Executive Summary

This report is intended to provide a general summary of black bear harvest in Bear Management Units (BMU) 200, 216, 240, 280, and 290 for the 2022 season in Region 2 in Montana. All data are preliminary and subject to change.

Region 2 continues to be a popular place for black bear hunting in western Montana. Roughly one quarter of the State's annual total harvest comes from Region 2, ranging from 19% to 27% of the annual bears harvested ($\bar{x} = 0.23, \sigma = 0.03$; 2010-2022; Figure 1). Prior to the 2020 license year, black bear spring and fall hunting seasons resulted in between 250 to 350 bears harvested annually by hunters in Region 2 ($\bar{x} = 311, \sigma = 38; 2010 - 2019$; Figure 2). During this period license sales were relatively stable and annual variation in harvest was largely attributed to variation in food availability and its relationship to bears' vulnerability to harvest.

Beginning in 2020, bear harvest trends began to deviate from the 250-350 bears per year benchmark, increasing annually by between 15-23% ($\bar{x} = 17.8\%$; 2020-2022; Figure 2). The 2022 license year resulted in a total harvest of 566 bears within Region 2's four BMUs. This represents an 82% increase from the Regional mean annual hunter harvest during the 2010-2019 period. Although many factors may be influencing the increase in bear harvest, one important driver is the increase in black bear license sales, which as of 2022, have increased approximately 33% (relative to 2015-2019) to record sales levels Figure 3).
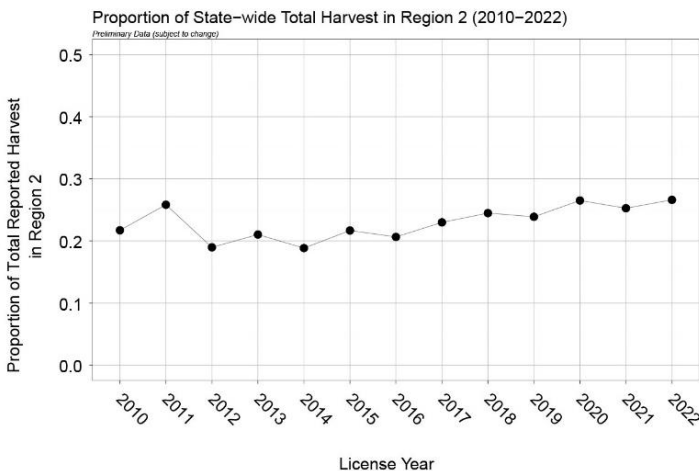

Figure 1. The proportion of total black bears harvested in Montana during spring and fall seasons which occurred in Region 2 from 2010-2022.
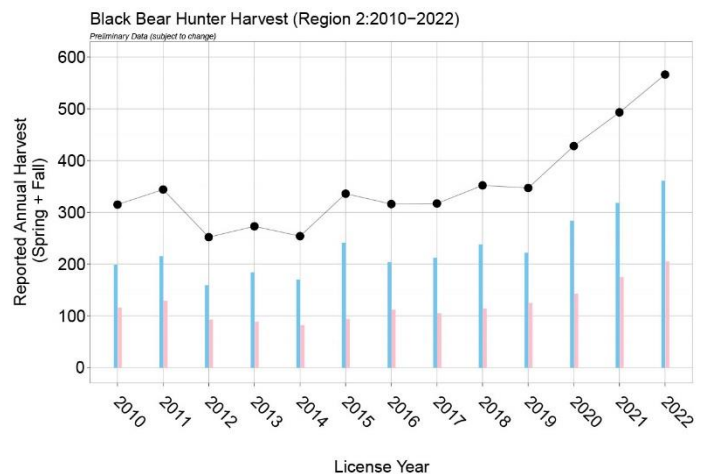

Figure 2. Total reported hunter black bear harvest 2010-2022. Black points and line show total harvest and sex specific contribution are show as blue (males) and pink (females) bars for each license year.

Although resident license sales (Resident Black Bear and Sportsman's with Black Bear License types) make up the overwhelming majority of sales, it is worth noting the non-resident license sales had the largest percent increase (211%) during the 2010-2022 period.

The proportion of black bears harvested in Region 2 by resident hunters has decreased slightly during the 2010-2022 period, although they still represent the vast majority of successful black bear hunters in Region 2 ($\bar{x} = 87\%, \sigma = 4\%$; Figure 4). A linear regression of the proportion of resident hunter black bear harvest versus license year was statistically significant and showed a reduction from 90.8% resident harvest in 2010 to 83.6% resident harvest in 2022 ($F_{1,11} = 8.27$, $p-value$: 0.015). This decrease follows the pattern in license sales of a large proportional increase (211%) in non-resident hunters during
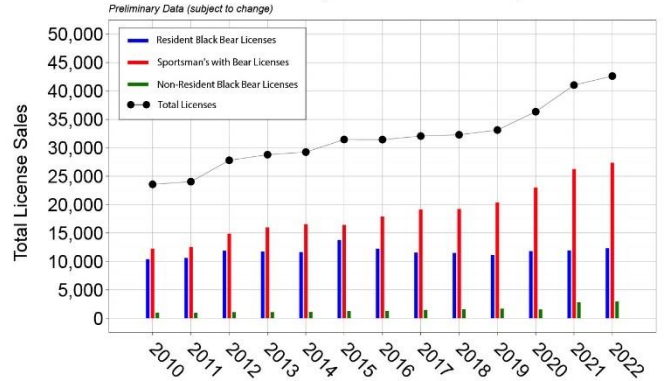

Figure 3. Total black bear license sales by type for 2010-2022. Black lines and points represent the total black bear license sales, and the colored bars show individual license type sales for each year.

this period. In 2010, nonresidents who successfully harvested a bear in Region 2 came from 15 different states, with only one of those states with greater than one black bear harvested. In 2022, non-residents who were successful at harvesting a bear from the Region came from 32 different states, with 23 states with greater than one black bear harvest ($\bar{x} = 2.9, \max = 10$).

The relative contribution of the spring season to the total harvest has varied over time with a non-significant, but increasing trend from roughly 40% in 2010, to just under 60% in 2022 (Figure 5). Overall, the spring season accounts for a slight majority of harvested black bears in Region 2 ($\bar{x} = 56\%, \sigma = 9\%$).

The distribution of the 2022 total harvest reflects the availability of high-quality black bear habitat in the northern and western parts of Region 2. Focal areas of higher black bear harvest are apparent in BMUs 200, and around Missoula in BMUs 216 and 290 (Figure 6). Note that harvested bears in BMU 301 that exist within Region 2 are not included and are considered part of the Region 3 take given the BMU designation.
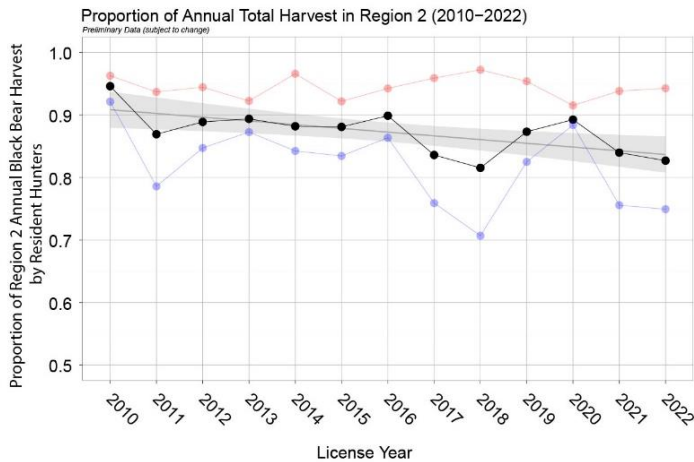

Figure 4. The proportion of Region 2 harvest from resident black bear hunters from 2010-2022. Black points and dashed lines show the proportion of total annual harvest and the shaded region and solid line are the fitted linear regression results and 95% CI ($F_{1,11} = 9.56$, $p-value$: 0.01). The blue lines and points show spring-only harvest, and the red lines and points show fall-only harvest.
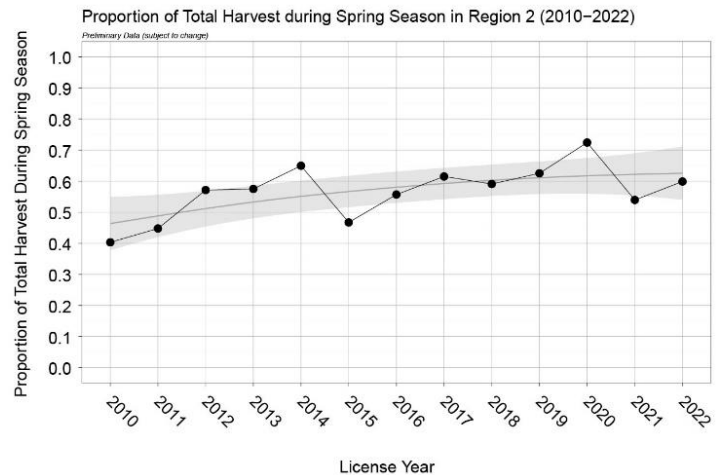
Figure 5. The proportion of Region 2 black bear harvest occurring during the Spring season 2010-2022. Black points and lines show the annual data, and the shaded gray region and solid line are the fitted nonlinear regression results and 95% CI.
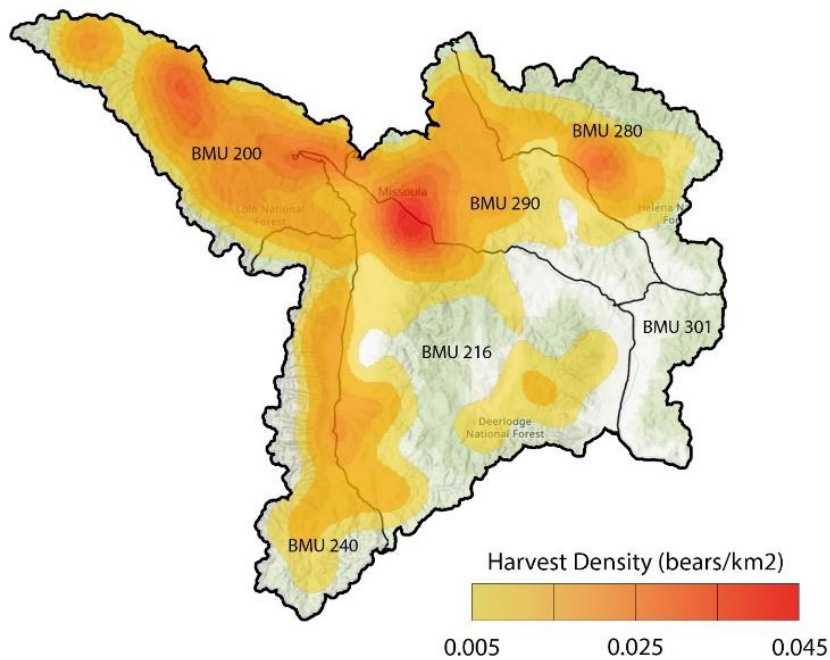
Figure 6. Kernel Density Estimate of black bear harvest location (as determined by the center of the Township, Range, and Section of reported harvest) for 2022 in Region 2. Note that harvested bears in BMU 301 that exist within Region 2 are not included and are considered part of the Region 3 take given the BMU designation

Due to financial constraints, teeth were not collected in Region 2 from 2012-2018 and during the 2020 season, bears were not inspected by FWP staff due to Covid. Accordingly, data is limited to adequately assess trends in age-related harvest criteria over time. Mean age at harvest between 2019-2022 was ≥ 4 for males and ≥ 6 for females (Figure 7) which meets the criteria adopted in 1994 by FWP for sustainable harvest (FWP 1994) although later research questioned the value of using age and sex ratio harvest data to inform management (FWP 2011). Although mean age at harvest and sex composition may not be of significant stand-alone value, they can help inform current and future Integrated Population Modeling (IPM) research, therefore efforts to collect teeth from harvested bears will continue.
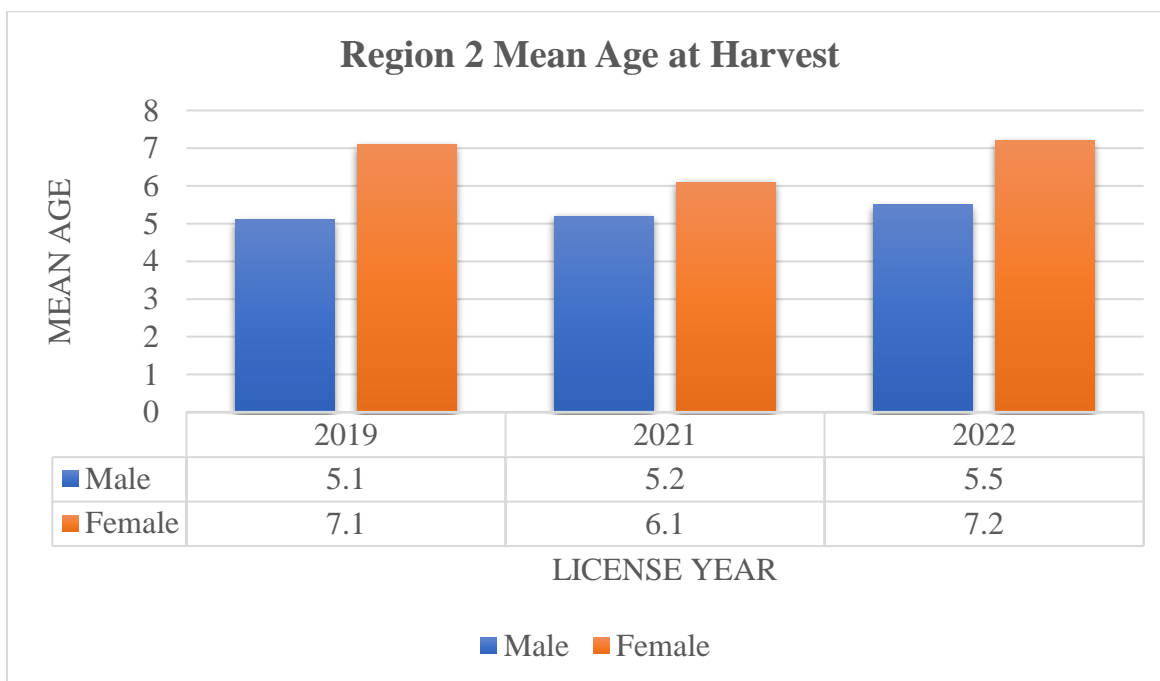

Figure 7. Mean age at harvest for black bears in Region 2.

