Game Management Zone 5B Alternative Harvest Strategy Review: Frequently Asked Questions

Ministry of Forests, Lands, and Natural Resource Operations

November 9, 2011

Addendum to "Evaluation of Alternative Moose Harvest Strategies in Game Management Zone 5B; East Cariboo" MFLNRO September 2011, referred to in this document as "The Report"

This FAQ document provides answers to several questions and concerns that have been expressed from stakeholders regarding the status and harvest management options for moose in GMZ 5B, as described in the above document.

1. **What type of population model was used in the analysis? What data did it include, and what assumptions were made?**

The population model used to assess the different harvest strategies for moose in GMZ 5B is known as a stage-structured dynamic population model. It is very similar in its operation to other population models used by many wildlife management agencies across North America. A stochastic population model, such as the population model used in this assessment (which includes uncertainty in information like survival rates), is considered more appropriate than a deterministic model (which does not include any uncertainty) for informing management decisions as it incorporates the acknowledged error around each of the estimated population parameters, and uses this to inform the accuracy of the results.

The population model is described in detail on pages 16 and 17 of the report. The data included in the model includes the current moose population estimate and composition (extrapolated from stratified random block surveys within portions of GMZ 5B), the annual number of moose harvested by resident and non-resident hunters, and current estimates of First Nations needs for moose to provide for food, social and ceremonial purposes (see page 6 of the report). The model assumes that First Nations will harvest all their needs, and that all harvesting (residents, non-residents and First Nations) is additive to natural mortality. Density dependence was not incorporated into the model as there is no evidence that density dependence is operating at current moose densities. The effect of density dependence was investigated by including density dependence in a modified version of the model (i.e. some compensation between hunting and natural mortality), but including density dependence had little effect on the modelling results over the projected 5 year period (2012 to 16). The model projected the impact of various harvest strategies on the moose population using a procedure known as Monte Carlo simulation. That is, the model is re-run many times (in fact 10,000 times) each time considering the

uncertainty in the information (for example, survival and recruitment rates) and providing a population projection based on that uncertainty. By repeating the simulation many times, the model considers all possible outcomes given the uncertainty in the information. This allowed the outputs (e.g. moose population size, bull/cow ratio) to be expressed as an average, as well as described by a likelihood or probability that the population size or bull/cow ratio is below a certain number (called the "performance measure", e.g. the performance measure for the bull/cow ratio is 30/100, so the model can be used to indicate the probability that the bull/cow ratio will be below this level).

2. **Figure 1 of the report does not show the survey areas that were discussed in the report. Can you provide a map that shows their location within the WMU's of GMZ 5B?**

The following map outlines Game Management Zone 5B and the Management Units (MUs) and Limited Entry Hunting (LEH) Sub-zones contained within. All surveys from 1999 to present covered the entire area of the LEH sub-zone that the survey was conducted in. This allows estimates of the total moose population within a sub-zone. As an example both the 2000 and the 2006 surveys in 5-02B covered the entire 5-02B sub-zone and are therefore directly comparable.

