Montana Statewide Elk Management Plan Draft

2023

Montana Department of Fish, Wildlife & Parks

Wildlife Division

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Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

ATV-All-Terrain Vehicle

BLM-Bureau of Land Management

BMA-Block Management Areas

bTB-Bovine Tuberculosis

CE-Conservation Easement

CWD-Chronic Wasting Disease

DNRC-Montana Department of Natural Resources and Conservation

EMU-Elk Management Unit

FWP-Montana Fish, Wildlife & Parks

iPOM- Integrated Patch Occupancy Modeling

HD- Hunting District

IPM- Integrated Population Model

LEPOC- Lion Ecoregional Population Objective Committee

NDVI-Normalized Difference Vegetation Index

MCA-Montana Codes Annotated

USFS-United States Forest Service

USFWS-United States Fish and Wildlife Service

WMA-Wildlife Management Area

PREFACE

This Elk Management Plan has multiple uses. It is intended to: 1) guide the planning and policy decisions regarding elk management and conservation in Montana, 2) assist Montana Fish, Wildlife & Parks (FWP) personnel when considering elk management recommendations, 3) define FWP's commitment to the public to responsibly manage elk populations, and 4) guide FWP to meet statutory requirements in sustainably managing elk populations.

Major changes from 2005 Elk Management Plan

The previous Elk Management Plan used by FWP was adopted in 2005. Since adoption, changes on the landscape and new social considerations have prompted the need to develop an updated plan. There are several functional differences between the 2005 and 2023 Elk Management Plan. The 2023 Elk Management Plan includes an option to update the Plan approximately every 5 years (offset from biennial season setting years), with an expected lifespan of at least 15 years at which time FWP will assess the possibility of an update, a major revision, or development of a new plan. This is different from the 2005 Elk Management Plan, which included the option to propose changes to population objectives and regulation packages annually; however, that process was used sparingly over the lifespan of the Plan. Additionally, there was no end date associated with the 2005 Elk Management Plan. By allowing for periodic updates, the new Elk Management Plan can more readily be adjusted to incorporate new information and management tools as needed while providing more regular opportunity for public input.

Another difference is the structure by which harvest regulations are prescribed for each hunting district (HD). The 2005 Elk Management Plan included a set of hunting regulation packages (Standard, Liberal and Restrictive) with population measurement criteria (i.e., triggers) for moving from one regulatory package to another and directly tied hunting regulation packages to results of monitoring data. However, as elk management tools have changed over the past 18 years, the prescription of a specific season type resulted in prescribed season packages that were no longer available (e.g., A7 licenses), or conversely, new tools that are now available not being prescribed by the Plan because they didn't exist at the time of development (e.g., shoulder seasons, 3 elk bag-limit per hunter). The 2023 Elk Management Plan offers more flexibility by providing harvest matrices for antlerless and antlered elk that describe season types currently available in Montana ranging from liberal to restrictive. Each HD can move through the harvest matrices as needed to meet multiple objectives and the matrices can be updated during the review period as necessary.

Also, the local scale in the 2023 Plan is the survey unit scale, which is primarily individual hunting districts (HDs), but occasionally includes multiple HDs, whereas the 2005 Plan's local scale was the Elk Management Unit (EMU). FWP still recognizes the elk interchange and overlap in elk populations at the EMU scale, however, because regulations are set at the HD scale, elk

are typically counted at the HD scale, and because the public is more familiar with HDs opposed to EMUs, this Plan focuses at the HD scale when determining local scale objectives.

Further differences between the two Plans include the number and type of objectives used to determine success. Statewide, the new Plan has more objectives than the 2005 Elk Management Plan. Statewide objectives are programmatic, affect statewide policies, or address issues that apply broadly within the state. At the local scale, the 2005 Elk Management Plan focused on a population size objective, including a bull objective for most EMUs. The 2023 Elk Management Plan still includes population demographic objectives (population size and bull metrics), but it also includes elk distribution objectives and recreation-based objectives. Additionally, the new Plan includes metrics to determine success in meeting elk management goals and objectives. These metrics will allow the department to report status and progress on meeting goals and objectives. Using a larger suite of objectives at both the statewide and local scales better reflects the ecological and social complexity of elk management, allows the department to consider multiple objectives simultaneously, and is more transparent when there are competing objectives and tradeoffs.

Lastly, the 2005 Elk Management Plan defined bull objectives for most EMUs but did not specify those that would have special management to achieve a higher bull:cow ratio or older age bull structure. The 2023 Draft Elk Management Plan explicitly defines which HDs are considered "Special Management Districts". If an HD is not a "Special Management District," then it is considered a "Bull Opportunity District."

INTRODUCTION AND BACKGROUND

Authority

Montana Fish, Wildlife & Parks and the Fish and Wildlife Commission (Commission) are granted responsibility for managing Montana's wildlife within the Montana Code Annotated (MCA). More specifically, elk management and implementation of an elk management plan, are described within the MCA.

Montana Fish, Wildlife & Park's Mission, Vision, and Core Values

Mission – "Montana Fish, Wildlife & Parks, through its employees and citizen commission and board, provides for the stewardship of the fish, wildlife, parks and recreational resources of Montana, while contributing to the quality of life for present and future generations."

Core Values – "Serve the public, embrace the public trust, honor tradition and heritage, work with landowners, use science, provide leadership, provide stewardship, value our workforce."

Vision – "Montana is a place where people have abundant opportunities to connect with the world-renowned fish, wildlife, and state parks resources that define our state, and where a responsive and relevant FWP has the resiliency and public support it needs to lead the way in

making sure these resources remain an essential part of Montana's culture, economy, and high quality of life."

Elk Management Plan Development Process

In April 2020, the Commission endorsed FWP beginning the process to develop a new Elk Management Plan. In the first step, FWP assembled the Elk Management Plan Initial Guidance Citizens Group. The group was diverse, independent, and represented multiple stakeholder perspectives. The group met three times during winter 2020 and developed 19 Guiding Principles using a facilitated, structured process (see Appendix A for more information).

Real-time public comment opportunities were offered during two of the group's meetings. Montana Fish, Wildlife & Parks received three public comments during these opportunities. The Guiding Principles were presented to the Commission in April 2021, and a 30-day public comment period was opened. FWP received 33 public comments during this time.

In the summer of 2022, another Elk Management Citizen Advisory Group was developed to forge new relationships among stakeholders and collaboratively develop new and creative ideas and recommendations for issues surrounding elk management in Montana to balance hunter and landowner interests. The group met 10 times and developed 15 recommendations to be considered by the FWP Director. The recommendations were released for public comment, and FWP received 1,397 comments (see Appendix B for more information).

Local public scoping efforts were initiated in summer 2022. The scoping period was open from June 20–October 15, 2022. Fifty meetings were held across the state to gather feedback on elk population sizes, other elk management challenges, and goals for each HD. In total, FWP received 824 comments that were used in developing proposed goals and measures related to objectives for each HD.

Work completed by the citizens groups and public comment received during those processes helped guide statewide objectives, goals, and strategies included in this Plan. Area biologists developed proposed goals and measures for local elk population demographic objectives, distribution objectives, and elk recreation objectives after considering public scoping comments and elk biology while maintaining relative consistency across HDs and regions.

In Montana, hunting regulations are evaluated biennially and can be changed with Commission approval. This Plan is intended to guide FWP proposals to meet the objectives set forth. Thus, the process of setting objectives is important and must come before determining hunting regulations. Hunting regulations must be determined only after the desired biological and sociological goals have been clearly identified [Lipscomb 1974]. Evaluating hunting regulations biennially provides wildlife managers the opportunity to assess the efficacy of a regulation in meeting objectives, and adapt harvest strategies regularly.

Plan Timeline and Updating Process

This Plan includes an option to update approximately every 5 years (offset from biennial season setting years), with an expected lifespan of at least 15 years (2023-2038) at which time FWP will assess the possibility of an update, a major revision, or development of a new plan. By allowing for periodic updates, the new Elk Management Plan can more readily be adjusted to incorporate advanced monitoring or management approaches as needed while providing more regular opportunity for public input. At each 5-year update assessment, measures associated with both statewide goals and local scale goals will be evaluated and reported publicly. Following evaluation, the department will bring forth any proposed changes.

TOPICS RELEVANT TO ELK MANAGEMENT IN MONTANA

History

Elk were widely distributed across North America prior to the arrival of the first Europeans Bryant and Maser 1982 and in Montana, were distributed throughout the lengths of the Missouri and Yellowstone River valleys and overlapped with numerous tribal territories. At the time of the Lewis and Clark expedition in 1804 and 1805, observations extended little beyond the vicinity of the major river valleys. By the early 1800s, unregulated subsistence, market, and hide hunting had almost eliminated elk east of the Mississippi River. Unregulated hunting continued to reduce elk in the western United States, and elk were gone from eastern Montana by the mid-1880s and were also heavily reduced in western Montana.

Elk probably reached a low point in numbers in North America during 1900–1910. In 1910, it was estimated that fewer than 50,000 elk existed in North America Thomas and Lyon 1987. About half were associated with Yellowstone National Park (YNP), Jackson Hole, and the surrounding areas. The establishment of YNP in 1872 and its remoteness was a major factor in preserving elk in North America.

During the late 1910s and 1920s, local and national interest in protecting and expanding existing elk herds increased. Many local sportsman's clubs were formed with a primary purpose of preserving elk. In 1910, the first transplant of elk from YNP was made to Fleecer Mountain, near Butte, Montana Picton and Lonner 2008. During the period from 1910–1940, 1,753 elk from YNP, Jackson Hole, and the National Bison Range were transplanted to 31 sites in the National Forests of Montana West 1941. In 1913, the Sun River Game Preserve was established, and hunting season closures were established elsewhere.

In 1922, about 13,000 elk were estimated to occur in the National Forests of Montana and northern Idaho, exclusive of YNP West 1941. Probably about 7,500–8,000 of these elk were in Montana. In 1928, an estimated 10,900 elk were in Montana Raymer 1930. By 1940, the National Forests of Montana, excluding YNP, were estimated to contain 22,000 elk West 1941. Although the precision of these estimates are subject to question, the general trend provides a relative sense of elk population growth in Montana during the early 20th century.

The era of management on the basis of biology began in 1940 [Picton 1991]. At that time there were seven major native elk herds in Montana and small elk herds at scattered transplanted locations [West 1941]. In 1940, the first State Game Manager position was created, biologists were hired, and the first portion of the Judith River Game Range was acquired by the State for elk winter range.

Reintroduction of elk through transplants continued and from 1941 to 1970 an additional 4,140 elk were released into Montana, mostly from YNP. As a result of these and earlier transplants and natural increases in distribution of existing elk, elk began to fill in much of their former habitat, including some areas of eastern Montana. Today, all timbered mountainous areas of central and western Montana contain elk, as well as some of the open habitat types. Additionally, huntable elk herds exist in areas of eastern Montana. While post-hunt elk populations were estimated at about 8,000 in 1922, biologists counted over 141,000 elk in the state during aerial surveys in 2022. Elk are much more abundant and well distributed today than they were a century ago in Montana.

Elk Hunting

Hunting has cultural value and is important to many Montanans [Eliason 2008, Teel and Manfredo 2010.] For Montana residents, General Elk Licenses are unlimited (one per hunter) and available over the counter, whereas nonresident elk hunters must obtain an Elk License via drawing. The number of Big Game Combination Licenses allocated to nonresidents has been set by the legislature at 17,000 since 1979 (MCA 87-2-505). However, there are additional elk license options for nonresidents available over-the-counter or via draw, such as B-licenses, Nonresident Youth Big Game Combination Licenses, Nonresident College Student Combination Licenses, and others. In hunting districts where numbers of B-licenses or special permits are limited, nonresidents are limited to, but not guaranteed, 10% of license or permit quotas by law (MCA 87-2-506).

Elk Hunter Numbers and Days

Montana Fish, Wildlife & Parks annually surveys a random sample of elk license holders via telephone. From these surveys, the number of license holders who actively hunted for elk, the number of days spent afield hunting for elk, and the number of elk harvested can be estimated with a predetermined level of confidence. These data highlight the importance of hunter survey data along with licensing information to estimate the number of hunters who *actively* hunted for elk in a given year.

Between 2004 and 2021, the estimated number of hunters who actively hunted for elk in Montana fluctuated between 102,860 in 2012 to 113,976 in 2017 (Figure 1). During 2004–2021, the estimated number of days hunters spent pursuing elk varied between 811,831 days in 2006 to 1,066,716 days in 2016 (Figure 2). Number of days spent hunting per hunter varied between 7.8 days per hunter (2006) to 9.4 days per hunter (2016 and 2021). During the same timeframe, nonresident elk hunters comprised 13-18% of total active elk hunters in Montana. In comparison, a 2016 nationwide survey estimated 9.2 million big game hunters in the United States and 712,000 of those hunters hunted for elk a total of 6 million days [USFWS 2016]. If the

nationwide and state hunter effort datasets are compared, Montana hunters comprise approximately 14-18% of the nation's elk hunters and elk hunter days.

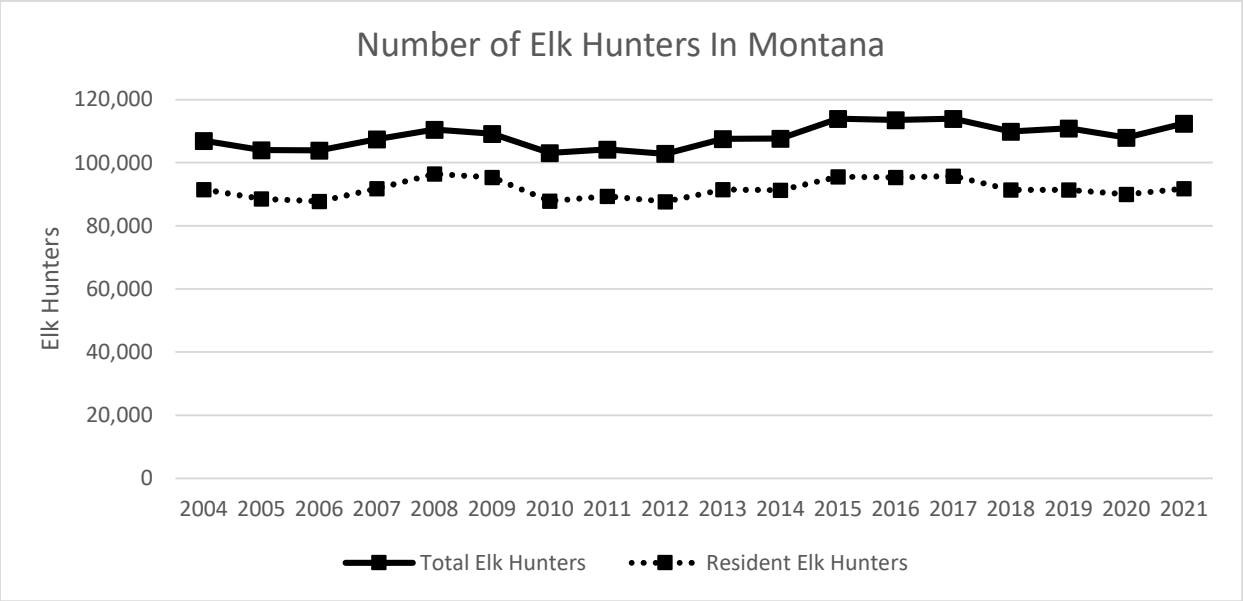


Figure 1. Estimated number of elk license holders who actively hunted for elk during each license year, 2004–2021 (FWP hunter harvest survey data).

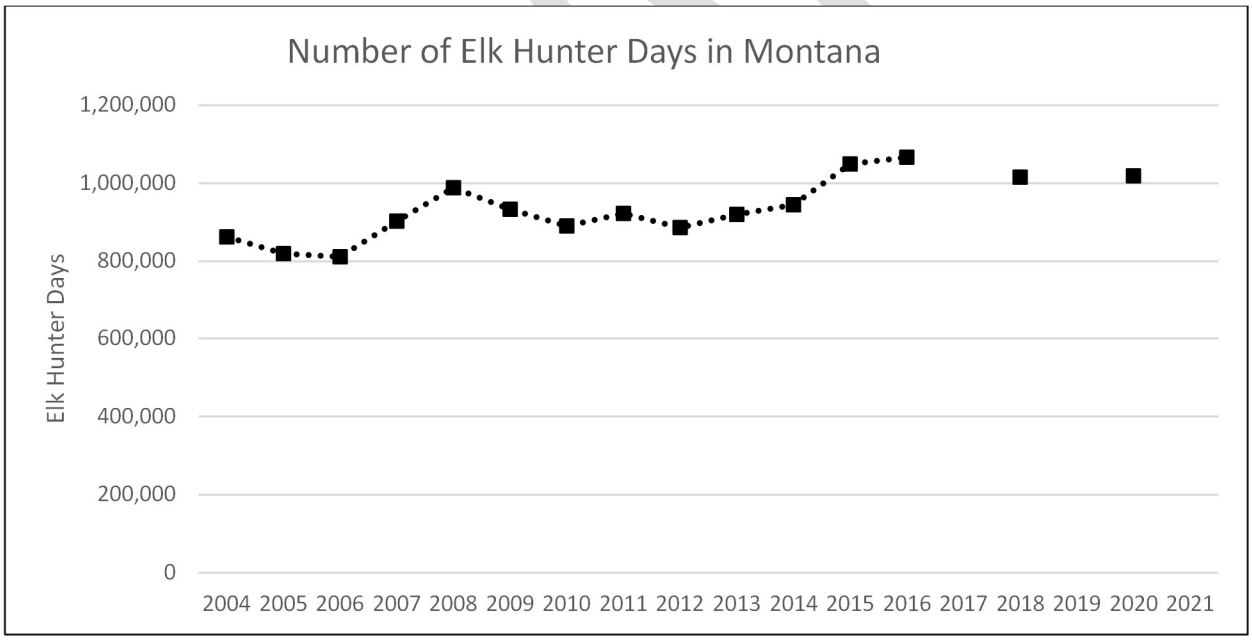


Figure 2. Estimated number of days spent elk hunting during each license year, 2004–2021 (FWP hunter harvest survey data).

Harvest Statistics

Elk harvest is estimated for each hunting district annually using a telephone survey of a random stratified sample of elk license holders. Elk hunting effort data is also collected during these surveys. This method has been shown to be cost effective and reliable, whereas other methods such as self-reporting can have unacceptable levels of bias if follow-up surveys are not

conducted [Lukacs et al. 2011]. Statewide, elk harvest peaked in 1994 with a total estimated harvest of 32,433 (Figure 3). Beginning in 2004, Montana allowed for the take of two elk, only one of which could be antlered. In 2020, Montana allowed for the take of three elk, only one of which could be antlered. These additional opportunities were allocated using B-licenses.

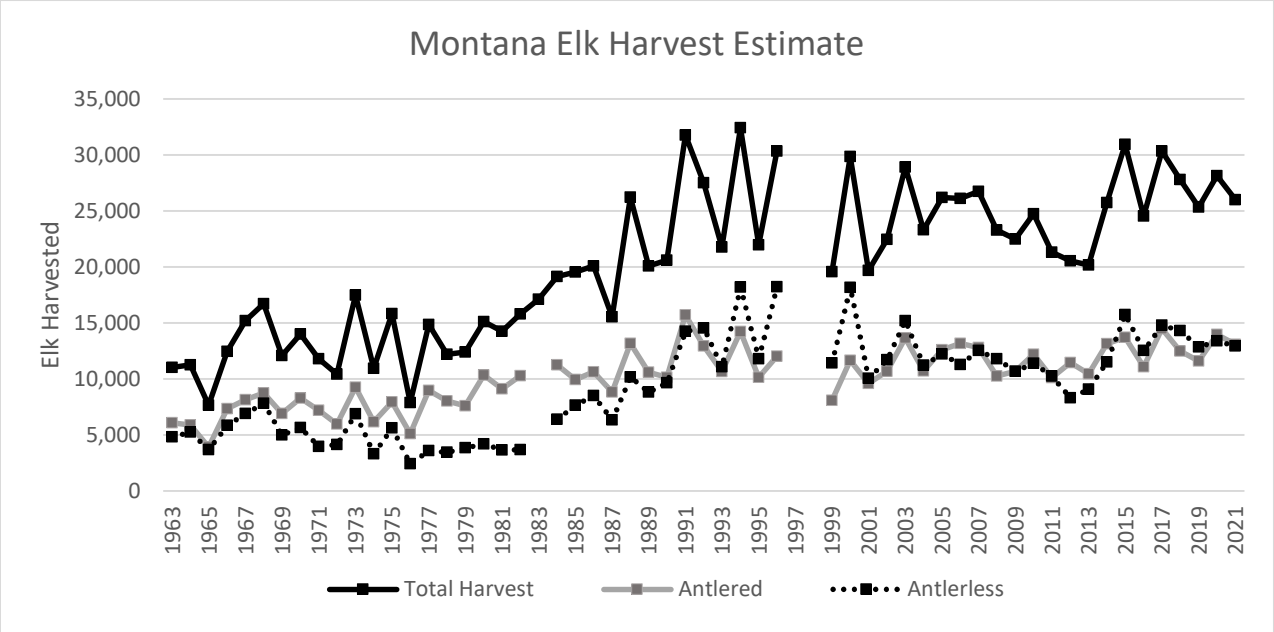


Figure 3.Estimated number of elk harvested during each license year, 1963-2021.

Archery Hunting

Currently, the archery season is six weeks long, beginning the first Saturday in September and extending into mid-October. Historically, archery hunting was offered to provide hunter recreation rather than population management [FWP 1989, FWP 2005]. Although the level of elk harvest with archery equipment is notable, in many HDs, archery opportunity is still offered primarily to provide recreation more so than for population management.

The number of hunters purchasing an archery stamp in Montana has steadily and substantially increased over time (73% increase 2004-2021; Figure 4) which has resulted in increased archery harvest. For example, total archery harvest increased 56% from 2004 to 2021 (Figure 5). Archery harvest varies by FWP administrative region and is still a small but increasing proportion of the overall harvest (Figure 6). Region 3 has the highest average number of elk harvested with archery equipment, whereas eastern Montana, specifically Regions 6 and 7, have the highest percentages of harvest attributed to archery (Table 1).