<u>Region 2 Hound Hunting:</u>

Black bear hunting with the aid of hounds became a legal means of pursuit in the spring of 2022. Hunting with the aid of hounds is only legal during the spring black bear hunting season in portions of 200, 216, and 240 that are not designated as occupied by grizzly bears. Of the 261 black bears harvested in the spring of 2022, 25 (9.5%) were harvested with the aid of hounds. Of those 25, 16 (64%) were male and 9 (36%) were female. Average age determined by tooth cementum analysis of these black bears was $\bar{x} = 7$ (male; $\bar{x}=6.8$, female; $\bar{x}=7.2$; range=2-15). Twenty-one (84%) black bears hunted with hounds were harvested in BMU 200 (male=14, female=7), 3 (12%) were harvested in BMU 216 (male=2, female=1), and 1 (4%) female was harvested in BMU 240. As using the aid of hounds is a relatively new means of hunting black bears, we plan to monitor trends closely. Hunters using hounds can potentially be more selective than still hunters and selection for older age-class and male bears by hunters using hounds has been found in some states (Litvaitis and Kane 1994, Malcolm and Van Deelan 2010). Over time we should be able to gain more insight into any harvest trends related to sex and age class of bears harvested using hounds in Montana.

Individual Bear Management Unit (BMU) Analyses

<u>Changepoint Analysis</u>

We evaluated total, male, and female harvest times series (2010-2022) in each of Region 2's BMUs (200, 216, 240, 280, and 290) for points of structural change of the time series using a regression-based approach. Specifically, we tested if the harvest time series could be explained with a single linear regression model, or if multiple segments of the time series, each with their own regression equation, better fit the harvest data. We used the *StructChange* package in program R and specified a minimum segment length of three consecutive years, which allowed for a maximum of 3 changepoints (i.e., four segments) for the 2010-2022 timeseries. For each time series we evaluated the null model (0 changepoints) against the (optimally located) 1, 2, and 3 changepoint models. We used BIC to select the best supported model and associated changepoint locations.

Although analysis of harvest trends and the detection of changepoints in harvest trends are an important aspect of black bear management, patterns in the numbers of bears harvest alone tell us very little about the status of a population. Additional analyses of harvest data (i.e., age of harvested bears) can provide further insights into population sustainability and trends.

<u>Standardized Harvest Criteria</u>

We present a modified version of the three harvest criteria outlined in the FWP 1994 black bear management plan (1. Percent of females in annual harvest, 2. Median age of hunter harvested females, and 3. Median age of hunter harvested males). Specifically, instead of using median ages, we use age data to classify bears into subadult (<5 years old) and adult (>=5 years old) age classes and summarize the proportion of adult bears in the harvest. Using the proportion of adults rather than median age is consistent with the approaches of neighboring state management criteria (Idaho and Wyoming) and has been shown to be a more sensitive indicator of population dynamics than median age (Idaho Fish and Game, 1998; Wyoming Game and Fish 2007).

Black bear harvest criteria as a management tool is directly related to bears' vulnerability to hunter harvest. Combinations of age-class (adult vs. subadult) and sex provide a well-documented gradient of black bear vulnerability to hunter harvest (Bunnell and Tait 1980, Harris 1984, Kolenosky 1986, Beecham and Rohlman 1994, Koehler and Pierce 2005). The bold behavior and larger home ranges of adult males make them most likely to encounter hunters, and thus, they are most vulnerable to harvest (Bunnell and Tait 1980, Beecham and Rohlman 1994). Subadult males are more vulnerable than subadult females due to larger dispersal distances farther from their natal home range (Beecham and Rohlman 1994, Costello et al. 2001). Adult females are least vulnerable to harvest due to their more cautious behavior, smaller home ranges and the potential to be accompanied by cubs and therefore not available for harvest (Beecham and Rohlman 1994; Figure 8).
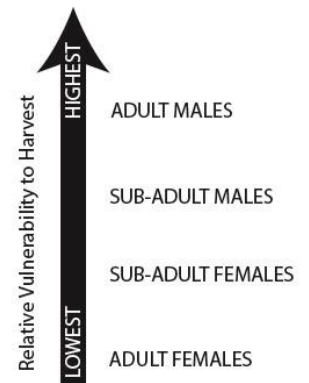
Relative Vulnerability to Harvest

HIGHEST

ADULT MALES

SUB-ADULT MALES

SUB-ADULT FEMALES

LOWEST

ADULT FEMALES

Figure 8. Gradient of harvest vulnerability by sex and age-class

Thus, a high proportion of adult males in the harvest may indicate a lightly harvested population, where recruitment of subadult males into the adult age-class at year $t+1$ is sufficient to offset adult male harvest (and additional non-harvest mortality) during year t. Conversely, a low proportion of adult males may indicate higher levels of harvest have been occurring over time and the adult male population has been depleted and younger individuals represent a larger proportion of the male harvest. A range of 25-35% adult males in the harvest indicates a stable black bear population with moderate to heavy harvest (Beecham and Rohlman 1994, Costello et al. 2001; Table 2). Levels lower than 25% indicate a higher level of harvest, which has reduced the adult male segment of the population. Levels higher than 35% indicate a lighter harvest level (Table 1).

If harvest levels increase above a stable level and remain high, additional adult and subadult males will be removed from the population, and eventually the proportion of females in the harvest will begin to increase (Fraser et al. 1982, Kolenosky 1986, Beecham and Rohlman 1994). Beecham and Rohlman (1994) suggest a target proportion of female harvest of 35% to maintain a stable population. To allow for annual variation we use a range of 30% to 40% females in the total harvest as indicative of a stable black bear population.

Objective	% Adult[1] Males in Total Harvest	% Females in Total Harvest	% Adult[1] Females in Female Harvest
Population Reduction	*< 25%*	*> 40%*	*> 55%*
Stable Population	*25 - 35%*	*30-40%*	*45-55%*
Population Increase	*> 35%*	*<30%*	*< 45%*

[1] >= 5 years old

Table 1. Harvest criteria ranges

Finally, as the proportion of females in the harvest increases, the younger (subadult) females may be removed from the population resulting in an increase in the harvest of older females (Kolenosky 1986, Beecham and Rohlman 1994). This trend can be monitored by tracking the proportion of adults in the *female* harvest. Monitoring this metric is especially important with late-reproducing species like bears since removing adult females not only reduces the number of bears in the population but also decreases the reproductive potential of the population. The delayed response of slow reproducing species to population reductions was noted by Harris (1984) and was demonstrated in modeling efforts by Miller (1990), who predicted black bear populations

reduced by 50% would take an average of 17 years to recover if hunting pressure was reduced by 25% (Wyoming Game and Fish, 2007).

BMU HARVEST RESULTS (BMU 200):

Total Harvest Trend:

This BMU receives the highest amount of harvest of any BMU in Region 2. Hunter Harvest has increased approximately 69% in recent years (> 2019). A changepoint analysis supported a significant change in harvest patterns for total bears and males between 2019-2020, and females between 2018-2019 (Figure 9, Table 2).
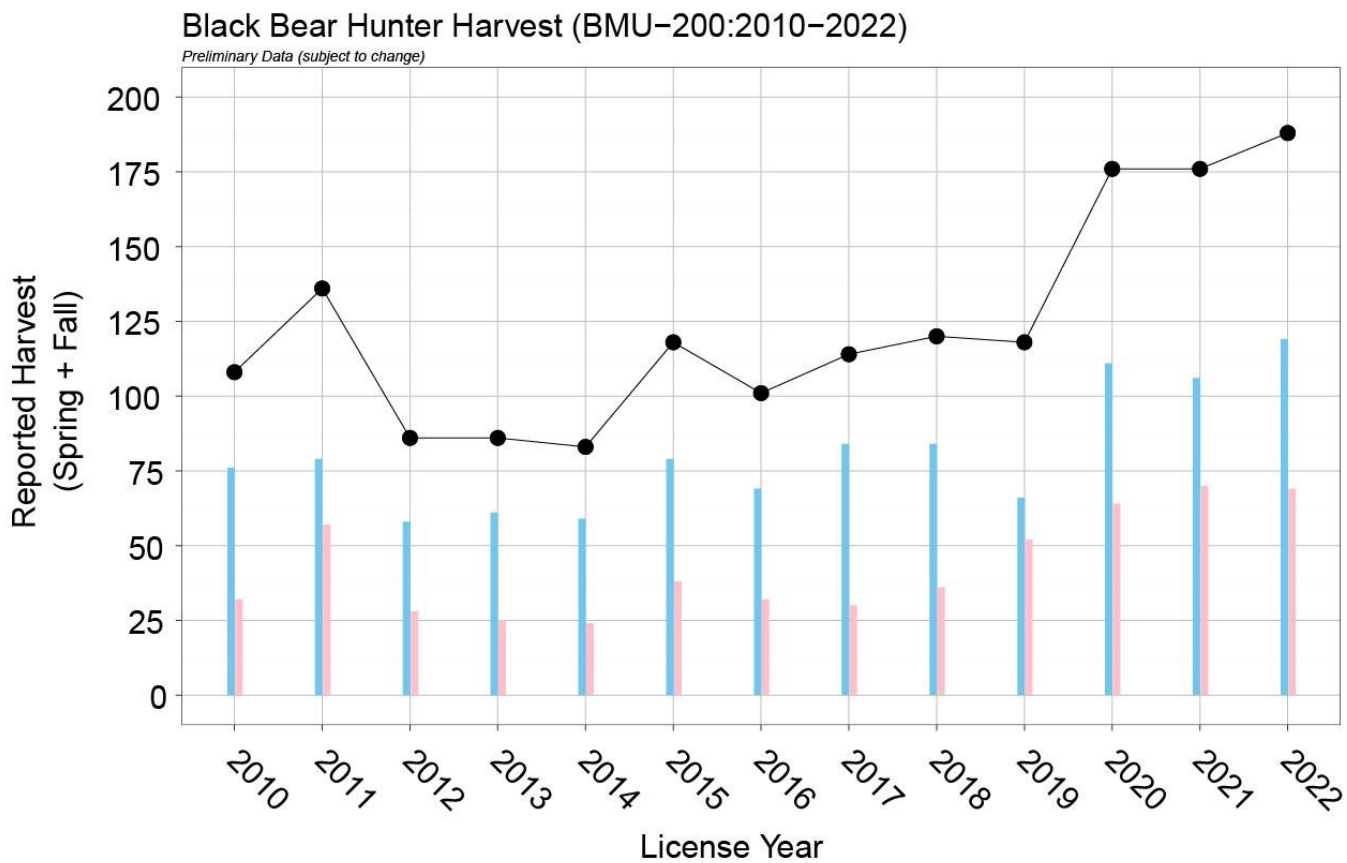

Figure 9. Male, female, and total black bear harvest in BMU 200 (2010-2022). Black points and lines indicate total reported hunter harvest and colored bars represent annual female (pink) and male (blue) harvest. A changepoint analysis indicated statistical support for a change in total and male harvest between license years 2019 and 2020, and a change in female harvest between license years 2018 and 2019 (see Table 2).

BMU	Cohort Model	BIC for modeled Changepoints (m)				Breakdates (Top Model)
		0	1	2	3	
200	Total Harvest	133.85	**117.41**	119.98	123.79	2019
200	Male Harvest	118.88	**103.82**	105.45	111.10	2019
200	Female Harvest	114.83	**103.52**	106.77	111.59	2018

Table 2. Changepoint Analysis Model Results (BMU 200)

* Location refers to the License Year immediately prior to the change. For example, if the changepoint location is 2018, the changepoint occurred between the 2018 and 2019 license years.