Cariboo Region

**Game Management Zone 5b,
Wildlife Management Units (WMU),
and Moose Limited Entry Hunting (LEH) Zones**

Legend

Wildlife Management Units - Region 5

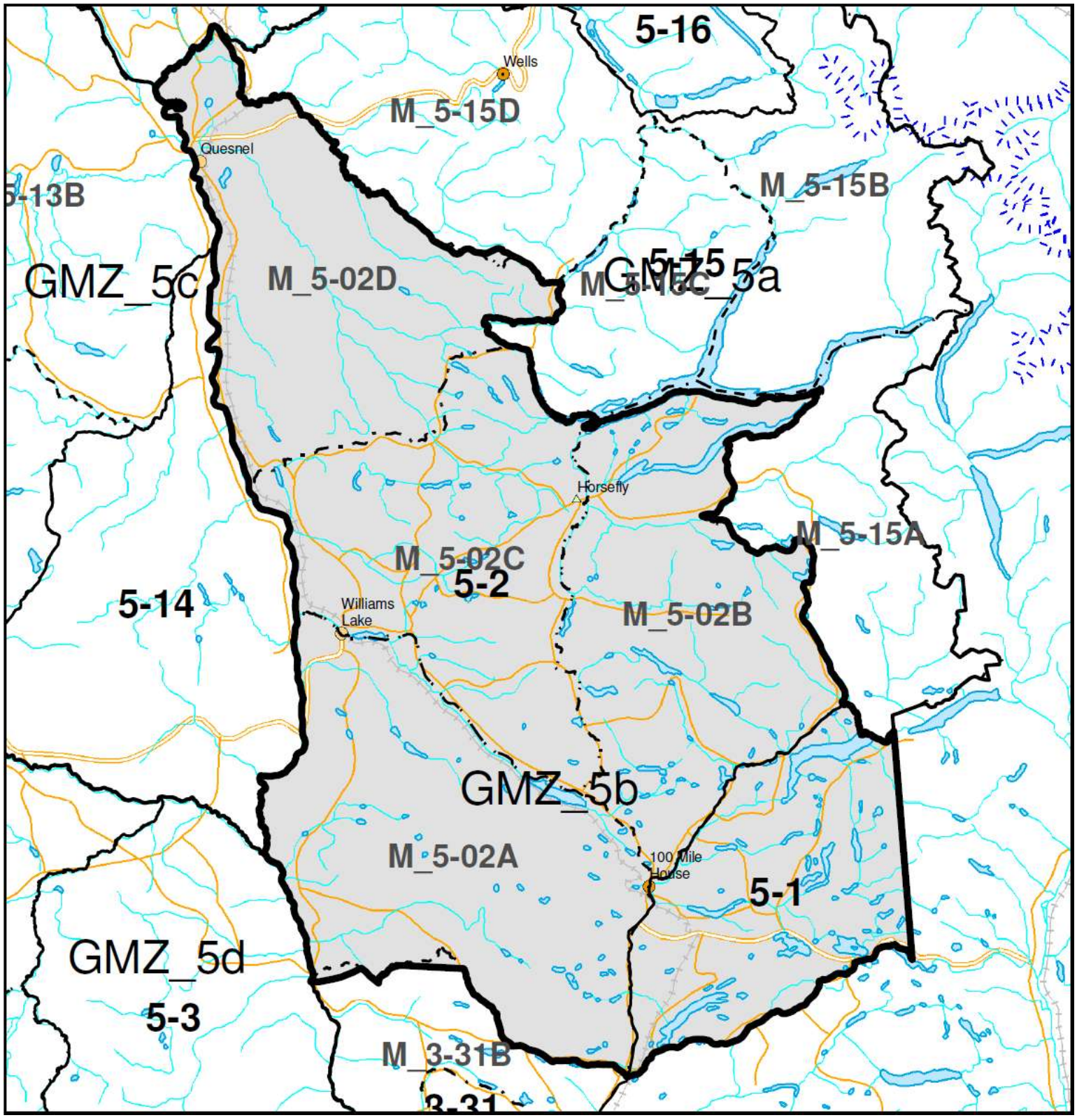
Limited Entry Hunting Zone - Moose

1:1,000,000

0 5 10 20 Kilometers

N

Produced by: Ministry of Environment
Produced for: FLNRO
Filepath: W:\wlap\wmf\Workarea\nfreeman\wl_oneoff\wl11_001_reg5_gmz5b_wmu_mooseLEH_8x11.mxd\wl11_001_reg5_gmz5b_wmu_mooseLEH_8x11.pdf
Date Created: Nov 4, 2011
Created by: NF, MOE, Williams Lake



3. **What are the confidence limits for the surveys reported in Table 1 of the report? Are the changes in moose density over time statistically significant?**

Management Unit 5-01 Survey History and Statistical Comparison

Year	Survey Area(km²)	Estimated Density	Total Moose Estimate (90% CI)	Bulls/100 Cows	Calves/100 Cows	Statistical Change in Moose Density Detected
1996	1,616	0.43±0.07	689±112.4 (16.3%)	21.1±4.8	48.1±7.8	N/A – initial survey in MU
2000	2,320	0.32±0.04	737±99.5 (13.5%)	47.9±14.1	33.3±6.8	Yes; Statistically significant decrease in density based on 1996 common survey area

Management Unit 5-02A Survey History and Statistical Comparison

Year	Survey Area(km²)	Estimated Density	Total Moose Estimate (90% CI)	Bulls/100 Cows	Calves/100 Cows	Statistical Change in Moose Population Detected
1996	1,936	0.09±0.017	166±31.1 (18.7%)	19.1±10.4	31.6±9.3	N/A – initial survey in zone
1998	2,336	0.23±0.040	539±94.5 (17.5%)	40.9±10.6	61.0±9.8	Yes; Statistically significant increase in density based on 1996 common survey area
2001	3,424	0.22±0.037	762±129 (16.9%)	35.1±11.0	50.3±10.4	No; Based on 2001 survey area