The contribution of archery harvest to overall harvest becomes more prominent when examining bull harvest; antlerless harvest by archers appears to be minimal (<6% of total antlerless harvest). Approximately 21–28% of nonresident bull harvest was during archery season (2015–2021), whereas 16–23% of resident bull harvest was from archers during the same time. Nonresidents made a larger contribution to total archery harvest (29%) than they did to total rifle harvest (17%).

Region	2004-2021 Average Elk Harvested	2004-2021 Average Elk Harvested with Archery Equipment	2004-2021 Average Percent Harvested Elk by Archery Equipment
Statewide	25,205	3,010	12%
Region 1	1,301	202	16%
Region 2	4,128	447	11%
Region 3	11,238	1,043	9%
Region 4	4,739	667	14%
Region 5	2,027	236	12%
Region 6	808	207	26%
Region 7	933	205	22%

Table 1. Summary of average elk harvest by Region including average archery harvest.

Impacts of archery harvest and hunting pressure on elk distributions are complicated and context dependent. Studies from the late 1980s indicated no consistent changes in elk distributions in response to archery hunting. More recently, effects on elk distributions have been found in response to archery hunting [Conner et al. 2001, Vieira et al. 2003, Proffitt et al. 2013 & 2016a]. Additionally, there are roads that are open during archery season and closed during rifle season. These motorized routes and the increased use of them during archery season affect elk security during archery season. FWP recognizes that under specific circumstances, archery hunting can influence elk distribution if hunter densities are high enough.

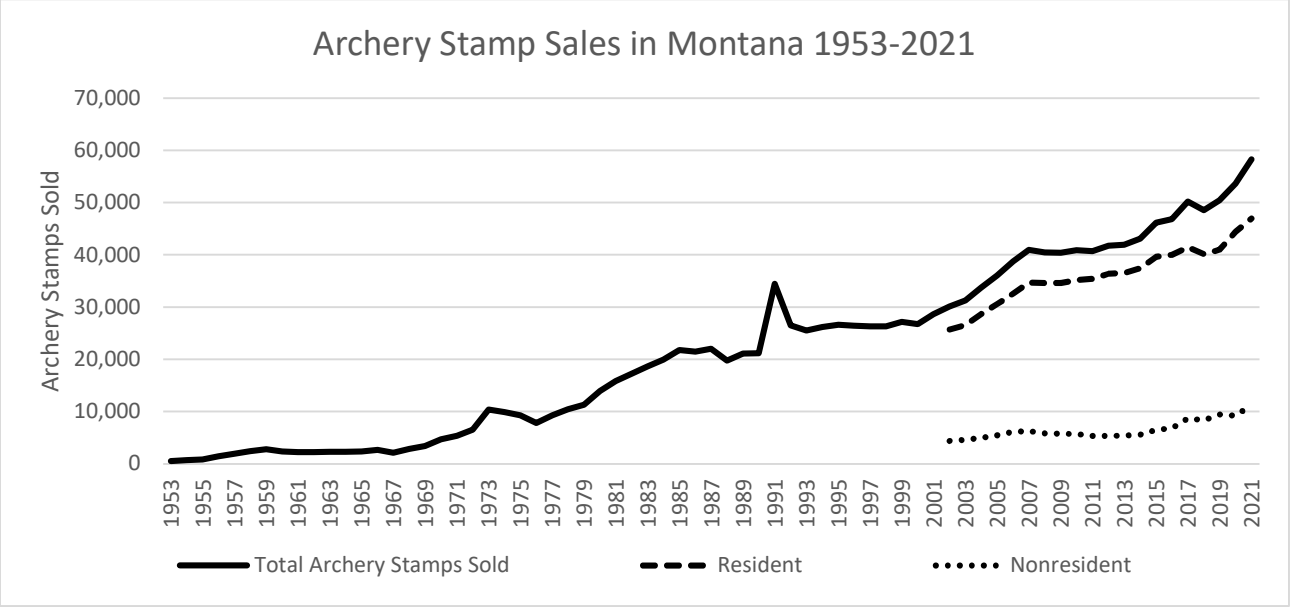


Figure 4. Total archery stamp sales in Montana from 1958–2021 as well as residency of archery stamp holders from 2002–2021. Prior to 2002, residency information of archery stamp holders is not available.

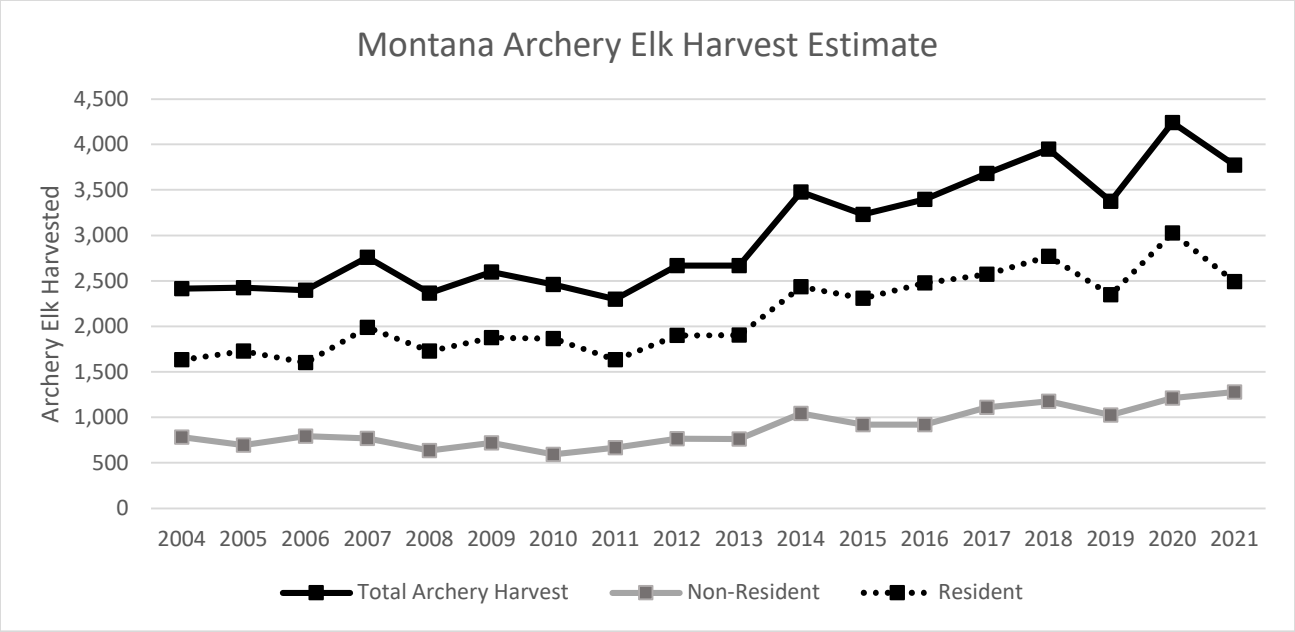


Figure 5. Estimated total number of elk harvested during each license year, as well as total number of elk harvested by residents and nonresidents from 2004–2021 (FWP hunter harvest survey data).

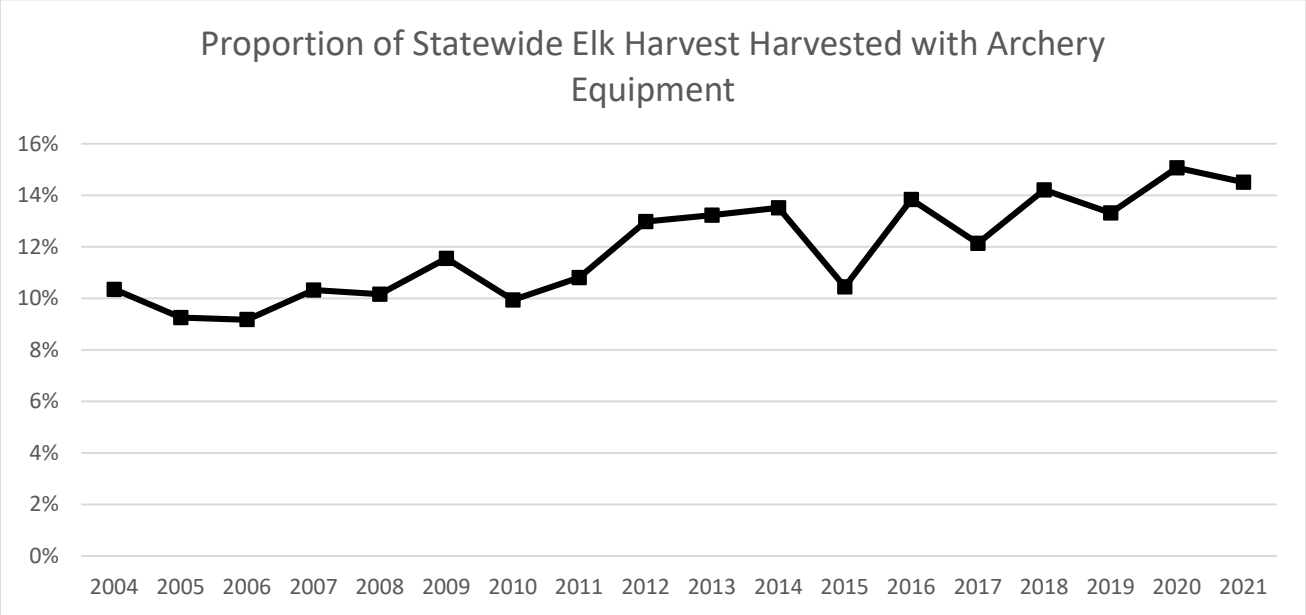


Figure 6. Proportion of total elk harvested that were harvested with archery equipment 2004–2021 (FWP hunter harvest survey data).

Access

Hunter Success Across Different Access Types – Hunters were surveyed by FWP following the 2013 and 2018 hunting seasons to determine what type(s) of land they hunted (hunters could hunt more than one type; Figure 7) and the elk harvest success rate on each of the access types (Figure 8) [Lewis et al. 2014, Lewis 2019]. Hunters most commonly pursued elk on public land (Figure 7)

and were most successful on private land that charged access fees (Figure 8) [Lewis et al. 2014, Lewis 2019]. Although the elk harvest success rate was highest on private land that charged an access fee, because such a small percentage of hunters reported using that access type the total harvest on that access type may be less than the total harvest on other access types. Thirty three percent of elk hunters who responded to the survey were satisfied or very satisfied with hunting access and 35% were dissatisfied or very dissatisfied with hunting access [Lewis et al. 2014].

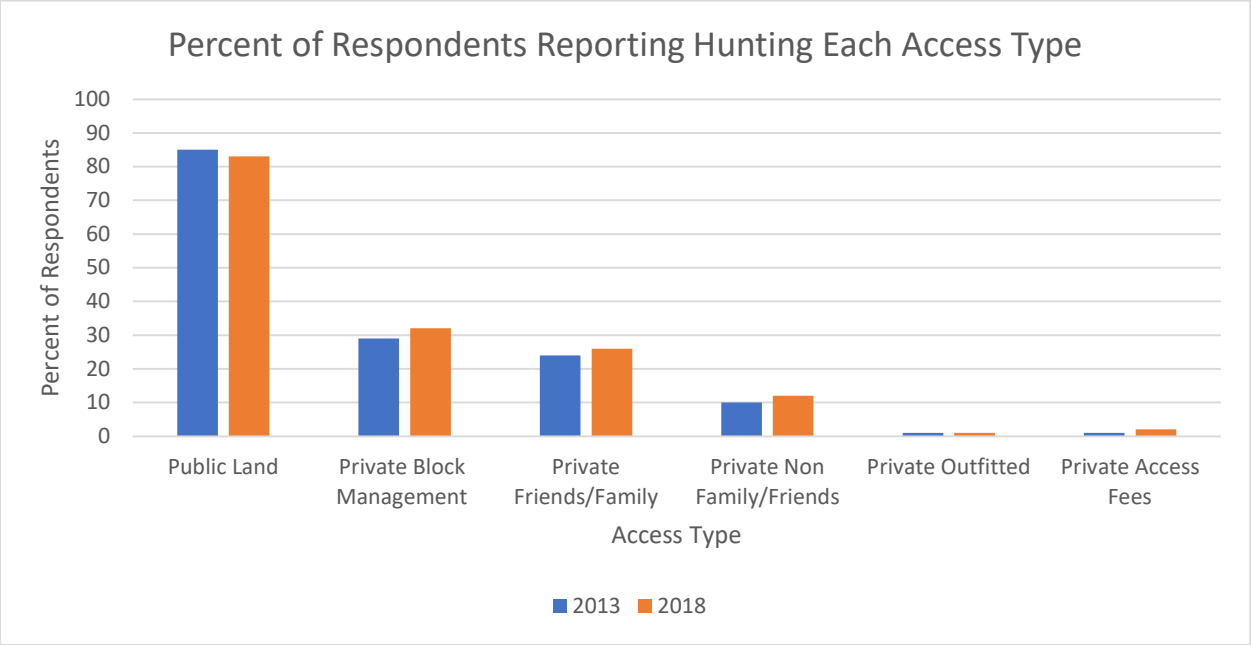


Figure 7. Proportion of survey respondents reporting hunting for elk on each access type in the 2013 and 2018 hunting seasons. Hunter could report hunting more than one type (Lewis et al. 2014, Lewis 2019).

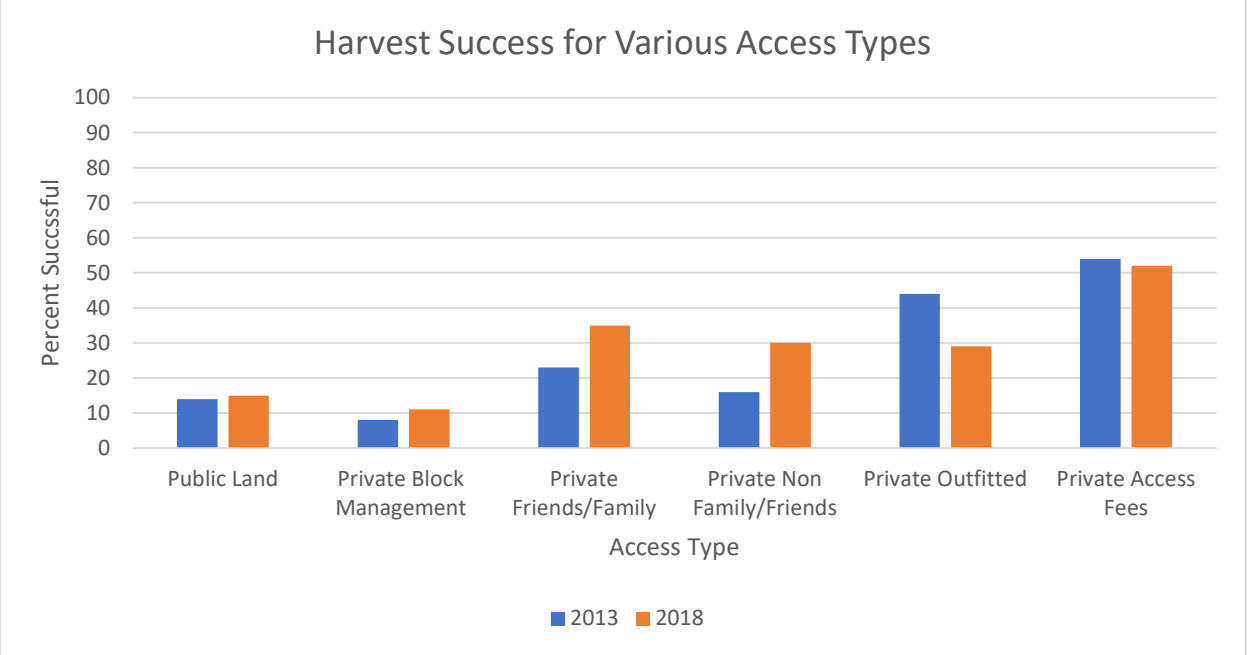


Figure 8. Reported elk harvest success reported for the 2013 and 2018 hunting seasons on various access types (Lewis et al. 2014, Lewis 2019).

Concurrent with the elk hunter effort/success by access type survey, a survey of rural private landowners was conducted asking them to specify what type of elk hunting access they allowed on their private land. Generally, only about 25% of private land is available for free public hunting access [Lewis et al. 2015, Lewis 2019]. Land is not considered open for free public hunting access when hunting is restricted for use by particular groups or individuals, requires hunters to pay fees, requires that individuals have a direct connection with landowner (family or friend), or does not allow hunting [Lewis et al. 2014].

FWP Hunting Access Enhancement Programs

Block Management Program – This program was created in 1985 and expanded in 1996. The program is a voluntary, cooperative agreement between FWP and landowners. The program provides hunter management assistance, an impact payment, weed management bonus, and a complimentary license benefit to offset the impacts from allowing free public hunting access on private lands. By enrolling private land acres in Block Management, additional public land may become accessible by access to the enrolled lands. The program is funded by license fees paid by hunters in Montana, primarily (~80%) by nonresident big game license revenue. As of 2022, 6.8 million acres are enrolled in the program; this equates to 7% of the land area of Montana (Figure 9). Of the enrolled acres, 5.7 million are privately owned whereas the other 1.1 million acres are public lands, some of which would not be accessible if the surrounding private lands were not enrolled. Acres enrolled in Block Management peaked at 8.8 million in 2002. Since then, the Program has lost ~2 million acres or >3,000 square miles of enrolled land. In 2020, landowners in the Block Management Program were surveyed along with elk license holders. Ninety percent of enrolled landowners indicated they were satisfied or very satisfied with the program, and 67% of elk license holders responded that they are supportive of the program [Lewis and Kool 2021].

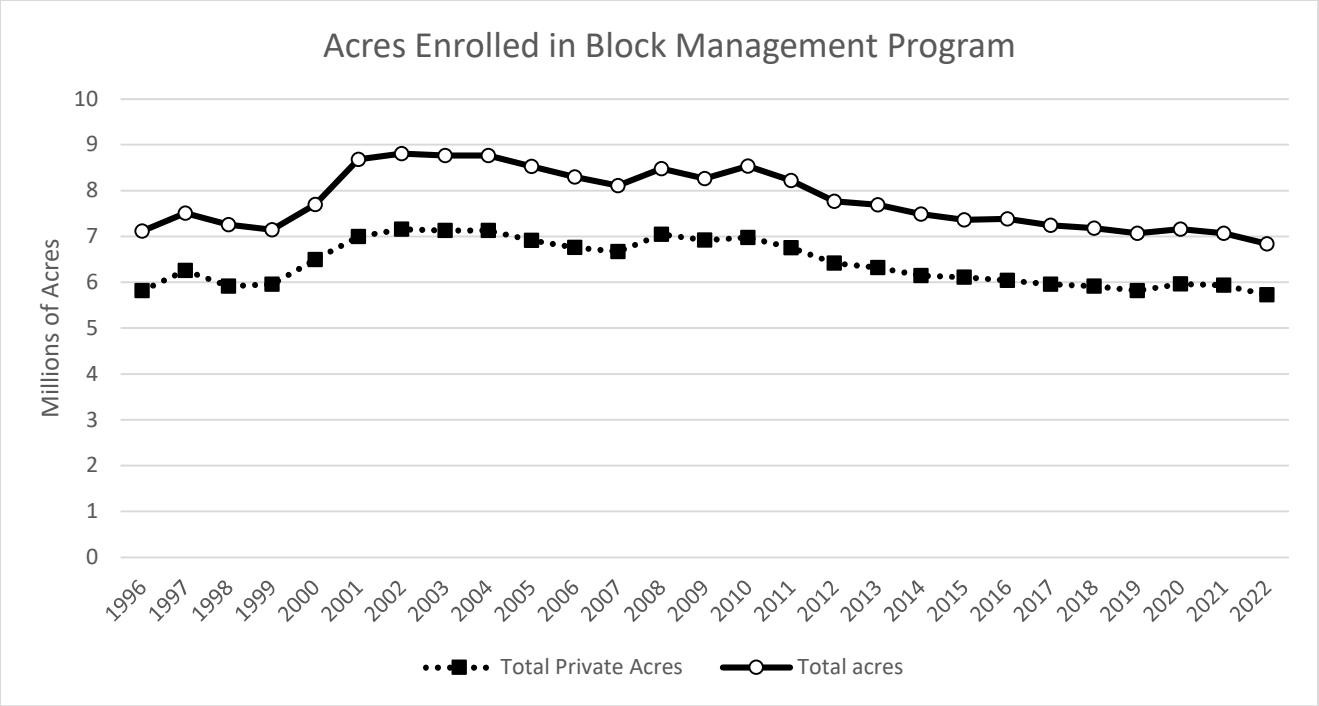


Figure 9. Total private acres enrolled in FWP's Block Management Program 1996–2022.

Elk Hunting Access Agreements – This program provides landowners with an elk license, permit, or combination thereof in exchange for allowing free public elk hunting access as described in a signed agreement approved by the Commission. The permit and license are only valid on the landowner's property. As of 2021, participating landowners receive one elk license or permit in exchange for allowing three public license or permit holders access to hunt their property.

Public Access Land Agreement Program – This program seeks to open or improve free public access to isolated parcels of state or federal land for hunting or fishing. These isolated public lands are surrounded by private land without a dedicated easement that provides access. The program is a way for landowners to facilitate public access to public lands for hunting and/or fishing in exchange for a payment and other negotiated improvements.

Access Public Lands –This program is intended to improve access to public lands and reduce conflict between sportsmen and landowners. To accomplish this, the program provides or enhances access corridors to public lands in exchange for incentives such as fencing, cattle guards, water crossings, signs, and increased patrolling if necessary. Projects may include providing signage to clarify designation of access route and property boundaries or may include obtaining right-of-way easements for a limited term length or in perpetuity.

Unlocking Public Lands – The objective of the Unlocking Public Lands Program is to allow the public to cross parcels of enrolled private land to gain access to otherwise inaccessible parcels of state or federal (Bureau of Land Management; BLM or United States Forest Service; USFS) land for the purpose of outdoor recreation compatible with the use of public lands, which

includes hunting, trapping and fishing. The program allows private landowners to enter into contractual agreements with FWP and receive an annual tax credit.

Management Access Projects Program – This program seeks to work with private landowners whose needs fall outside the criteria of the Block Management Program to achieve a species-specific level of harvest. Often no formal agreements are used, but rather assistance is provided on an as-needed basis. The landowner in collaboration with FWP determines when, where, and how the public may access private land and may restrict access during specific times in accordance with program guidelines. Landowner incentives may include an FWP hunt coordinator and/or compensation through FWP payment for free public hunting access.

