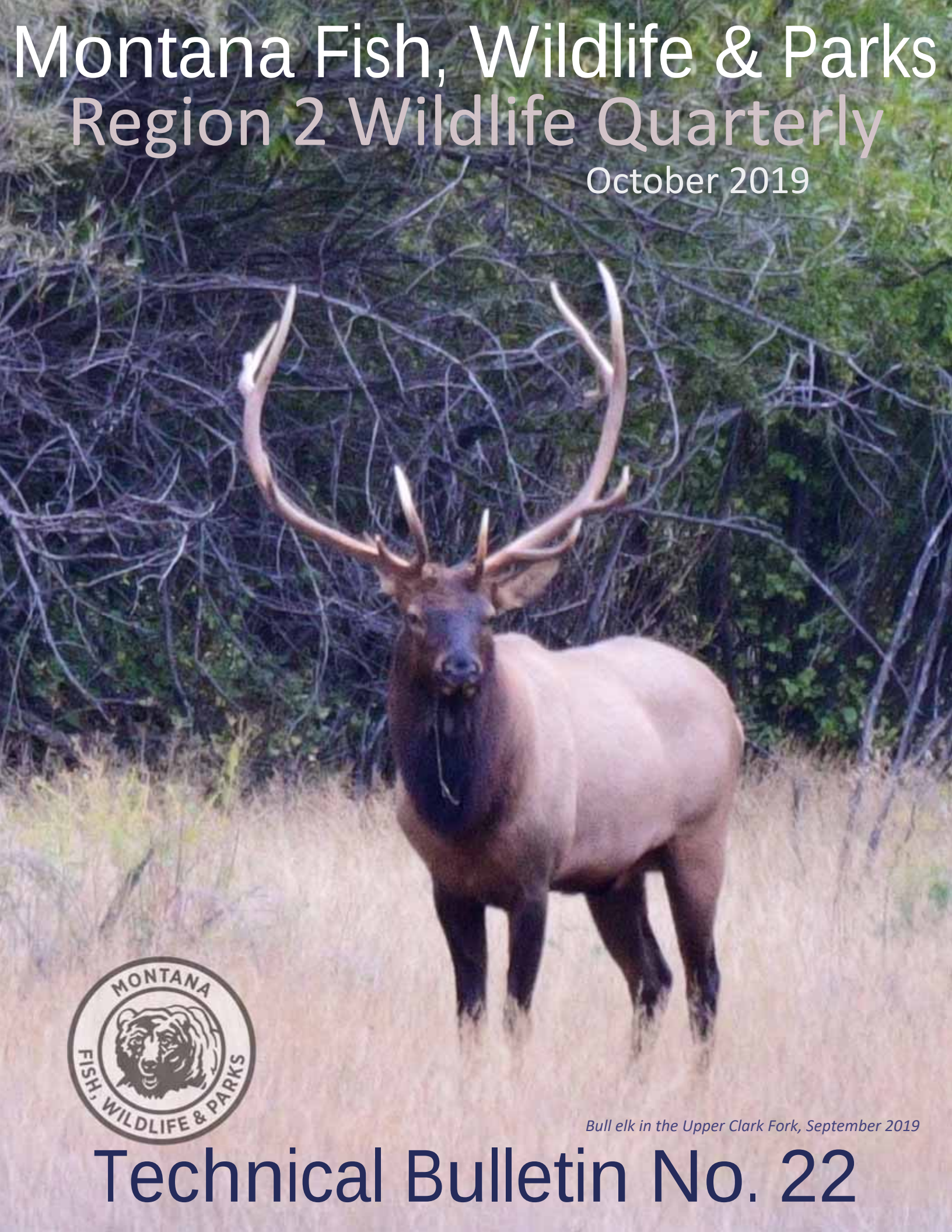
Montana Fish, Wildlife & Parks
Region 2 Wildlife Quarterly

October 2019



Bull elk in the Upper Clark Fork, September 2019

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Region 2, 3201 Spurgin Road, Missoula MT 59804, 406-542-5500

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The Region 2 Wildlife Quarterly is a product of Montana Fish, Wildlife & Parks; 3201 Spurgin Road; Missoula 59804. Its intent is to provide an outlet for a depth of technical information that normally cannot be accommodated by commercial media, yet we hope to retain a readable product for a wide audience. While we strive for accuracy and integrity, this is not a peer-refereed outlet for original scientific research, and results are preliminary. October 2015 was the inaugural issue.