Spring & Fall Harvest Trends:

Drivers of the overall harvest trend (Figure 9) are reflected in the season cumulative harvest by day of season. The 2022 spring season was the second highest total spring harvest in BMU 200 with 26% of the harvest occurring in the late spring season from June 1st to June 15th (Figure 10).
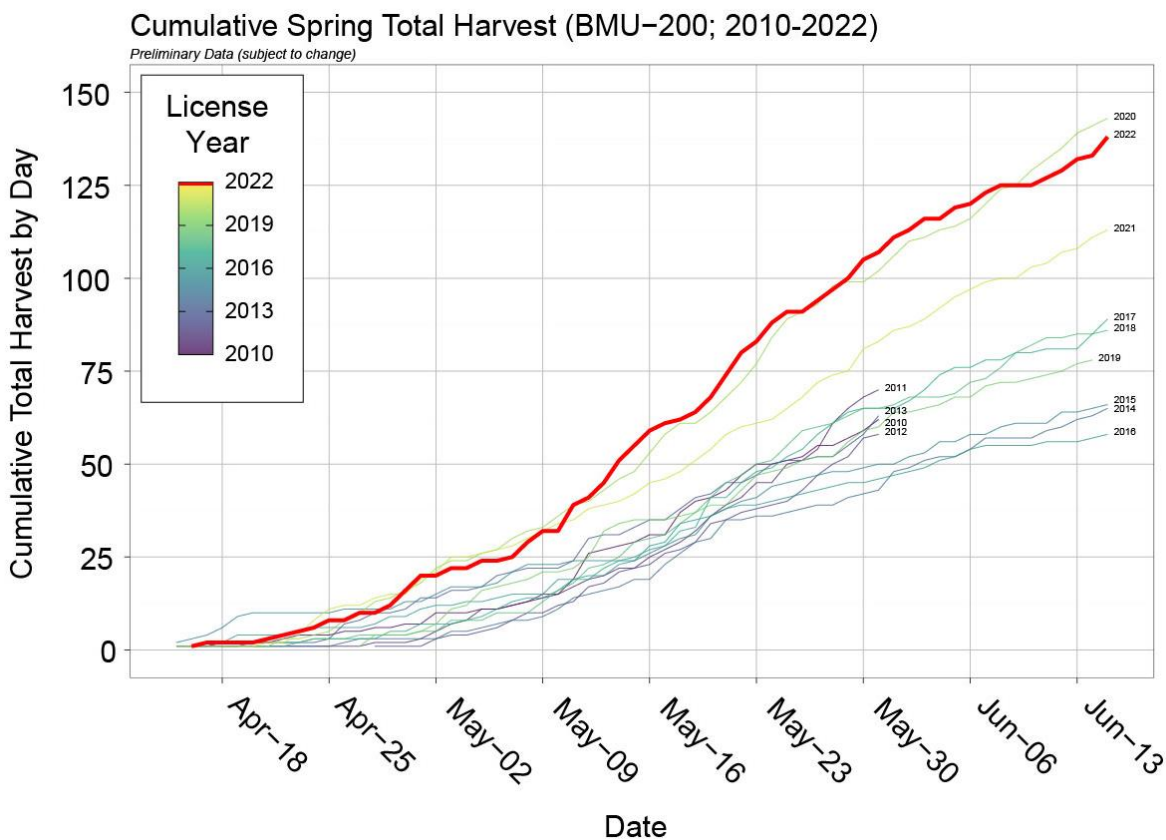

Figure 10. Cumulative daily spring harvest in BMU 200 (2010-2022). Thin colored lines show the daily cumulative harvest, and the bold red line shows indicates the most recent license year (2022). Note that harvest trend lines end on last reported harvest and therefore the 2014 change in Spring Season ending date (5/31 to 6/15) is evident.

Fall harvest during 2022 did not show a fundamentally different pattern in cumulative harvest through the season relative to other years in the 2010-2022 time period (Figure 11), suggesting that spring season drove the increase in total annual harvest.
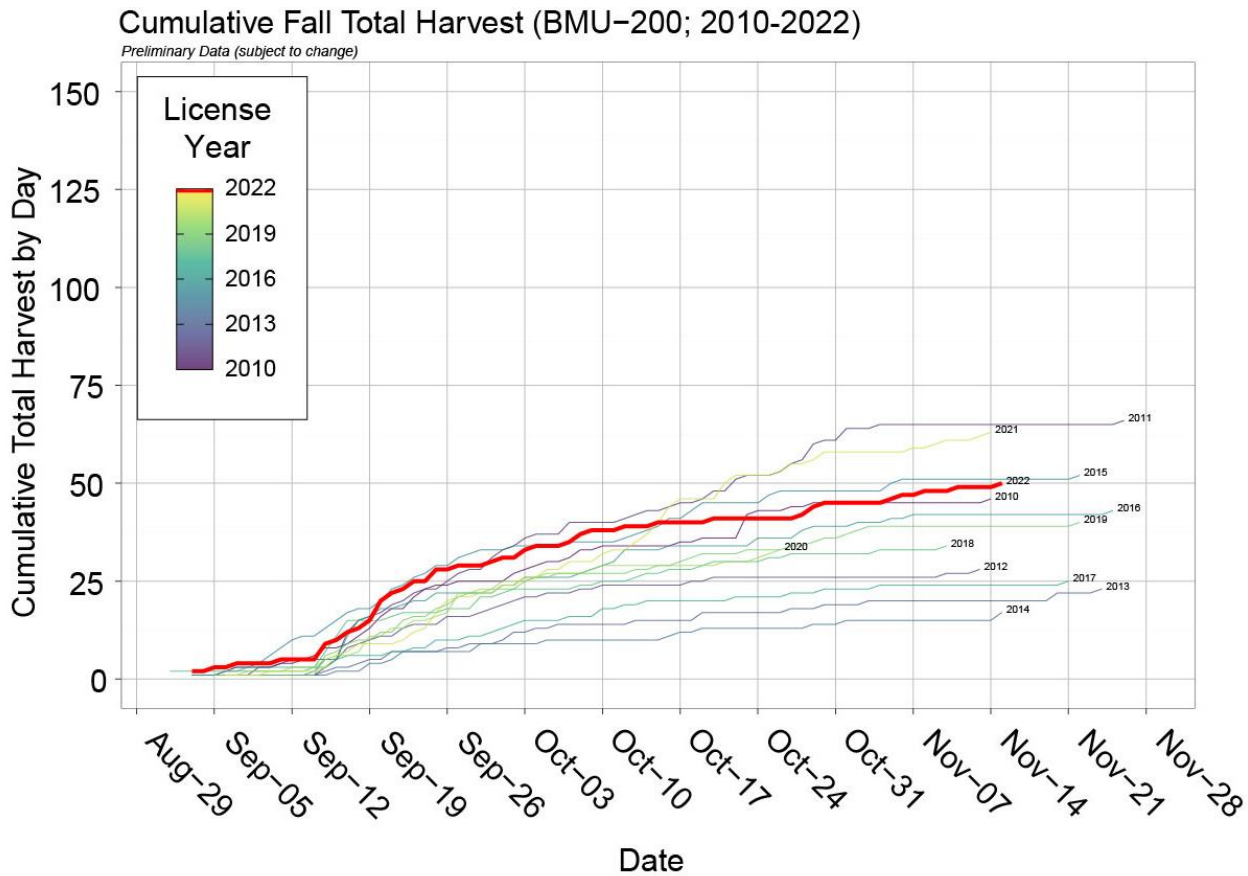

Figure 11. Cumulative daily fall harvest in BMU 200 (2010-2022). Thin colored lines show the daily cumulative harvest, and the bold red line shows license year 2022. Note that harvest lines end on the date of last reported harvest and therefore the season lines have different end dates. For all years the fall season runs through the duration of the General Rifle Season for deer and elk.

The 3-year moving average of the percent females in the total annual harvest has been mostly within the stable range (30-40%) during the 2010-2022 period. Before 2019 the 3-year average was at, or below the target value of 35%. After 2018 the percent of females has been steadily increasing and is currently at the upper end of the range (Figure 12). This pattern is consistent with the changepoint analysis for females and its support for a 2018-2019 changepoint with an increasing trend after this period.

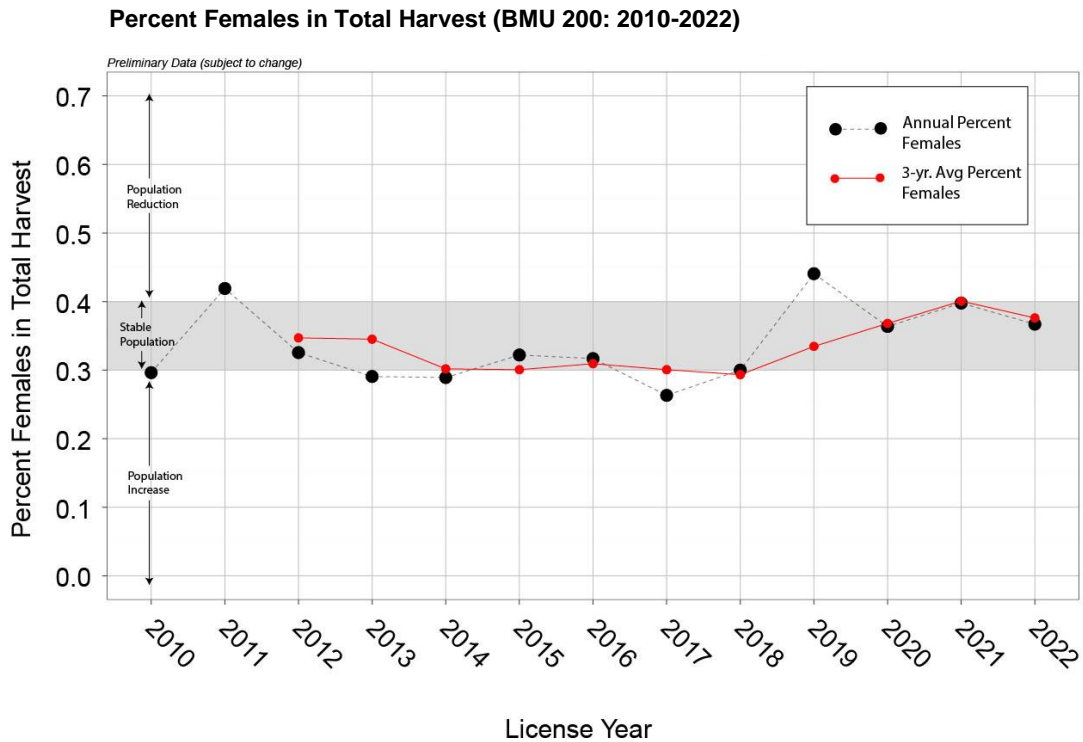**Percent Females in Total Harvest (BMU 200: 2010-2022)**

Figure 12. Percent Females in the total annual black bear harvest in BMU 200 (2010-2022). Points and dashed lines indicate proportion of total reported hunter harvest that were females. The red points and solid line show the 3-year moving average of percent females to account for annual variation in harvest. The grey shaded region shows the range of proportions associated with population reduction, stability, and population increase (Table 1).

The 3-year average of the percent of adult males in the total harvest is within the stable range ($\bar{x} = 27\%; Table\ 3$). The 3-year average of percent females in the total harvest is within the stable population range ($\bar{x} = 38\%; Table\ 3$). The 3-year average of the percent of adult females in the female harvest is within the stable population range ($\bar{x} = 53\%; Table\ 3$).

Harvest Criteria

Year	Objective	% Adult[1] Males in Total Harvest	% Females in Total Harvest	% Adult[1] Females in Female Harvest
	Population Reduction	< 25%	> 40%	> 55%
	Stable Population	25-35%	30-40%	45-55%
	Population Increase	> 35%	<30%	< 45%
2019		27%	44%	58%
2020*		-	36%	-
2021		23%	40%	37%
2022		31%	37%	64%
3-year Avg.		27%	38%	53%

[1] >= 5 years old

Table 3. Harvest Criteria and current status for BMU 200

BMU HARVEST RESULTS (BMU 216):

Total Harvest Trend:

This BMU receives a moderate amount of harvest compared to other BMUs in Region 2. Hunter Harvest has been relatively stable, or minorly cyclical, from 2010-2021. The total harvest for license year 2022 (136) represents a 67% increase (66% Males; 91% Females) from the 2010-2022 average harvest ($\bar{x} = 81$). Because we used a minimum segment length of 3 years for changepoint analyses, this increase in harvest was not supported as a significant change. Changepoints were selected for 2014-2015 (males), 2015-2016 (females) and 2016-2017 (total; Figure 13, Table 4).
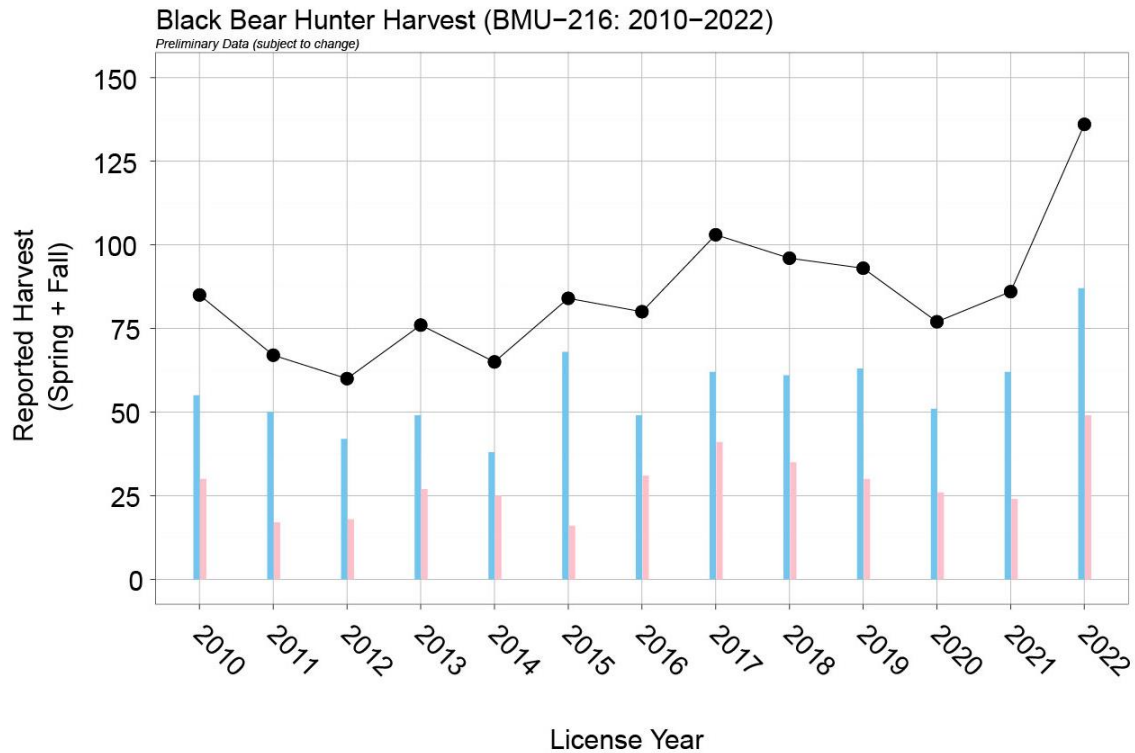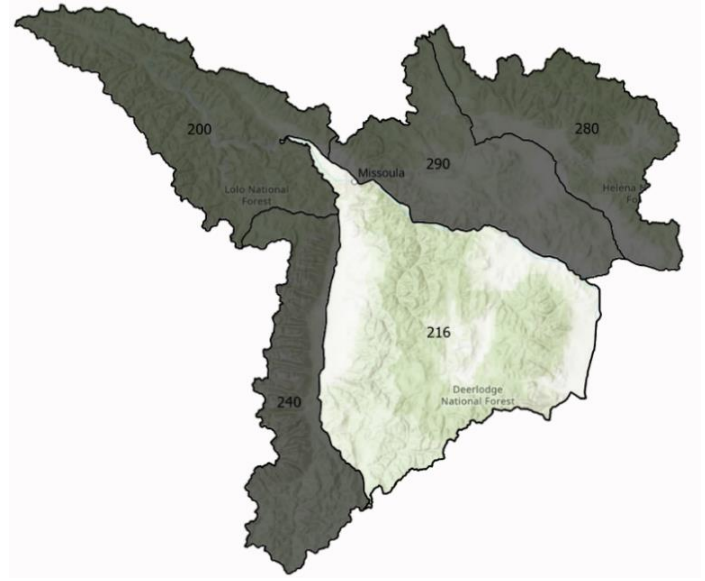