Habitat Montana Program – This program was established by legislation (HB 526) in 1987, when portions of license dollars were earmarked for protection of wildlife habitat. The aim of the program is to conserve and protect habitat and contribute to providing recreational activities including hunting and fishing opportunities. Conservation of high-quality habitat is typically accomplished by fee title acquisition, conservation easements (CEs), or habitat leases funded by the Habitat Montana Program, along with other partners. Although the Habitat Montana Program is not an access program, hunting access is obtained when CEs, habitat leases, and most fee title acquisitions are completed (access limitations may apply and vary among projects).

Economics of Elk

Hunting Revenue

In 2016, the United States Fish and Wildlife Service (USFWS) conducted a survey of hunting, fishing, and other wildlife related recreation across the United States. They estimated that $14.9 billion was spent on big game hunting trips and equipment nationwide [USFWS 2016]. Similarly, FWP estimated that in 2020, elk hunters in Montana spent about $187.1 million annually on trip related expenditures (transportation, food, beverages, lodging, and access or guide fees) [Lewis 2021] with residents spending ~$87.8 million and nonresidents spent~ $99.3 million [Lewis 2021].

License Revenue

Total number of elk licenses sold in Montana increased from 143,405 in 2005 to 186,917 in 2021 (Figure 10). Noticeable increases in license sales occurred in 2010 and 2015. During these years, many antlerless permits were converted to B-licenses allowing hunters to purchase more than one elk license (2010) and the concept of shoulder seasons was adopted by the Commission, with a trial in several districts (2015).

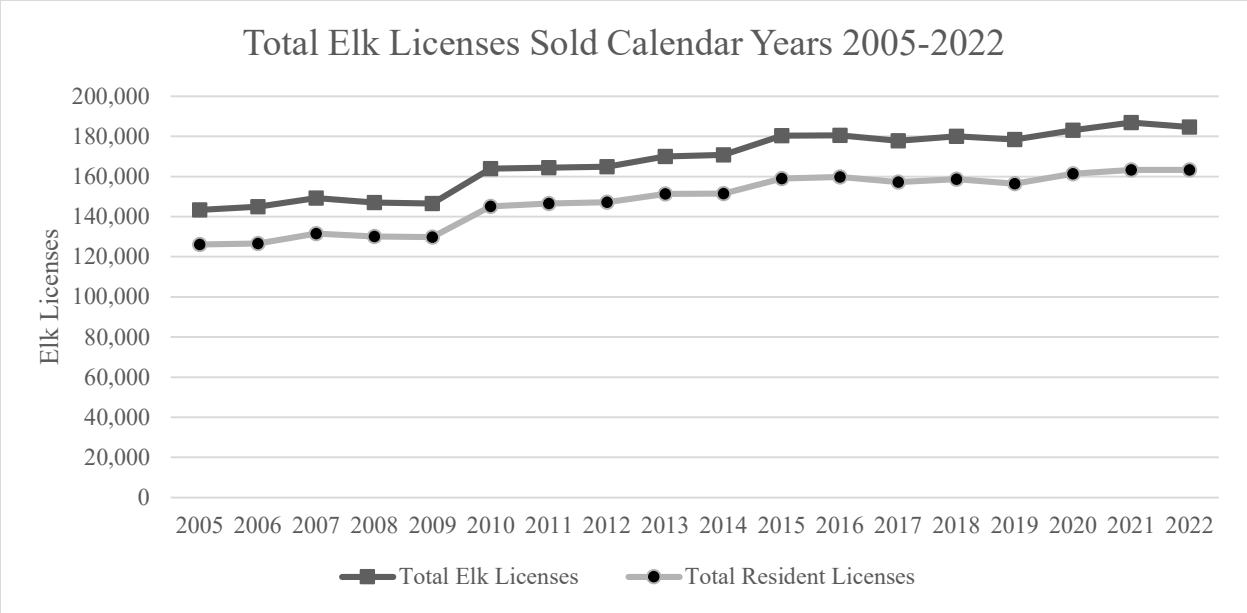


Figure 10. Elk licenses sold 2005–2022. Total licenses include General Elk Licenses as well as B-licenses. Both resident and nonresident licenses are represented in the figure.

Revenue to FWP from elk license sales was nearly $9 million in 2005 and increased to over $17 million in 2021 (Figure 11). Total revenue described does not include elk permit drawing fees, archery license fees, or conservation license fees. It also does not include the share of Federal Pittman-Robertson funds that could be attributed to elk hunting/hunters. Thus, elk hunting is an important source of funding to FWP and the economic benefits generated from elk and elk hunting provide for and benefit the conservation and management of numerous other species.

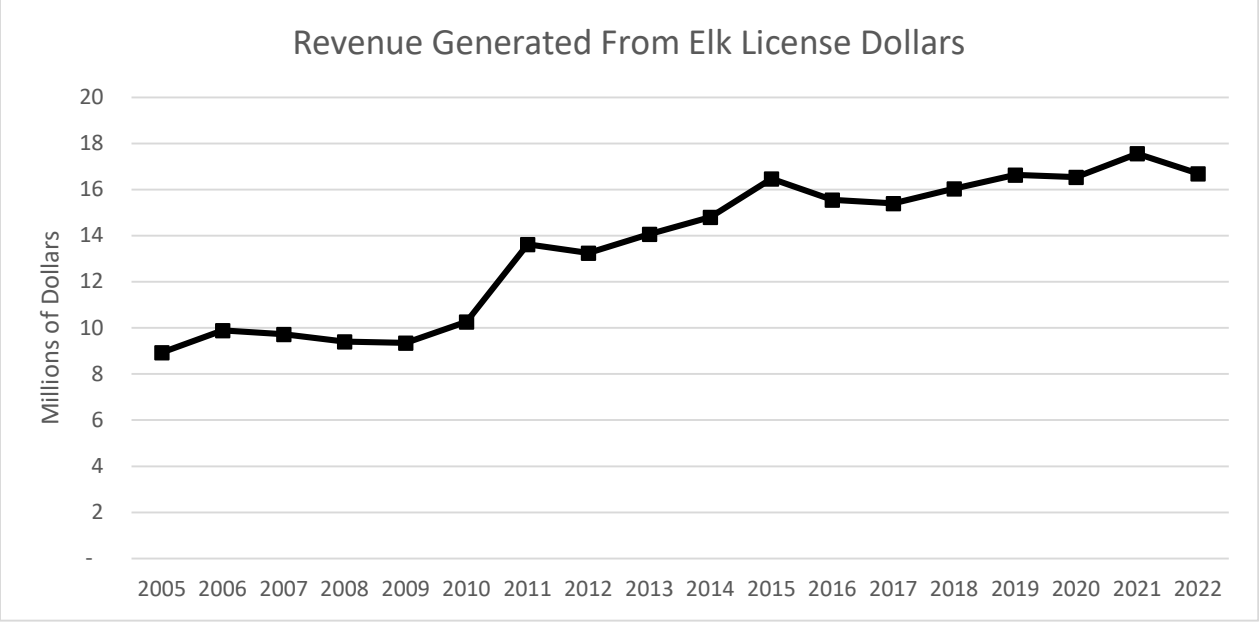


Figure 11.Total estimated revenue generated from elk licenses sold in Montana.

Outfitting

Outfitting is a major industry in Montana with elk hunting being a significant source of revenue. Clients are primarily nonresidents with only ~ 1–1.5% of resident elk hunters using the services of outfitters [King and Brooks 2001, Lewis et al. 2014, Lewis 2019]. The website of Montana Outfitter and Guides Association (MOGA) was surveyed for listings of elk hunting services. Fifty-nine businesses utilizing the MOGA website provided price information on guided elk hunting trips on their individual websites. The average for reported price options (*n* = 175) for a bull elk hunt in 2022 was $6,511 (where available, we reported the 2:1 hunter:guide pricing). This is an 87% increase over the $3,472 price noted in the 2005 Elk Management Plan. Although we do not have an estimate of the number of elk hunters that used the services of outfitters in 2022, outfitting elk hunters contributes substantially to income brought into the state.

Elk Population Monitoring

Aerial Surveys

In the 2005 Elk Management Plan, where numerical population objectives were included, they were based on counts from aerial surveys. Likewise, population demographic objectives in this plan are also based on observed number of elk during aerial surveys where they can occur. Aerial elk surveys are typically flown using a fixed-wing aircraft or helicopter with the pilot and one biologist. During aerial elk surveys, biologists count all visible elk in the survey area, known as a complete coverage survey. These surveys do not yield an overall abundance or population estimate, rather a minimum count and index of the population trend which can provide useful information over time (increasing, decreasing or stable).

Given elk behavior, landscape variables, and seasonal weather patterns within a specific HD, biologists design and conduct surveys to yield optimal results. Most surveys (76%) are conducted between January and April [FWP 2013]. Good winter surveying conditions include cold clear/sunny days and complete snow cover. Fresh snow can also be helpful for biologists and pilots to track elk. Some aerial surveys are flown at other times of the year during spring green-up (March–May) or during the summer (July). Spring green-up surveys are predominately used in heavily forested habitats (i.e. the northwest part of the state) because this is when and where elk are most visible. A thorough review of Montana elk surveys can be found in the Survey and Inventory Protocols for Big Game in Montana: Elk [FWP 2013].

Observing all elk in an HD during a survey is highly unlikely. Rather, it is expected that some will be missed. Factors such as habitat type, time of day, group size, snow cover, elk activity, time of year, weather, aircraft, pilot and observer can affect the number of animals observed. To mitigate factors associated with survey variability, biologists consider multiple years of data. A long-term trend count can be used to gauge relative changes in the population [Mills 2012].

In general, elk are classified during aerial surveys, but in some areas, classification is done from ground observations separate from aerial surveys. Classifying consists of counting cows, calves, and bulls (sometimes bulls are further classified into age classes based on antler size). After elk have been counted and classified, biologists calculate standardized calf to cow ratios

(calves:100 cows), and bull to cow ratios (bulls:100 cows). Age and sex ratios provide a standardized metric to compare across years and sites. Interpreting age and sex ratios can be challenging because they distill multiple processes into a single metric. For example, calf:cow ratios represent harvest, pregnancy, juvenile survival, and cow survival in a single variable Caughley 1974, Bender 2006, Harris et al. 2008, Lukacs et al. 2018. Similarly, bull:cow ratios are influenced by recruitment and mortality which may differ between sexes. Antlerless harvest may have a substantial influence on measured calf:cow ratios Lukacs et al. 2018 and bull:cow ratios Bender 2006. For example, when harvest of adult females is occurring, an increase in calf:cow ratios may be observed. This is because if adult females are removed via harvest, the denominator of the ratio is decreased and the numerator remains constant, resulting in an increase in the ratio. An increased calf:cow ratio in this situation should not be interpreted to reflect an increase in recruitment of calves when compared with years when no adult females are harvested. Incorporating count and classification data from surveys into an IPM that also uses additional data may improve inference Paterson et al. 2019. For more information see **Elk Population Monitoring: Elk Integrated Population Model** section.

Calf:cow ratios are used by biologists as an index of recruitment into the population. Obtaining calf:cow ratios from aerial or ground-based surveys is less expensive and less time consuming than other direct measures of recruitment (such as radio-collaring calves), and calf:cow ratios have been shown to be a reliable index to recruitment Harris et al. 2008. Typically in Montana, biologists use calf:cow ratios collected during late winter or early spring as an estimate of recruitment. However, because potentially significant calf mortality might occur in late winter, calf:cow ratios may need to be corrected for assumed mortality from the date of survey to June 1 (when calves are assumed "recruited" to the population). Comparing recruitment indices like calf:cow ratios among areas can be challenging because not all data are collected during the same time period or in the same manner. Surveys that occurred substantially earlier in the year may result in greater calf:cow ratios simply because calf mortality continues throughout the fall and winter.

Estimating bull:cow ratios through classifying elk during aerial surveys provides an index of the proportion of bulls in the population. Overall bull sightability is often less than cows and calves as bulls are known to separate from other age and sex classes in winter more so than during other seasons Unsworth et al. 1998. Finding smaller bachelor groups of bulls can be more challenging. Proportionally, smaller bachelor groups are more often missed during aerial surveys than larger groups. Additionally, bulls may be misclassified as cows during spring green-up surveys if they have already dropped their antlers. Therefore, bull:cow ratios recorded during surveys can be biased low, and the true ratio is generally higher than reported. Flying surveys with fresh snow cover can aid in locating single or small groups of bulls.

Observed bull:cow ratios are often compared to management objectives or biological requirements. Some state wildlife agencies set bull:cow ratio objectives for immediately post-hunting season whereas other states have pre-hunting season bull:cow ratio objectives.

Bull:cow ratios collected post-season (mid-late winter) may be biased lower because the sexes are separated during this time [Unsworth et al. 1998] and bachelor bull groups have lower detectability. If surveyed during the rut, adult elk are mixed in distribution and unbiased sex ratios can be obtained [Bender and Spencer 1999, Bender 2006], however these do not account for bulls removed during the fhunting harvest to follow. Montana has set post-season bull:cow ratio goals for most HDs where post-season or spring green-up aerial survey data are available. For more information see **HD OBJECTIVES** section. The bull:cow ratios measured in mid-late winter or early spring should be considered minimum ratios because of the timing of the surveys.

Though ideal in much of the state, aerial surveys are impractical in some areas such as northwest Montana that are thickly timbered or northeast Montana where elk densities are very low. In northwest Montana, FWP is evaluating other techniques for estimating elk numbers, such as using of trail cameras to estimate abundance.

Hunter Harvest Surveys

Elk harvest is estimated annually by FWP using a telephone survey of a random stratified sample of elk license holders. This method allows harvest and hunting effort to be estimated for each hunting district with a defined level of confidence. For more information see **Elk Hunting: Harvest Statistics** section.

Check Stations

Check stations are conducted in all seven FWP administrative regions in Montana. Check station data can include information on animals harvested as well as some information on hunter effort. Data collected on harvested elk passing through the check station include sex and age of the animal, number of antler points, and location of harvest (region or HD). Age is determined by tooth wear or via cementum analysis of an extracted tooth. At some check stations, additional antler measurements are collected. Data from check stations are limited in that they do not provide an unbiased or precise estimate of harvest or effort. The data can provide an index to harvest timing, age structure of the harvested animals, and hunter demographics as well as providing valuable personal interactions between hunters and FWP staff.

Hunter data usually includes number of successful and unsuccessful hunters in a party. At certain stations, data collected also includes information such as origin of hunting party, whether an off-road vehicle or horse trailer was with the hunting party, whether the party included youth, nonresident, or resident hunters, and various other metrics. Check station data can be used to suggest changes in elk age structure, antler size, local hunter demographics, and other local information of interest.

Radio-collaring efforts

Montana FWP routinely deploys radio-collars on elk as part of ongoing research. Each research project is focused on answering specific questions such as evaluating the effects of hunter access, habitat alterations on elk resource selection, the effects of predation on elk populations, or conducting disease surveillance within a population. Though radio-collars may

be deployed to provide data focused on a specific research question, additional information is gathered as well. Biologists use this information during routine operations such as survey planning or commenting on project proposals.

Elk Integrated Population Model

Recently in Montana, an Integrated Population Model (IPM) was developed for elk using inputs from aerial counts, harvest, and herd composition data along with vital rates to estimate the elk population in a hunting district [Paterson et al. 2019]. This method accounts for biases within each data type, can account for multiple sources of error, and can produce population estimates, even when data are missing. Biologists can apply the IPM when evaluating the abilities of a harvest rate to achieve goals within a given time frame, and to determine the desired harvest needed to reach population objective.

Elk Population Dynamics

Ungulate populations are driven by adult female survival and juvenile recruitment [Gaillard et al. 2000]. For elk, adult female survival has the greatest potential to influence the population growth rate [Raithel et al. 2007, Eacker et al. 2017]. Adult survival [Eacker et al. 2017] and calf survival [Raithel et al. 2007] have been shown drive population growth in different systems indicating that populations can operate differently from one another. Factors that affect adult elk survival include predator numbers or density, precipitation, age of individual, and habitat quality [Brodie et al. 2013, Horne et al. 2019, Middleton et al. 2013, Proffitt et al 2009, Creel and Winnie 2005, Eacker et al. 2016]. Factors affecting calf survival include forage productivity, weather, snow depth, number of different predator species in the system, predator abundance, calf size, and nutritional state of pregnant cow while calf is in-utero [Proffitt et al. 2014, Eacker et al. 2016, Lukacs et al. 2018, Horne et al. 2019, Paterson et al. 2019].

Fecundity is the ability to produce offspring over time and is important to elk population dynamics. Fecundity for elk is a product of the probability of conception and the probability of a fetus surviving in-utero until birth. For species that have multiple offspring at once, litter size is important; elk typically only have a single calf (twin pregnancies <0.5%; triplet pregnancies <0.01% [Cunningham et al. 2009]). Because there is little information regarding fetal survival, most estimates of fecundity rely on pregnancy rates.

Nutritional condition is an important factor influencing pregnancy rate [Cook et al. 2013, Proffitt et al. 2014, Proffitt et al. 2016b]. Elk with access to better nutrition had pregnancy rates of 89%, whereas those with lower quality diets averaged 72% [Proffitt et al. 2016b]. Pregnancy rate also varies with age of the female, increasing from yearlings to a plateau for middle aged females (2-16), then declining with older age classes (17+) [Paterson et al. 2022a].

Fecundity and calf survival together yield recruitment. At one year old, a calf is considered "recruited" into the population. Recruitment is a product of conception, in utero survival to birth, and calf survival for the first year of life [Paterson et al. 2019].

Bull Age Structure

Public concerns have been raised about too few bulls or too few mature bulls in the herd resulting in delayed or prolonged breeding cycle. Breeding timing has been shown to be earlier and more synchronous when breeding is done by older bulls [Noyes et al. 1996 and 2004; Cook et al. 2004]. A more synchronous breeding period should result in a more synchronous birthing period which can have a predator swamping effect and potentially increase the survival of calves during their first weeks after birth. Cook et al. (2004) argue that impacts from breeding timing on calf overwinter survival are unlikely due to the role of summer nutrition. Later born calves are larger at birth and grow faster than earlier born calves under favorable conditions, indicating that later born calves are not always disadvantaged [Cook et al. 2004]. Ultimately, there is little evidence that low bull ratios relate to delayed breeding results and lower calf survival, especially with adequate nutrition. There have been no realized population level effects from delayed or prolonged breeding cycles.

Similarly, little evidence exists in support of public concerns regarding low pregnancy rates as a result of low bull numbers, low mature bull numbers [Noyes et al. 2002], or low bull:cow ratios [Hamlin and Ross 2002]. Pregnancy rates have been related to female kidney fat index [Noyes et al. 2002], female body fat in fall [Cook et al. 2013], female age, and summer precipitation [Proffitt et al. 2014]. In one study, bull elk older than yearlings were responsible for 70% of copulations while only comprising 25% of the bull population [Squibb 1985], indicating that relatively few older bulls can still accomplish a majority of the breeding. Regulation changes in Montana that have increased numbers and ages of bulls have not resulted in an increase in recruitment [MFWP 1990, Vore and DeSimone 1991, Hamilin and Ross 2002], indicating factors other than number of bulls or number of adult bulls in the population are more important to pregnancy and calf survival [Hamlin and Ross 2002]. Increasing bull:cow ratios or changing bull harvest structure is unlikely to have much effect on herd productivity [Bender and Miller 1999, White et al. 2001, Bender et al. 2002].

Because there is little evidence that bull:cow ratios observed in Montana are contributing to negative population consequences, we consider a total bull:cow ratio of 10:100 to be adequate in meeting the biological requirements of accomplishing breeding within a herd. This minimum ratio of 10:100 accounts for all bulls, including yearling bulls or “spikes”. Yearling bulls counted at the time of survey will be 2.5 years old and be brow-tined-bulls by the following breeding/hunting season. A bull:cow ratio goal of ≥10:100 does not indicate the herd will be managed down to 10:100, but rather management actions will be triggered if lower than 10:100. Most HDs in Montana meet or exceed this minimum ratio. Any bull:cow ratio objectives set higher than 10:100, or ratios that include a brow-tined-bull:cow ratio are done so to meet social desires of more bulls, older age classes of bulls, or larger antler size of bulls.

Habitat

The 2022 elk distribution consists of 59% public land and 41% private land (Figure 10). Note the 2022 elk distribution is not mapped within Indian reservations or National Parks as FWP does not have management authority in the areas. In Montana, public land management of elk

habitat is the primary responsibility of the USFS (44%), BLM (7%), Montana Department of Natural Resources and Conservation (DNRC; 5%), U.S. Fish and Wildlife Service (USFWS; 2%) and FWP (0.9%). The missions of these agencies recognize the importance of quality wildlife habitat, yet many include a multiple-use mandate. Multiple use of landscapes can make providing quality elk habitat a challenge. Management of elk habitat on private lands is the prerogative of the landowner. Montana Fish, Wildlife & Parks directly manages elk habitat only on FWP administered Wildlife Management Areas (WMAs), on private and public lands enrolled in FWP habitat conservation programs, and partially on lands under FWP CE agreements. However, FWP actively works with land management agencies to inform land management decisions. Also, FWP collaborates on projects with non-governmental organizations (NGOs) to conserve or improve elk habitat. The collaboration does not end at the state border, because some elk herds range into other states, Canadian provinces, or Indian reservations.

