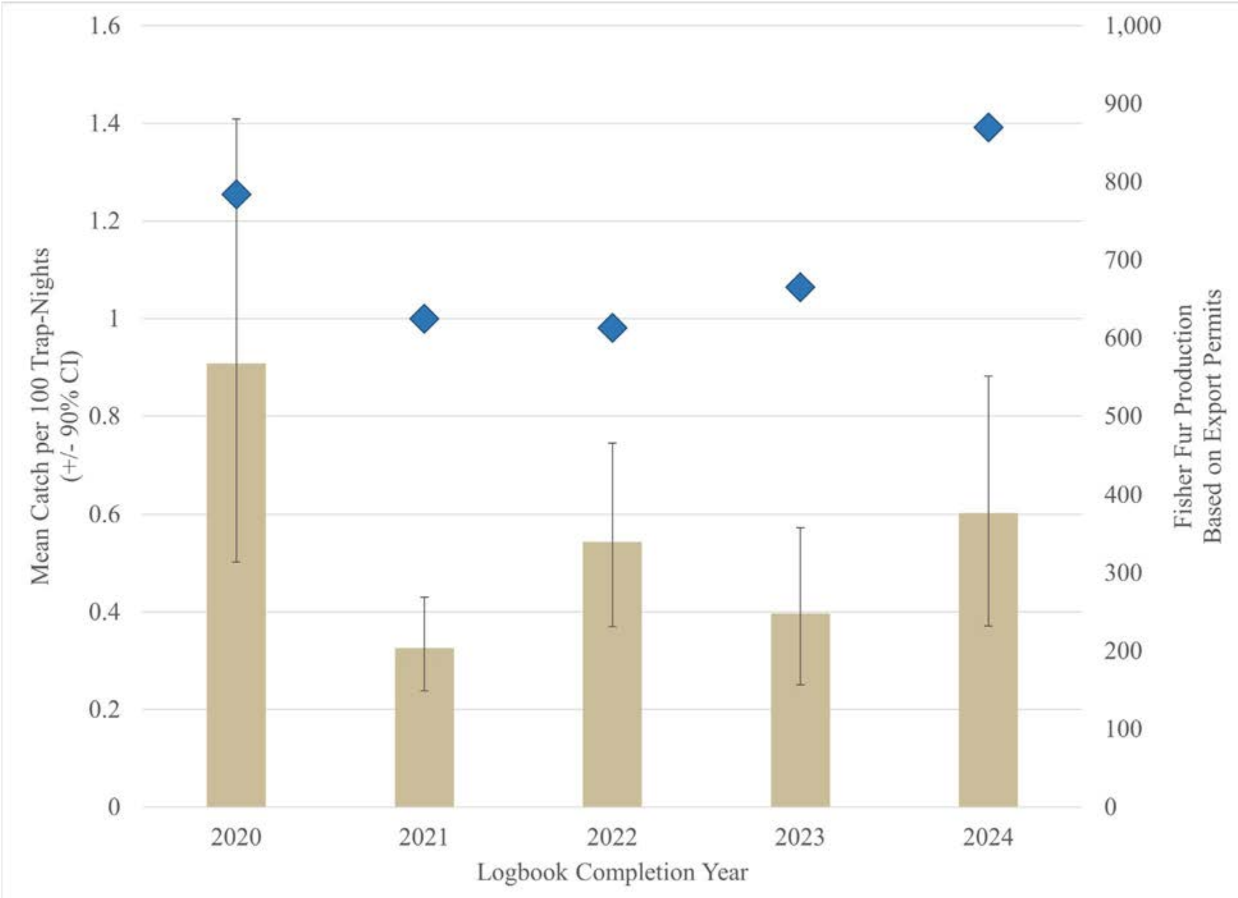


Figure 16. Fisher fur production in Alberta (blue diamonds; GoA 2024b) and catch-per-unit effort (CPUE; beige bars, +/- 90% CI) have fluctuated between 2020 and 2024.

On average, it took about 180 trap nights for each fisher harvest (5-year mean CPUE of 0.56, SE = 0.10). That would be the equivalent of setting 26 traps for approximately a week and catching one fisher. The level of precision in annual estimates for fisher CPUE was poor at all levels. (Figures 17, 18).

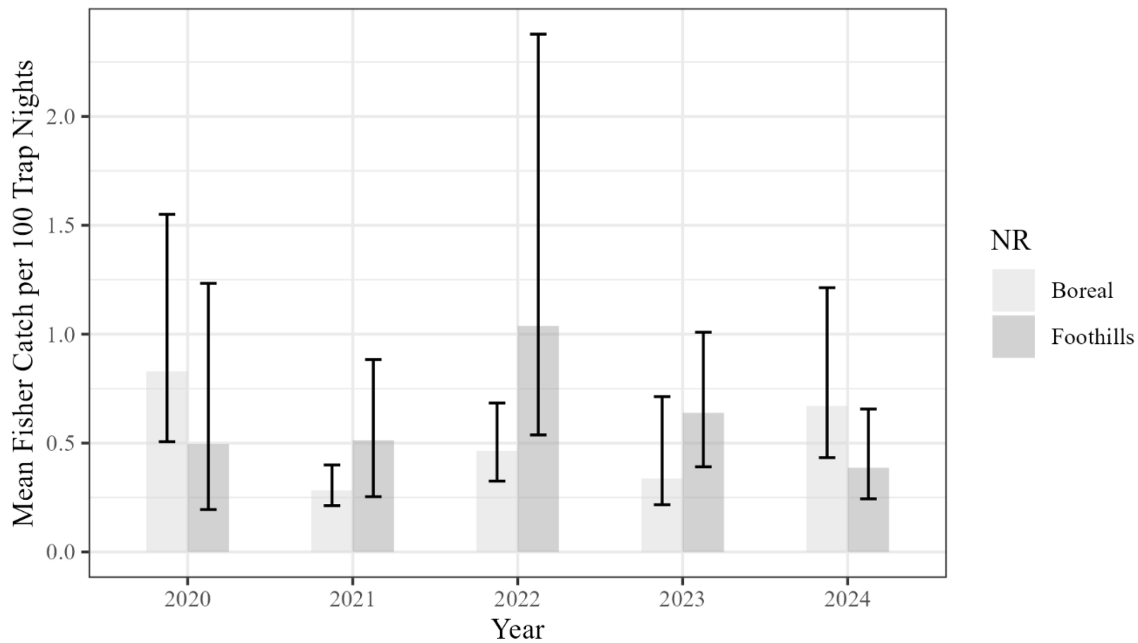


Figure 17. Average fisher catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta's Natural Regions (NR) between 2020 to 2024. Note: The Rocky Mountains NR has no fisher trapping season.