Management Unit 5-02B Survey History and Statistical Comparison

Year	Survey Area(km²)	Estimated Density	Total Moose Estimate (90% CI)	Bulls/100 Cows	Calves/100 Cows	Statistical Change in Moose Population Detected
1996	1,520	0.65±0.110	988±167.1 (16.9%)	25.3±5.7	25.3±6.9	N/A – initial survey in zone
2000	3,248	0.59±0.086	1926±279.3 (14.5%)	26.8±5.9	23.7±4.9	No; Based on 1996 common survey area
2006	3,344	0.39±0.048	1311±162.8 (12.4%)	29.0±7.3	18.4±4.8	Yes; Statistically significant decrease in density

Management Unit 5-02C Survey History and Statistical Comparison

Year	Survey Area(km²)	Estimated Density	Total Moose Estimate (90% CI)	Bulls/100 Cows	Calves/100 Cows	Statistical Change in Moose Population Detected
1994	960	0.50±0.096	479±92.0 (19.2%)	12.3±9.5	36.4±11.4	N/A – initial survey in zone
1997	960	0.28±0.041	273±39.8 (14.6%)	31.4±9.1	48.7±11.1	Not statistically tested
2001	3,152	0.62±0.088	1943±275 (14.2%)	20.9±5.6	44.8±9.6	Not tested due to differences in survey area
2011	3,152	0.51±0.079	1619±249 (15.4%)	43.4.±11.6	35.3±8.9	No; the decrease in density from 2001 to 2011 was not found to be statistically significant

Management Unit 5-02D Survey History and Statistical Comparison

Year	Survey Area(km^2)	Estimated Density	Total Moose Estimate (90% CI)	Bulls/100 Cows	Calves/100 Cows	Statistical Change in Moose Population Detected
1999	3,296	0.67±0.0	2196±325 (14.8%)	24.1±5.7	32.0±3.5	N/A – initial survey in zone
2004*	N/A	N/A	N/A	N/A	N/A	N/A

*Although a 2004 SRB survey was listed under MU5-02D in table 1 from the report, when hard copies of the reports were checked, the 2004 SRB survey was actually performed in 5-15D (GMZ 5A).

4. **What were the bull/cow and calf/cow ratios (and their associated confidence limits) from the surveys shown in Table 1?**

Refer to tables above.

5. **How were the GMZ 5B moose population estimates, bull/cow and calf/cow ratios determined in 2008 and 2011?**

2008 GMZ 5B moose population estimate of 6727

The 2008 GMZ 5B moose population estimated was calculated using the 2006 5-02B Stratified Random Block (SRB) survey and both the 2001 5-02A and 5-02C SRB surveys. The unadjusted moose estimates from all surveys were summed, and a Sightability Correction Factor (SCF) of 1.44 was then applied to account for the estimate of moose missed during the surveys. The applied SCF was calculated as a weighted average of the survey specific SCFs utilized in the three SRB surveys incorporated into the population estimate (see page 6 of the report for a more detailed explanation of how a SCF is calculated). The total estimate of moose in the surveyed areas was then extrapolated to the total estimated suitable moose habitat area in the GMZ (14,769km^2). Suitable moose habitat was defined as all area excluding: glaciers, rocks, ice, large lakes, grasslands, and major centers (Williams Lake, Quesnel, and 100 Mile House).

In order to conduct the population projections under the various harvest strategies, it was also necessary to develop an estimate of the precision ("coefficient of variation" or CV) for the population estimate. Because of the extrapolation method used to calculate the 2008 GMZ 5B population estimate, there was no statistical method for determining the CV. Rather, we used a series of expansion factors to increase the CV from the original survey results. These included increasing the survey CV by 50% to account for the application of the SCF, then doubling the CV to account for the extrapolation from the surveyed area to the GMZ. This resulted in a 2008 GMZ 5B population estimate of 6727 moose with a CV of ±39%.