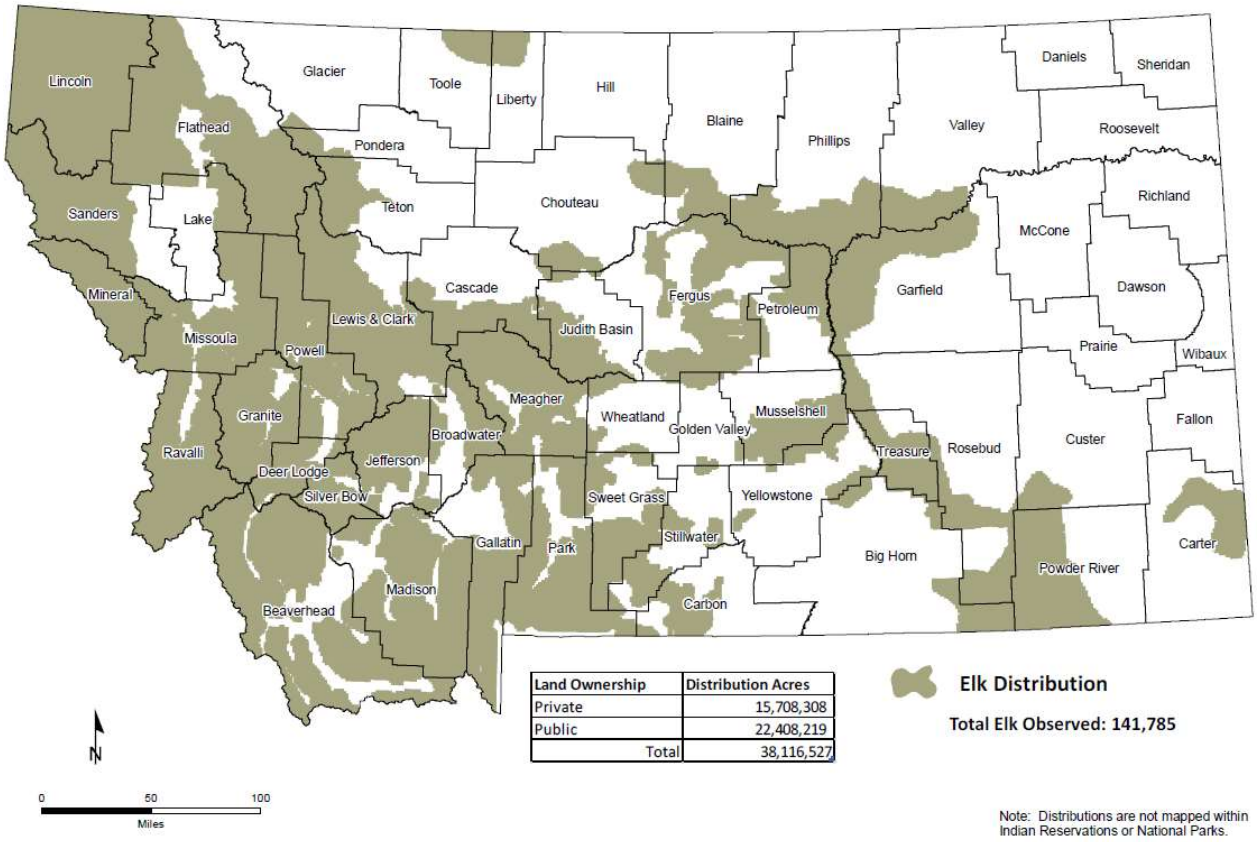


Figure 12. Elk distribution in Montana as of 2022. Note: distributions are not mapped within Indian reservations or National Parks.

FWP's Habitat Program

In 1940, 1,004 acres of big game wintering habitat were purchased by the Montana Fish & Game Department in the area of what is now known as the Judith River WMA (now

approximately 9,658 acres), the state's oldest WMA. As of 2022, FWP has 41WMAs within the current elk distribution in Montana. The area of WMAs currently estimated to be used by elk exceeds 366,000 acres.

Similarly, the Habitat Montana Program allows FWP to purchase CEs. Conservation easements allow landowners to be compensated for voluntarily keeping their property undeveloped for future generations. The lands included under CEs remain privately owned and can remain working lands (timberlands, farmlands, grazing lands) which can be beneficial to wildlife populations. As of 2022, there are 64 conservation easements entirely or partially within the current elk distribution covering almost 441,000 acres of perpetually conserved habitat.

Both WMAs and conservation easements contribute to providing winter range for big game populations. Within the defined elk winter range in Montana, about 4% is either under conservation easement or are part of a WMA, about 6% is owned by the State of Montana (not including FWP lands), and about 45% is federally owned.

Montana Fish, Wildlife and Parks biologists and managers provide technical assistance to land managers regarding elk habitat. Additionally, FWP has conducted and funded substantial research exploring relationships between elk and their habitat. Montana Fish, Wildlife and Parks administers voluntary habitat programs on private lands, which often times leverages FWP programs with other federal or NGO programs to create large scale habitat improvements on private lands. FWP biologist involvement in habitat management is a critical piece of identifying habitat limiting factors for elk, finding solutions to elk habitat issues and partnering with landowners, agencies and other conservation groups.

Habitat Programs Administered by FWP that Benefit Elk

Habitat Montana Program– The Habitat Montana Program uses license dollars to fund high value habitat projects through conservation easements, fee title acquisitions, and habitat conservation leases. The goal of the program is to conserve and restore habitat for fish and wildlife. Benefits of the program include:

- WMAs purchased through the Habitat Montana Program provide critical wildlife habitat, including winter range for big game herds
- Access to outdoor recreation has been secured and enhanced
- Soil and water are conserved
- Landscape-scale ecological functions are sustained
- Watershed quality has been maintained and improved for communities, fisheries, and other downstream users
- Accomplishments have supported the removal of species from federal Endangered Species Act listing or avoidance of listing

- Conservation easement projects have helped support keeping ranchers on the land and maintaining rural and agriculture-based lifestyles
- Conservation easements have averted urban-sprawl in fire-prone forest settings and related fire management issues
- Rural business and agricultural economies have been supported and enhanced
- The wood products industry has benefitted by retaining and supporting sustainable working forests
- Scenic open-space values have been preserved
- Other less tangible quality-of-life benefits have been maintained or enhanced

Forest Legacy Program– The Forest Legacy Program provides funding for conserving high value working forests. The program is administered by the U.S. Forest Service and managed in Montana by FWP. This voluntary incentive-based program operates through nationally competitive grants. Montana forest values conserved by the program include wildlife habitat, sawmill timber and other forest products, public access for recreation, watersheds for municipalities and irrigation, cultural and aesthetic values, and other social and ecological benefits.

The program began operating in Montana in 2000 and has since supported nearly 261,000 acres of permanent conservation, including 243,000 acres of conservation easements and 18,000 acres of fee title acquisitions, the latter managed by FWP as Wildlife Management Areas. The Forest Legacy Program is funded from offshore oil and gas lease earnings through the Land and Water Conservation Fund. Additional information about the national program can be found on the US Forest Service's website.

Wildlife Habitat Improvement Program Grants– The Montana Wildlife Habitat Improvement Act was passed into law by the 2017 Legislature. The purpose of the act is to make federal funding available to restore priority wildlife habitats by managing noxious weeds. The legislation makes available up to $2 million annually in federal Pittman-Robertson Wildlife Restoration funds, which requires a dollar of nonfederal matching funds (cash) for every 3 dollars of federal grant funding.

Projects are intended to be focused on ecologically important wildlife habitats with landscape-scale benefits. Grants, which are paid in the form of reimbursed expenses, may be issued for up to five year’s duration. Priorities for funding include:

- Landscape-scale projects lands that are open to public hunting and involve priority wildlife habitats
- Noxious weed infestations that directly impact habitat functions
- Broad partnerships involving multiple landowners
- Proposals with leveraging beyond the minimum match funding requirement
- Projects that retain or restore native plant communities.

Carrying Capacity

There are multiple definitions of carrying capacity for wildlife populations. Common definitions (as they pertain to elk) include:

- Biological carrying capacity, which is the maximum number of elk that the habitat can support long-term
- Nutritional carrying capacity, which is the maximum stable population of elk that can be supported by the nutrition available
- Ecological carrying capacity, which is the population level at which elk are not negatively influencing native plants and other animals
- Social carrying capacity, which is the social tolerance for animals on the landscape

Overall, the biological concept of carrying capacity indicates that there are limits to the number of animals a landscape can support without degradation or without severe mortality during extreme weather events.

Beyond the scope of biological definitions of carrying capacity, social tolerances define social carrying capacity. Social carrying capacity more routinely dictates maximum number of elk for a given area and can be translated into population size goals. Often, social carrying capacity is below that of any biological carrying capacity. Depending on which values and which social group is considered, the social carrying capacity may differ. For example, agricultural producers may request elk numbers lower than biological carrying capacity because of the impact on their land whereas sportspersons may request much higher elk numbers to enhance their recreational experience.

Although wildlife managers have long considered the concept of biological carrying capacity as one of the potential factors influencing elk populations, it is not a concept that can easily be translated to a defined population number for multiple reasons. First, it varies seasonally, annually, and among years. Carrying capacity can be affected by weather conditions such as drought and winter severity. It can be affected by habitat changes such as forest succession or forest fires. Because multiple species use the same landscape, other ungulates often compete for the same forage resources as elk. Some elk move seasonally and sometimes change their distribution seasonally or among years which changes the availability of forage resources. Finally, because forage grows and cures over time, and forage resources change throughout the year, measuring production may be difficult and expensive, and remotely sensed data may not adequately quantify habitat quality. Therefore, carrying capacity remains an important consideration in elk management, but using measurements of indices associated with it have proven challenging to incorporate in any management paradigm.

Habitat Selection

Wildlife select habitat at different scales. The distribution of elk across North America is the coarsest selection scale (first order). The home ranges that individual elk inhabit within the overall distribution is a finer scale of selection (second order). Within an individual's home

range, certain habitat types and areas of use are considered a fine scale selection (third order). Finally, within those areas of use, elk select certain food items to consume which is the finest scale typically assessed (fourth order) Johnson 1980.

A review of the recent literature (<20 years) of elk habitat selection studies conducted in Montana show some general patterns. Factors other than simple resource availability influence habitat selection. Selection may change based on factors such as predation risk, hunting pressure, or weather conditions such as deep snow. Although elk exhibit predictable resource selection patterns at and within their home range, the specifics of those patterns may differ among years, seasons, sex, scale, and locale. Because Montana has diverse habitat types across the state, selection patterns documented in one area may not be representative of elk selection in other areas/habitat types.

Elk of both sexes use a variety of habitats, from open grasslands to dense stands of forested habitat throughout winter Boyce et al. 2003, Creel et al. 2005, Mao et al. 2005, Proffitt et al. 2010, Cleveland et al. 2012, Shamhart et al. 2012. Winter habitat selection is influenced by hunting pressure, risk of predation Creel et al. 2005 and environmental factors like snow depth and forage availability as influenced by slope and elevation Mao et al. 2005 Proffitt et al. 2010, Boyce et al. 2003. During winter months, elk will select previously burned forest Mao et al. 2005 and rested pastures Shamhart et al. 2012 to take advantage of the forage resources of these areas provided they occur in areas where snow cover doesn't limit use.

During spring, female elk will select moderate elevation and slope, ridgetops, and faces that provide high solar radiation and intermediate "greenness" (Normalized Difference Vegetation Index; NDVI) values. They also select areas with agricultural landcover. Female elk avoid areas with snow accumulations during this period as well as roads Rayl 2019.

In summer, males select for greater forest cover while avoiding roads Morris et al. 2016. Female habitat selection across multiple study areas in southwestern Montana indicated nutritional resources, represented by NDVI, were most important in habitat selection, followed by motorized route density Ranglack et al. 2022. Also, previously burned areas (12–14-year-old) may be important for selection during this time Boyce et al. 2003.

Open hunting seasons influence habitat selection by elk. Both male and female elk make selection decisions based on similar risk factors Lowrey et al. 2020. Elk select for nutritional resources during this time Ranglack et al. 2017, DeVoe et al. 2019 found within various habitat types including forest valley bottoms, shrublands, grasslands, or burned forest Mao et al. 2005, Proffitt et al. 2013, Proffitt et al. 2016, DeVoe et al. 2019, Snobl 2022. Female elk select for increased canopy cover, Ranglack et al. 2017, Lowrey et al. 2020, Proffitt et al. 2016, but male elk habitat selection is not strongly influenced by canopy cover Lowrey et al. 2020. Elk avoid roads Ranglack et al. 2017, DeVoe et al. 2019, Lowrey et al. 2020, Proffitt et al. 2016, Proffitt et al. 2013. Elk seem to exploit terrain roughness or ruggedness Proffitt et al. 2016, DeVoe et al. 2019, Lowrey et al. 2020 and elevation Mao et al. 2005, Proffitt et al. 2013 to avoid disturbance from hunters. Furthermore, elk disproportionally use areas with restrictive access during hunting season to avoid disturbance Profitt et. al 2016.

Overall, elk use a variety of habitats and habitat selection may change throughout the year depending on weather, vegetative phenology, and disturbance. Managing for a mosaic of habitat types seems optimal to provide habitat for elk to use during different times of the year. Although factors such as slope, elevation, and ruggedness cannot be influenced by management actions, these characteristics define high use areas where habitat management efforts will yield the greatest benefits for elk.

Forage and Nutrition

Elk nutrition has been described as a function of frequent decisions made by an individual at small scales, and includes interactions between foraging behavior, abundance of forage, nutrient content, and vegetation composition [Cook et al. 2013, 2016]. Nutrition has been linked to conception dates, pregnancy rates, age of puberty, body size, and calf survival [Hines et al. 1985, Noyes et al. 2002, Cook et al. 2004, Cook et al. 2013, Eacker et al. 2016]. Numerous studies have indicated that forage quality may be more important than forage quantity [Cook et al. 2004, 2013, 2016, Devoe et al. 2019], and elk have been shown to select habitat based on forage qualities over vegetation composition and other landscape characteristics [Van Dyke and Darragh 2007, Ranglack et al. 2016]. Elk may not be able to compensate for a lack of high-quality forage [Cook et al. 2016.], indicating that there is a minimum threshold for the abundance of high-quality forage required for elk.

Although nutritional influences are difficult to detect, they can affect many aspects of elk productivity [Cook et al. 2013]. The first is the age of puberty; in a year with high nutritional condition, more yearlings may enter estrus as compared to years with low nutrition [Hines et al. 1985]. Next, nutrition may influence conception rates and dates [Cook et al. 2004, Cook et al. 2013]; in an experimental nutrition trial, 80% of cow elk in the low nutrition group failed to conceive [Cook et al. 2004]. Additionally, inadequate nutrition in the months before the breeding season may delay conception, de-synchronize the birth pulse, or result in low pregnancy rates [Noyes et al. 2002, Cook et al. 2013, Proffitt et al. 2016b]. And lastly, summer elk calf survival can be dependent on biomass of preferred forage [Eacker et al. 2016]. If we assume high precipitation in winter precludes the pregnant cow from accessing or acquiring adequate nutrition when the calf is in-utero, then maternal carryover effects of low nutrition may also explain lower calf survival the following summer. Each of these influences on elk productivity may be subtle, but cumulatively could result in a major effect [Cook et al. 2013].

Although nutrition throughout the year is important for elk herd health, summer nutrition may be more influential to elk productivity than nutrition during other times of the year. Elk body fat levels in spring were a function of fat levels from the previous fall [Cook et al. 2013]. This indicates that when elk are found to be malnourished during winter, the cause may in fact be poor summer-fall nutrition. The influence of summer nutrition on elk can affect pregnancy rates, body size, fat accretion, and body size of calves [Cook et al. 1996, Cook et al. 2013, Proffitt et al. 2016b]. Summer nutrition was found to have a larger effect on elk population dynamics than limited winter forage and winter weather [Cook et al. 2013]. Pregnancy rates <85% in prime aged adult females may indicate summer or fall nutritional limitations [Cook et al. 2004]. In southwest Montana, nutrition is not a common

limitation on pregnancy rates or overwinter survival [Cook et al. 2004, Evans et al. 2006, White et al. 2011], however some Montana elk populations do experience lower pregnancy rates correlated with lower nutrition [Proffitt et al. 2016a].

Elk Security Habitat

Elk vulnerability has been defined as the measure of an elk's susceptibility to being harvested during the hunting season. Security habitat has been defined by different standards, but generally it is an area where elk are less vulnerable to harvest while meeting their seasonal habitat needs. There is an inverse relationship between elk vulnerability and elk security; as elk security declines, elk vulnerability increases. Managing security habitat allows for additional control over total harvest without changing harvest regulations.

Security habitat was first formally defined by Hillis et al. (1991) as including areas that were at least ½ mile (800 m) from an open road, at least 250 acres in size, and comprised at least 30% of an analysis unit. Lyon and Christensen (1992) defined security areas as, "any area because of its geography, topography, vegetation, or a combination, that will hold elk during periods of stress."

Although Hillis et al. (1991) defined the concept of security habitat and put forth guidelines, the paper was explicit about the need for improvement based on further research. Refinements to the original definition of security habitat have been developed using elk habitat selection during hunting season and assuming elk seek security habitat during this time. A study conducted in southwest Montana analyzing 9 different elk herds developed security habitat recommendations that included over 13% canopy cover, 1.7 miles (2760 m) from motorized routes in patches at least 7.8 mi^2 (20 km^2) [Ranglack et al. 2017]. Similarly, another Montana study recommended managing for canopy cover of 23–60% in areas 1.1–2.3 miles (1846–3679 m) from motorized routes [Lowrey et al. 2020]. Also, FWP and the USFS recommended managing for conifer stands with at least 40% canopy cover to provide hiding and thermal functions on elk spring-summer-fall ranges [FWP and USFS 2013]. Exploring interactions between cover and distance to roads has shown that elk in roaded areas select for greater canopy cover [Unsworth et al. 1998]. When canopy cover is adequate, road management alone can drive elk security and elk distribution on public lands [Christensen et al. 1993, Proffitt et al. 2013]. In central and eastern Montana, where there is less canopy cover, private lands with limited hunting access, topography, and distance to roads influence elk security.

Because nutrition and hunter pressure may drive habitat selection in some instances, the importance of security habitat has been challenged [Proffitt et al. 2010 and 2013, Cleveland et al. 2012, Ranglack et al. 2016, 2017, DeVoe et al. 2019]. Yet, the presence of security habitat on public lands may entice elk to spend more time there than on private lands with restricted hunting access which may serve as refuges [Proffitt et al. 2013, Ranglack et al. 2017, DeVoe et al. 2019, Lowrey et al. 2020].

Elk and Mule Deer Competition

In parts of western North America, elk populations have increased, and mule deer populations have decreased. This leads some to wonder if increasing elk numbers have caused mule deer to decline. Considering some of the physiological and behavioral differences between the two species, oftentimes elk do have an advantage over mule deer. For example, mule deer have smaller stomachs and highly specialized diets whereas elk have larger stomachs and more general diets [Wickstrom et al. 1984]. This means elk can take advantage of preferred mule deer forage (browse), but rarely do mule deer take advantage of elk preferred forage (grasses) [Keegan and Wakeling 2003]. Also, when quality habitat is limited, an elk's larger stomachs can obtain adequate energy from higher quantities of low-quality forage [Wickstrom et al. 1984].

During winter conditions, mule deer movements become restricted in snow depths >10 inches, whereas elk are not significantly restricted until snow depth reaches 18 inches [Lindzey et al. 1997]. However, less snow may still cause elk to move to areas with more accessible forage [Sweeney and Sweeney 1984] whereas mule deer may not readily move in response to snow accumulation because of their specialized diet. Also, because elk are taller, they can use forage that may be out of reach for a mule deer [Keegan and Wakeling 2003] and may more easily navigate obstacles such as fences and downfall. This means when severe winter weather occurs, elk may not be impacted to the extent mule deer are. Also, when severe winter weather occurs and elk move down in elevation, they can physically displace mule deer from their winter range.

In addition to the behavioral and physiological advantages elk may have, habitat alterations that have occurred during the last several decades may benefit elk more than mule deer [Keegan and Wakeling 2003]. Elk consume a higher proportion of grasses on winter range than mule deer [Christianson and Creel 2007]. Therefore, replacement of early succession shrublands (preferred deer forage) with grassland (preferred elk forage) and forest habitats, may benefit elk more than mule deer.

Often times there are social differences in opinions of publics wanting more deer, more elk, or more of both species. Although there is considerable overlap in the habitats they can use, often times habitat needs diverge and therefore managing habitat to maximize populations of both species in the same landscape can be difficult.

Types of Habitat Management

There are a variety of habitat management techniques to enhance or restore elk habitat, many of which focus on resetting forest succession to earlier seral stages. Generally, forest succession begins with early seral stages consisting of deciduous shrubs, forbs, and grasses and then as conifer overstories close, shade tolerant evergreens become dominant [Cook et al. 2016]. Early seral stages are crucial for providing high nutrition for elk as digestible energy declines with forest succession [Cook et al. 2016] and generally, advanced forest seral stages have negative effects on ungulate nutrition [Irwin and Peek 1979 & 1983, Collins and Urness 1983, Riggs et al. 1996, Peek et al. 2001, Keane et al. 2002, Cook et al. 2016]. These results imply that forest managers may need to promote forest disturbances to reset forest succession to an earlier seral stage to provide higher nutrition for elk. Forage can be affected by fire, livestock grazing, noxious weeds, and forest management [USFS FWP 2013].

Burning is one method of resetting forest succession. Prescribed burns or allowing wildfires to burn when socially and ecologically acceptable could improve forage quality [Barker et al. 2019a] and quantity [Snobl et al. 2022]. However, effects of burning on elk nutrition and use are variable through time [Van Dyke and Darragh 2007, Long et al. 2008], and elk typically increased use of recently burned sites, eventually returning to levels of pre-burn use after about 10 years [Van Dyke and Darragh 2007]. This elk use pattern follows forage quality patterns after a burn [Van Dyke and Darragh 2007, Proffitt et al. 2019]. Small burns at dispersed time and space intervals are recommended [Van Dyke and Darragh 2007, Long et al. 2008, Proffitt et al. 2016b], and maintaining a mosaic of fire history may benefit elk by producing and maintaining nutritious habitats [Proffitt et al. 2016b].

Livestock grazing is a common land management practice. Managed grazing is a tool that can improve elk habitat by enhancing forage palatability and altering herbaceous composition and structure [Krausman et al. 2009]. In Montana, elk select pastures that have been recently grazed [Grover and Thompson 1986] or those grazed within a rest-rotation grazing system [Shamhart et al. 2012] more so than pastures where livestock grazing has been eliminated. These findings indicate that rest-rotation grazing systems on public lands may help shift elk distributions away from ungrazed private lands.

Forest management techniques including the use of herbicides, forest thinning, and clearcut logging may create early seral stages with high nutritional value [Cook et al. 2016, Vales et al. 2017]. The effectiveness of these treatments depends on the specific locations and the ecological characteristics of the site [Cook et al. 2016]. Clearcut logging in Montana has been shown to remove canopy cover allowing for an increase in forage production and species diversity [Hammond 1980]. However, an important consideration for logging is the increase in the number of roads and the loss of canopy cover, both of which affect elk security habitat.