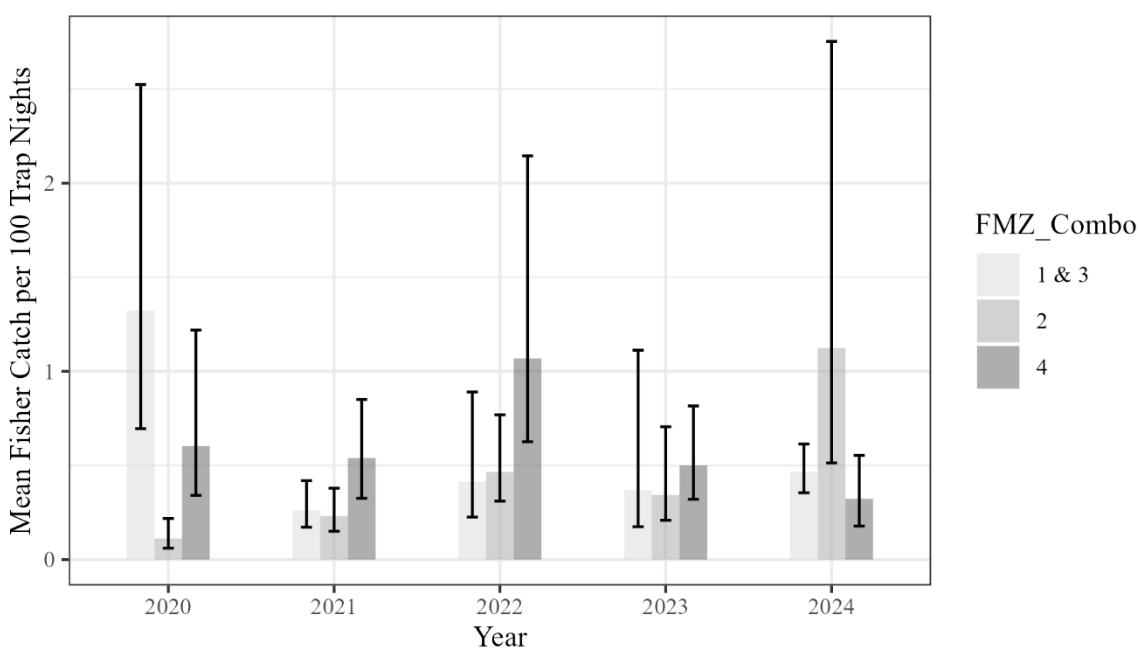


Figure 18. Average fisher catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta's Fur Management Zones (FMZ; 1 & 3 combined) between 2020 to 2024. Note: FMZs 5 & 6 has no fisher trapping season.

The two-year provincial average ratio of juvenile to adult females was 1.4 (SE = 0.11); however, there was substantial uncertainty in the annual estimates (approx. +/- 43%). Separating the data by natural region and FMZ produced even less precision (+/- 44% to +/- 87%), so those estimates have not been presented here.

Fifty-eight percent of the total fisher harvest (all RFMAs and years combined) was male. We pooled yearly ratios across RFMAs and age classes for a provincial ratio of 1.4 males harvested per 1 female (SE = 0.05). When we divided the harvest into natural region, the male to female fisher ratio was 1.4 males (SE = 0.07) per female for the Boreal Forest Natural Region, where annual precision was moderate (approx. +/- 27%). Precision was poor for the Foothills Natural Region (approx. +/- 70%), where we did not meet the ten RFMA minimum in all years. Annual estimates for FMZ values were likewise poor (averaging +/- 49%), so have not been presented here.

4.5.3 Otter and wolverine

Sample sizes for otter and wolverine are low and likely will remain that way as they are not as widespread or numerous. A total of 207 RFMAs reported setting traps for otter over the 5-years with an average of one otter harvested per trapline (1.9 males:1 female). Otter quotas range from one to ten otter per RFMA and large traplines can harvest an additional one to three otter for each added township. The average number of otter traps set was five traps for 35 days. On average, 2% of the total otter catch was unintentional. Otter CPUE and associated error estimates have fluctuated since 2020 (Figure 19). At no point have precision targets been met.

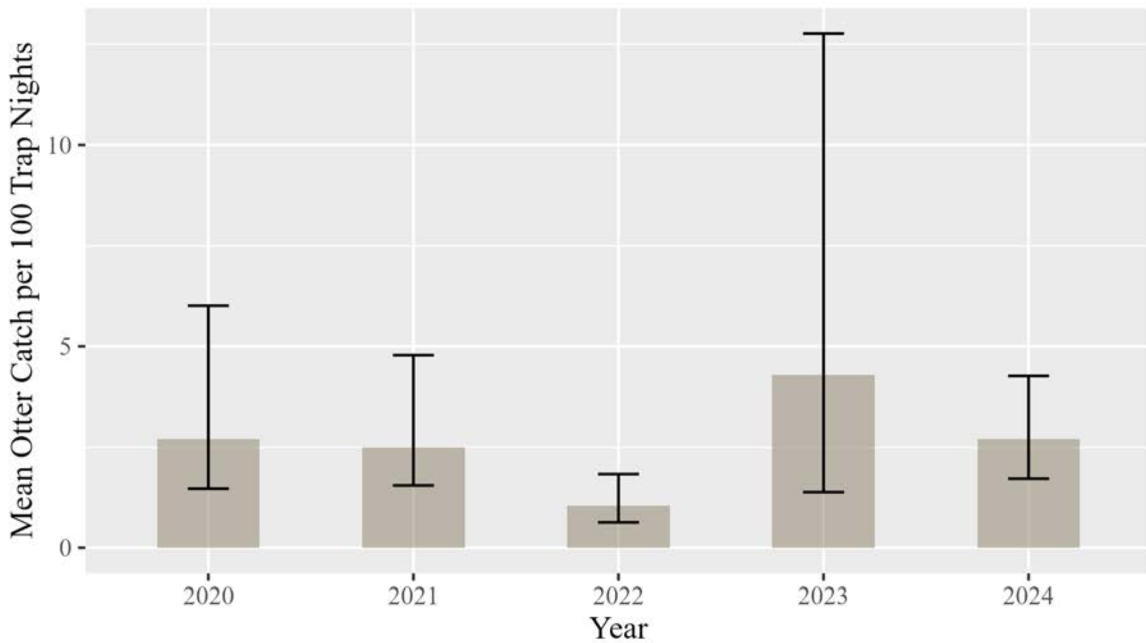


Figure 19. Otter trapping catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta has fluctuated between 2020 and 2024.