The 2008 GMZ 5B estimated bull/cow and calf/cow ratios, 40/100 and 42/100 respectively, were calculated from the estimated bull/cow and calf/cow ratios calculated from the 3 SRB surveys used in the population estimate, along with two 2007 composition surveys conducted in the MU subzones not covered by the SRB surveys (5-01 and 5-02D). The ratios from the surveys were averaged, giving equal weight to the SRB survey estimates, and the more recent composition survey estimates.

2011 GMZ 5B moose population estimate of 6265

The 2011 GMZ 5B moose population estimate was calculated using the 2011 5-02C SRB survey. The 2011 5-02C SRB survey density was extrapolated to the entire GMZ, maintaining the density ratio between the historically low and historically high density areas of GMZ 5B. GMZ 5B can be divided into two portions based on the average moose density from past SRB surveys: the historically low density portion containing MUs 5-01 and 5-02A (1994-2011 average density = 0.26 moose/km2), and the historically high density portion containing MUs 5-02B, 5-02C, and 5-02D (1994-2011 average density = 0.48 moose/km2). MU 5-02C is within the historically high density portion of GMZ 5B, therefore we extrapolated the estimated density from the 2011 survey of 0.51 moose per km^2 to the 9284km^2 of suitable moose habitat within the high density portion of the GMZ (refer to Table 2 in the report), for an estimate of 4735 moose. We maintain the historic density ratio between the historic densities (0.26 to 0.48) to calculate an estimated 2011 density for the low density portion of GMZ 5B of 0.27 moose per km^2. Extrapolating this density out to the 5485km^2 of suitable moose habitat in the low density portion of the GMZ, gives a 2011 estimate of 1530 moose. Adding the low and high density area estimates together gives a total moose population estimate in GMZ 5B for 2011 of 6265 (refer to Table 2 in the report).

The precision of the population estimate (CV) was calculated using a similar procedure as for 2008. This resulted in a 2011 GMZ 5B population estimate of 6265 moose with a Coefficient of Variation of ±25%.

The 2011 GMZ 5B bull/cow and calf/cow ratios, 43/100 and 35/100 respectively, were taken from the ratios calculated for the 2011 5-02C SRB survey. No recent composition surveys have been conducted in the GMZ, so the estimated ratios could not be supplemented with reconnaissance data. Composition surveys are planned for December of 2011 to supplement the current estimates of GMZ bull/cow and calf/cow ratios.

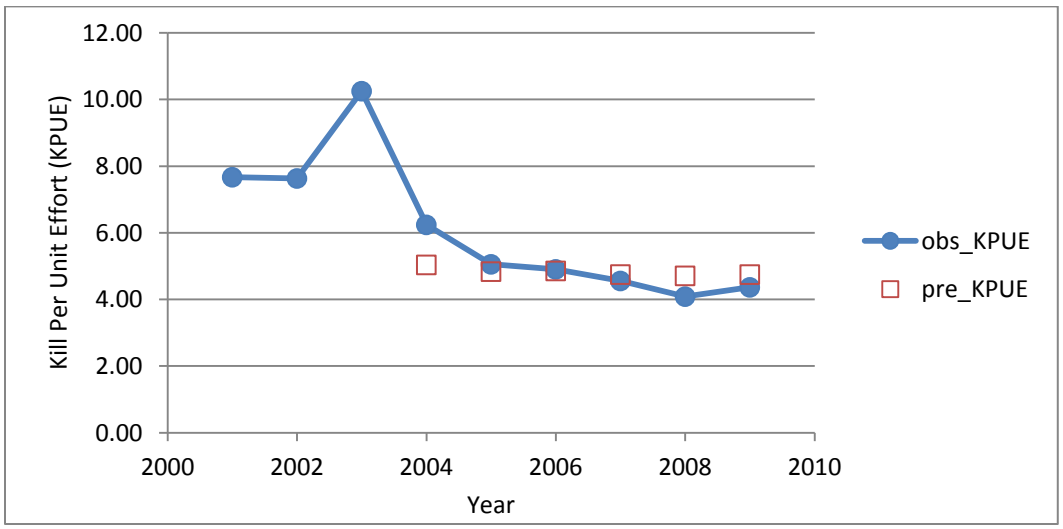
6. **In Table 2, you indicate the 2011 population is 6265 moose. How accurate is this estimate, and how was the error in the estimate considered in the model?**

The 2011 GMZ 5B population estimate was 6265 moose with an estimated standard error (SE) of 1559 (refer to question 5). This would equate to a 90% Confidence Interval of 6265 ± 2557 (3708 – 8822). The 2011 SRB survey had a 90% confidence interval of ± 15.4% which is well within the target CI of SRB surveys as outlined in the RISC (Resource Inventory Standards Committee). When the results of a SRB survey are extrapolated out to the much larger GMZ area the SE increases substantially, as would be expected.