Figure 13. Male, female, and total black bear harvest in BMU 216 (2010-2022). Black points and lines indicate total reported hunter harvest and colored bars represent annual female (pink) and male (blue) harvest. A changepoint analysis indicated statistical support for a change in total harvest between license years 2019 and 2020, and a change male harvest between license years 2013 and 2014, and changes in female harvest between license years 2014 and 2015 and subsequently in license years 2018-2019 (see Table 4).

BMU	Cohort Model	BIC for modeled Changepoints (m)				Changepoint Location (Top Model)
		0	1	2	3	
216	Total Harvest	118.40	**116.37**	121.23	126.32	2016
216	Male Harvest	106.99	**105.19**	109.50	116.55	2014
216	Female Harvest	99.35	**97.77**	102.49	107.59	2015

Table 4. Changepoint Analysis Model Results (BMU 216)

* Location refers to the license year immediately prior to the change. For example, if the changepoint location is 2018, the changepoint occurred between the 2018 and 2019 license years.

All the top supported models for the changepoint analysis selected a single changepoint but were within 2 BIC unit of the model with zero changepoints suggesting minimal difference in support between these models. These results are evident in the timeseries plot (Figure 13).

Spring & Fall Harvest Trends:

Drivers of overall harvest are reflected in cumulative harvest by day of season. The 2022 spring season was the highest total spring harvest in BMU 216 (2010-2022) and with 2017, 2018, and 2019 explain the high points in the total harvest timeseries (Figure 14).
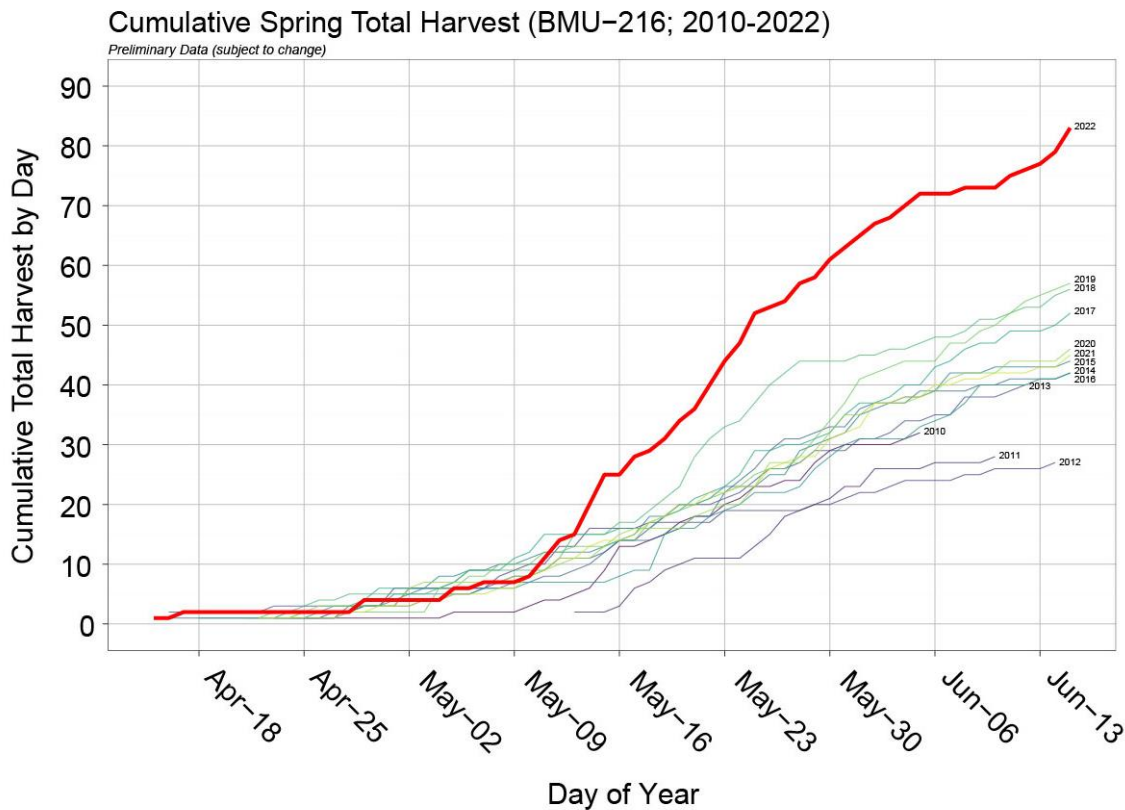

Figure 14. Cumulative daily spring harvest in BMU 240 (2010-2022). Thin colored lines show the daily cumulative harvest for License Years 2010-2021, and the bold red line shows license year 2022. Note that harvest trend lines end on last reported harvest Spring Season ending date and reflect the variable spring season end dates (5/31 to 6/15) that have occurred portions of this district during the 2010-2022 period.

Fall harvest during 2022 in BMU 216 (Figure 15) was tied highest recorded seasonal harvest (2010-2022), with 83% of the Fall harvest occurring before the general rifle opener on October 23rd. Record spring and fall years during 2022 in this BMU explain the large increase in total annual harvest for license year 2022.
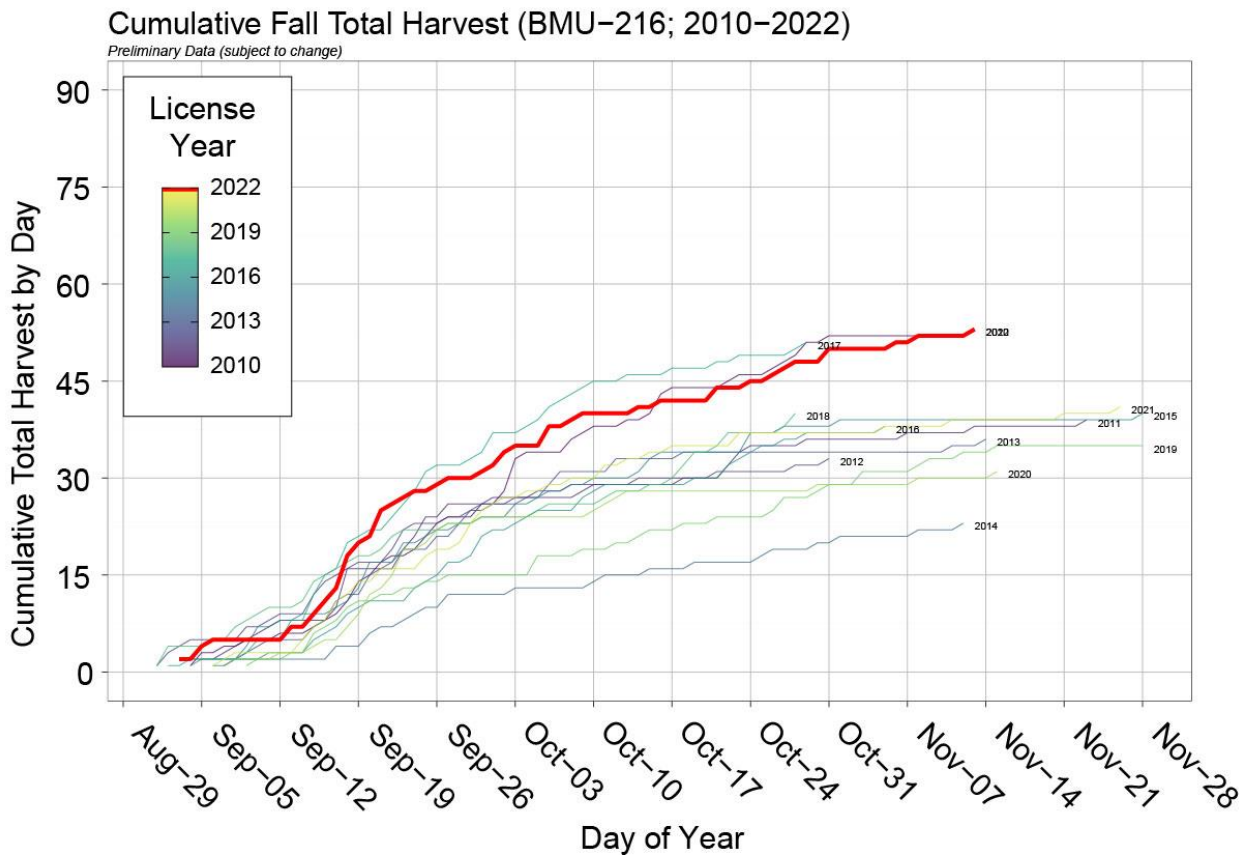

Figure 15. Cumulative daily fall harvest in BMU 216 (2010-2022). Thin colored lines show the daily cumulative harvest, and the bold red line shows license year 2022. Note that harvest lines end on the date of last reported harvest and therefore the plotted lines have different end dates. Fall season runs through the duration of the General Rifle Season for deer and elk.

Standardized Harvest Criteria:

The 3-year moving average of the percent females in the total annual harvest in BMU 240 has been within the stable range (30-40%) during the 2010-2022 period (Figure 16).
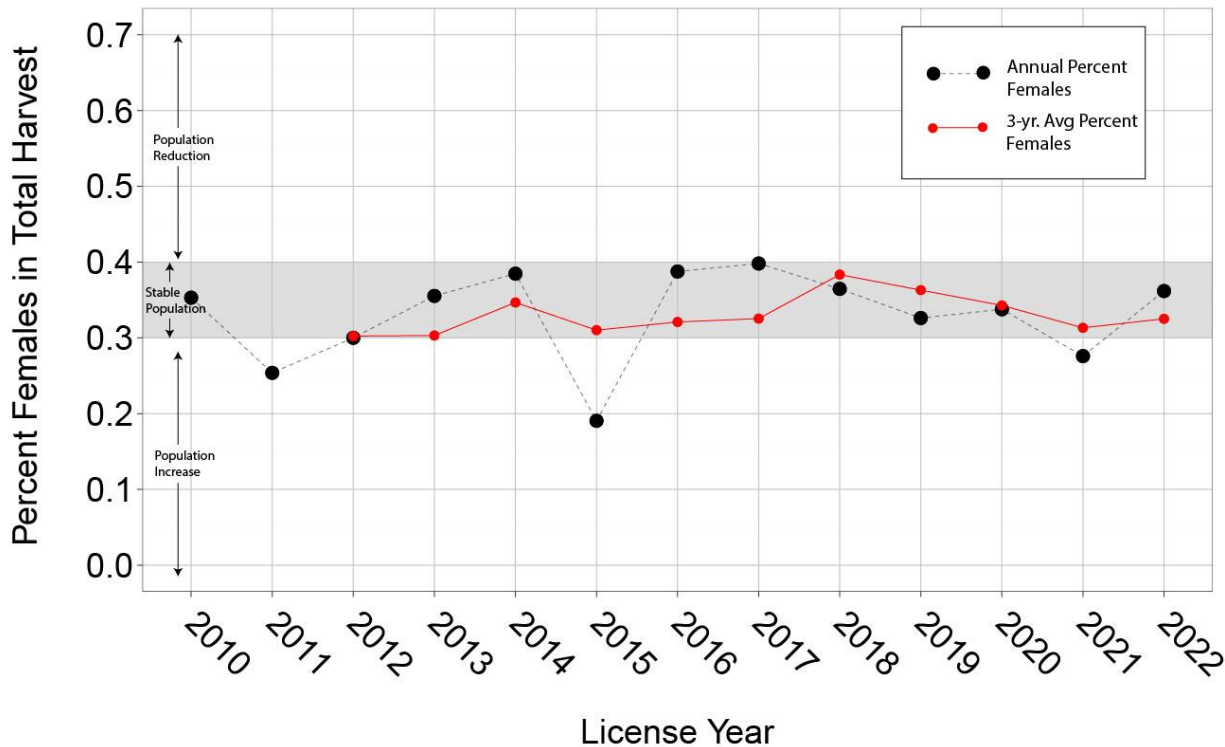
Figure 16. Percent Females in the total annual black bear harvest in BMU 216 (2010-2022). Points and dashed lines indicate proportion of total reported hunter harvest that were females. The red points and solid line show the 3-year moving average of percent females to account for annual variation in harvest. The grey shaded region shows the range of proportions associated with population reduction, stability, and population increase (Table 5).