Natural changes to canopy cover have occurred across Montana and other Western states with recent mountain pine beetle (*Dendroctonus ponderosae*) outbreaks. In the Elkhorn Mountains of southwest Montana, 80% of lodgepole pines (*Pinus contorta*) were killed by pine beetles [Lowrey et al. 2020]. Despite high lodgepole pine mortality, canopy cover remained high; higher than uninfested ponderosa pine and Douglas fir forests [Lowrey et al. 2020]. However, elk may experience negative consequences of pine beetle infestations through time as dead trees blow-down, making travel difficult [Lowrey et al. 2020].

When evaluating habitat for elk, forage is a primary physiological need and is a primary management focus when elk needs are being considered. Elk are primarily grazers that will use browse, especially during winter. Early seral stages, especially within conifer forests, provide suitable forage. Security cover is an important behavioral need and is secondary to the physiological need for forage. Components of security cover include physical screening cover as well as topographical and spatial (distance) aspects that help elk avoid humans, especially during hunting season. In habitats with fewer trees, steep terrain and distance from roads comprise greater proportions of security cover than in forested habitats. Using techniques to

reset forest succession to earlier seral stages may improve nutrition for elk, it may also reduce cover resulting in a loss of security habitat.

Habitat Recommendations

Dispersing habitat efforts through time and space will provide a variety of seral stages in a mosaic pattern across the landscape [Van Dyke and Darragh 2007, Cook et al. 2016, Vales et al. 2017, Barker et al. 2019b]. Managing habitat for a mosaic of early successional vegetative communities could improve both quality and predictability of forage [Barker et al 2019b], and spatially separating small treatment areas will also stabilize the boom-bust cycles of forage and cover [Vales et al. 2017].

Managers should consider the scale of alteration necessary to achieve goals. For example, small acreages of high-quality food may be nutritionally beneficial to elk during the winter when herds are concentrated on winter range; these small areas are less effective during summer when elk are widely distributed [Cook et al. 2013]. If summer nutrition is a limited resource, managers may want to consider larger scale alterations. Alternatively, disruptions of large tracts of habitat may make forage unpredictable and hamper elk migration [Barker et al 2019b].

The U.S. Forest Service and FWP collectively provided recommendations for elk habitat management for four national forests in Montana (Custer, Gallatin, Helena and Lewis and Clark) [USFS and FWP 2013]. The specific habitat recommendations are as follows:

1. The scale of elk habitat analysis should be elk herd unit home ranges, which can further be defined as areas large enough to encompass natural variation in the way the elk use the landscape.
2. Elk habitat management needs to be viewed within the ecosystem context with other species' needs considered in addition to elk.
3. Elk on winter range should experience minimal human disturbance. Also canopy cover and forage recommendations should be able to meet the needs of elk.
4. Security areas should be defined by following the concept of the Hillis Paradigm (1991), but numerical parameters for each analysis unit may be different. Motorized routes during hunting season should be considered when defining security areas. Security areas should be well distributed throughout an analysis unit.
5. To promote elk use of summer range, motorized route density should be ≤ 2 road miles/square mile [Christensen et al. 1993]. However, traffic volume and route location may also be important factors in elk use of habitat.
6. Forest cover outside of winter should accommodate the needs of elk within the realistic range of forage and cover values for the analysis unit. Generally, 40% canopy cover can suffice for providing both thermal and hiding functions during these times of year. Cover assessments should consider health, quantity, configuration and location of conifer cover species.
7. There are no specific minimum patch size recommendations for forested cover.

8. High quality abundant forage should be available during all seasons. Specifically, a diversity of well distributed native forbs, grasses, and shrubs are recommended. Habitat should contain a variety of successional stages, as well as key ungulate forage habitats such as riparian, aspen, grassland, sagebrush and other shrublands.
9. Avoid activities in known elk calving areas May 15–June 30. Delineating calving areas where brucellosis is a concern should be a priority so that future spatial/temporal separation between elk and livestock during this time can be maintained.

Wildlife managers and land managers need to collaborate and simultaneously consider security habitat, license structure/levels, and access management The best habitat may go unused if hunting pressure too high, because elk selection for areas without hunter access tends to be a driving factor in elk selection during fall.

Predation

Predator-prey interactions are dynamic across space and time and are difficult to generalize in that local herds experience the effects of predation differently. Predation can be a source of additive mortality or compensatory mortality. Additive mortality is mortality that would not have otherwise occurred, thus it is in addition to existing mortality. Compensatory mortality replaces mortality that would have occurred anyway, decreasing the other types of mortality that would have otherwise occurred, meaning it has little effect on the population. For example, if an elk population is at carrying capacity and there is not enough food resources, some individuals are bound to starve to death. In this case, if a predator killed an individual that was doomed to starve to death, there would be no net difference in the number of dead elk; the predation compensated for the starvation loss (compensatory mortality). However, in a system where the elk population is below carrying capacity, food resources are plentiful, and survival is high, an elk that would have otherwise survived but is killed by a predator is added to the baseline level of mortality (additive mortality). Therefore, population responses to predation depend on multiple factors including environmental conditions such as habitat type, habitat quality, weather, and other mortality sources (including human harvest of elk). These can affect how significant the effect of predation is on an elk population.

Large carnivore populations are recovering and expanding in the west, including Montana. Montana currently has complex predator communities including wolves, grizzly bears, black bears, and mountain lions.

Direct Effects

The direct effects that predation can have on elk populations depends on whether the mortality is additive or compensatory. If additive, then predation could cause population declines. Predation not only influences elk at the population level, but also at the individual level. At the individual level, characteristics such as age and size can influence the likelihood of predation Horne et al. 2019. Most newborn calves cannot evade predation until they are about a week old

Johnson 1951; during this vulnerable time various predators have been linked to calf mortality. Black bears, grizzly bears and mountain lions have been documented as primary predators and the impact is variable, likely dependent on habitat security. As calves get older, wolves also become a primary predator Raithel 2005, White et al. 2010, Eacker et al. 2016, Barber-Meyer et al. 2008, Horne et al. 2019. Primary predators of adult elk in Montana include mountain lions and wolves.

Coursing predators, like wolves, may be more selective in the prey they take, focusing on vulnerable individuals, compared to stalking predators, like mountain lions, that are more opportunistic in their prey selection. For example, if a pack of wolves detects a group of elk and begins to chase the herd, the elk begin running; this provides an opportunity for wolves to focus on the weaker or slower individuals. When a mountain lion detects and stalks or ambushes a herd of elk, vulnerability may be more a function of proximity and prey size than of performance.

Indirect Effects

Predators can also indirectly affect elk by causing them to alter movement patterns, foraging behavior, vigilance, grouping patterns, and habitat selection. Elk may exhibit behavioral changes to predation risk at large spatial and temporal scales Creel et al. 2005, Liley and Creel 2008, Proffitt et al. 2009. However, behavioral responses to predators vary temporally and spatially, are hard to predict, and may depend on habitat type Garrott et al. 2005. For example, elk disaggregate in response to predation risk in sagebrush habitats and aggregate when in grasslands Proffitt et al. 2009. When elk alter habitat use because of predators or perceived predation risk, there may be nutritional consequences Pierce et al. 2004 resulting in less access to grazing opportunities that reduce survival or reproduction Christianson and Creel 2007, Christianson and Creel 2010. However, this tradeoff has not been shown to affect elk body fat White et al. 2011 or pregnancy in Montana elk herds White et al. 2011, Proffitt et al. 2014, Paterson et al. 2022b. Also, Paterson et al. (2022) conducted a comprehensive analysis of forage-risk tradeoffs for elk in Montana and found that elk had to tradeoff between selecting high quality forage and avoiding lions, but there was no such tradeoff for avoiding wolves (i.e., impact varies among predators). Additionally individual elk behave differently, which may be why there is not a population-level effect Paterson et al. 2022b.

Another behavioral response to predation risk is altering group size. Although some research found no relationship or a weak relationship between wolf predation risk and elk group size Gude et al. 2006, Proffitt et al. 2015, others in more forested winter ranges documented that predation risk can affect elk group size Creel and Winnie 2005, Winnie and Creel 2007. Group size is important to an individual's risk of being preyed upon. For example, a lone elk may be able to evade predation by avoiding detection. If detected, the single elk is the sole target of a predation attempt. In contrast, elk in larger groups are more likely to be detected by predators, but their individual odds of being killed by a predator once detected is influenced by the number of other elk in the group. There is a tradeoff in group sizes between detectability and a dilution effect and an ideal group size may be 6–9 in forested winter ranges Winnie and Creel 2007.

Lastly, vigilance is the action of keeping careful watch for potential predators. As elk display heightened vigilance, they spend less time foraging or resting. Elk vigilance is dependent on variables associated with prey and predator characteristics [Liley and Creel 2008]. For example, elk adjust vigilance levels based on the group they are in (prey) and the type of immediate threat (predator) they are facing [Liley and Creel 2008]. Elk groups of 10–20 displayed more vigilance than groups that were larger or smaller [Liley and Creel 2008].

Carnivore Management

Current statewide management for large carnivores that have the potential to impact elk (i.e., mountain lions, wolves, and black bears) focuses on public hunting and trapping through existing rules and laws that provide the regulatory framework for hunting or trapping seasons. MCA 87-1-217, Policy For Management Of Large Predators, identifies "preserve citizens' opportunities to hunt large game species" as a primary goal in managing large predators, superseded only by protecting humans, livestock, and pets and preserving and enhancing the safety of the public during outdoor recreational and livelihood activities. Because grizzly bears are federally listed as a threatened species under the Endangered Species Act and are currently not managed by the state of Montana, they are omitted from further management and monitoring discussion herein.

Carnivore management through increasing harvest or agency-initiated lethal removal may be considered to increase prey populations that are at lower numbers than desired. Relationships between carnivore harvest and ungulate populations are unclear in many cases. Carnivore harvest can increase elk calf survival, recruitment, or population growth [White et al. 2010, Proffitt et al. 2014, Paterson et al. 2019, Proffitt et al. 2020]. However, increasing carnivore harvest may not influence elk survival if there are other significant sources of elk mortality, such as human harvest [Brodie et al. 2013], extreme weather conditions (calves), or if non-target carnivores are having a significant impact to elk mortality in place of the targeted species [Proffitt et al. 2014]. Prey responses to predator management may also be influenced by the proximity of the prey population to the capacity of the habitat to support them. For predation management to be effective, predators must be regulating the prey population [Ballard et al. 2001].

Under certain circumstances, liberalizing carnivore harvest may increase elk calf recruitment. A recent study in Montana monitored elk calf survival throughout changes in mountain lion harvest and found that summer and winter calf survival were lowest before liberalized harvest, highest during liberal harvest, and intermediate four years post liberalized harvest [Proffitt et al. 2020].

Integrated Carnivore-Ungulate Harvest Management

To address concerns regarding effects of predation on elk populations, wildlife managers may design integrated carnivore-ungulate harvest management programs. These programs use a combination of liberalized carnivore and restrictive ungulate harvest regulations to achieve population abundance goals [Proffitt et al. 2020]. Two key factors distinguish integrated carnivore-

ungulate management from predator control programs: the focus of public hunters and hunting seasons as the primary mechanism for carnivore removals, rather than agency staff, and the adjustment of ungulate harvest regulations simultaneous with liberalized carnivore harvest Proffitt et al. 2020. Additionally, integrated carnivore ungulate programs involve careful assessment of system-specific carnivore-ungulate relationships, such as cause specific mortality and the degree to which predation is additive versus compensatory for each carnivore species involved. Rather than simply reducing all carnivore populations locally, this information is used to target the most likely carnivore species to a specific degree to improve the most important vital rate(s) believed to be limiting performance of an elk population. Thus, individual prescriptions for an integrated carnivore-ungulate management program will vary from one location to another depending on limiting factors and regulation flexibility of carnivore species involved (e.g., quotas, season lengths, bag limits).

Monitoring ungulate and carnivore populations while integrating management programs is important to evaluate the effects on both populations. Ungulate data needed to evaluate effects varies depending on the vital rates believed to be limiting the ungulate population. Elk data that could be collected and used to evaluate effects may include adult, neonate, and juvenile survival, recruitment and population trend. For information on carnivore population monitoring, see **Carnivore Monitoring Programs** section.

The ability to implement carnivore harvest treatments to benefit ungulate populations is challenging given the social dynamics and controversy surrounding carnivore harvest, and public support for carnivore harvest regulations is often unknown or controversial Decker et al. 2009, Treves 2009, Boertje et al. 2010, Mitchell et al. 2018, Proffitt et al. 2020. Formal public involvement of the full diversity of stakeholders is critical to program success. FWP has used a structured decision making (SDM) format to implement integrated carnivore-ungulate management (e.g., Northwest Lion Ecoregional Population Objective Committee) and uses the framework in the development of carnivore monitoring programs to ensure adequate information is available for the development of integrated carnivore-ungulate management programs.

Carnivore Monitoring Programs

Predator-prey dynamics are inherently complex and dynamic; employing adaptive strategies is a key to developing solutions. Monitoring programs serve as a cornerstone for adaptive carnivore management ensuring the long-term conservation of populations while responsibly managing the population and addressing potential impacts to prey populations. In recent years, FWP has advanced new monitoring protocols for mountain lions, wolves, and black bears to better inform carnivore-ungulate management decisions.

Montana Mountain Lion Monitoring and Management Strategy–In 2019, FWP began implementing the Mountain Lion Monitoring and Management Strategy FWP 2019a, which outlines the state's new approach to conserving, monitoring, and managing mountain lions within an adaptive management framework. The strategy incorporates 25 years of field research that improved understanding of lion ecology and interactions with their prey. The strategy divides

the state into four ecoregions, which delineate the spatial boundaries and scale of all monitoring and management moving forward. Population abundance is estimated in each ecoregion using an IPM which combines data from mandatory reporting of lion harvest, vital rates estimated from past radio-collar studies, and a field-based spatial capture-recapture (SCR) method for estimating population density relative to habitat quality utilizing lion DNA. The IPM is also used to develop projections of future population change under alternative harvest scenarios that will inform management decisions. For more information see: https://fwp.mt.gov/conservation/wildlife-management/mountain-lion

One of the management guidelines from the Management Strategy states: "FWP will maintain a balance between mountain lion populations, their prey, and humans by helping direct local harvest of mountain lions, if and as needed, to manage prey survival and reduce human-lion conflicts." Upon completion of population monitoring in each ecoregion, information from the Mountain Lion IPM, ungulate survey data, and conflict data are presented to a stakeholder committee who work through a structured decision making process to develop a recommendation to the Department on 1) target population trend over a 6-year period, 2) degree of ecoregional population size change (% up or % down), and 3) Lion Management Unit (LMU) emphases (e.g., older-age class harvest, conflict reduction, aid ungulate populations, more opportunity, etc.). During the Northwest Lion Ecoregional Population Objective Committee (LEPOC) process in 2022 the committee recommended additional population decreases in 3 ungulate focal areas and 1 conflict focal area. The process repeats every 6 years in each ecoregion with updated population estimates and a new committee.

Wolf iPOM (Integrated Patch Occupancy Modeling)–The primary means of monitoring wolf distribution, numbers, and trends in Montana is now Integrated Patch Occupancy Modeling (iPOM). The iPOM method uses annual hunter effort surveys, known wolf locations, habitat covariates, and estimates of wolf territory size and pack size to estimate wolf distribution and population size across the state. iPOM estimates of wolf population size are the preferred monitoring method due to accuracy, confidence intervals, and cost efficiency.

Regulated public harvest of wolves was recommended by the Governor's Wolf Advisory Council as the main management tool for wolves and was included in Montana's Wolf Conservation and Management Plan that was approved by the USFWS during 2004. FWP has developed and implemented wolf harvest strategies that maintain a recovered and connected wolf population, reduce wolf-livestock conflicts, reduce wolf impacts on low or declining ungulate populations and ungulate hunting opportunities, and effectively communicate to all parties the relevance and credibility of the harvest while acknowledging the diversity of values among those parties. FWP is currently revising Montana's Wolf Conservation and Management Plan. The Montana public has the opportunity for continuous and iterative input into specific decisions about wolf harvest throughout the public season-setting process. For more information on wolf monitoring and harvest see: https://fwp.mt.gov/conservation/wildlife-management/wolf

Black Bear Monitoring– In response to changing harvest regimes in recent years, FWP proposed new research objectives and methods for monitoring black bears across the state. The primary objective of the monitoring protocols is to obtain population density and abundance estimates for black bears at spatial scales comparable to that of bear management units (BMUs). This is accomplished through the synthesis of periodic abundance estimates (every 4-5 years) and an IPM which incorporates harvest, harvest sex ratios, age of harvested bears, hunter success, and black bear vital rates to project population trends in periods between abundance estimates.

The monitoring program operates at two spatial scales: 1) regional (or ecoregion) level and 2) within each region at the bear management unit (BMU) level. Monitoring population density and abundance at the regional level cycles temporally using a 1-year "on", 3-4 years "off" schedule and be staggered across the state so that only one region is sampled each year. During "off" years an IPM will use harvest, population vital rate and environmental data to project population estimates between the cyclical 4–5-year field efforts.

Human-Elk Conflict

Increases in elk numbers and distribution over the last century have created management challenges on private and public land over issues such as crop damage, competition for forage with livestock, lack of vegetative regeneration, vehicle collisions, and transmission of diseases to livestock Bunnell et al. 2002, Haggerty and Travis 2006, Walter et al. 2011. Habituation of elk to human presence can strongly influence conflicts involving elk Thompson and Henderson 1998 and areas with inadequate hunting access are more likely to have complaints than those with hunting opportunities Adkins 1991. Elk conflict sometimes occurs among individuals who allow hunting but whose neighbor does not Adkins 1991.

Management decisions consider concerns about agricultural damage Van Tassell et al. 1999. Conflicts surrounding elk can result in decreased social tolerance, which may influence lower elk population size goals more so than biological factors. In fact, Montana statute states, "landowner tolerance" means the written or documented verbal opinion of an affected landowner regarding the impact upon the landowner's property…"(MCA § 87-1-301). Also, Montana statute (MCA § 87-1-323) states the Commission, "shall determine the appropriate elk…numbers that can be viably sustained. The department shall consider the specific concerns of private landowners when determining sustainable numbers pursuant to this section." Therefore, the Montana Fish and Wildlife Commission is obligated by statute to consider social tolerance of elk when determining appropriate or target number of elk.

In a 1990s study, 44% of Montana landowners with elk on their property thought numbers were too high a that time Irby et al. 1997. Similarly, in a 2007 survey, 43% of landowners surveyed agreed that, "*there are too many elk in Montana right now*" Lewis et al. 2007 and 50% of landowners thought, "*FWP needs to take measures to decrease Montana's elk populations*" Lewis et al. 2007.

Over objective populations of elk may need to be reduced to alleviate damage to native vegetation, agricultural production, and to reduce risk of disease transmission Walter et al. 2011. In

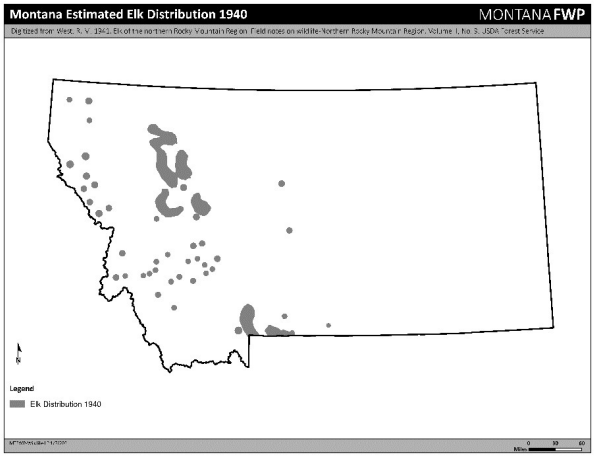
areas where elk populations have exceeded social tolerance, added harvest of adult female elk is commonly prescribed. However, adult female harvest goals may not be met if public access to the animals is limited [Proffitt et al. 2016].

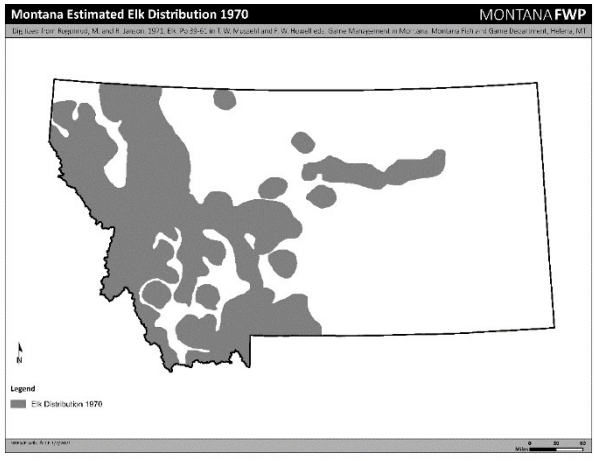
While social tolerance helps to define acceptable population levels, public perceptions also influence the methods prescribed to adjust elk populations [Walter et al. 2011]. Although the public generally supports many non-lethal methods of redistributing local elk populations [Walter et al. 2011], elk become habituated to non-lethal deterrents if elk do not experience negative physical stimuli [Nolte 1999, Jones et al. 2021]. Non-standard tools for elk population control such as agency sharp shooting may be useful in small, controlled settings, where agency staff could obtain access, but these approaches are unlikely to reduce populations on a large scale. Additionally, non-standard tools are generally less socially acceptable, biologically effective, or fiscally feasible at a larger scale [Walter et al. 2011].

Elk Distribution

The distribution of elk on the landscape is dynamic and can be described at multiple spatial and temporal scales. At the statewide scale, distribution can be defined as areas inhabited by elk at some point during the year, and the current Montana statewide distribution estimate is at a 1 mile^2 scale. At a more local scale, distribution can be defined as elk inhabiting a property, pasture, or specific area during a shorter time scale such as a night/day, week, month or season.

Statewide elk distribution in Montana has been estimated differently over time. Regardless of methods, the elk distribution has increased in the last century (Figure 11). Elk are currently inhabiting areas that were unoccupied by elk in 1940.