The population model utilized in the assessment takes the variability around the population estimate (CV) and the variability around the bull/cow and calf/cow ratio estimates (CV) into account when conducting the Monte Carlo simulation analysis (see question #1).

7. **Your GMZ population estimates from 2008 to 2011 indicate that bull moose numbers have increased, while Figure 2 and Figure 4 show that both resident success rate and the resident bull harvest has declined. Are these results not contradictory?**

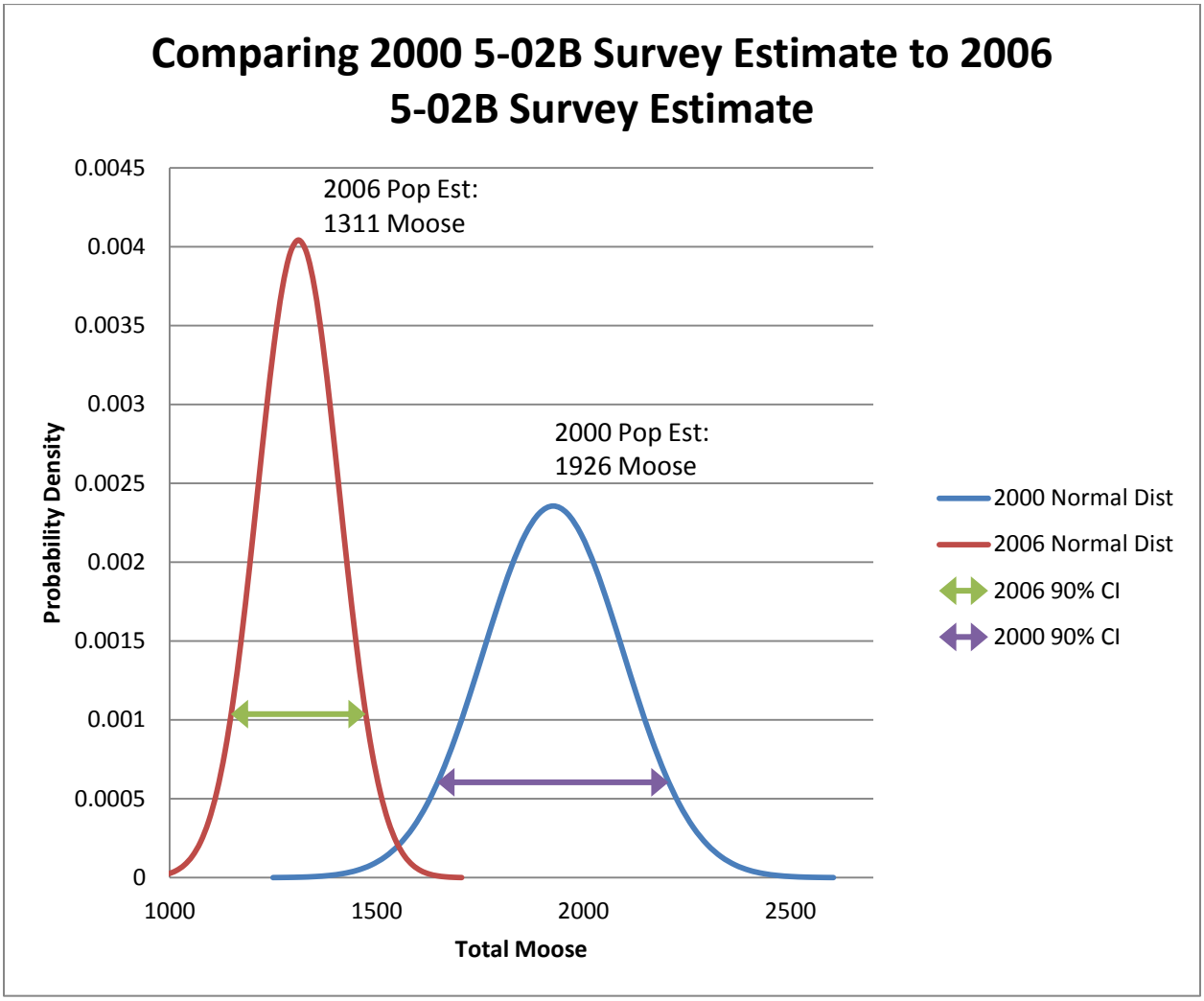
Though this may appear to be a bothersome discrepancy, the two estimates are on different time scales. The GMZ level population estimate for bulls are from 2008 (1410 bulls) and 2011 (1514 bulls). The hunter harvest graphs are from 2001 to 2009. The following figure shows the observed kill per unit effort (obs_KPUE) from the hunter harvest data, as well as the predicted kill per unit effort (pre_KPUE) from the population model. During the period for which the model was used to predict population size, the estimates of KPUE are similar. The graph also indicates a slight increase in KPUE between 2008 and 2009. We will need information on the 2010 and 2011 hunter harvest (which is currently unavailable) to further evaluate whether the trend in the GMZ bull estimate is contradictory to the hunter harvest data.