The 3-year average of the percent of adult males in the total harvest is in the population reduction range ($\bar{x} = 23\%$; $Table\ 5$). The 3-year average of percent females in the total harvest is near the lower limit of the stable population range ($\bar{x} = 32\%$; $Table\ 5$). The 3-year average of the percent of adult females in the female harvest is within the stable population range ($\bar{x} = 52\%$; Table 5).

|		Harvest Criteria		
Year	Objective	% Adult[1] Males in Total Harvest	% Females in Total Harvest	% Adult[1] Females in Total Harvest
	Population Reduction	*< 25%*	*> 40%*	*> 55%*
	Stable Population	*25 - 35%*	*30-40%*	*45-55%*
	Population Increase	*> 35%*	*<30%*	*< 45%*
2019		19%	32%	68%
2020		-	34%	-
2021		21%	28%	35%
2022		29%	34%	53%
3 yr Avg.		23%	32%	52%

[1] >= 5 years old

Table 5. Harvest Criteria and current status for BMU 216

BMU HARVEST RESULTS (BMU 240):

Total Harvest Trend:

This BMU receives a low to moderate amount of harvest compared to other BMUs in Region 2. Hunter Harvest has increased approximately 110% in recent years (> 2019). A changepoint analysis supported a significant change in harvest patterns for total, males, and females between 2019-2020 (Figure 17, Table 6).
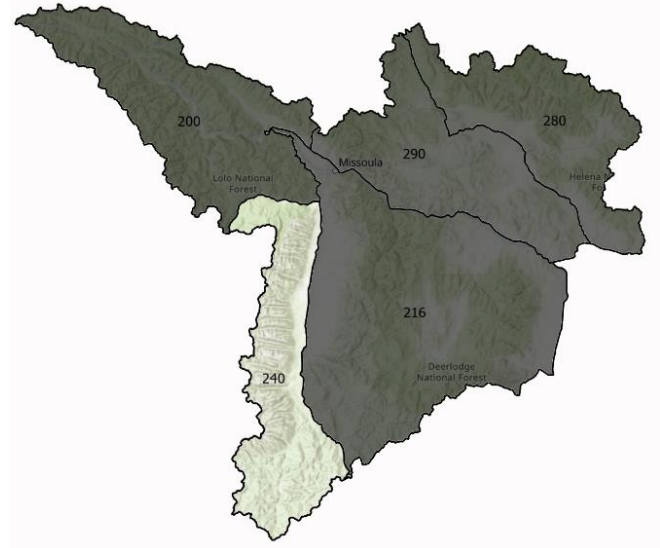
Black Bear Hunter Harvest (BMU−240:2010−2022)
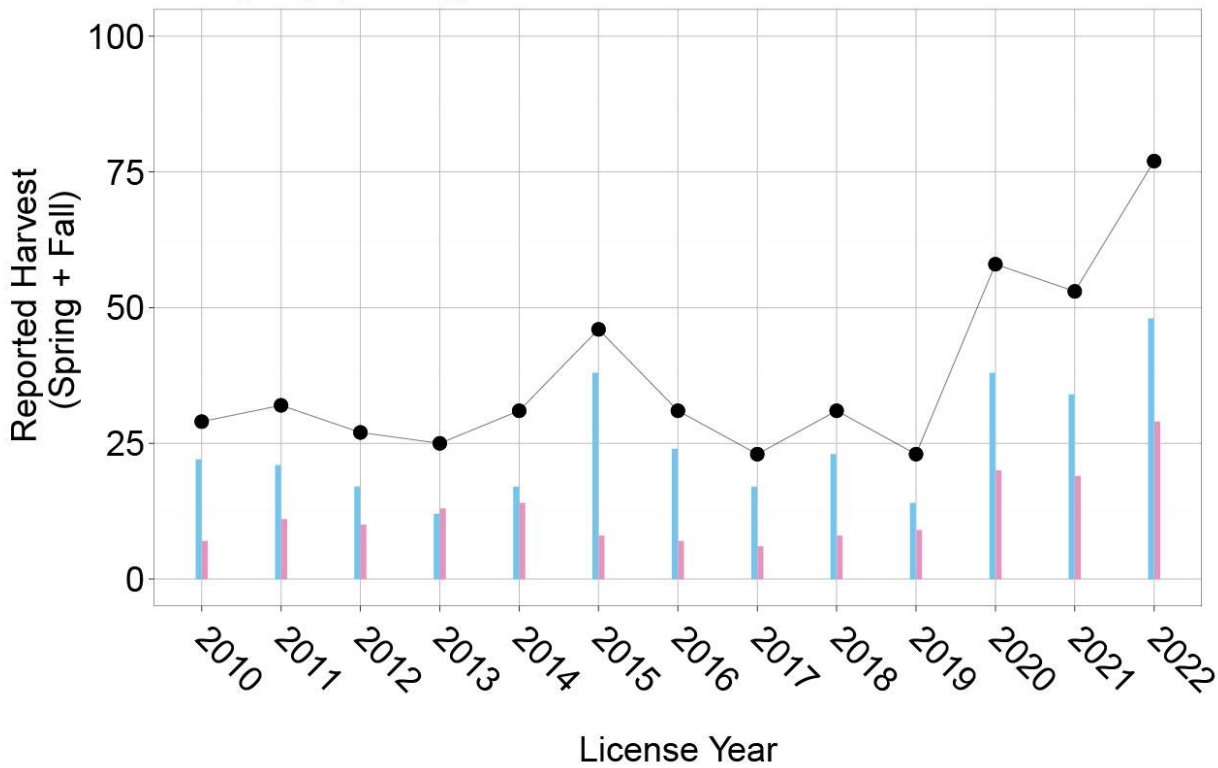
Preliminary Data (subject to change)

Figure 17. Male, female, and total black bear harvest in BMU 240 (2010-2022). Black points and dashed lines indicate total reported hunter harvest and colored bars represent annual female (pink) and male (blue) harvest. A changepoint analysis indicated statistical support for a change in total, male, and female black bear harvest between license years 2019 and 2020 (see Table 6).

BMU	Cohort Model	BIC for modeled Changepoints (m)				Changepoint Location (Top Model)
		0	1	2	3	
240	Total Harvest	113.6366	**99.27054**	102.9986	105.8601	2019
240	Male Harvest	103.3985	**96.58314**	99.9749	103.0969	2019
240	Female Harvest	90.3978	**76.55165**	78.25621	83.26805	2019

Table 6. Changepoint Analysis Model Results (BMU 240)

* Location refers to the license year immediately prior to the change. For example, is the changepoint location is 2018, the changepoint occurred between the 2018 and 2019 license years.

Spring & Fall Harvest Trends:

Drivers of the overall harvest trend (Figure 9) are reflected in the season cumulative harvest by day of season. The 2022 spring season was tied the highest total spring harvest in BMU 240 and in combination with 2020 and 2021 represent the three highest years of spring harvest (Figure 18).
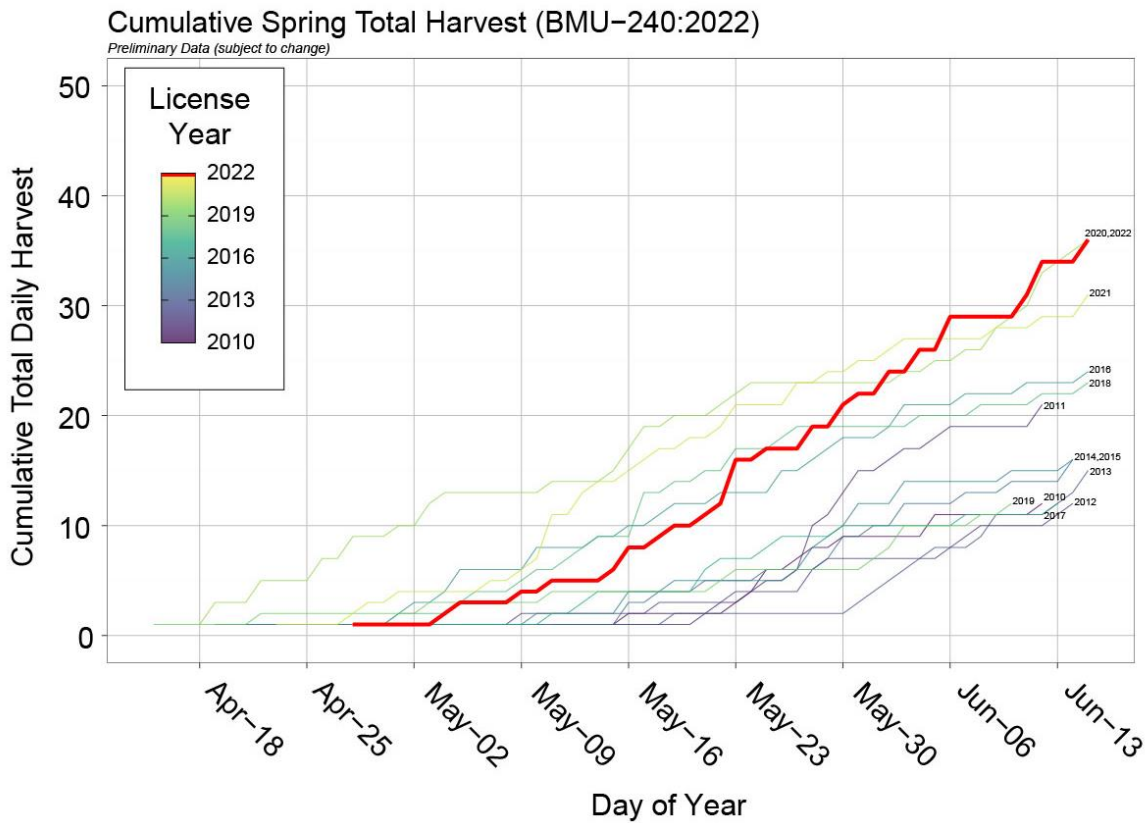

Figure 18. Cumulative daily spring harvest in BMU 240 (2010-2022). Thin colored lines show the daily cumulative harvest for License Years 2010-2021, and the bold red line shows license year 2022.

Fall harvest during 2022 in BMU 240 was the highest recorded seasonal harvest (2010-2022), with between 2-4 times the level during other years in the 2010-2022 time period, except perhaps for license year 2015 (Figure 19). These high fall harvest years (2015 and 2022) in this BMU explain the peaks in total annual harvest.
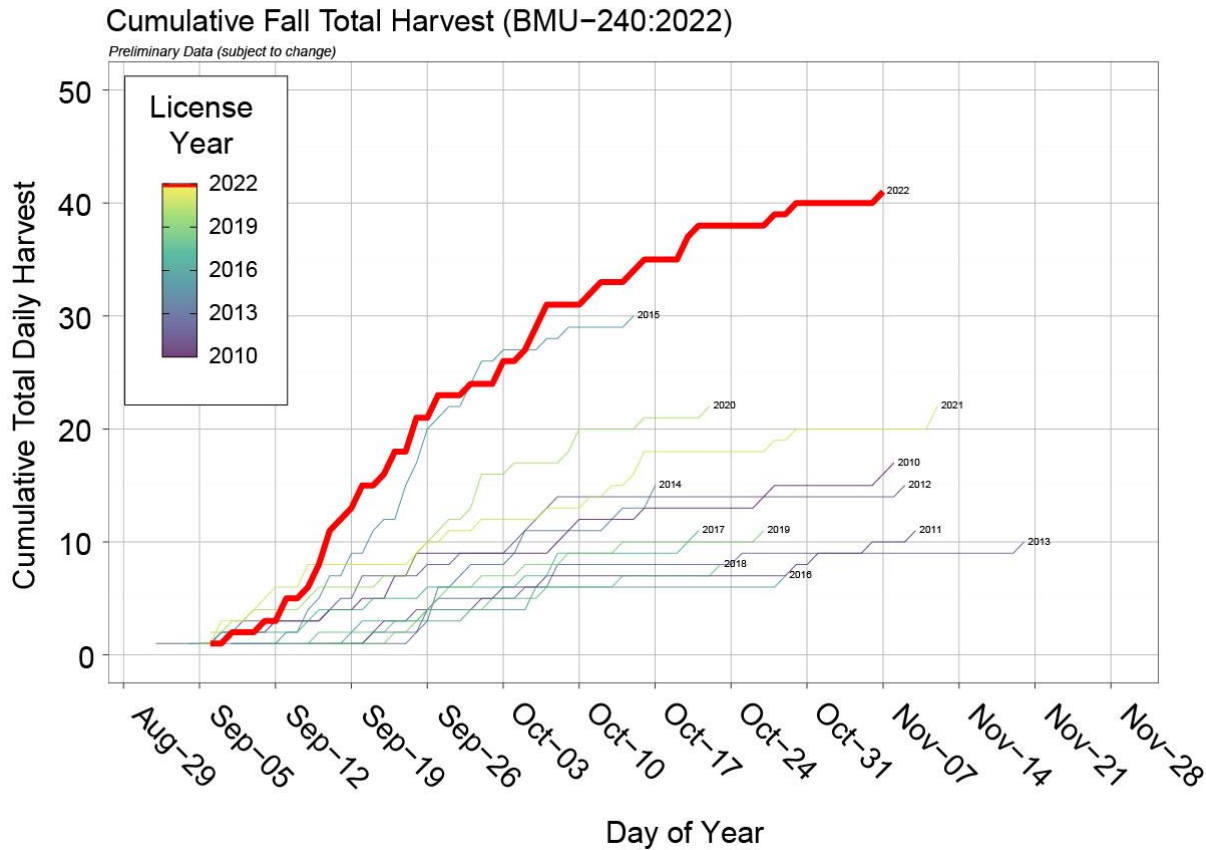

Figure 19. Cumulative daily fall harvest in BMU 240 (2010-2022). Thin colored lines show the daily cumulative harvest, and the bold red line shows license year 2022. Note that harvest lines end on the date of last reported harvest and therefore the season lines have different end dates. Fall season runs through the duration of the General Rifle Season for deer and elk.