Ten Years of Managing Wolves, Lions and Elk

This fall marks the 10th anniversary of Montana's first regulated hunting season for wolf in 2009. (Wolves were not hunted in 2010, but hunting resumed with delisting in 2011.) It also marks 10 years since elk calf recruitment in the West Fork of the Bitterroot slumped to a regionally unprecedented 9 calves per 100 cows in 2009, before recovering to 32 calves per 100 cows in 2013.

In 2009, we did not know how the wolf-elk relationship would shake out at the end of 10 years, and every possible scenario worried someone.

Today we stand with the privilege that once seemed beyond our grasp: the benefit of hindsight and the informed experience of having managed large carnivores and prey on the contemporary Montana canvas. Arguably, we have completed the first chapter of Montana's greatest predator-prey experiment. Where we go from here can, for the first time, be guided by where we've been, by what we've learned firsthand.

Montana's commitment to ungulate and large carnivore research during this past decade is coming to bear as we move forward. Scientific publications from FWP and other researchers, in and around Montana, fill numerous pages in peer-refereed journals and other publications around the globe, with more soon to appear.

Ironically, a paper by *Idaho* scientists Jon Horne, Mark Hurley, Craig White and Jon Rachael in the latest issue of *The Journal of Wildlife Management* serves as our primary source for this issue of Montana's *Region 2 Wildlife Quarterly*. Their paper entitled, "Effects of Wolf Pack Size and Winter Conditions on Elk Mortality," offers an excellent organization of topic areas and references on the subject, while also contributing new insights and analyses, across a sweeping swath of the Northern Rockies, that corroborate our findings on this side of the State Line.

One of us recalls his Big Game Management class, offered in the Wildlife Management graduate curriculum at Montana State University, taught many years ago by Dr. Harold Picton. The class required students to read, annotate and critically review landmark papers in the scientific literature and lead a discussion in class, if called upon. My—er, this person's—three-ring binders of notes may still live in a box somewhere out back. It was a good way to learn back then, and it's a good way to keep up with the leading research today.

We thought you'd like to read our notes on Horne et al. 2019.

Recovery of Large Carnivores

Notes based on Horne et al. 2019

Black bear on the National Bison Range, MT, in Fall, 2019.

For decades, bears, gray wolves and mountain lions were reduced and held to scarcity across The West. Effects of large carnivores on elk were minimal. Montana elk studies in the 1970s-1980s typically assumed that less than 5% of the adult females would succumb to "natural mortality" in any given year, including predation.

Seeds of recovery for bears, wolves and mountain lions were sown in the 1970s and gradually came to fruition in the 2010s. Today, we appreciate the benefits of having recovered and managed populations of large carnivores on the landscape, alongside the significant challenges that require continual management attention.

Notes based on Horne et al. 2019

Elk south of Darby, MT, in Fall, 2018.