More than 50% of the trappers that actively trapped for otter felt they were common with stable interannual numbers on their RFMAs. In all, 77% of those trapping otter are from the Boreal Natural Region. There is no otter season in FMZs 5 & 6.

A total of 152 RFMAs reported setting traps for wolverine over the 5-years (average of 30 logbook participants each year) with an average of one wolverine harvested per trapline (1.5 males:1 female). The quota for wolverine during the five-year period was one per season per RFMA. An individual trapper may own more than one RFMA. The average number of wolverine traps set was seven traps for 46 days. On average, 34% of the total wolverine catch was unintentional. Wolverine CPUE and associated error estimates have fluctuated since 2020 (Figure 20). Interpreting these results is difficult, as none of the spatial scales examined met our precision targets.

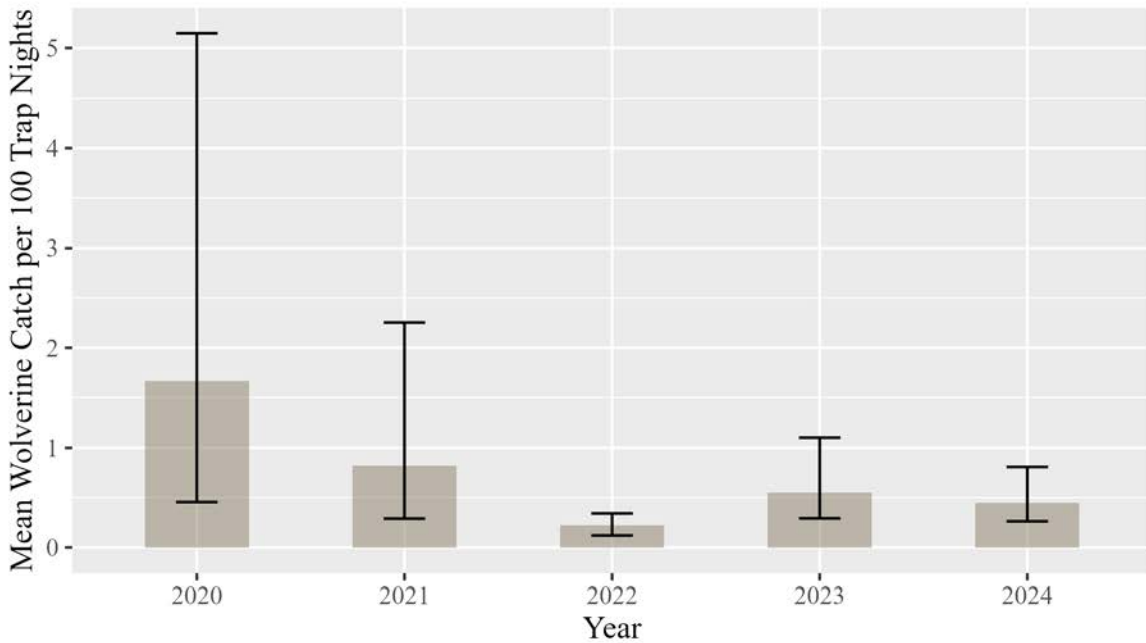


Figure 20. Wolverine trapping catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta between 2020 and 2024.

Nearly 50% of the trappers that actively trapped for wolverine felt they are common and stable on their RFMAs. Most logbook participants harvesting a wolverine are from the Boreal Natural Region (84% in 2020, 78% in 2021, 89% in 2022, 100% in 2023, and 75% in 2024). An average of about 170 otter pelts and 66 wolverine pelts were taken each year in Alberta, based on export permits from 2019/20 to 2023/24 (GoA 2024b).

4.6 Wolf management program

In 2021/22, trappers began including wolf harvest in logbooks. The proportion of logbook participants that were part of the wolf management program increased with each year, from 53% in 2022, to 64% in 2023, and 66% in 2024. Trappers are required to complete logbook entries to participate in the wolf management program. A total of 297 RFMAs participating in the wolf management program reported setting traps for wolves, with an average of one wolf harvested per trapline (1.3 males:1 female). Most of these logbooks represent repeat RFMA participants each year. On average, trappers set up at three bait sites for a total of 50 traps for 96 days. Wolf CPUE remained relatively constant at the provincial level (Figure 21). Despite low precision, CPUE did increase over the three years in the Foothills Natural region, going from 0.041 (CI = 0.022–0.060) to 0.160 (CI = 0.069–0.265). We did not detect an obvious trend in the Boreal or Rocky Mountains wolf CPUE data.

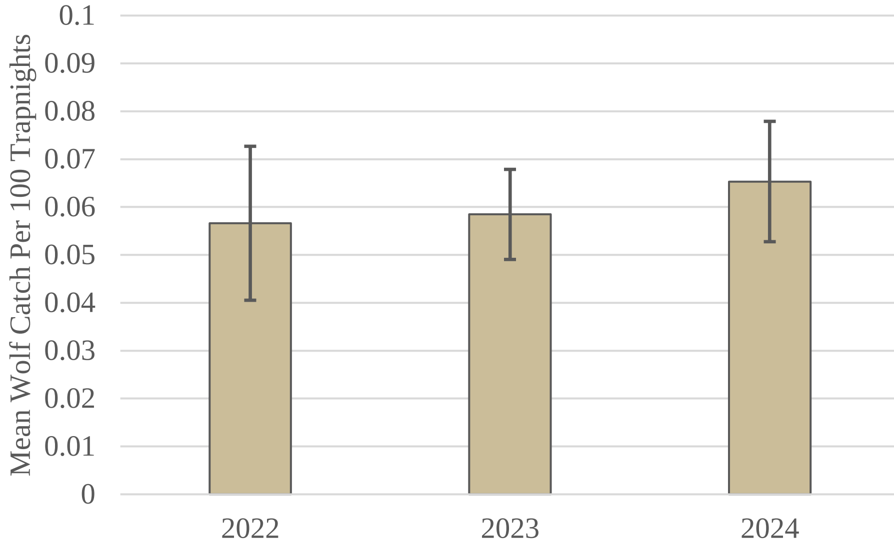


Figure 21. Wolf trapping catch-per-unit effort (CPUE; mean +/- 90% CI) in Alberta has remained stable between 2022 and 2024.

Most trappers aged their catch using body size, identifying 39% as adult male, 17% juvenile male, 27% adult female, and 15% juvenile female. A total of 411 wolves were harvested over the 3-year period, with harvest coming from 64 percent of participants. Wolves were perceived as being scarce by 63% of participants and perceived to be on the decline by 50%.