Standardized Harvest Criteria:

The 3-year moving average of the percent females in the total annual harvest in BMU 240 has cycled between being above and below the stable range (30-40%) during the 2010-2022 period but has been within the 30-40% range since 2019. The high harvest of females during 2013 and 2014 may have driven the subsequent rapid drop in 2015, though the proportion of females in the harvest has been trending upward after the 2015 low point. (Figure 20). This pattern is consistent with the changepoint analysis for females and its support for a 2019-2020 changepoint with increasing trend after this period.

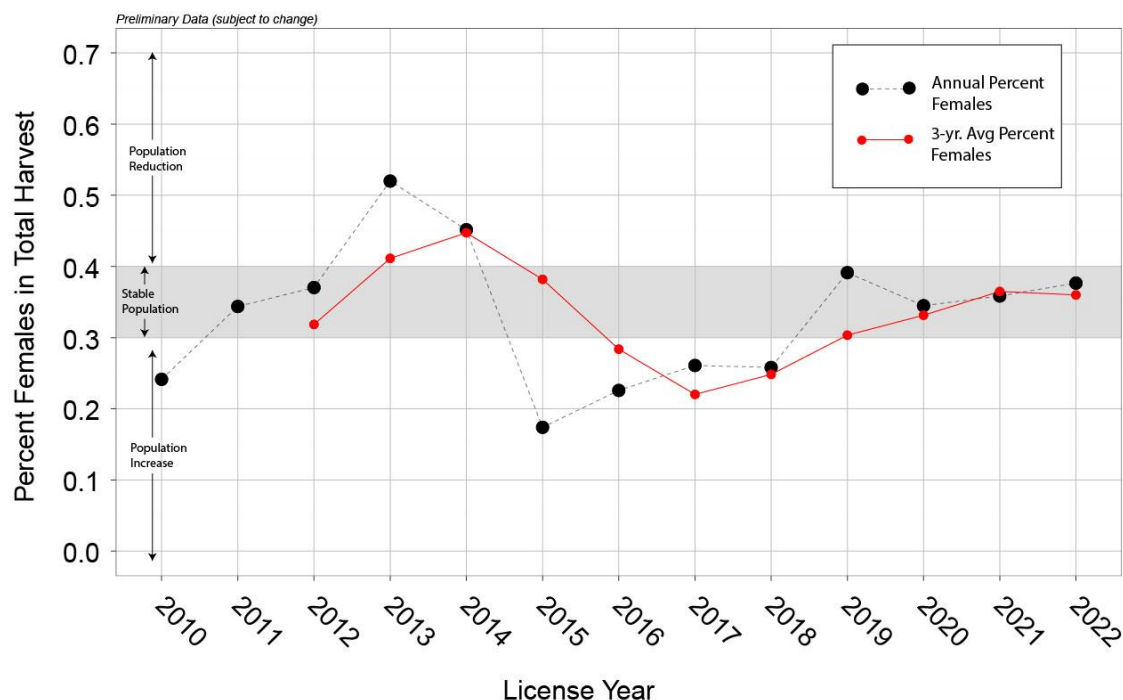## Percent Females Total in Harvest (BMU-240:2010-2022)

Figure 20. Percent Females in the total annual black bear harvest in BMU 240 (2010-2022). Points and dashed lines indicate proportion of total reported hunter harvest that were females. The red points and solid line show the 3-year moving average of percent females to account for annual variation in harvest. The grey shaded region shows the range of proportions associated with population reduction, stability, and population increase.

Small sample sizes of aged bears (males 2019 = 10, females 2019 = 7) warrant caution when interpreting the proportion of adults in the harvest (Table 7). The 3-year average of the percent of adult males in the total harvest is within the stable population range ($\bar{x} = 28\%; Table\ 7$). The 3-year average of percent females in the total harvest is within the stable population range ($\bar{x} = 37\%; Table\ 9$). The 3-year average of the percent of adult females in the female harvest is at the upper end of the population increase range ($\bar{x} = 44\%; Table\ 9$).

Year	Objective	% Adult[1] Males in Total Harvest	% Females in Total Harvest	% Adult[1] Females in Total Harvest
			Harvest Criteria	
	Population Reduction	< 25%	> 40%	> 55%
	Stable Population	25 - 35%	30-40%	45-55%
	Population Increase	> 35%	<30%	< 45%
2019		22%	39%	29%
2020		-	35%	-
2021		28%	36%	65%
2022		34%	39%	39%
3 yr Avg.		28%	37%	44%

[1] >= 5 years old

Table 7. Harvest Criteria and current status for BMU 240

BMU HARVEST RESULTS (BMU 280):

Total Harvest Trend:

This BMU receives a moderate amount of harvest compared to other BMUs in Region 2. Hunter black bear harvest has increased approximately 66% in recent years (> 2018; $\bar{x}_{2010-18} = 31.1; \bar{x}_{2019-22} = 51.8$). A changepoint analysis supported a significant change in harvest patterns for total and male bears between 2018-2019 and for female bears between 2019-2020 (Figure 21, Table 8).
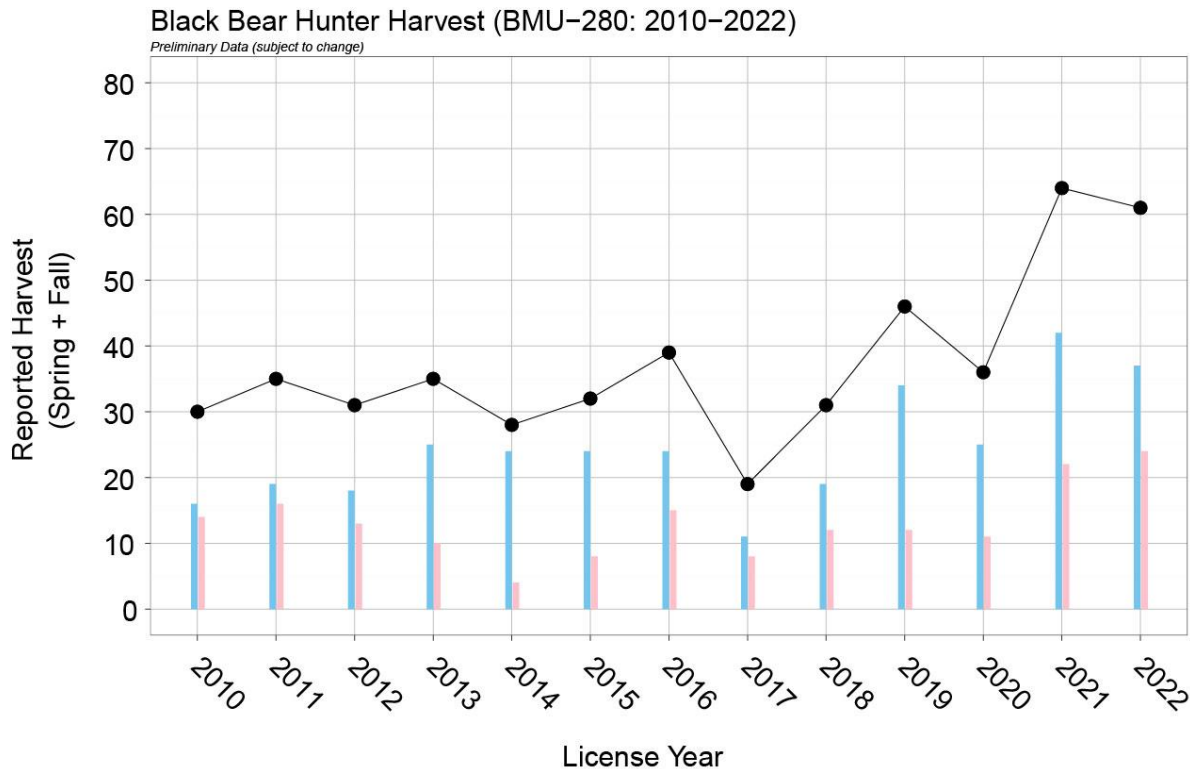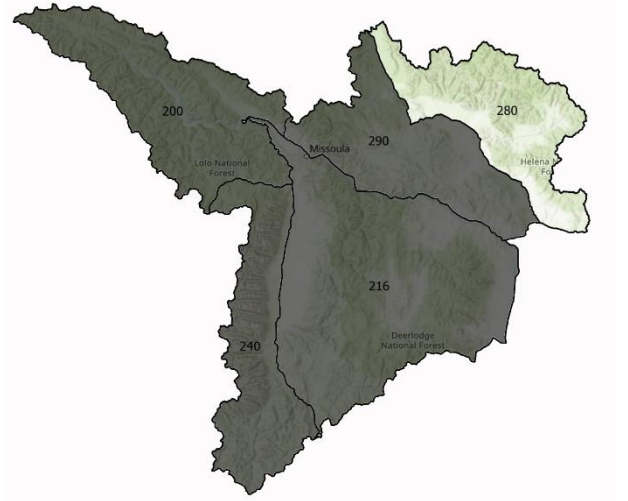

Figure 21. Male, female, and total black bear harvest in BMU 280 (2010-2022). Black points and dashed lines indicate total reported hunter harvest and colored bars represent annual female (pink) and male (blue) harvest. A changepoint analysis indicated statistical support for a change in total harvest between license years 2018 and 2019, and a change male harvest between license years 2018 and 2019, and a change in female harvest between license years 2019 and 2020 (see Table 8).

BMU	Cohort Model	BIC for modeled Changepoints (m)				Changepoint Location (Top Model)
		0	1	2	3	
280	Total Harvest	107.14	**100.17**	104.97	110.27	2018
280	Male Harvest	97.27	**89.16**	93.28	95.55	2018
280	Female Harvest	85.27	**84.02**	86.41	88.86	2019

Table 8. Changepoint Analysis Model Results (BMU 280)

* Location refers to the license year immediately prior to the change. For example, is the changepoint location is 2018, the changepoint occurred between the 2018 and 2019 license years.

Spring & Fall Harvest Trends:

Drivers of the overall harvest are reflected in the seasonal cumulative harvest by day. The 2022 spring season was the second highest total spring harvest in BMU 280 and in combination with 2019 and 2021 follow the pattern in total harvest (Figure 22). Although these years were the highest on record, they are not fundamentally different from other years in the time series relative to cumulative increase over the season.
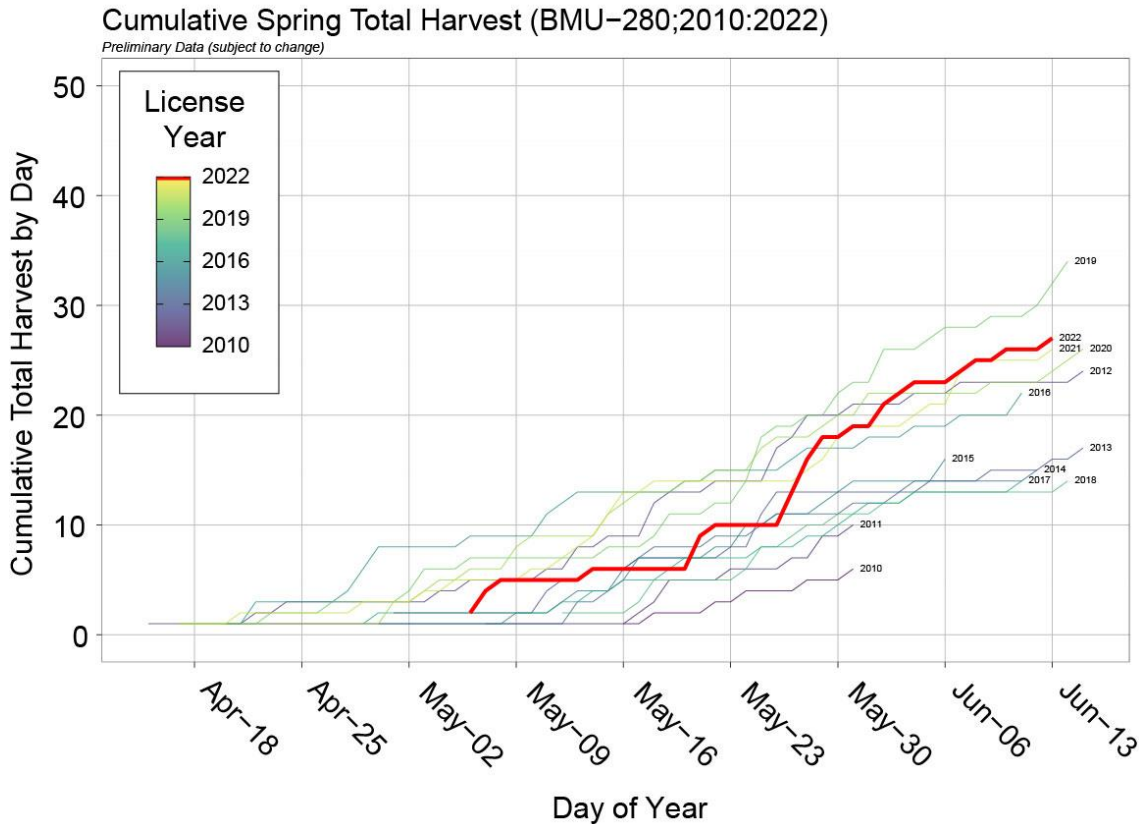

Figure 22. Cumulative daily spring harvest in BMU 280 (2010-2022). Thin colored lines show the daily cumulative harvest for License Years 2010-2021, and the bold red line shows license year 2022. Note that harvest trend lines end on last reported harvest and therefore the 2012 change in Spring Season ending date (5/31 to 6/15) is evident.