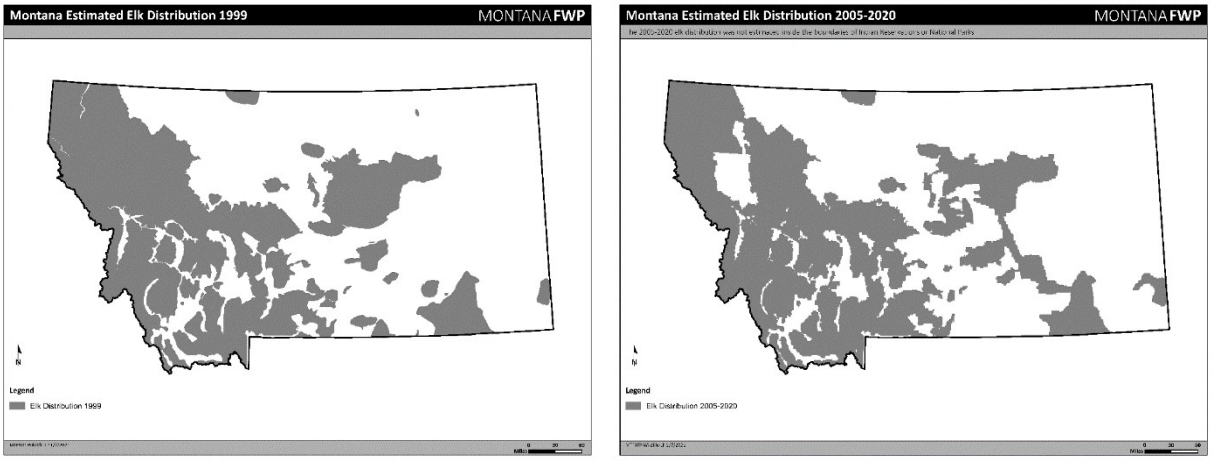


Figure 13. Montana Estimated elk distribution 1940–2020. Note: elk distribution is not mapped in Indian reservations or National Parks in the 2005-2020 distribution map.

Although we can note changes in the statewide elk distribution over time, local concentrations of elk are typically more noticeable and more problematic. At the local scale, elk concentrations appear to be changing, resulting in higher numbers of elk or higher elk densities in some places. When these concentrations occur on private lands, they can cause damage.

Local elk distributions are of high interest and are highly important to stakeholders; however, quantifying local elk distributions during various times of the year has proven difficult. Biologists mark elk locations during aerial surveys, but those locations only represent a single day within a single season. Because elk move daily and seasonally, winter survey locations are often not helpful in determining elk distribution during other times of the year, such as during hunting season. In areas where adequate sample sizes of elk are radio-collared, GPS location data during different seasons can help determine local seasonal elk distributions. Elk harvest locations can also be used as an index for elk distribution during the hunting season. However, harvest locations but must also be interpreted with caution, as certain factors such as access or ownership restrictions on valid licenses may lead to harvest locations not being reflective of the true elk distribution across the landscape during a hunting season.

Changes in Land Use

The Homestead Act of 1862 along with the Enlarged Homestead Act of 1909 undoubtedly shaped the present and future of Montana. These acts accompanied by the Industrial Revolution allowed for agriculture in Montana to become established. Homesteaders were required to live on the land for five years and make improvements (such as build a dwelling and cultivating) before they could become legal owners. This era invited and encouraged changes in land use from native vegetation to cultivated crops and livestock production. These products were essential food sources during westward expansion of European settlement in the US.

Certain attributes contribute to land being suitable for conversion from native range to crop production. Some of these factors include deep arable soils, ruggedness, solar intercept, water

holding capacity, annual precipitation, temperature, duration of frost-free period, and soil type [Smith et al. 2016]. The attributes that make land suitable for conversion are some of the same factors sought after by big game during winter. Big game winter range must have the right combination of elevation, slope, aspect, and vegetation; often this includes low elevation grasslands near timbered areas [Vore 2012].

In Montana, grasslands are the primary ecosystem converted to croplands. Wheat, alfalfa, and barley are the most common first crop planted upon conversion [Lark et al. 2018]. Irrigated agriculture on elk winter range can provide quality nutrition for elk, but the increased use of this type of land can create conflict between elk and landowners who rely on agricultural production as a major source of income.

In recent decades, there has also been an increasing trend of Montana landowners that rely little on their property as a sole source of income and receive a majority of their income from other sources; these landowners are more interested in natural amenities like wildlife and scenery than they are with livestock production [Haggerty and Travis 2006]. For many of these landowners, their Montana property is not a primary residence, and they may only spend a portion of the year residing in Montana [Haggerty and Travis 2006].

Traditionally, a large portion of Montana landowners in rural areas relied on their property's agricultural production as a primary source of income. These property owners may have a lower tolerance for elk, as elk can compete with livestock for forage, damage stored or growing crops, damage fences, and may pose disease risk to livestock. Whereas landowners that rely less on their property for income may have a higher tolerance for elk on their property. This scenario creates tension because elk are not sedentary, and although one landowner may have high tolerance and encourage herds to grow, a neighboring landowner may have less tolerance for herds causing damage to their property resulting in financial loss. Not only is there disagreement of elk tolerance between these types of landowners, but this disagreement results in conflict over tools used to decrease the elk population, such as hunting.

Refuge Areas

Across Montana, some elk populations have exceeded the desired population size yet have low harvest despite liberal hunting seasons. Many of these situations involve refuge areas on private lands or inaccessible public lands where concentrations of elk result. Elk quickly adjust their behavior as they discover and use refuge areas, including residential areas. A single refuge area may affect elk distribution and limit elk harvest across an entire hunting district. Often elk become yearlong residents on refuge areas and affect neighboring non-refuge properties that do not want more elk presence. If not disturbed, elk use of refuge areas may expand to yearlong use [Burcham et al. 1999] thus creating a management challenge when they remain concentrated during fall hunting seasons. If large concentrations of elk do move from a refuge area to one with public hunting access during hunting season, a "shoot-out" situation may occur where a high number of hunters shoot into the large herd raising safety and ethical concerns.

Refuge areas can cause:

- high numbers of elk
- high elk densities
- large elk group sizes
- increased disease transmission potential
- problematic distributions
- reduced seasonal elk migrations to public lands
- more yearlong resident elk
- game damage on private lands
- reduced harvest
- impaired management

Many of these consequences are detrimental to the long-term health and management of elk, domestic livestock, and private and public lands supporting elk. History has shown that efforts to manage elk numbers, distribution, or disease risk without addressing refuge areas are minimally effective and often unsuccessful. Elk availability for harvest is reduced when elk use refuge areas [Proffitt et al. 2010], which creates a challenge for wildlife managers [Haggerty and Travis 2006].

During hunting seasons (both archery and rifle), elk move to and use privately owned areas that restrict hunter access [Burcham et al. 1999, Proffitt et al. 2010, 2016, Ranglack et al. 2017, Sergeyev et al. 2022]. Elk tend to select areas with less hunter access [Proffitt et al. 2010, 2013, 2016] and areas farther from hunter access points [Unsworth et al. 1998, Rumble et al. 2005, Proffitt et al. 2010]. Hunter access has more influence on elk habitat selection than distance to motorized routes or canopy cover [Ranglack et al. 2017].

A study researching hunting access in the Upper Yellowstone area of southwest Montana found a substantial increase (8% to 22%) in the amount of land closed over time to any hunting during 1979–2003; public hunting access decreased in this same time frame from 63% to 49% [Haggerty and Travis 2006]. A landowner survey conducted by FWP found that free public hunting access for bull elk on private land also decreased from 4.6 million acres to 4.3 million acres (7% decrease) from 2015–2019, whereas free public hunting access for cow elk remained relatively stable at 5.1 to 5.2 million acres (~1% increase) [FWP 2020a].

Because elk avoid hunters, increased hunter activity may exacerbate the problem of harvesting enough elk to reach population objective levels [Proffitt et al. 2016]. Elk have more difficulty avoiding hunters when duration and amount of hunting pressure is varied spatially and temporally [Cleveland et al. 2012]. Harvest opportunities and hunting activity within refuge areas may distribute elk more evenly across ownerships [Sergeyev et al. 2022].

Other Causes of Problematic Distributions

Hunting

Hunter numbers can affect elk in various ways such as shifting distributions [Proffitt et al. 2013], changing concentrations [Gude et al. 2006], increasing movement rates [Proffitt et al. 2009, Cleveland et al. 2012],

movements into more secure habitats [Morgantini and Hudson 1985], or selection for areas with little or no hunting pressure [Proffitt et al. 2010, 2013, 2016, Ranglack et al. 2017, Sergeyev et al. 2022]. Additionally, elk discern temporal variation in risk within and outside of hunting seasons [Gude et al. 2006, Unsworth et al. 1998, Proffitt et al. 2010, Coe et al. 2011]. For example, during hunting season, elk distribution was centered on private land that prohibited hunting, whereas during non-hunting time periods, elk distribution was centered in a different location [Proffitt et al. 2010]. Hunting may cause changes to elk group sizes [Gude et al. 2006, Proffitt et al. 2009], but this response is dependent on habitat type. In grassland flats, group sizes decreased during hunting season whereas in forested areas or grassland hills, group sizes increased in response to hunting [Proffitt et al. 2009].

Other Outdoor Recreation

Recreation can occur in various forms, including all-terrain vehicle (ATV) riding, cross country skiing, horseback riding, hiking, and snowmobiling. Although this section focuses on these activities which are common activities in Montana, other recreational activities also influence elk movements and distribution. Recreation can cause elk to shift their behavior [Naylor et al. 2009, Wisdom et al. 2018] and avoid recreating humans. After recreational activities have ceased, elk may return to trails previously recreated on by humans [Cassirer et al. 1992, Wisdom et al. 2018]. Viewshed is an important component of elk response to recreationists and elk move to areas out of view of trails and recreationists [Cassirer et al. 1992, Wisdom et al. 2018].

Not only do elk avoid recreationists, but there can be consequences to young calves if their mother is repeatedly disturbed. Cow elk with calves that were subjected to repeated disturbance for 3–4 weeks during peak calving season were 22% less likely to have a calf survive to summer compared to those with "normal disturbance levels" [Phillips and Alldredge 2000]. Similarly, productivity decreased during disturbance treatment years, then rebounded once disturbance treatment had ceased [Shively et al. 2005]. These data indicate that repeated or chronic disturbance by humans could result in population level impacts.

ATV riding is a common activity in many areas of Montana and often occurs during hunting season and hunting activity. Elk moved more in response to ATV riding [Naylor et al. 2009] and distanced themselves more from ATVs than from other types of recreationists [Wisdom et al. 2018]. ATV riding in proximity to elk caused them to feed less [Naylor et al. 2009]. In Montana, the number of registered off-highway motorcycles and quadricycles increased during 2011–2022 (Figure 12), likely increasing their use commensurately. Elk movements and distance from recreationists increased in response to mountain biking, hiking and horseback riding, but to a lesser extent than that observed during ATV riding [Naylor et al. 2009, Wisdom et al. 2018].

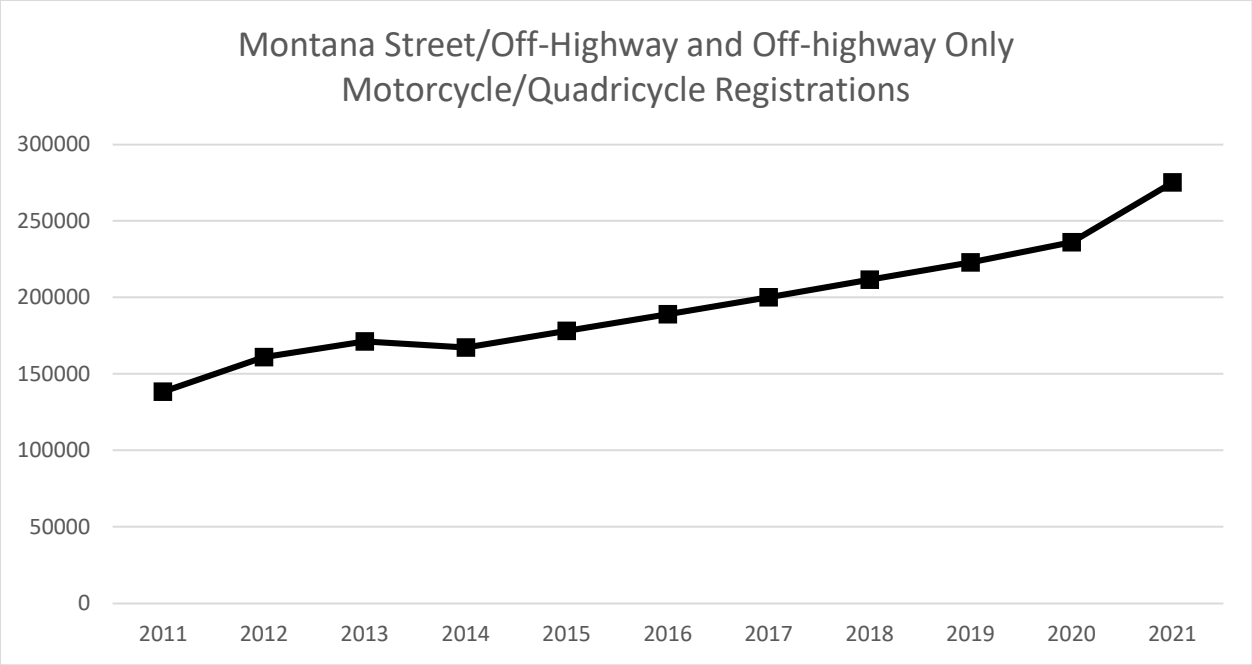


Figure 14. Registrations of Motorcycles or Quadricycles in Montana for off-road use (includes Off-highway, and Street/Off-Highway). Data obtained from the Montana Department of Justice (https://dojmt.gov/driving/mvd-by-the-numbers)

Elk were temporarily displaced by cross country skiers, but typically returned to the same drainage after recreationists had left the area [Cassirer et al. 1992]. Although elk move away from heavily used ski trails, they did not alter overall winter distribution in response to skiers [Ferguson and Keith 1982]. Additionally, elk may respond to snowmobile activity by displaying more vigilant behavior, traveling, or defensive actions [Borkowski et al. 2006] and snowmobile activity can cause an increase in elk stress hormones, although there is no evidence of a population level effect from these hormones [Creel et al. 2002].

Often, roads and trails are a metric used when researching elk responses to recreation and elk resource selection in general. Both road density and distance to roads can influence elk distribution and habitat selection [Proffitt et al. 2013, Ranglack et al. 2017, Wisdom et al. 2018]. Ultimately, if roads and recreation are influencing elk distributions, then managing motorized road access could affect elk distribution on public lands [Proffitt et al. 2013].

To mitigate the effects of human recreation on elk, several recommendations include reducing human activity on elk winter range to prevent elk displacement [USFS FWP 2013] and avoiding human activities that may disturb elk during calving period (May 15–June 30) [USFS FWP 2013]. Currently, there is ongoing collaborative research between FWP, University of Montana, and Colorado Parks and Wildlife to quantify the effects of trail-based recreation on elk habitat use across a range of trail-use intensities; Montana is providing data from an area with few trails (Ruby Mountains) whereas Colorado is providing data with numerous trails, trails being added, and high trail use.

Montana's Statewide Comprehensive Outdoor Recreation Plan [FWP 2020b] outlines six goals for 2020–2024:

- Goal 1: Promote outdoor recreation opportunities for all Montanans
- Goal 2: Enhance public access to outdoor recreation resources and facilities
- Goal 3: Support economic vitality of communities and state
- Goal 4: Improve quality of life through outdoor recreation experiences
- Goal 5: Adapt outdoor recreation for a changing environment
- Goal 6: Honor Montana's outdoor legacy [FWP 2020b].

Within Goal 6 of the Plan, one of the recommendations is to "Conserve Montana's outdoor and natural resources" and two of the strategies to meet the recommendation include "balance outdoor recreation use with ecological function of natural resources including fish, wildlife and their habitats" and "Integrate social and ecological goals in outdoor recreation planning efforts." FWP is striving to meet the rising demand of outdoor recreation opportunities and simultaneously ensure that negative effects on wildlife and their habitats from outdoor recreation are reduced.

Habitat and Landcover

Elk distribution in Montana can be driven by differing nutritional resources found on public and private land [DeVoe et al. 2019]. Irrigated agriculture includes significantly higher crude protein content and percent digestible protein than native grasses or browse [Mould and Robbins 1981], making irrigated agriculture attractive and valuable for elk. Although irrigated agriculture makes up a small portion of resident elk year-round ranges (0.01%) elk disproportionately use it compared to other available habitat types [Middleton et al. 2013]. Additionally, elk group sizes are influenced by habitat type, and the probability that a group of elk will be large increases in grasslands [Gude et al. 2006, Proffitt et al. 2015]; elk aggregations tend to be largest on flat grasslands and smallest in forests [Gude et al. 2006, Proffitt et al. 2009, Proffitt et al. 2015].

Predators

Predators are commonly implicated as one of the causes for problematic elk distributions and there is evidence that large predators and predation risk can affect elk seasonal distributions, habitat selection, aggregations, and group sizes [Mao et al. 2005, Cross et al. 2010b, Creel and Winnie 2005, Proffitt et al. 2009]. Elk may be less likely to migrate away from agricultural areas if they provide a refuge from predation [Barker et al. 2019b], which may provide another incentive for elk to remain resident (non-migratory) [Middleton et al. 2013]. The presence of wolves has been found to influence elk group size (dependent on habitat type) [Creel and Winnie 2005, Gude et al. 2006, Winnie and Creel 2007, Gower et al. 2009, Proffitt et al. 2009].

The effects of large carnivores influencing elk distribution vary by species and location [Paterson et al. 2022b]. Other factors such as habitat quality or human presence were equally or more

important than predators in influencing distribution. Elk adjust behavior and small-scale distribution in response to predators, but they are consistently more sensitive to human activity. For more information see **Predation** section.

Management strategies

Problematic distributions which result in limited harvest confound management. Hunting affects distribution; hunting can be a source of problematic distributions or a tool used to address problematic distributions. Hunting was shown to be the only effective tool in reducing the use of restricted hunting access areas when compared with hazing, herding, and special hunting seasons [Burcham et al. 1999]. Hunting pressure can decrease elk group size [Gude et al. 2006, Proffitt et al. 2009], and by manipulating levels of hunting pressure on public and private lands, managers may be able to affect elk distributions [Proffitt et al. 2016]. Game damage hunts increase elk movement more than the general hunting season and had the greatest ability to generally disperse elk [Cleveland et al. 2012]. However, manipulating hunting pressure may not have an effect on changing the selection patterns of individual elk after they are aware of specific resources like agriculture [Proffitt et al. 2016]. Punctuated hunting seasons may be valuable in breaking cycles of habituation [Cleveland et al. 2012]. Additionally, restricting elk access to irrigated agriculture may be beneficial and may stop elk from becoming habituated and causing problematic distributions [DeVoe et al. 2019], although restricting elk access may be challenging in practice.

Allowing limited hunting within a refuge area can reduce the proportion of elk using the area as well as time elk spend there [Burcham et al. 1999, Sergeyev et al. 2022]. However, sometimes gaining hunting access to restricted areas is not an option and elk management strategies may not be viable if neighbors are making different choices regarding elk tolerance and hunting access [Haggerty and Travis 2006]. Therefore, managing the surrounding areas may be the only option. By varying hunting pressure spatially and temporally, elk cannot reliably determine safe or risky areas; this may limit use of refuges, particularly if the refuge experiences some level of hunting pressure [Proffitt et al. 2009, 2010, Cleveland et al. 2012]. Gradation in hunting pressure may reduce elk herds that seek areas with restricted hunting access [Proffitt et al. 2009].

Liberalized hunting pressure on elk using public lands may result in increased use of refuge areas by elk. If elk that occupy publicly accessible areas are consistently hunted more frequently and thus experiencing increased harvest, that segment of the elk population may be reduced [Proffitt et al. 2016], although inaccessible elk numbers may increase. To keep elk on public lands, recommendations include reduced hunting pressure on public land during archery season, more restrictive hunting seasons in areas with high motorized route densities, closure of certain motorized routes during archery and rifle hunting seasons, and increasing security in areas with high hunter effort [Ranglack et al. 2017, Devoe et al. 2019]. Reducing hunting pressure will generally decrease harvest, which limits the ability of this strategy to meet numerical objectives. Providing some level of hunter access across public and private lands will be necessary to manage elk population numbers and distribution [Proffitt et al. 2016, DeVoe et al. 2019].

Enhancing habitat on public lands may be an effective tool for shifting problematic elk distributions away from private land onto public lands, but long periods following treatment are often necessary to generate desired future conditions.

Migration

Elk in Montana often make substantial migrations, ranging from 15 miles to 125 miles [FWP 2020c]. Elk benefit from migration by gaining access to high quality forage and reducing predation risk [Fryxell and Sinclair 1988]. However, some migratory populations of elk have shown declining recruitment and may be struggling [Middleton et al. 2013]. This begs the question if the benefits that these populations historically gained from migration still exist under current conditions, or if declines might be more severe if migrations no longer continued?

One Montana study showed that forage quality for migratory elk was lower than that for resident elk [Barker et al. 2019a]. To gain the nutritional benefits of migration, elk need areas along the migration route that have predictable high-quality forage [Barker et al. 2019b]. Habitat changes such as wildfire may create high quality forage for elk. Because wildfires are unpredictable and managers often work to suppress them, habitat changes from wildfire may not be as common as they were historically. Habitat improvements such as silvicultural treatments or prescribed burns will result in quality habitat being consistently available if they are implemented in a mosaic pattern across space and periodically through time. Additionally, elk harvest may be a useful tool in reducing elk becoming resident, particularly in areas with irrigated agriculture on winter range [Barker et al. 2019a].

Exposure of migratory elk to predation varies and is difficult to generalize across migration routes, seasonal use areas, local predator communities, and other factors such as human activity [Middleton et al. 2013, Hebblewhite and Merrill 2007]. Certain land uses that create refuge from harvest or predation, in addition to providing high quality forage, can contribute to elk becoming yearlong residents [Barker et al. 2019 a & b].

When considering elk management and harvest regulations, managers must consider the consequences of migratory elk being subject to different harvest pressure compared to resident elk. In some areas, proportionally more migrants that inhabit public lands are harvested compared to resident elk on private, inaccessible lands; alternatively, some migratory herds are not available for harvest during the general season because they are not present in the hunting district when hunting occurs. These scenarios may require tailored regulations to address migratory populations.

In February 2018, Department of the Interior Secretarial Order 3362 was signed. This Order is directed at improving habitat quality of big-game winter range and migration corridors. In response to this Order, Montana developed a State Action Plan. The State Action Plan focuses efforts in Montana by prioritizing focal areas of interest. FWP considers elk migration when developing elk conservation projects and implementing elk management strategies, as described in FWP's Terrestrial Wildlife Movement and Migration Strategy.