In addition, an average of 35 RFMAs who were not part of the wolf management program (outside of the Caribou Recovery Zone) spent time and effort trapping wolves each year over the three-year period. In total, 64% of these trappers harvested 211 wolves over three years, and roughly 54% felt wolves were both common and stable on their RFMAs.

4.7 Additional local ecological knowledge

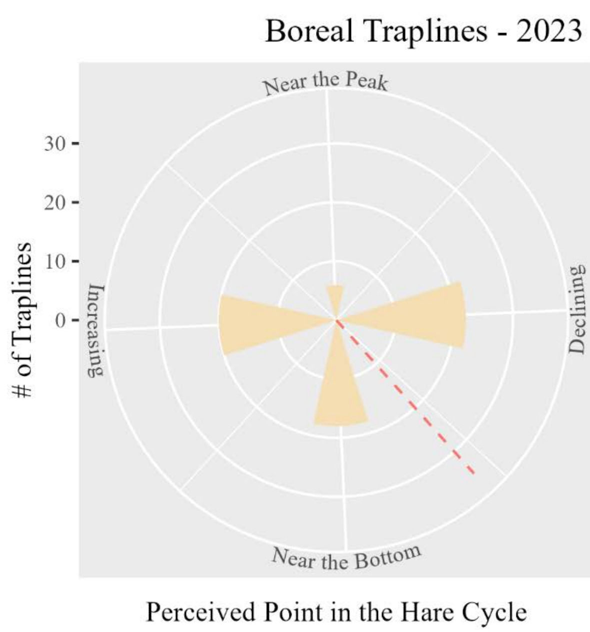
4.7.1 Forest grouse

A total of 131 RFMA holders provided forest grouse data while submitting their furbearer logbook in 2020/21. The majority of RFMAs had both ruffed and spruce grouse occupying them, and in many cases, other species of grouse. Sharp-tailed grouse occupied 27% of the RFMAs, while ptarmigan occupied 15%. Spruce grouse were most often associated with black spruce (30%), mixedwood (28%), and white spruce (19%) stands in the 20- to 50-year age class.

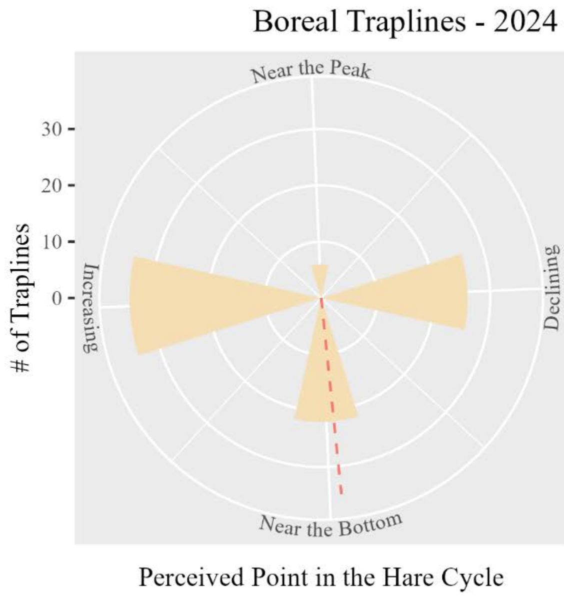
Almost half (48%) of the survey respondents believed that the three-year trend from 2018 to 2020 held stable for forest grouse, while 29% believed numbers were decreasing. Of those who suspected a decline in grouse numbers between 2018 and 2020, roughly 22% speculated that this may be associated with cool and wet springs, 16% linked the decline to forest harvest practices, 13% to hunter harvest, and 12% to unusually high predation. Trappers with RFMAs in the Fox Creek, Edson, Whitecourt, and Swan Hills regions (areas with high spruce grouse hunter harvest and effort, as determined by provincial hunter harvest reports) identified forest harvest, herbicide spraying associated with forest harvest, and hunter harvest as the primary factors believed to impact grouse populations there.

4.7.2 Snowshoe hare

In 2022/23 and 2023/24, we incorporated a local knowledge question to the logbook asking trappers at what stage they feel the snowshoe hare cycle is in on their RFMA. We expected to see the strongest hare cycle for traplines in the Boreal Natural Region and for the timing to vary somewhat across the province (Krebs et al. 2018). Although logbooks did report variation among traplines, on average trappers in the Boreal perceived that hare numbers had been in the decline phase (Figure 22a) and were near the bottom of the cycle (Figure 22b).



a)



b)

Figure 22. Trapper perception of the snowshoe hare cycle on Boreal traplines in 2023 (a), and 2024 (b). The dashed line is the circular mean. The cones represent the number of trappers that reported each cycle phase (i.e., a larger cone represents more traplines).

Additional years of snowshoe hare cycle information will be compared to lynx CPUE over time to determine whether there is a correlation between the two data types.

5.0 DISCUSSION

The voluntary logbook program captures valuable data from a dedicated group of active ATA members; as such, this sample may not accurately reflect trapping effort across all registered traplines in Alberta. Trapping activity peaked each year during December when the ground is frozen providing reasonable trapline access and most pelts reach prime condition (November to February for most furbearers; GoA 2024b). Throughout much of Alberta, and in the Boreal in particular, trapline access is often restricted until waterways are frozen and snow cover is adequate for snowmobile travel. Overall, winter access is often occurring later in the season now due to milder starts to the winter season.

Based on logbook data between 2018 and 2024, the average number of total hours trappers spent per year on their traplines has remained stable or increased, while fur prices dropped significantly from 2018 to 2020 for marten, lynx, fisher, and otter (77%, 52%, 70%, and 49% price decreases, respectively). Wolverine prices have continually increased since 2018, and marten, lynx, fisher, otter, and wolf pelt prices are now higher than prices in 2018. We do not know if the activity of other trappers (i.e., those who did not participate in the logbook project) changed over this period, but other jurisdictions have observed declines in the number of active trappers with decreasing fur price (Ahlers et al. 2016, Bauder et al. 2020). However, it has also been suggested that some contemporary trappers may remain active through periods of low fur prices primarily for non-economic reasons (Bauder et al. 2020). If ATA logbook participants represent this more dedicated group of trappers who continue putting in effort even as price declines, their data may provide a more accurate reflection of the underlying furbearer population than the general harvest numbers, particularly when indexed for trapper effort.