Conversely, fall harvest during 2021 and 2022 in BMU 280 show fundamentally different patterns in both the overall harvest level and time of season compared to other years in the 2010-2022 time series (Figure 23). These high fall harvest years (2021 and 2022) in this BMU explain the marked jump in total annual harvest and may be attributed to the increased vulnerability to harvest during poor food years when bears are in hyperphagia.
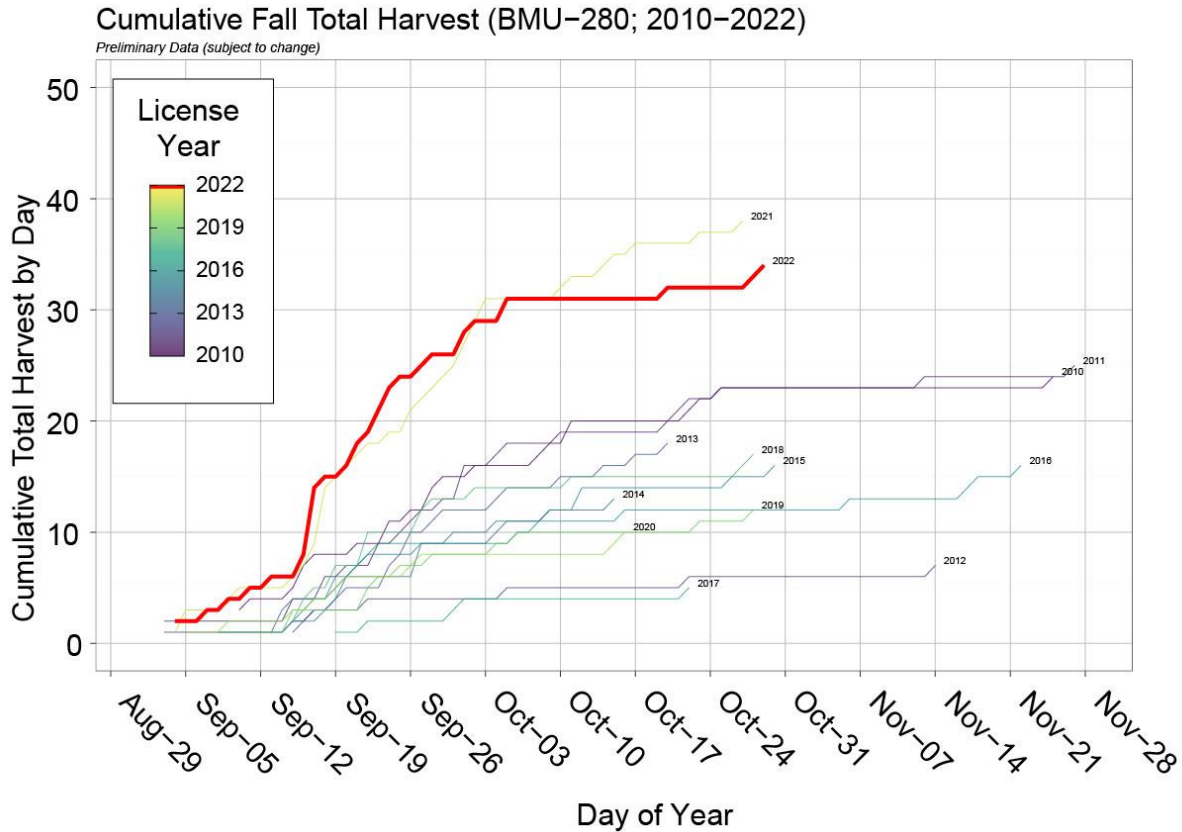

Figure 23. Cumulative daily fall harvest in BMU 280 (2010-2022). Thin colored lines show the daily cumulative harvest, and the bold red line shows license year 2022. Note that harvest lines end on the date of last reported harvest and therefore the season lines have different end dates. Fall season runs through the duration of the General Rifle Season for deer and elk.

Standardized Harvest Criteria:

The 3-year moving average of the percent females in the total annual harvest in BMU 280 has cycled between being above and below the stable range (30-40%) during the 2010-2022 period but has been within the 30-40% range since 2017. The recent increase in total harvest beginning in 2021 is reflected by the increasing trend in the percent females in total harvest (Figure 24).
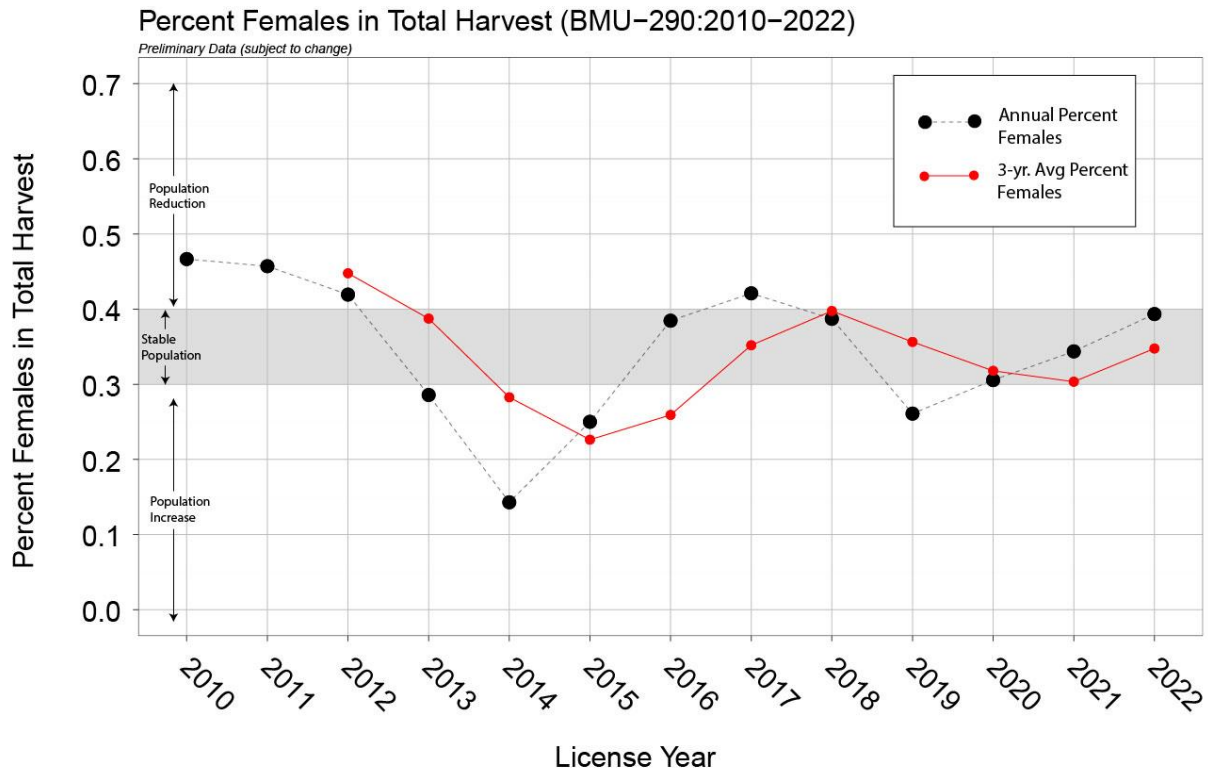
Figure 24. Percent Females in the total annual black bear harvest in BMU 280 (2010-2022). Points and dashed lines indicate proportion of total reported hunter harvest that were females. The red points and solid line show the 3-year moving average of percent females to account for annual variation in harvest. The grey shaded region shows the range of proportions associated with population reduction, stability, and population increase (Table 9).

Small sample sizes of aged bears warrant caution when interpreting the proportion of adults in the harvest (Table 9). The 3-year average of the percent of adult males in the total harvest is within the stable range ($\bar{x} = 34\%; Table\ 9$). The 3-year average of percent females in the total harvest is within the stable population range ($\bar{x} = 30\%; Table\ 9$). The 3-year average of the percent of adult females in the female harvest is at the upper end of the stable population range ($\bar{x} = 53\%; Table\ 9$).

		Harvest Criteria		
Year	Objective	% Adult[1] Males in Total Harvest	% Females in Total Harvest	% Adult[1] Females in Total Harvest
	Population Reduction	< 25%	> 40%	> 55%
	Stable Population	25 - 35%	30-40%	45-55%
	Population Increase	> 35%	<30%	< 45%
2019		43%	26%	75%
2020		-	31%	-
2021		25%	34%	30%
2022		26%	42%	59%
3 yr Avg.		31%	36%	55%

[1] >= 5 years old
Table 9. Harvest Criteria and current status for BMU 280

BMU HARVEST RESULTS (BMU 290):

Total Harvest Trend:

This BMU receives a moderate amount of harvest compared to other BMUs in Region 2. Hunter black bear harvest has slowly increased from approximately 50 in 2014 to just over 75 in 2020. The 2021-2022 average total harvest represents a 47% increase in recent years ($\bar{x}_{2018-20} = 74; \bar{x}_{2021-22} = 109$). A changepoint analysis supported a significant change in harvest patterns for total and male bears between 2019-2020) and no changepoints were detected for female bears (Figure 25, Table 10).
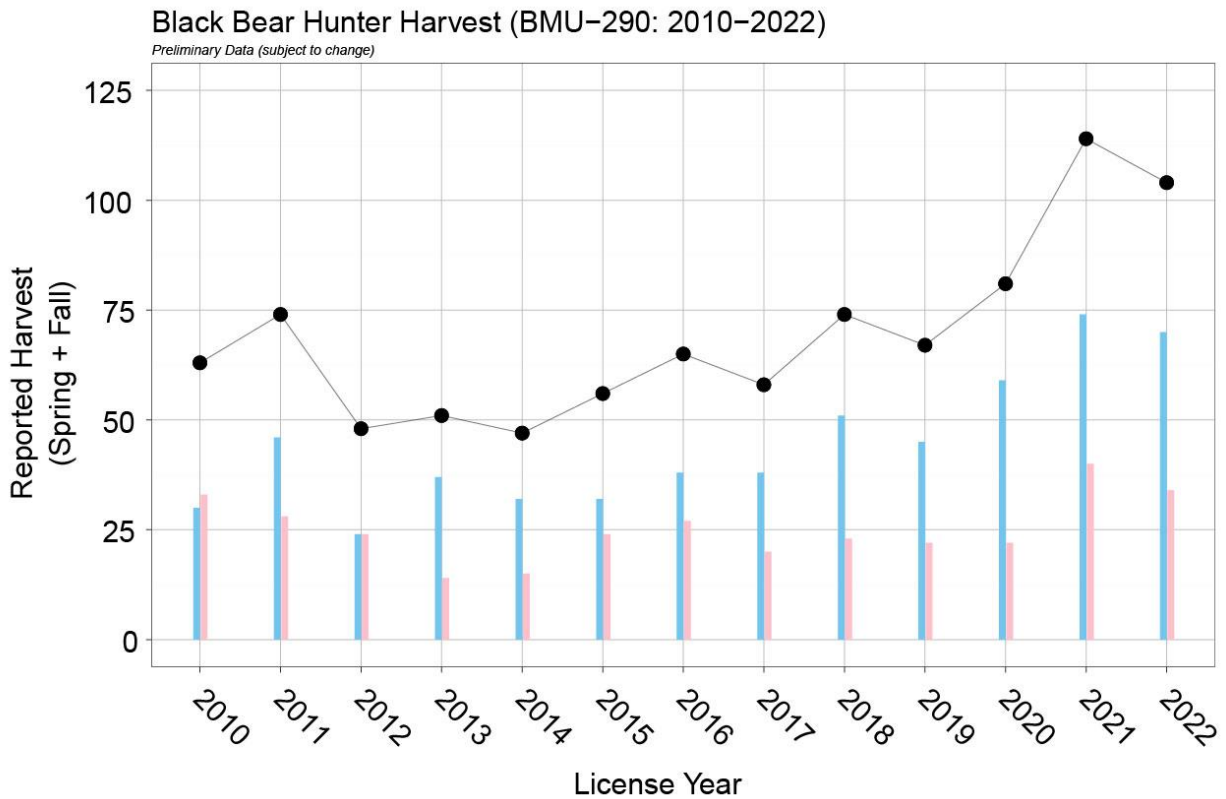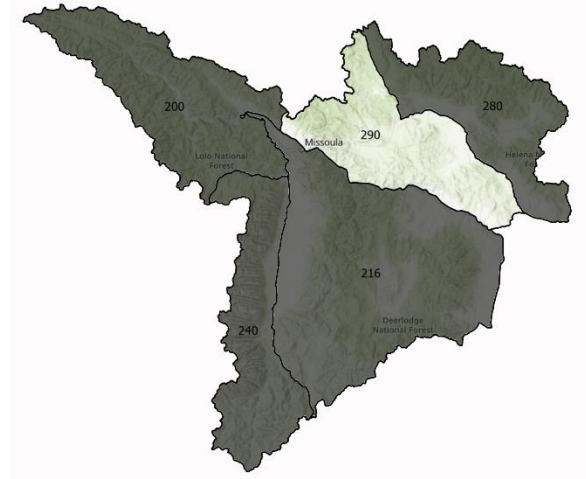

Figure 25. Male, female, and total black bear harvest in BMU 290 (2010-2022). Black points and dashed lines indicate total reported hunter harvest and colored bars represent annual female (pink) and male (blue) harvest. A changepoint analysis indicated statistical support for a change in total and male harvest between license years 2019 and 2020. No changepoint was detected for female harvest (see Table 10).