Disease

Although elk may carry and transmit many viruses, bacteria, and parasites, there are several that are currently of concern in Montana. These are concerning due to their potential to have a negative population level effect on elk herds (i.e., Chronic Wasting Disease) or potential risk of transmission to domestic livestock, which may result in substantial financial and biological impacts on the livestock industry (i.e., Brucellosis and Bovine Tuberculosis).

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is a fatal neurologic disease caused by an abnormally folded prion protein (referred to as a "prion"). The disease is known to affect elk, deer, moose and caribou and there is no known cure. At an individual level, an elk infected with CWD will die. At a population level, reductions in population and decreases in population growth rates may occur [Gross and Miller 2001, Miller et al. 2008, Wasserberg et al. 2009, Almberg et al. 2011, Monello et al. 2014, Geremia et al. 2015, Edmunds et al. 2016, Samuel and Storm 2016]. Animals infected with CWD may show no clinical symptoms of the disease for months or years, meaning that a harvested animal that appears healthy may still have CWD. If the animal has progressed to the symptomatic stage of disease, symptoms include behavioral changes, poor body condition, increased salivation, increased thirst, a "pot-bellied" appearance, incoordination, and loss of awareness.

CWD prions have been detected throughout the body of infected animals and can be transmitted through direct contact with bodily fluids such as saliva, feces, urine, semen, or any of the infected animal's body parts after death. Additionally, CWD prions can persist in the environment for years. This means that susceptible animals can contract the disease after contacting contaminated soil or feed. Once CWD is present within a wild population or its environment, it is extremely difficult, if not impossible, to eliminate. To date, no reported cases of CWD infection have occurred in humans, but human health officials recommend avoiding consumption of the brain, spinal cord, eyes, spleen, tonsils, and lymph nodes of any harvested game animal, and to avoid consuming any animal known to be infected with CWD.

Montana first detected CWD in free ranging elk during fall 2019, which followed the first CWD detection in deer in the state in 2017. Captive elk in Montana have tested positive for CWD in 1999 and 2020. Montana has a CWD Management Plan that was initially developed in 2017 and is updated periodically.

The Montana CWD Management Plan focuses on 1) managing CWD detection in new areas in Montana, 2) limiting the spread of CWD in Montana, 3) maintaining or reducing prevalence of CWD, 4) improving CWD communication and educational outreach, and 5) providing testing of hunter harvested animals. FWP's CWD Management Plan generally focuses on mule deer and white-tailed deer, because these species tend to exhibit the highest prevalence in areas where multiple cervid species overlap. Even in areas where CWD is detected first in elk, it is extremely likely that mule deer or white-tailed deer in the area are also infected and have higher prevalence of the disease. Consequently, when CWD is detected in an elk, FWP's response will likely still focus on deer. Samples from elk will be collected, but intensity of sampling will be

dependent on the individual circumstances. FWP will continue to use the CWD Management Plan to guide surveillance, monitoring, and management of CWD in Montana.

Brucellosis

Brucellosis is a disease caused by the bacteria *Brucella abortus*. The disease is present in free ranging elk in and around the Greater Yellowstone Ecosystem, which poses a risk for transmission from elk to livestock. The disease typically causes abortion in pregnant females and is transmitted by oral contact with infected birth tissues and fluids [Thorne et al. 1978, Cheville et al. 1998]. Brucellosis was likely introduced from cattle to wildlife in the Greater Yellowstone Ecosystem shortly before 1917 [Meagher and Meyer 1994]. In 1954, the United States began a national brucellosis eradication program which was successful in eradicating known brucellosis infections from cattle by the end of 2000 [Ragan 2002]. However, more recently, infections in domestic herds of cattle and bison have occurred around the Greater Yellowstone Ecosystem and were all presumably infected by free ranging elk [Beja-Pereira et al. 2009, Higgins et al. 2012, Rhyan et al. 2013, Kamath et al. 2016]. In Montana, brucellosis in elk is spreading beyond the Greater Yellowstone Ecosystem to new elk populations [Cross et al. 2010a] and is expanding at a rate of 3–8 km per year [Kamath et al. 2016]. As of 2022, prevalence in elk populations in Montana ranged from 0–38% [FWP 2022].

In elk, brucellosis can result in abortion during the first pregnancy after infection and can cause abortions in subsequent pregnancies, birth of weak calves with high mortality, or reduce pregnancy rates [Thorne et al. 1978, Cotterill et al. 2018, FWP 2022]. Although elk may retain antibodies to brucellosis long after an infection, only about 8% shed the bacteria during an abortion or live birth [FWP 2022], and they likely only shed the bacteria for 1–2 years [Thorne et al. 1978, FWP 2022]. Detectable antibodies to brucellosis may diminish over time, however the individual elk is likely still immune for their lifetime [Benavides et al. 2017]. Although it appears brucellosis can have a substantial effect on the fecundity of infected individuals, measurable effects on elk populations have not been detected.

Domestic livestock experience similar individual effects when infected with brucellosis. Typically, an abortion occurs, and other impacts may include subsequent abortions, weak calves, future infertility, and decreased milk production [Xavier et al. 2009, Herrera 2008]. Because of the potential for transmission to humans, brucellosis in livestock has very restrictive rules. These restrictions can result in reduced trade with other states and nations, increased testing and vaccination requirements, and potential quarantine or eradication of a herd, all of which come at financial costs to individual producers and the Montana livestock industry as a whole. Therefore, although brucellosis has little direct impact on elk populations, the transmission risk and the effects to the state's domestic livestock industry are substantial and ultimately results in decreased tolerance for elk on private lands.

Transmission risk varies by elk density, elk seroprevalence, and environmental conditions that vary by location and year [Cross et al. 2010 a & b, Proffitt et al. 2015, Rayl et al. 2019 & 2021]. The highest elk-livestock transmission risk in Montana is on private lands in the Madison and Paradise valleys and generally occurs in March and April, but may extend into May depending on snow conditions.

Most of the transmission risk comes from large populations of migratory elk [Rayl et al. 2019 & 2021], however, per-capita risk is higher from resident elk, so dissuading resident elk is expected to help reduce transmission [Rayl et al. 2021]. Decreasing elk density may decrease brucellosis seroprevalence; however, large reductions in elk density are likely required to see a noticeable effect on seroprevalence and this magnitude of reduction may not be feasible [Brennan et al. 2014, Proffitt et al. 2015]. In general, the acceptability of elk management tools in areas with brucellosis relies on multiple factors and the specific context of the situation [Metcalf et al. 2017].

Elk management in areas with brucellosis often employ different strategies than used in areas without brucellosis. Currently Montana has a plan for these specific areas: Elk Management in Areas with Brucellosis: Work Plan. This plan was developed in 2012 by a citizen work group. The plan is reviewed by the citizen work group and Commission annually. The work plan has three fundamental goals: 1) reduce commingling of elk and livestock (primarily cattle); 2) reduce associated risk of brucellosis transmission; and 3) maintain elk on the landscape. The plan uses a stepwise implementation of non-lethal tools such as hazing, fencing, or habitat adjustments to reduce comingling of elk and livestock before considering lethal tools such as management hunts or kill permits. The work plan is considered a risk mitigation plan, not a disease eradication plan. FWP will continue to use the Work Plan to guide management of brucellosis in Montana.

Bovine Tuberculosis

Bovine tuberculosis (bTB) is a bacterial disease caused by *Mycobacterium bovis*. Bovine TB is primarily a disease of cattle, but can affect many other species of mammals, including elk and humans. The disease can spillover from livestock to wildlife which can then serve as a reservoir, potentially transmitting the disease to other susceptible wildlife and cattle. Livestock producers may be subject to substantial regulatory and economic consequences if bTB-free status is compromised; specific consequences could include strict quarantine, increased testing requirements, and depopulation of livestock herds. Bovine TB was found in elk at a Montana game farm in the early 1990s but has not been detected in free ranging elk in Montana.

The disease is primarily spread from animal to animal via respiratory secretions but can be transmitted by the fecal-oral route or by ingestion of contaminated food. Shared feeding is believed to be the primary transmission pathway between wildlife and cattle, as feed becomes contaminated with infectious saliva, urine, and feces.

There are no documented elk population declines caused by bTB. However, if bTB were found in Montana elk populations, there would be decreased tolerance for elk on the landscape, likely resulting in aggressive management to decrease elk populations.

Montana currently has a Montana Bovine Tuberculosis Surveillance Plan [FWP 2019b] which includes goals of 1) early detection of spillover to wildlife, 2) preventing the disease from becoming endemic in wildlife, and 3) preparing to respond with increased surveillance in the event of a wildlife detection to determine the prevalence and distribution of the disease. If bTB were found in free ranging elk in Montana, the current surveillance plan would provide guidance for

sampling to determine the distribution and prevalence. Following those initial efforts, a management response would be crafted based on the information gained.

Harvest Strategies

Currently in Montana, General Elk Licenses are unlimited in number with one license available to each hunter for Montana residents. Additionally, a hunter may hold an Elk B-License, allocated via random draw or purchased over-the-counter. B-Licenses are valid for the take of antlerless elk only. A hunter may hold up to 3 Elk Licenses in a year (either 3 B-Licenses or 2 B-Licenses and one General Elk License). Elk Permits, which validate a General License in a specific area, are allocated through a random draw; an Elk Permit does not allow the hunter to harvest additional elk. An Elk Permit allows hunters to hunt in a restricted area, restricted time period, or for a specific sex of elk where there are other restrictions in place for General Elk License holders. Elk harvest in Montana is allocated by using combinations of valid license types, permits, and season dates. Limited numbers of licenses and permits are available to nonresident hunters as well.

Antlerless Hunting Regulation Types

Allowing harvest of antlerless elk on the General Elk License is a common method of allocating antlerless harvest and has been used in Montana longer than the other antlerless harvest regulation types described in this section. There are various ways to allocate antlerless harvest with a General Elk License, such as:

- authorized for the entire season
- authorized for only a portion of the season
- authorized for only the archery season
- authorized for youth and holders of a Permit To Hunt From Vehicle (PTHFV)
- authorized only on certain landownership types, such as private land only

As of the 2022 hunting season, 60% of HDs have General Elk License antlerless opportunity offered for at least a portion of the HD and portion of the season.

B-Licenses were first used in 2004 which allowed the take of a second elk for each hunter. In 2020, hunters were authorized to harvest up to three elk per hunter. B-Licenses may be limited by a quota or unlimited and sold over the counter. B-Licenses may only be valid for certain dates, or certain landownership types, such as private land only. As of the 2022 hunting season, 57% of HDs offer limited B-licenses and 37% offer unlimited B-licenses (10% of HDs offer both limited and unlimited B-licenses).

Shoulder seasons are defined as any firearm season printed in the hunting regulations that occurs outside the 5-week general firearm season between August 15 and February 15. The primary purpose of shoulder seasons is to supplement existing antlerless harvest. Montana started using shoulder seasons on a trial basis in winter 2015. From 2016–2022, shoulder seasons were used in 44–54 HDs depending on the year. As of the 2022 hunting season, 38% of HDs use shoulder seasons (22% of HDs have both early and late, 6% offer early only, 10% offer

late only). General Elk Licenses, Limited B-Licenses, and Unlimited B-Licenses are used in different HDs to allocate antlerless harvest during elk shoulder seasons.

Bull Hunting Regulation Types

Some areas in Montana offer Limited Elk Permits that hunters must apply for and draw via random allocation. Demand for these limited opportunities is high because they often provide the opportunity to pursue older, larger-antlered bulls. This regulation type typically allows for greater bull survivorship into older age classes and increased bull:cow ratios but limits overall hunter opportunity [Bender and Miller 1999]. As of 2022, about 24% of HDs in Montana use limited permits for bull elk hunting; Montana did not make use of limited permits for bull elk hunting until 1964.

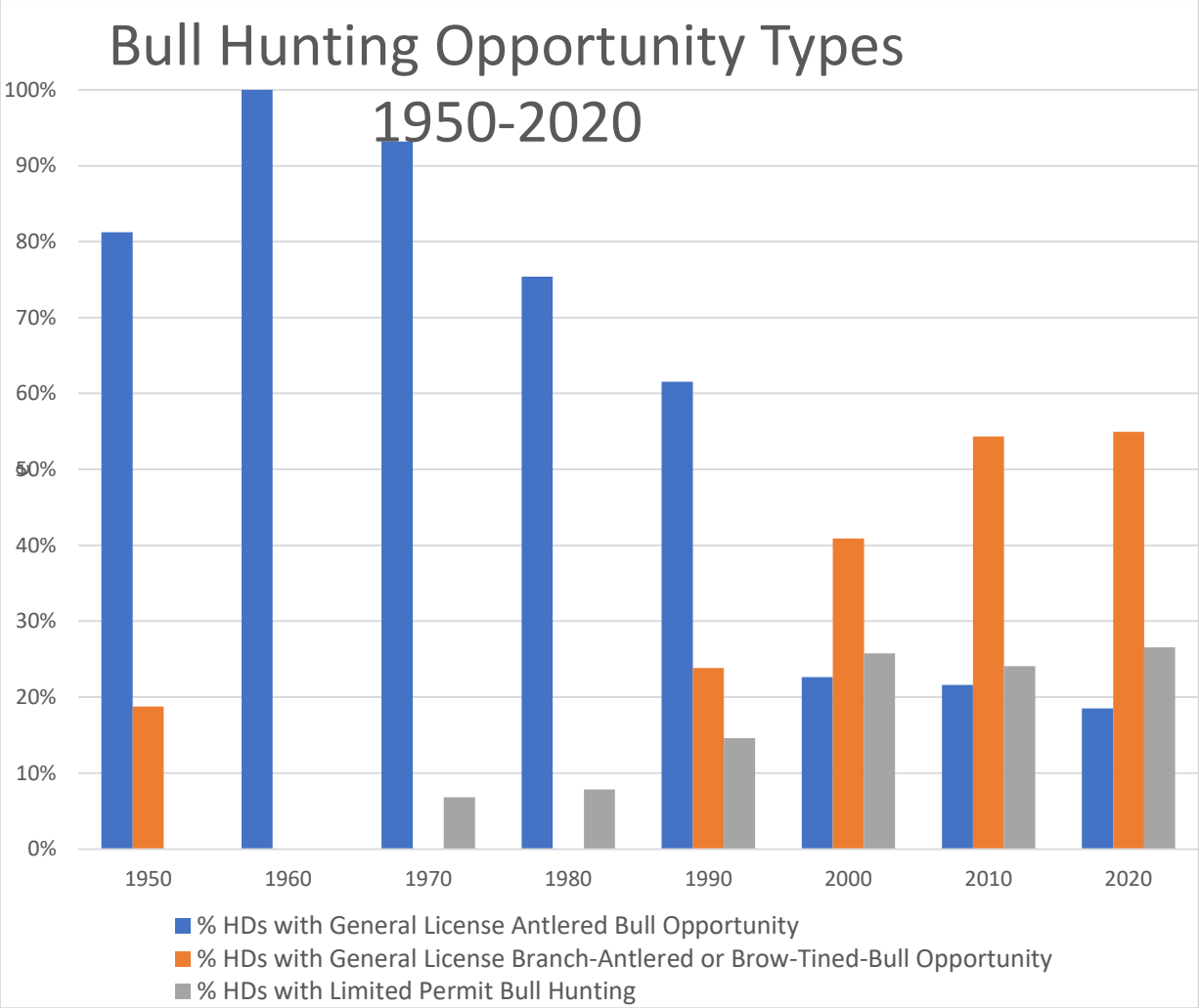


Figure 15. Bull hunting opportunity types 1950-2020.

Antler Point Restrictions – Restricting bull harvest on the General Elk License to only branch antlered bulls and brow-tined bulls are regulation types that have been used in Montana as early as 1940. The regulation types became popular during the mid-1980s and 1990s with the

intent to increase the total number of bulls that survived the hunting season. The brow-tined bull regulation type is still common in Montana. A study conducted on these regulations indicated that ~15% of spikes were illegally harvested [Hamlin and Ross 2002]. The brow-tined bull regulation has been successful in increasing total post season bull:cow ratios, although this increase occurred slowly [Hamlin and Ross 2002]. The regulation type does not increase the number of mature (>4 year old) bulls [Hernbrode 1987, Carpenter 1991, Bender and Miller 1999, Vore and DeSimone 1991, Hamlin and Ross 2002]. As of 2022, 58% of HDs in Montana have a brow-tined bull on a General Elk License regulation type.

Another form of an antler point restriction regulation used in Montana allows spike bull harvest on the general license while limiting brow-tined-bull harvest by permit. Because some yearling bulls have branches or brow-tines >4 inches, they may not be lawfully harvested using the General Elk License protected by permits. This regulation type was implemented in the Elkhorn Mountains (HD 380) in 1987 and in HD 339 in 1996. Under this regulation in HD 380, the number of bulls ≥ 2.5 years old increased, the annual bull mortality was halved (45%), and the percent of branch antlered bulls increased from ~4% to 40–50% on winter range [FWP 1990] when compared with the previous regulation type that allowed any antlered bull to be harvested with a General Elk License. This regulation type allows spike harvest to continue with the General Elk License while increasing the proportion of older age class bulls.

The implementation of other types of point restrictions on bull harvest is a topic occasionally raised by hunters. One such example is to restrict harvest to only those bulls with at least 6 points on one antler. These regulation types focus harvest on the single segment of the population that hunters tend to want more of (older age class) rather than spreading harvest across multiple age classes. Eventually this will decrease the average age of the male segment of the population, reduce the number of larger antlered animals by protecting only the smaller, younger males, and potentially promote genetics of individuals who will never reach the number of points that would make them eligible for harvest.

ANTLERLESS HARVEST MATRIX

This section represents available antlerless harvest opportunities during each of 5 seasons (early shoulder season, archery season, general rifle season, muzzleloader season, and late shoulder season). Within each season's table, the most liberal antlerless harvest opportunity is at the top with the most restrictive harvest opportunity at the bottom. Using a combination of seasonal opportunities, an HD can liberalize or restrict harvest as necessary to meet population demographic objectives, distribution objectives, and/or recreation objectives. It is not required to move up and down through the tables one row at a time, i.e., at times season proposals may skip rows to move to more liberal or more restrictive season types.

There may be instances where increasing harvest opportunity does not result in an increase in realized harvest. Additionally, increased opportunity may result in a distributional shift that

results in elk being unavailable or inaccessible for harvest. These are potential outcomes considered when determining the appropriate season type to propose for an HD.

	Early Antlerless Season Options (Early Shoulder Season)	Quota Type[1]
Liberal ↑	August 15 to General Season opener: General License opportunity for antlerless elk and B-Licenses	Unlimited Limited
	August 15 to General Season opener: B-License opportunity for antlerless elk	Unlimited Limited
	August 15 to General Season opener: General License opportunity for antlerless elk and B-Licenses	Limited
	August 15 to General Season opener: General License opportunity for antlerless elk	
	August 15 to Archery-Only Season opener: General License opportunity for antlerless elk and B-Licenses	Unlimited
	August 15 to Archery-Only Season opener: B-License opportunity for antlerless elk	Unlimited
	August 15 to Archery-Only Season opener: General License opportunity for antlerless elk and B-Licenses	Limited
	August 15 to Archery-Only Season opener: General License opportunity for antlerless elk	
	August 15 to Archery-Only Season opener: Limited OTC B-License opportunity for antlerless elk	Limited
Restrictive ↓	No antlerless opportunity during Early Season	

Table 2. Antlerless harvest opportunities during early antlerless season (early shoulder season).

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

	6-Week Archery Only Season Options	Quota Type[1]
Liberal ↑	6-week Archery-Only Season with General License and B-License opportunity for antlerless elk	Unlimited Limited
	6-week Archery-Only Season with B-License opportunity for antlerless elk	Unlimited
	6-week Archery-Only Season with General License opportunity for antlerless elk	
	6-week Archery-Only Season with B-License opportunity for antlerless elk	Limited
	1-6 weeks of Archery-Only Season allows General License opportunity for antlerless elk	
↓ Restrictive	No antlerless opportunity during Archery-Only Season	

Table 3. Antlerless harvest opportunities during archery-only season.

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

	5-Week General Season Options	Quota Type[1]
Liberal ↑	5-week General Season General Elk License antlerless opportunity and B-Licenses	Unlimited
	5-week General Season with B-Licenses	Unlimited
	5 week General Season General Elk License antlerless opportunity and Limited B-Licenses	Limited
	5-week General Season General Elk License antlerless opportunity	
	1 - 4 weeks General Season General Elk License antlerless opportunity	
	5-week General Season with B-Licenses	Limited
	5-week General Season youth ONLY opportunity	
	General season antlerless with quota	
↓	1-4 week General Season with B-Licenses	Limited
Restrictive	No antlerless opportunity during General Season	

Table 4. Antlerless harvest opportunities during general rifle season.

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

	9-Day Muzzeloader-Only Season Options	Quota Type[1]
Liberal ↕ Restrictive	9-day Muzzeloader-Only Season with General License and B-License opportunity for antlerless elk	Unlimited Limited
	9-day Muzzeloader-Only Season with B-License opportunity for antlerless elk	Unlimited
	9-day Muzzeloader-Only Season with General License opportunity for antlerless elk	
	9-day Muzzeloader-Only Season with B-License opportunity for antlerless elk	Limited
	No antlerless opportunity during Muzzeloader-Only Season	

Table 5. Antlerless harvest opportunities during muzzleloader-only season.

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

	Late Antlerless Season Options (Late Shoulder Season)	Quota Type[1]
Liberal ↕ Restrictive	End of General Season to Februrary 15: General License and B-License opportunity for antlerless elk	Unlimited Limited
	End of General Season to ending prior to Februrary 15: General License and B-License opportunity for antlerless elk	Unlimited Limited
	End of General Season to February 15: B-License opportunity for antlerless elk	Unlimited
	End of General Season to February 15: General License opportunity for antlerless elk	
	End of General Season to February 15: B-License opportunity for antlerless elk	Limited
	End of General Season to ending prior to February 15: B-License opportunity for antlerless elk	Unlimited
	End of General Season to ending prior to February 15: General License opportunity for antlerless elk	
	End of General Season to ending prior to February 15: B-License opportunity for antlerless elk	Limited
	No late season antlerless opportunity	

Table 6. Antlerless harvest opportunities during late antlerless season (late shoulder season).