5.1 Marten harvest sustainability and habitat use

The level of precision for marten population trend monitoring at the provincial scale using logbook CPUE data generally met standard wildlife monitoring objectives (+/- 20% at a 90% confidence interval). However, due to sample size limitations (i.e., not enough logbooks submitted) in many cases, the variation associated with dividing the CPUE data into natural regions and FMZs often produced a lower level of precision than allows us to present estimates within these confidence intervals. Annual results for the Boreal Natural Region failed to meet our precision target but were always close, suggesting that a modest increase in the sample of annual logbook submissions may produce a robust data set. Roughly half as many logbooks coming from the Foothills Natural Region produced more variable data, which means that only large changes in CPUE may be detectable. With half again as many (or less) logbooks producing marten data from the Rocky Mountains Natural Region, uncertainty in those estimates was high and the region failed to meet the ten RFMA minimum after 2021. In the future, tracking marten trends within the Boreal Natural Region holds substantial promise for attaining rigorous CPUE estimates, while achieving the same for the Foothills and Rocky Mountains will require a significant increase in participation from trappers in those areas. We assume that this is possible, however, as Foothills participation and precision nearly hit the target in 2019.

To this point, we have not detected trends in marten harvest that cause concern for population sustainability. On its own, a decline of 55% in the provincial marten fur production index from 2017/18 to 2021/22 could have been worrying; however, our estimate of catch per 100 trap nights did not decline over that same period, suggesting that factors beyond population size may have resulted in the declining number of exported pelts. Indeed, the annual CPUE appears to have increased during this same period (Figure 5). This demonstrates the value of tracking effort over the long term as export data alone may be a poor indicator of marten population trend. Anecdotal information from individuals at small scales can also be misleading. We noticed this when localized perceptions of marten population trends were not always in sync with insights from the more structured and spatially extensive logbook data.

When we initially became involved with the logbook initiative, several trappers in the Foothills shared their concerns about the marten population. We heard of concern from several government biologists as well, and discussions had begun about initiating a quota for marten. Since that time, average CPUE in Foothills traplines has increased and the proportion of trappers perceiving a declining population has decreased. Without a longer-term data set, it is difficult to know which of the endpoint CPUE values (0.72 in 2017/18 or 1.91 in 2022/23) is more reflective of the typical condition for Foothills trappers, and whether the population naturally cycles between these two conditions (and beyond). It is worth noting that variation among RFMAs is substantial, suggesting that trappers may experience a very different trapping reality from one trapline to another. It is only by pulling all the individual trapline datapoints together that we can get a sense of the overall population trend.

Using province-wide catch rates to identify marten abundance over their geographic range is valuable but may overlook important subpopulation conditions and trends. When we tested if year or natural region could help to explain the variation in catch rate data, we found that year did not appear to have an effect, suggesting no overall directional change in the population between 2018 and 2024. In contrast, trappers in the Boreal region had significantly lower catch rates (0.64, 7-year average) when compared to trappers in the Foothills (1.29, 7-year average). Although not significantly different as a result of the uncertainty around the Rocky Mountain estimates, the Boreal had lower marten catch rates when compared to the Rocky Mountains (1.34, 7-year average). This raises the question of whether habitat productivity may vary among these geographic areas. Marten habitat has often been associated with mature conifer forest (Takats et al. 1999), which is commonly found in the Foothills and Rocky Mountains natural regions. However, logbook participants in the Boreal Natural Region have indicated that they often catch marten in mixedwood forest stands, shrubby areas, and black spruce bogs. A camera-trap research project conducted by ATA and ACA to collect data on wolverines in the Boreal Natural Region found that marten were less likely to visit a camera site as the amount of conifer in the surrounding forest increased (manuscript in review). This all suggests that marten in the Boreal may be using different habitats than those in the Foothills and most likely in the Rocky Mountains as well. Further research would be required to determine if population densities and/or productivity vary among these habitats.

A harvest ratio of three juveniles to one adult female has been a recommendation by some as an indicator for sustainable marten harvest (Strickland and Douglas 1987). These data for 2018–2024 indicate an overall provincial average of three juveniles harvested per one adult female. Other authors have argued that this ratio is not always a dependable method for determining a sustainable harvest level because of local variation in prey, harvest history, and population composition (Strickland 1994, Fortin and Cantin 2004). Fortin and Cantin (2004) suggest that the male to female harvest ratio is a more consistent indicator of a sustainable population than the juvenile to adult female ratio. They proposed that maintaining a sex ratio of 1.5 males per 1 female or higher may prevent overharvest. The provincial average from these data over seven years was 1.8 males harvested per 1 female. Both the age class and sex ratios of marten harvest in Alberta fall within the recommended values for sustainable harvest levels.

5.2 Marten population trend - Statistical population reconstruction

Although SPR can be used with as little as four consecutive years of data, the precision and bias of the estimates improves as additional years of data are added (Clawson et al. 2017a). In particular, the impact of additional years of harvest and effort data is most pronounced in scenarios with low quality auxiliary data (Clawson et al. 2017a). Clawson et al. (2017a) further note that within the first ten years of data collection, the precision of abundance estimates depends more on the quality of auxiliary data rather than the number of years of harvest data. Because empirical auxiliary data are not available for marten in Alberta, additional years of harvest and effort data will likely be particularly important for refining abundance estimates for marten.

While the trends in marten abundance over the seven years of sampling did not change between the low vs. high harvest scenarios, the magnitude of our abundance estimates did vary widely, highlighting the importance of accurate auxiliary data. We relied on the published literature for estimates of both annual harvest and natural survival metrics and used both as auxiliary data to parametrize SPR models. Even so, the PopRecon platform requires only one source of auxiliary data to operate. Survival estimates for cryptic species such as marten are logistically challenging to obtain and generally come from extensive efforts using radio collars on a representative sample of the population (Millspaugh and Marzluff 2001). Any future work on Alberta's marten population might consider estimating natural survival using tagged animals and ideally parsing out survival by sex and age class (i.e., adult vs juvenile). When comparing model precision between types of auxiliary data Clawson et al. (2017a) found that survival metrics outperformed that from auxiliary harvest data in simulation runs for estimating abundance. While survival data for furbearers is challenging and costly, they would help gain accuracy for SPR predictions of abundance. GPS collars could also be used to investigate other questions such as habitat use and response to disturbance (e.g., Viau et al. 2024). In the absence of empirical auxiliary data, it is likely prudent to consider different levels of harvest as well as survival as auxiliary data, and to focus on modelled trends in abundance rather than absolute numbers. Alternatively, methods of conducting SPR that rely less on auxiliary data (e.g., Bellier et al. 2024) may be worth exploring.

Marten trapping success likely varies widely across the province. For example, Webb and Boyce (2009) found strong relationships between industrial activity, forest cover, and marten trapping success in west-central Alberta. Trapping success was lower in areas with increased industrial activity and greater amounts of open cover (Webb and Boyce 2009). Similarly, population abundance and density would be expected to vary based on habitats. SPR is designed to estimate yearly abundance of harvested species and thereby identify trends in abundance. If spatially explicit density estimates are required, a different methodological approach is likely needed (Efford and Fewster 2012).