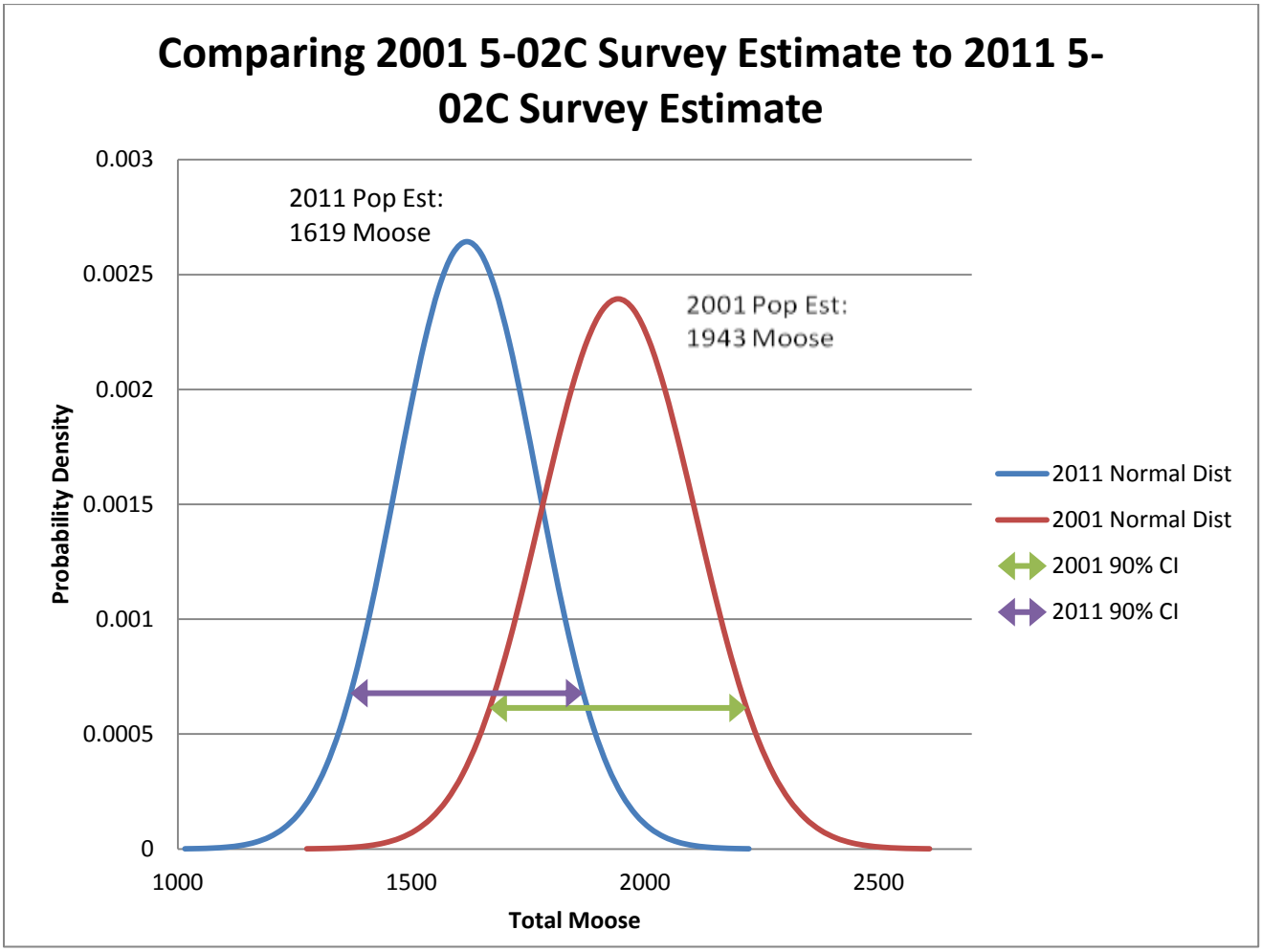
8. **What is the evidence that supports the statement in the report, page 20: "From the updated population estimate and the supporting harvest data analysis, there is strong evidence that the GMZ 5B moose population has declined since the early 2000s"?**