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

ANTLERED HARVEST MATRIX

This section represents available antlered harvest opportunities during each of 3 seasons (archery season, general rifle season, and muzzleloader season). Within each season's table, the most liberal antlered harvest opportunity is at the top with the most restrictive harvest opportunity at the bottom. Using a combination of seasonal opportunities, an HD can liberalize or restrict harvest as necessary to meet population demographic, distribution and/or recreation objectives. It is not required to move up and down through the tables one row at a time, i.e., at times season proposals may skip rows to move to more liberal or more restrictive season types.

There may be instances where increasing harvest opportunity does not result in an increase in realized harvest. Additionally, increased opportunity may result in a distributional shift that results in elk being unavailable or inaccessible for harvest. These are considerations that FWP will use to determine the appropriate season type to propose for an HD.

Under circumstances where an HD is chronically and significantly over the stated population size goal and is using limited either-sex permits or limited bull permits, FWP will propose to allow a brow-tined-bull or any bull on a General Elk License regulation type. This may be in addition to antlerless opportunity on the General Elk License. Chronically and significantly over population size goal is defined as being the mid-range of population goal above the top of the goal range (i.e., if the goal range is 100-200, then mid-range is 150 and mid-range above the top would be 350) for 3 or more consecutive years without a demonstrable change in population trajectory.

	6-week Archery-Only Season Options	Quota Type[1]
Liberal	6-week Archery-Only Season with General Elk License opportunity for any bull	
	6-week Archery-Only Season with General Elk License opportunity for brow-tined bull	
	6 week Archery-Only Season with permits valid for any bull	Unlimited[2]
	6 week Archery-Only Season with permits valid for brow-tined bull	Unlimited[2]
	1-5 week Archery-Only Season with General Elk License opportunity for any bull	
	1-5 week Archery-Only Season with General Elk License opportunity for brow-tined bull	
	6-week Archery-Only Season with permits valid for any bull and 6-week spike harvest allowed on General Elk License	Limited
	6-week Archery-Only Season with permits valid for any bull and 1-5 week spike harvest allowed on General Elk License	Limited
	6 week Archery-Only Season with permits valid for any bull	Limited
	6 week Archery-Only Season with permits valid for brow-tined bull	Limited
	1-5 week Archery-Only Season with permits valid for any bull	Limited
	1-5 week Archery-Only Season with permits valid for brow-tined bull	Limited
Restrictive	No antlered opportunity during Archery-Only Season	

Table 7. Antlered harvest opportunities during archery-only season.

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

[2] Unlimited bull permits are located in the table based on the level of opportunity they provide, however past experience has demonstrated that at times, use of an unlimited permits increases interest above that of general license opportunity, thus in reality they may be more liberal than indicated in the table.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

	5-week General Season Options	Quota Type[1]
Liberal	5-week General Season with General Elk License opportunity for any bull	
	5-week General Season with General Elk License opportunity for brow-tined bull	
	5-week General Season with permits valid for any bull	Unlimited[2]
	5- week General Season with permits valid for brow-tined bull	Unlimited[2]
	1-5 week General Season with General Elk License opportunity for any bull	
	1-5 week General Season with General Elk License opportunity for brow-tined bull	
	5-week General Season with permits valid for any bull and 5-week spike harvest allowed on General Elk License	Limited
	5-week General Season with permits valid for any bull and 1-5 week spike harvest allowed on General Elk License	Limited
	5-week General Season with permits valid for any bull	Limited
	5-week General Season with permits valid for brow-tined bull	Limited
	1-4 week General Season with permits valid for any bull	Limited
	1-4 week General Season with permits valid for brow-tined bull	Limited
Restrictive	No antlered opportunity during General Season	

Table 8. Antlered harvest opportunities during general rifle season.

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

[2] Unlimited bull permits are located in the table based on the level of opportunity they provide, however past experience has demonstrated that at times, use of an unlimited permits increases interest above that of general license opportunity, thus in reality they may be more liberal than indicated in the table.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

	9-Day Muzzeloader Only Season Options	Quota Type[1]
Liberal	9-day Muzzeloader-Only Season with General Elk License opportunity for any bull	
	9-day Muzzeloader-Only Season with General Elk License opportunity for brow-tined bull	
	9-day Muzzeloader-Only Season with permits valid for any bull	Unlimited[2]
	9-day Muzzeloader-Only Season with permits valid for brow-tined bull	Unlimited[2]
	9-day Muzzeloader-Only Season with permits valid for any bull and spike harvest allowed on General Elk License	Limited
	9-day Muzzeloader-Only Season with permits valid for any bull	Limited
	9-day Muzzeloader-Only Season with permits valid for brow-tined bull	Limited
Restrictive	No antlered opportunity during Muzzeloader-Only Season	

Table 9. Antlered harvest opportunity during muzzleloader-only season.

[1] Within a limited quota permit option, changing permit quotas can further restrict or liberalize opportunities within those season types.

[2] Unlimited bull permits are located in the table based on the level of opportunity they provide, however past experience has demonstrated that at times, use of an unlimited permits increases interest above that of general license opportunity, thus in reality they may be more liberal than indicated in the table.

Note: in some cases, increased opportunity does not result in increased harvest, specifically if/when additional hunting pressure shifts elk distribution to areas where harvest cannot be achieved. The ultimate season structure for any hunting district will rely on several factors including; status relative to population goals, other goals of the HD, and social considerations. Per MCA 87-1-301, the Fish and Wildlife commission has full authority to set elk hunting seasons.

STATEWIDE MANAGEMENT DIRECTION

Statewide management direction was generated using a combination of citizens group inputs, public comment input, and FWP staff input. It is intended to influence statewide programs, policies, and practices that affect elk management. The statewide management direction is organized in a format that includes seven objectives, 20 goals, and numerous measures and strategies. Objectives are defined as a long-term, overarching vision. Goals are the individual pieces necessary to achieve the objective. Measures define criteria for success and will be evaluated by FWP to track progress. Strategies are tools FWP can use to accomplish the goals and objectives. At times, certain goals and the strategies necessary to accomplish them may be in conflict with other goals and strategies. When this occurs, FWP can be more transparent in the tradeoffs associated with prioritizing certain goals over others.

Objective 1: Resolve disagreement about population objectives and how they are set and implemented

Goals	Measures of Success	Strategies
Maximize public input in setting elk objectives	Implement feedback collection methods during elk plan development and during periodic reviews of plan	• Provide at least one in-person meeting where each hunting district's population Goal is reviewed and feedback is collected • Provide an online comment option with specific information for each hunting district/population Goal; feedback collected by HD
	Human dimensions survey will be sent to landowners and hunters in each district to reassess elk objectives every 5-6 years	• Use a human dimensions survey regarding the population objective in a HD. Use elk IPM, historical population data, and recent elk habitat research to inform potential population objective ranges for survey
Maximize local grassroot input	Local working groups are assembled and hold annual meetings to discuss elk management	• Where feasible, existing or new local working groups including hunters, landowners, outfitters, pertinent wildlife staff, and interested community members are assembled to assist with developing and evaluating objectives, providing comment on season structures, and discuss any other issues with elk management in the area

Objective 2: Resolve conflicts in concentrations, distributions and behaviors of elk

Goals	Measures of Success	Strategies
Maintain hunting as a primary tool for elk population management	≥ 99 % of elk lethally removed by humans are hunter harvested; <1% of elk lethally removed by humans are done using alternative methods	• Consider alternative population reduction methods only if the most liberal antlerless season available is applied and if hunting access is considered adequate, yet populations still remain higher than desired or if hunting is not considered a safe option under the circumstances. • Evaluate use and timing of shoulder seasons • Consider redefining the timing and length of the current 5-week general season to maximize effectiveness in areas where population control is an issue; effectiveness for alternative season structures would be considered, and public acceptability of having inconsistent season lengths and timing across HDs would be evaluated

Objective 2: Resolve conflicts in concentrations, distributions and behaviors of elk (continued)

Goals	Measures of Success	Strategies
Maximize partnerships between private landowners, land management agencies, and FWP	Implement a check box consent included on game damage hunt roster sign-up. Provide hunter contact information in batches to the landowner	• Allow hunters to provide FWP permission to share their contact information with landowners when they are selected for a management or game damage hunt on that property, so the landowner can contact them directly (in situations where this helps) • Allow hunters to provide FWP permission to share their contact information with landowners when they apply for a special permit or B-License, so landowners seeking hunters/ harvest on their property can contact permit/B-License holders if desired • FWP provides habitat project recommendations to land management agencies. FWP will revisit and reconsider previous recommendations that may no longer apply • Reaffirm FWP's relationships with USFS, BLM and DNRC • Re-establish private land technical assistance program to create and study new methods for defraying damage to fences and crops while improving landowner relations
	FWP is annually providing habitat recommendations to land management agencies	
	FWP releases annual report detailing technical assistance and landowner liaison program accomplishments	
	See additional applicable Strategies and Measures within the "Maximize satisfaction with elk distribution in MT for: Hunters, Landowners, Wildlife Enthusiasts, Outfitters, Ag Producers" Goal section	
Minimize prevalence and spread of CWD in Montana	Maintain prevalence rates below 5% in elk that have been sampled	• Follow CWD Plan (e.g., minimize spread by humans, reduce concentrations around localized food sources, etc.)

Objective 2: Resolve conflicts in concentrations, distributions and behaviors of elk (continued)		
Goals	Measures of Success	Strategies
Maximize hunter access to elk	Maintain or increase number of Block Management Areas with elk opportunities statewide annually	• Focus on access programs that provide elk hunting opportunities in existing FWP programs (including outreach to landowner community) • Work with private landowners to increase the number of public hunters allowed access via FWPs contractual public elk hunting access agreements • Hire and maintain sufficient numbers of hunting access technicians and other staff to meet the needs of the Block Management Program • Develop access easements or lease program to provide elk hunting opportunity on private land • Implement an online reservation system for Type 2 Block Management Areas to more efficiently manage hunters and increase opportunities for elk hunters to obtain access (available for landowners that prefer this method). • Promote use of the "Hunter/Landowner Stewardship Course" by updating and improving the course, providing an incentive for those who complete the course, and ensuring adequate number of FWP staff to implement/ promote • Increase education/training about FWP's Hunt Planner • Increase Block Management payments and include consumer price index (CPI) in statute so that payments reflect current economy • Continue to support the Private Land Public Wildlife Council and facilitate implementation of their recommendations
	Maintain or increase number of Public Access Land Agreements or Access Public Land agreements annually, that include public access for elk hunting, where compatible with other objectives such as elk security habitat	
	Maintain or increase number of elk hunting access agreements annually	
	Total number of hunters who have passed the Hunter/ Landownership Stewardship course is >30,000	
	Maintain or increase acreage within elk distribution enrolled in Block Management Program	

Objective 2: Resolve conflicts in concentrations, distributions and behaviors of elk (continued)

Goals	Measures of Success	Strategies
Maximize satisfaction with elk distribution in MT for: Hunters, Land-owners, Wildlife Enthusiasts, Outfitters, Ag Producers	Maintain or increase percent of public land that is considered secure elk habitat in each Region	• Promote collaboration among neighboring land owners and land managers to homogenize elk hunting pressure across land ownerships, thereby reducing elk refuge situations and maintaining a more desirable distribution of elk • Use hunt information coordinators and hunting access technicians to efficiently manage hunter distribution and pressure across Block Management Areas and broader areas that allow public hunting access; hunt coordinators will submit a post-season summary including hunter and harvest data • Improve elk forage habitat on state and federal public lands; Each region will identify opportunities to improve elk forage on public lands not managed by FWP • Formally define elk security standards describing habitat features such as open road densities/distance to open roads, vegetation and topography that will encourage elk use of public lands, based on recently-published research; FWP will provide comment on public land management consistent with FWP elk security habitat standards • Build from research results and recommendations to limit the impacts of non-hunting recreation on elk distribution during winter, calving and hunting seasons • FWP will continue facilitating elk movement and migration by working closely with private landowners and public land managers as outlined in FWP's Terrestrial Wildlife Movement and Migration Strategy • In areas where elk are not meeting objectives, integrate existing data and expert opinion into a coordinated, adaptive management program; use predictive models (where available) and monitoring of elk populations and distribution, incorporating the effects of carnivore, habitat, hunter access, and harvest management, to clarify why elk populations are outside of objective ranges and improve the ability for management decisions to result in elk populations within objective ranges in the future
	FWP will implement projects to improve elk forage on Wildlife Management Areas as necessary	
	Regional staff will meet with land managers at least every 2 years to share priority habitat improvement information	
	At the statewide level, maintain at least 40% harvested elk on public land and at least 40% harvested elk on private land	
	Elk population status (below, at, above) relative to population goal will be shared with FWP assembled citizen groups that are tasked with making recommendations for mountain lion populations	

Objective 3: Reduce elk impacts on agriculture

Goals	Measures of Success	Strategies
Minimize impacts on agricultural production, private rangeland, and infrastructure	A majority of surveyed landowners feel they have tools available to them to minimize elk impacts to their operation	• Use FWP Game Damage Program to determine eligibility and provide tools available within program • Provide season structure that provides private landowners harvest tools for their properties • Use herders/hazers to disperse elk causing damage • Streamline hiring process of herders/hazers • Promote wildlife friendly fencing construction • Encourage and fund permanent solutions to chronic/ recurring game damage situations • Allow only resident hunters to sign up on hunt roster
	Game Damage Program becomes more efficient and effective; hunters are notified and arrive to hunt area faster, a higher proportion of initial notified hunters accept/participate in game damage hunts	• Add text messaging as an additional notification for hunters who are selected for game damage hunts with a response window of 24 hours to respond if interested • Provide list of hunters who accepted to landowners, when desired, for landowners to contact those hunters when the elk are present • Pre-approve those for landowners who have had game damage complaints in the past and are eligible for assistance • Add second sign up period for hunt roster for hunts that will occur after the General Rifle season • Encourage neighbor to neighbor discussions about the impacts of hunter access decisions on one another

Objective 3: Reduce elk impacts on agriculture (continued)

Goals	Measures of Success	Strategies
Minimize transmission of brucellosis to livestock	Trend of annual confirmed positive elk-livestock transmission cases in the DSA is not increasing	• Review and maintain annual Brucellosis Work Plan and present to Commission for approval annually • Annually summarize number of elk captured, maps of movements, brucellosis distribution, seroprevalence rates in elk herds and assess transmission risk to local livestock • Annually summarize number of hazers and hazing hours, management removals, management hunts per complaint
	Producer satisfaction with FWP risk reduction efforts at regional level is not decreasing	• Employ fencing, management hunts, management removals, and hazing as needed, following research recommendations and guidelines • Continue work with DOL to capture, collar, and test elk in peripheral areas to the DSA to determine distribution of brucellosis in elk to inform Board of Livestock decisions about the DSA boundary • FWP will partner with other groups (RMEF, Master Hunters) to improve the general understanding of diseased elk and possible solutions to protect working Ag lands and the habitat they provide • FWP will work with the hunting community to increase their awareness of brucellosis and what effects it has on livestock producers • Work with absentee landowners to educate them on the need to implement strategies such as hazing • Commit to long-term research related to brucellosis in elk herds with the goal of identifying ways to reduce elk-livestock transmission risk, such as manipulating elk populations, migratory propensity, seroprevalence (if possible), or developing new techniques to reduce contact with cattle • Develop research projects to test new management techniques
	Annually review elk-livestock brucellosis transmission risk including the latest information on elk population size, distribution, seroprevalence and research findings	
	Annually review management tools' ability to minimize transmission risk and develop research projects to test new management techniques	

Objective 4: Provide both ample hunting opportunity and hunt quality		
Goals	Measures of Success	Strategies
Maintain over-the-counter opportunity to hunt elk	Montana residents have the opportunity to hunt elk somewhere in the state using a General Elk License or an Elk B-License purchased over-the-counter	• Provide General Elk License opportunity (antlered, antlerless, or either-sex) in as much area of the state as possible, given other management direction specified in the elk plan or other socio-political or biological issues • Provide over-the-counter Elk B-Licenses or large quotas of limited-draw elk B-licenses (that may go to surplus over-the-counter sale if not fully prescribed) for elk populations in districts or regions that can handle that level of opportunity
Minimize impacts of crowding on hunter experience	A majority of survey respondents report the number of hunters observed per day is acceptable	• Conduct resident hunter satisfaction survey to determine the extent to which crowding is negatively impacting hunter experiences in each Region • Repeat hunter satisfaction survey every 5 years for continuous monitoring of hunter crowding perceptions • Consider alternative season structures that limit crowding • When limiting hunters in an area, consider the impacts of hunter displacement resulting in increased hunter pressure/crowding in other areas
Maintain limited-draw permit areas for hunting mature bulls	Hunters have the opportunity to apply for limited-draw permit areas	• Use limited-draw permit areas for bull or either-sex hunting opportunity where public access to elk could be high enough to be detrimental to the elk population and/or either-sex permits to create an older-age bull structure as directed by the Elk Management Plan
Maximize the use of the general rifle season as a primary management tool, reducing the need for additional hunts	Harvest during the General Season is greater than harvest in other seasons	• Consider adjusting general rifle season structure if antlerless harvest during the general season is less than antlerless harvest in other seasons • Consider redefining the timing and length of the current 5-week general season to maximize effectiveness in areas where population control is an issue
Maintain the availability of a variety of hunting tools for addressing elk conflicts	The number of hunting season types is maintained or increased from those available when the Elk Management Plan is finalized	• Maintain flexible season types for use as needed • Eliminate sideboards on using shoulder seasons so that they can be used as needed, as long as population is not below population goal
	Tools like shoulder seasons are not linked to population status relative to population goal (no longer required to be above population goal)	

Objective 5: Resolve conflict regarding recognizing landowners for providing elk habitat

Goals	Measures of Success	Strategies
Incentivize collaboration among stakeholders	Publicly share at least one success story annually; stories can include collaboration from statewide, regional, and local scales FWP staff submit at least one nomination for recognition of collaboration annually	• Publicly share success stories in statewide, regional, and local outlets describing when collaboration works • Nominate successful collaborators for statewide and national awards through many venues, such as Governor's Good Neighbor Awards
Maximize landowner-hunter cooperation with elements of the Elk Management Plan	FWP hosts "Elk Summit" within first year of new plan adoption	• Present information on new elk plan, such as research used in plan development, how the new plan will function, partnership stories, etc. • Market existing material (videos, etc.) on hunter and landowner behavior in more places to make it more accessible • Create more inclusive ways for the general public to receive, contribute to, and find data • See additional applicable Strategies and Measures within the "Maximize public input in setting elk objectives" and "Maximize local grassroot input" Goals sections
Maximize opportunity for FWP to improve hunter-landowner relations	Increase certifications from hunter-landowner stewardship online training Landowner relations is a topic at one CAC meeting in each region annually Make improvements to land-owner relations portion of existing FWP hunter education courses	• Update, improve, and promote hunter-landowner stewardship online training • Promote the importance of hunter-landowner relations to the Citizens Advisory Committees; CACs will be asked to provide ideas for promoting hunter-landowner relations • Develop a public hunter/bowhunter education advisory group to improve existing hunter/bowhunter education courses

Objective 6: Promote good hunter behavior		
Goals	Measures of Success	Strategies
Maximize internal and external programs that promote ethical hunter behaviors	Promote Master Hunter Program during scheduled hunter education classes, and create press releases annually Make improvements to hunter ethics portion of existing FWP hunter education courses	• Publicly support external ethical hunter programs. Examples of support include promoting the program during hunter education classes and via press releases as well as providing instructors when requested • Develop a public hunter/bowhunter education advisory group to improve existing hunter/bowhunter education courses
Maintain the fair chase principles in the management of hunting and regulation of hunting technology	Fair chase standards are recommended to the Commission; Fair chase work group holds one public meeting annually	• FWP requests the F&W Commission develop a statewide "Fair Chase Work Group" to address fair chase issues and the ethical use of technology in hunting. Group would host public meetings and lead discussions on fair chase. Group would develop a set of "Fair Chase" standards such as those from Boone and Crockett, Posewitz' book, Wyoming fair chase evaluation, or something similar • Enhance the fair chase portion of the hunter education class

Objective 7: Promote Good Governance		
Goals	Measures of Success	Strategies
Specific elk management strategies and actions in Montana's new Elk Management Plan must be consistent with current rules and statutes	FWP Legal will identify any practices inconsistent with statutes prior to each legislative session	• FWP Legal Department will review elk management plan for compliance with existing rules and statutes

LOCAL SCALE INFORMATION & MANAGEMENT DIRECTION

Local scale information includes characteristics and description of each area, tables and figures of elk counts, classification data, harvest, and hunter effort where those data are available. Data used to generate local scale information were obtained from FWP's Hunt Planner Mapping Application (HD size, primary habitat, and ownership), FWP's Harvest Reports (harvest and hunter effort), and FWP elk survey data (elk counts, recruitment, bull:cow ratios).

Local scale management direction was generated using a combination of public and FWP input and is tailored to the unique circumstances of each HD/group of HDs. It is intended to define management goals at the HD or multi-HD scale. It is organized in a format that includes objectives, goals, measures, and strategies. Objectives are defined as a long-term, overarching vision. A standard set of three objectives was used for nearly every local scale. Those objectives include:

- Manage toward elk population size and demographic targets
- Maintain an acceptable elk distribution
- Provide public elk recreation opportunities

Goals are the individual pieces necessary to achieve the objective and vary depending on the unique circumstances of each HD/group of HDs. Measures define criteria for success and will be evaluated by FWP to track progress. Strategies are tools FWP can use to accomplish the goals and objectives. Setting numerous goals and measures for every local scale better captures the complexity and diversity of elk management components. When FWP periodically evaluates the measures of success, it is possible that not all measures for an HD or group of HDs will be met. This should not be viewed as the HD failing as a whole, but rather should highlight the pieces of elk management that could be improved upon. Failure to meet a measure could be attributed to conflicting goals or strategies. When this occurs, FWP can be more transparent about the tradeoffs associated with prioritizing certain goals over others. Also, the evaluation process can highlight the components of elk management that are considered successful or satisfactory.

Elk population levels and male:female ratios have broad biological sideboards, but social values, concerns, and advocacies can contribute to narrower management prescriptions. Similarly, non-elk elements like hunter distribution, density, and access can have impactful relationships with elk and their management. These circumstances are often reflected in the commission direction to which FWP manages. This can include, for example, different allocation mechanisms ranging from general licenses sold over the counter to limited permits allocated via random drawing. Both biological and social elements relevant to elk management in specific areas are identified in this plan.