SPR models rely on trapper-reported harvest data including a reasonable measure of effort associated with that harvest. Maintaining participation over the years can be a challenge for citizen-collected data (Fraisl et al. 2022). We noticed that participation waned in FMZs 5 & 6 during the last few years of this seven-year study and as such, the data from those zones were combined due to the lower number of logbooks submitted. Continuing to effectively engage trappers in the collection of harvest, age, and effort data is important for collecting enough logbooks in each FMZ to track the population trend of marten among these zones. With year over year submissions of logbook data, SPR models have the potential as an analytical tool to track meaningful abundance estimates year to year (Clawson et al. 2017b).

5.3 Quota species harvest sustainability

5.3.1 Lynx

We have five years of lynx data with 440 logbooks showing at least one lynx harvest (several repeat RFMAs over five years). Both provincial lynx fur production and trapping productivity (CPUE) declined slightly from 2019/20 to 2021/22, but provincial lynx fur production has since begun to increase. Lynx fur prices were near a ten-year low in 2020/21 with a 46% drop from the previous year. However, lynx prices rebounded in 2021/22 with an increase of 39%, which may have influenced trapping effort that year. Prices have now quadrupled from 2020/21, reaching a ten-year high in 2024. If price has a significant influence on trapping effort, we might expect to see a substantial increase in the average number of trap nights among traplines. The average number of trap nights have gradually increased since 2019/20, but the annual average harvest of lynx has remained the same through to the 2024 trapping season. Therefore, this might suggest that were fewer lynx on the landscape in 2024 compared to 2020 since it is taking more effort to harvest a lynx, particularly in the Boreal Natural Region (see Figure 14).

Although trappers perceive lynx as being common and abundant on their RFMAs, a greater proportion of trappers feel lynx numbers have declined on their traplines over the past five years. Fluctuation in the lynx population over time would be expected, however, given that lynx populations are known to follow the snowshoe hare cycle (Elton and Nicholson 1942, O’Donoghue et al. 1997, Clark and Powell 2023). The trapper logbooks can give us insight into this unique predator-prey relationship. Although conditions varied across traplines, on average Boreal trappers suggested that hare numbers were near the bottom of the cycle by 2023/24. This aligns with the observed decline in Boreal lynx CPUE between 2019/20 and 2023/24. We will continue to monitor this relationship, particularly in the Boreal Natural Region where we might expect to see an increase in lynx CPUE as we move out of the snowshoe hare low. We expect evidence of a cycling hare population to be stronger in the northern portions of the region (Hodges 2000). In addition, we began collecting lynx age class information while lynx populations have been at or near what trappers collectively suggest is the bottom of the cycle. We would expect a response to increasing hare numbers to manifest in the proportion of juveniles in the harvest. Additional years of lynx harvest data will be necessary to estimate population trends and harvest sustainability.

5.3.2 Fisher

Provincial fur production based on export permits for fisher showed a decrease initially but has since rebounded. The CPUE for fisher varied over the five years of data, hitting the lowest level in 2020/21. It is difficult to interpret these results, however, given the large uncertainty (often +/- 40% or greater) in these data. Moreover, the average pelt price for fisher had varied substantially declining by 60% between 2019 and 2020 but has since risen beyond 2019 prices nearing a ten-year high.

On average, one fisher was harvested every 200 trap nights (equivalent of 29 traps set for one week). For comparison, one marten was harvested every 118 trap nights (17 traps for one week). Both fisher and marten seasons begin November 1 and end January 31 for most RFMAs (the season is extended to February 15 for select RFMAs) and both species can often be caught in the same traps. Incidental catch rate was higher for fisher and an index often used to assess harvest sustainability (male to female ratio) was lower than it was for marten. However, the five-year average provincial fisher male to female harvest ratio for the Boreal Natural Region (1.4) was near the suggested target of 1.5, and confidence intervals for the annual values always overlapped this target. Overall, trappers in the Boreal and Foothills natural regions are of the opinion that fisher are typically scarce on their lines and the populations are stable to decreasing. Additional years of logbook data, and a larger sample size of logbook submissions will be required to provide greater insight on fisher population trends.

5.3.3 Otter and wolverine

We will likely never have enough harvest and effort information from logbooks to provide robust estimates of abundance for otter or wolverine from SPR models. As such, other methods may need to be considered to track their population trends. For species such as these that naturally occur at low densities the effort associated with harvest can vary widely from one trapper to another and this confounds precision, adding variability to measures of CPUE.

Moreover, some trappers have included their lynx snares into the total number of wolverine traps as part of their effort, since lynx snares occasionally can catch a wolverine. Therefore, the number of trap nights and trapper effort for wolverine can be quite variable from one trapline to the next. We saw that wolverine had the highest percentage of unintentional catch (34%) among the species recorded. Occasionally, a trapper/RFMA will harvest more than one wolverine in a season (quota of one/season), which elevates the proportion of unintentional harvest.

Those trappers who are actively trapping for otter and wolverine are of the opinion that both species are common and stable on their traplines. Most of these RFMAs are from the Boreal Natural Region. Both otter (1.9) and wolverine (1.5) male to female harvest ratios meet the suggested target of 1.5 males to one female.

5.4 Wolf management program

Wolf harvest by both program participants and non-participants has continually increased over the three years, nearly doubling in harvest from 2021/22 to 2023/24. For the 2024/25 season, Alberta Professional Outfitters Society (APOS) agreed to boost funding for the wolf program initiative, rewarding non-program participants for each harvested wolf. APOS will also be providing a significant prize for the largest wolf pelt of the season which may elevate effort.

5.5 Logbook participation

The end of the forthcoming 2024/25 trapping season will mark the eighth year of systematic logbook data provided by ATA trappers. This report summarizes the first seven years of data collection, during which time trappers submitted logbooks from 389 individual RFMAs. However, the sample of logbooks has varied from year to year ranging from 126 in the first year, to 207 in the third. Annual submissions have since dropped to well below 200, which is a concern if this trend continues. An increase in annual logbook submissions is needed to reliably measure trends for marten among the six FMZs, and even more important for understanding trends for less abundant furbearers. We predict that at least 300 logbooks are needed on an annual basis to estimate marten indices for all FMZs.