GMZ 5B is comprised of two MU's (5-01 and 5-02) . For management purposes, MU 502 has been divided into 4 sub-zones including 5-02A, 5-02B, 5-02C and 5-02D. The information which supports the assertion that there is strong evidence that the GMZ 5B moose population, overall, has declined since the early 2000s is the following:

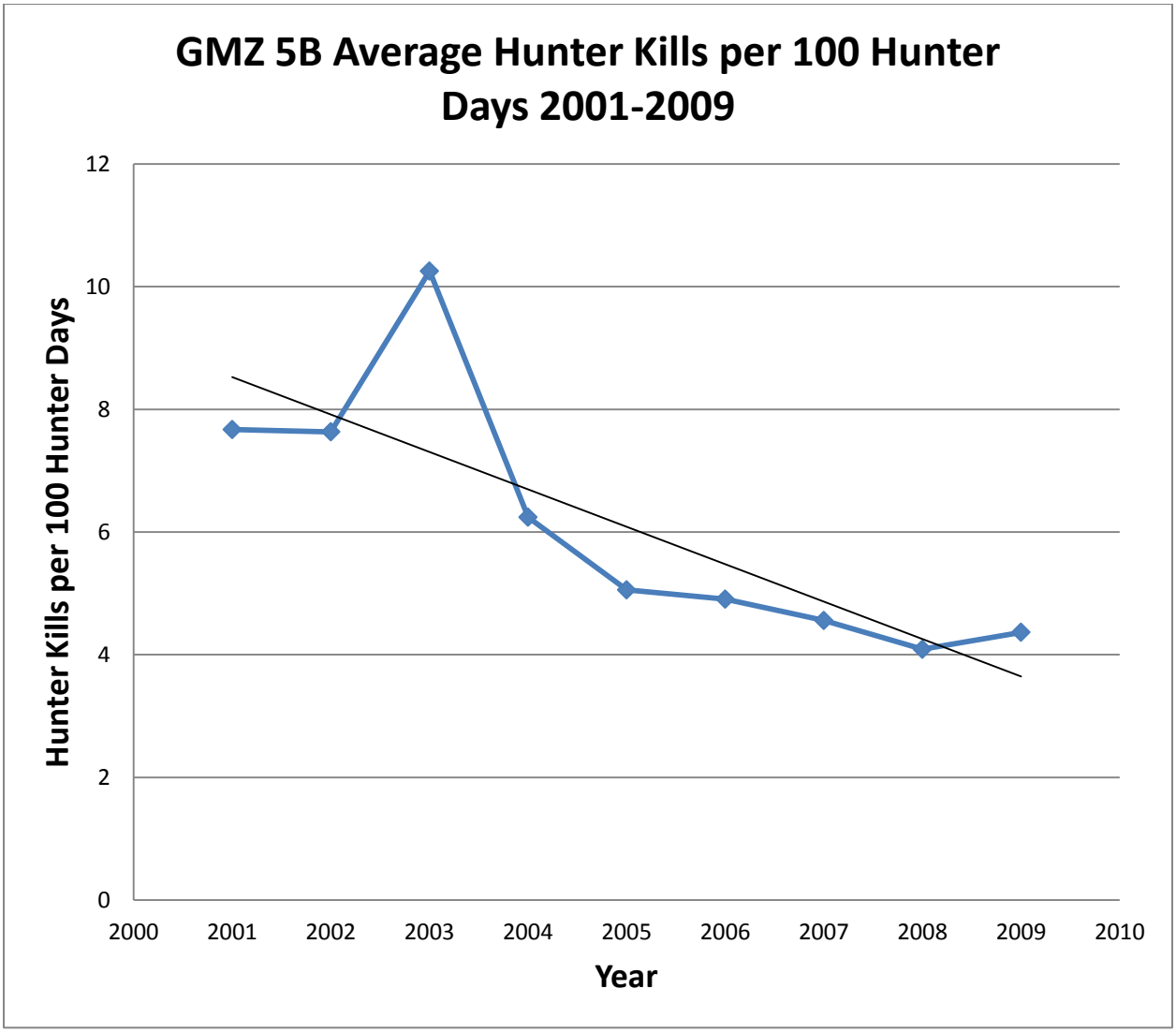
1) A statistically significant reduction in the MU 5-02B moose population from 2000 to 2006. The population estimate in GMZ 5B decreased (-32%) from 1926 ± 279 to 1311 ± 163 from 2000 to 2006. The following figure shows the probability distributions of the 2000 and 2006 SRB surveys in MU 5-02B and their associated 90% confidence intervals. As shown in the figure, there is almost complete separation of the probability distributions and no overlap of the 90% confidence intervals. This is very strong evidence that the moose population within 5-02B decreased from 2000 to 2006.