BMU	Cohort Model	BIC for modeled Changepoints (m)				Changepoint Location (Top Model)
		0	1	2	3	
290	Total Harvest	119.50	**108.54**	111.58	114.92	2019
290	Male Harvest	112.13	**99.53**	99.68	104.72	2019
290	Female Harvest	**92.94**	93.68	94.87	98.01	-

Table 10. Changepoint Analysis Model Results (BMU 290)

* Location refers to the license year immediately prior to the change. For example, is the changepoint location is 2018, the changepoint occurred between the 2018 and 2019 license years.

Spring & Fall Harvest Trends:

Drivers of the overall harvest trend are reflected in the season cumulative harvest by day of season. The 2022 spring season was the second highest total spring harvest in BMU 290 (Figure 26) and in combination with license years 2020 and 2021 follow the pattern of the identified changepoints between 2019 and 2020 (Table 10) .
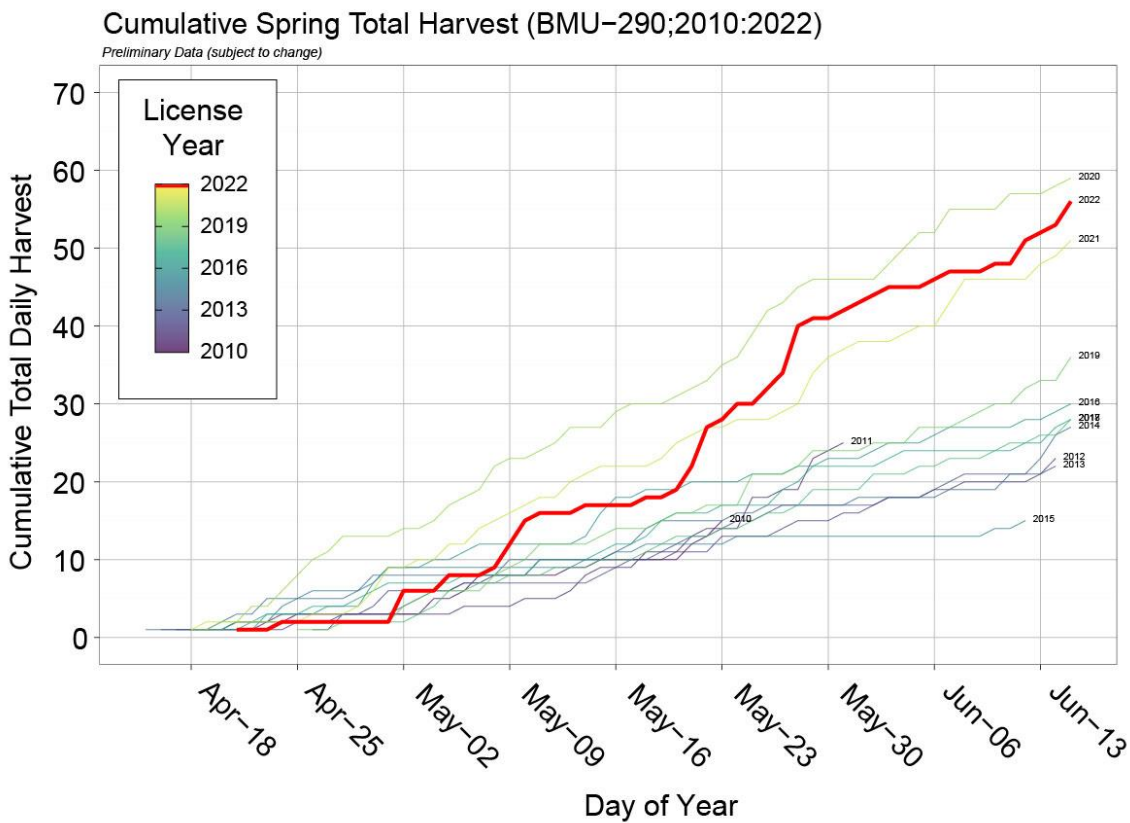

Figure 26. Cumulative daily spring harvest in BMU 290 (2010-2022). Thin colored lines show the daily cumulative harvest for License Years 2010-2021, and the bold red line shows license year 2022. Note that harvest trend lines end on last reported harvest and therefore the 2012 change in Spring Season ending date (5/31 to 6/15) is evident.

Fall harvest during 2022 in BMU 290 was high relative to most years in the 2010-2022 period but did not show a fundamentally different pattern from other years in the time series (Figure 27).
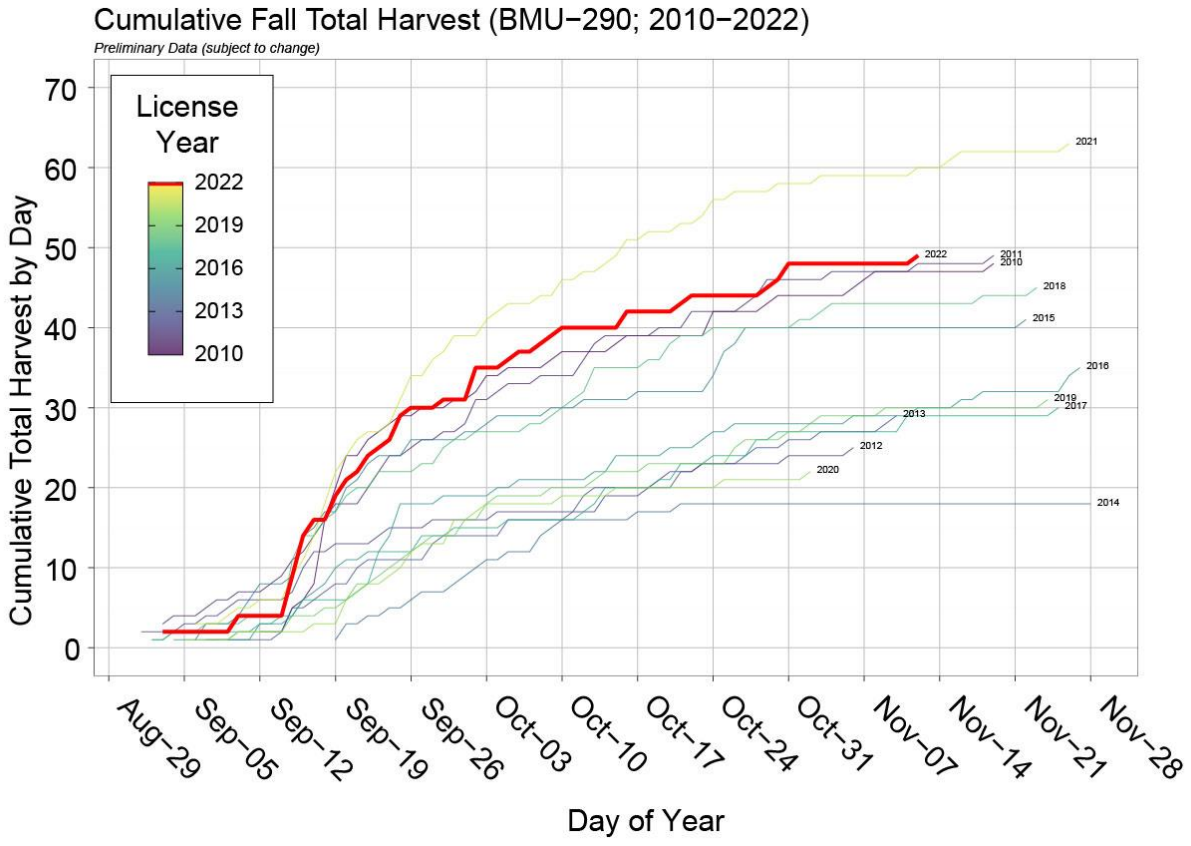

Figure 27. Cumulative daily fall harvest in BMU 290 (2010-2022). Thin colored lines show the daily cumulative harvest, and the bold red line shows license year 2022. Note that harvest lines end on the date of last reported harvest and therefore the season lines have different end dates. Fall season runs through the duration of the General Rifle Season for deer and elk.

Standardized Harvest Criteria:

The 3-year moving average of the percent females in the total annual harvest in BMU 290 has been relative stationary and within the stable range (30-40%) since 2013 with a decreasing trend in the last 5 years toward the range of population increase (Figure 28). This pattern is consistent with the changepoint analysis for females which supported no significant changepoints during the 2010-2022 period.

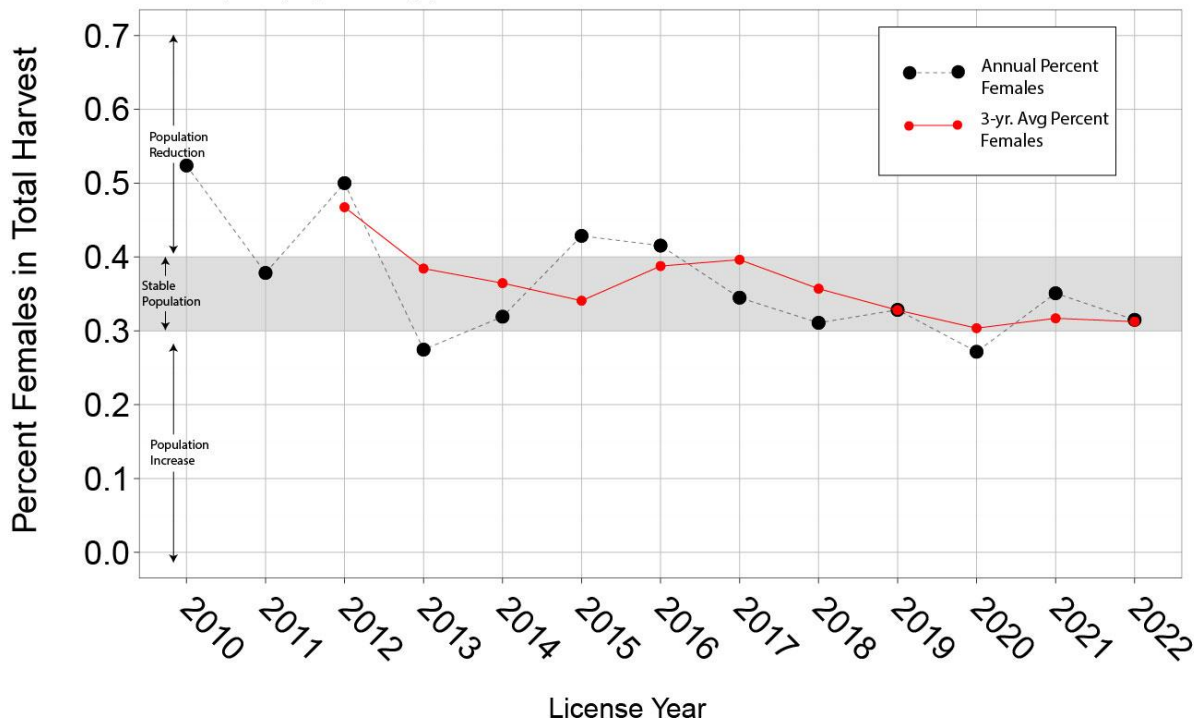## Percent Females in Total Harvest (BMU−290:2010−2022)

Figure 28. Percent Females in the total annual black bear harvest in BMU 290 (2010-2022). Points and dashed lines indicate proportion of total reported hunter harvest that were females. The red points and solid line show the 3-year moving average of percent females to account for annual variation in harvest. The grey shaded region shows the range of proportions associated with population reduction, stability, and population increase (Table 11).

Small sample sizes of aged bears warrant caution when interpreting the proportion of adults in the harvest (Table 11). The 3-year average of the percent of adult males in the total harvest is within the stable range ($\bar{x} = 28\%; Table$ 11). The 3-year average of percent females in the total harvest is within the stable population range ($\bar{x} = 32\%; Table$ 11). The 3-year average of the percent of adult females in the female harvest is within the stable population range ($\bar{x} = 52\%; Table$ 11).

Year	Objective	Harvest Criteria		
		% Adult[1] Males in Total Harvest	% Females in Total Harvest	% Adult[1] Females in Total Harvest
	Population Reduction	*< 25%*	*> 40%*	*> 55%*
	Stable Population	*25 - 35%*	*30-40%*	*45-55%*
	Population Increase	*> 35%*	*<30%*	*< 45%*
2019		24%	33%	47%
2020		-	27%	-
2021		25%	35%	55%
2022		35%	33%	55%
3 yr Avg.		28%	32%	52%

[1] >= 5 years old

Table 11. Harvest Criteria and current status for BMU 290

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