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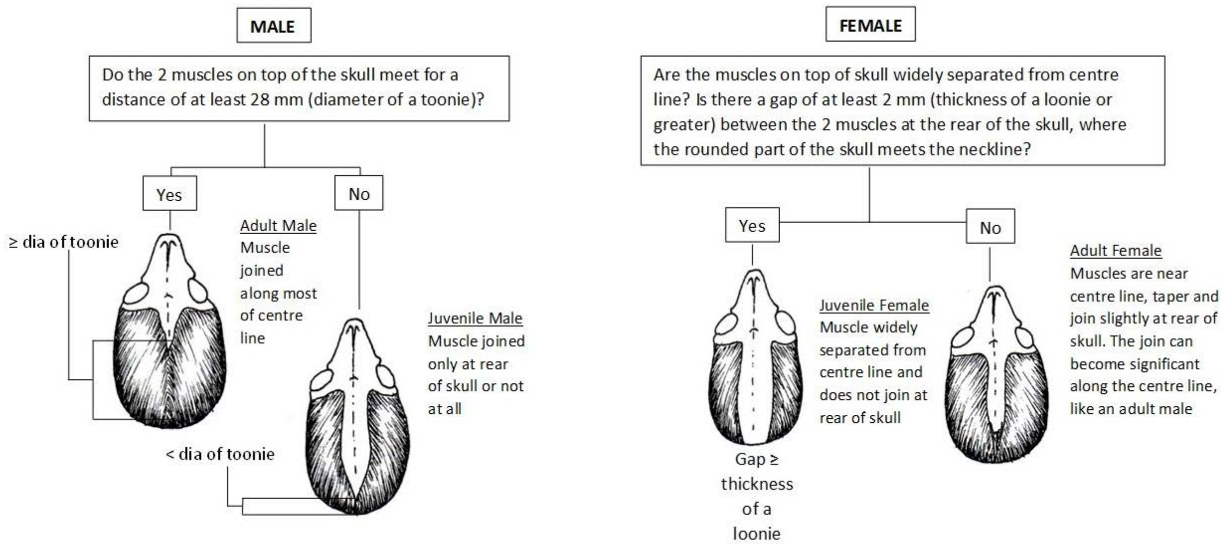
7.0 APPENDICES

Appendix 1. Diagram of how to determine marten age class using muscle coalescence on top of the skull.



Appendix 2. Example of 2023/24 hardcopy version of the ATA logbook.

ALBERTA TRAPPERS ASSOCIATION RFMA LOGBOOK 2023/24

Contact Info	Sr. Licence Holder:	RFMA #
	Address:	
	Phone: Email:	

Please read instructions on page 5 before completing the logbook. Information from this form can be submitted online at http://atalogbook.ab-conservation.com/

TRAPLINE ACTIVITIES **(includes prep, scouting, set/check, fur handling and cabin maintenance)**

Estimated monthly hours spent on trapline activities												
Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	**Total Hours**

MARTEN HARVEST

Please provide harvest totals under each marten gender/age class (**Unk** = age class unknown)
If you did not set traps for marten, please mark zeros in the boxes
Unintentional catch (when a harvest occurred using a trap that was not specifically set for the species harvested)
??? = I don't know/unknown

Please determine marten age class using the temporal muscles on the head (see diagram on page 5)

JuvMale	AdultMale	MaleUnk	JuvFemale	AdultFemale	FemaleUnk	Total	Number of these that were Unintentional
Average number of marten traps set							
Average number of days marten traps were set							
On my RFMA this year, I consider marten: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer) **Over the past 3 yrs, marten have been: INCREASING / DECREASING / STABLE / NATURALLY FLUCTUATING / ???**							

QUOTA SPECIES HARVEST: Complete the following if you'd also like to contribute data on quota species.
If you did not set traps for a particular species, please mark zeros in the boxes. Traps can be counted more than once if they might catch more than one species (example: marten and fisher)
Unintentional catch (when a harvest occurred using a trap that was not specifically set for the species harvested)
??? = I don't know/unknown

Page 1

FISHER

JuvMale	AdultMale	MaleUnk	JuvFemale	AdultFemale	FemaleUnk	Total	Number of these that were Unintentional
Average number of fisher traps set							
Average number of days fisher traps were set							
On my RFMA this year, I consider fisher: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer) **Over the past 3 yrs, fisher have been: INCREASING / DECREASING / STABLE / NATURALLY FLUCTUATING / ???**							

LYNX

JuvMale	AdultMale	MaleUnk	JuvFemale	AdultFemale	FemaleUnk	Total	Number of these that were Unintentional
Average number of lynx traps/snares set							
Average number of days lynx traps/snares were set							
On my RFMA this year, I consider lynx: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer) **Over the past 3 yrs, lynx have been: INCREASING / DECREASING / STABLE / NATURALLY FLUCTUATING / ???**							

OTTER

Male	Female	Total	Number of these that were Unintentional
Average number of otter traps set			
Average number of days otter traps were set			
On my RFMA this year, I consider otter: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer) **Over the past 3 yrs, otter have been: INCREASING / DECREASING / STABLE / NATURALLY FLUCTUATING / ???**			

WOLVERINE

Male	Female	Total	Number of these that were Unintentional
Average number of wolverine traps set			
Average number of days wolverine traps were set			
On my RFMA this year, I consider wolverine: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer) **Over the past 3 yrs, wolverine have been: INCREASING / DECREASING / STABLE / NATURALLY FLUCTUATING / ???**			

Page 2

WOLF TRAPPING INFORMATION

This section can be used to report wolf harvest that is part of your regular trapping activity or for those participating in the ATA Wolf Management Program.

Only include information for wolves taken on your RFMA. Do not include harvest taken under a resident fur management licence or damage control licence. If you harvested wolves on more than one RFMA, please submit a separate logbook for each.

Did you participate in the ATA Wolf Management Program this year? YES / NO

Number of wolves caught this year

JuvMale	AdultMale	JuvFemale	AdultFemale	Total Wolf Harvest
I determined age class of the wolves I harvested by: BODY SIZE / TOOTH WEAR / ??? / NA / OTHER - explain (Circle best answer) **NA – Not applicable. I didn't catch any wolves this year.**				
Number of wolf traps/snares set in total (all traps/snares in total)				
Average number of days wolf traps/snares were set (total days)				
Number of bait sites set for wolves this year				
This year, I consider wolves on my RFMA to be: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer) **Over the past 3 yrs, wolves on my RFMA appear to be : INCREASING / DECREASING / STABLE / NATURALLY FLUCTUATING / ???**				

Do you have any comments specific to the **ATA Wolf Management Program**? (General comments about your RFMA and trapping season will follow).

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TRAPPER LOCAL KNOWLEDGE

Trappers can also provide valuable information on other species that they see on their traplines, which sheds light on the health of wildlife populations in general. Questions in this section may change from year to year.