2) A decrease (-17%) in the moose population estimate for MU 5-02C from 1943 ± 275 in 2001 to 1619 ± 249 in 2011. Although the decrease in the estimated moose population from 2001 to 2011 was not statistically significant, there is considerable separation of the two surveys' probability distributions, and only moderate overlap of the 90% confidence intervals. Another line of evidence is a test to assess the probability of a 20% decline between 2001 and 2011. Applying this test shows that the likelihood of a 20% decline is about 42%. While there is not as strong support for a decline in MU 5-02C as for MU 5-02B, the evidence is consistent with the assertion of a population decline.



3) Resident hunter harvest trends which indicate a decrease in the moose population from early 2001 to 2009. Figure 2 in the report shows that hunter success in GMZ 5B has trended downward from 2001 to 2009 and Figure 3 shows that the average number of hunter days per kill in GMZ 5B has increased. This is inversely proportional to a decrease in the Kill Per Unit Effort (KPUE). The following figure shows the average resident hunter moose kills per 100 hunter days as a measure of KPUE. This decline is statistically significant, as tested by linear regression, which adds further support that there is evidence of a moose population decline in GMZ 5B. Taking the 3 lines of evidence, as discussed above, Ministry staff believe there is sufficient evidence to support the statement in the report that: "From the updated population estimate and the supporting harvest data analysis, there is strong evidence that the GMZ 5B moose population has declined since the early 2000s".



9. **What was the harvest by resident hunters, and non-resident hunters in GMZ 5B from 2001-2009?**

Game Management Zone 5B Resident and Non-Resident Moose Harvest from 2001-2009.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Resident	414	377	442	417	330	360	337	299	316
Non-Resident	62	68	80	66	64	67	53	52	39
Total Licensed Harvest	476	445	522	483	394	427	390	351	355

10. **How reliable are the estimates of FNs needs identified in Appendix III, and what actions has government taken to monitor the FNs harvest?**

First Nations (FNs) harvest of moose for sustenance makes up a substantial portion of the annual harvest of moose in the Cariboo Region and, therefore, must be taken into account when considering sustainable harvest levels for licensed hunters. The estimate of FNs needs outlined in the report was calculated using FNs per capita needs based on harvest surveys conducted in the 1990s and early 2000s and meetings with each FNs community to discuss the estimated sustenance needs of the community. These per capita estimates are used to update the total FNs needs in each GMZ based on the number of registered band members in each community. This method currently represents the most reliable means to estimate FNs needs without receiving updated quantitative information directly from the FNs communities.

In October and November of 2011 the Cariboo Region's Director of Resource Management and the Fish and Wildlife Section Head engaged in consultation with each of the Bands within the Cariboo Region regarding the moose allocation exercise, estimated harvest calculations, and estimates of community sustenance needs. They discussed whether the current estimates of band specific moose needs are reasonable, and discussed the accuracy of the estimates. The sharing of First Nations harvest information with government continues to be an area of sensitivity in the Cariboo. Programs and funding are now in place to allow government to improve relations with First Nations and attempt to gain valuable updated information on the current needs and harvest levels of First Nations.