Alberta Conservation Association is interested in where you think your trapline currently is in the snowshoe hare (rabbit) cycle. If you would like to share this information (optional), please answer the following two questions:

This year, I consider snowshoe hare on my RFMA to be: SCARCE / COMMON / ABUNDANT / ??? (Circle best answer)

I think hare numbers in my area are: NEAR THE PEAK / DECLINING / NEAR THE BOTTOM / INCREASING / ???

GENERAL COMMENTS:

General comments can include topics of interest such as weather, sign, disease, habitat change, other important wildlife, etc.

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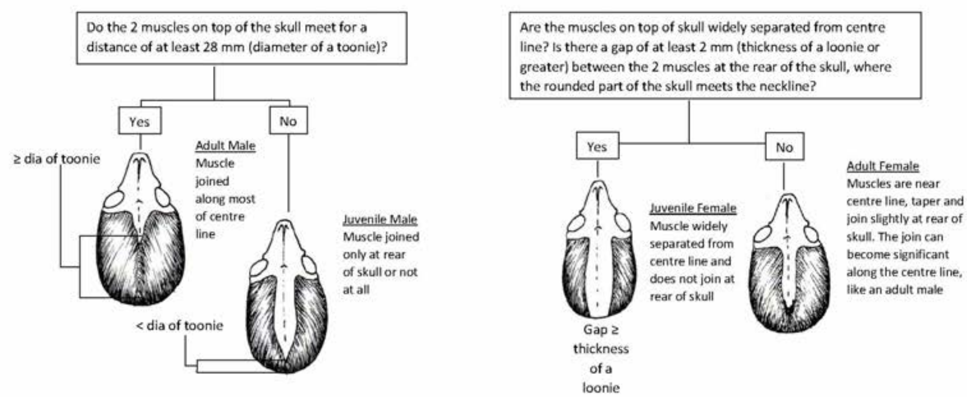
INSTRUCTIONS
It is very important that the information you provide for this document is accurate and is completed the same way throughout the province.

- **Be sure to only include furbearing animals taken on your RFMA**. Do not include fur taken under a *resident* fur management licence or damage control licence on this form.
- **Only include one RFMA per form**. If you are trapping multiple RFMA's, you must fill out a separate log for each. Do your best to separate out your effort and catch by RFMA.
- **Multiple partners** working on the same RFMA can keep track of their own information, but **only one RFMA form should be submitted for each RFMA**. Please combine time, trapping effort and harvest success the best you can for the final form and make a note in General Comments.
- **Please estimate the average number of traps set and for how many days traps were set on your RFMA**. Trapper effort and harvest success can be used to determine relative abundance.
- **If you set traps for a species but caught none, please record your trapper effort information and 0 caught**. This is still useful information.
- **Record the sex and age class information for each marten you harvest.** We recommend estimating age class while you are skinning an animal. Skulls stored in a freezer may be more difficult to age than those that are fresh.
- **Any reporting will only include grouped data** (i.e., specific RFMA information will not be shared with AEP or ATA).

Please submit logbooks by July 15th of each year to http://atalogbook.ab-conservation.com. Submitting online is the best way to maintain confidentiality and it saves financial resources. If you can't submit online yourself, this might be a great opportunity to involve a younger family member in your trapping activities. If you'd prefer, you can submit paper copies to your ATA Local or the ATA office.

How to Determine Age Class using Marten Skulls

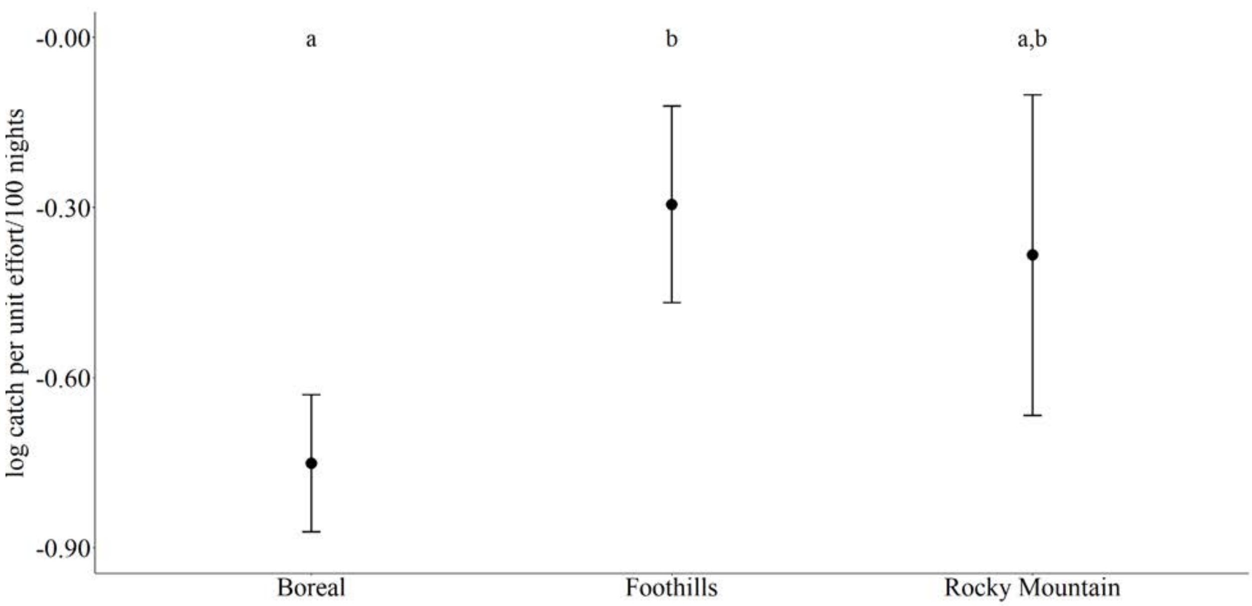


Appendix 3. Marten CPUE model comparison.

To test whether a given year or natural region could influence marten CPUE, we ran a linear mixed model with the log of the number of marten harvested per 100 trap nights (CPUE) as our response variable, natural region and year as our explanatory covariates, and RFMA as our random effect.

Model[1]	df	AIC	ΔAIC
NR	5	2415.64	0
YR+NR	11	2434.44	18.79
null	3	2426.47	10.83
YR*NR	23	2453.99	38.35
YR	9	2447.63	31.98

[1]Registered Fur Management Area (RFMA) was included as a random effect in each model. Natural Region (NR) and Year (YR) were included as explanatory variables.



Comparison of marten catch-per-unit-effort (log CPUE, +/- 90% CI) between Alberta's natural regions. Different letters indicate a significant difference in log CPUE.

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