Boise State Public Radio image

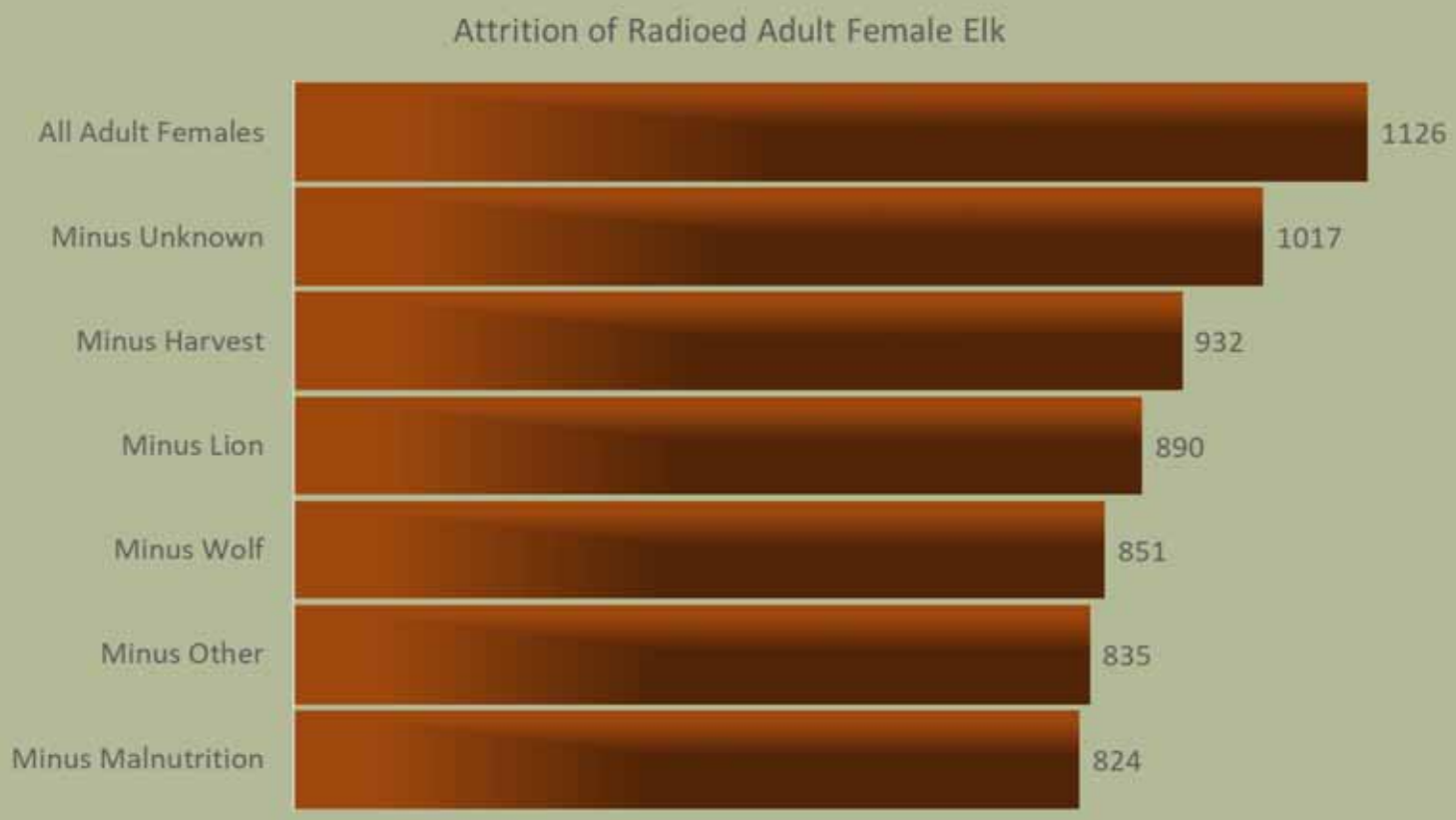
In winters from March 2004 to March 2016, Horne and his colleagues captured 1,244 adult female and 806 calf elk from 29 elk populations all across Idaho: Sandpoint to Idaho Falls and Boise to Coeur d' Alene. The average age of adult females was 7 years, and ranged from 1.5 to 21.5 years. They fitted captured elk with radio collars and mortality sensors that sent a radio pulse at an adjusted rate when the collar was still for several hours.

Adult Female Elk Mortality

Notes based on Horne et al. 2019

- Of 1,126 adult females radioed, this study documented 302 mortalities, which represented a 27% loss of radioed adult females within the period from 2004-2016.
- Unknown (likely not harvest-related) causes of death numbered 109, representing the fate of almost 10% of the radioed adult females.
- Harvests accounted for another 85 mortalities of adult females, or 7.5% of the radioed sample.
- Predation by mountain lion and wolf contributed almost equally, with 42 (3.7%) and 39 (3.5%), respectively—the highest among known, nonhunting, causes of adult female elk mortalities.
- "Other causes" was a catchall category with 16 entries (1.4%), including death from vehicle collision, disease and accidents.
- Malnutrition appeared quite low in the ranking of mortality factors, affecting only 11 individuals, or 1% of the adult females with radios.

The average annual mortality rate of adult females (excluding those harvested by hunters) was 0.09. That is, adult females faced a nine percent chance of death from causes other than hunting each year, on the average. Deaths were highest around May 1 of each year.



Adult female elk face mortality risks in everyday life, even though the probability of death is low overall. Above, a cow elk negotiates a fence when traveling to and from depredations on ranchers' crops in the Deer Lodge valley. Below, an elk washed up in a ditch flooded by heavy spring rain and snowmelt on the Blackfoot-Clearwater Wildlife Management Area in May 2018; cause of death is unknown.

Calf Mortality (Ages 6-18 Months)

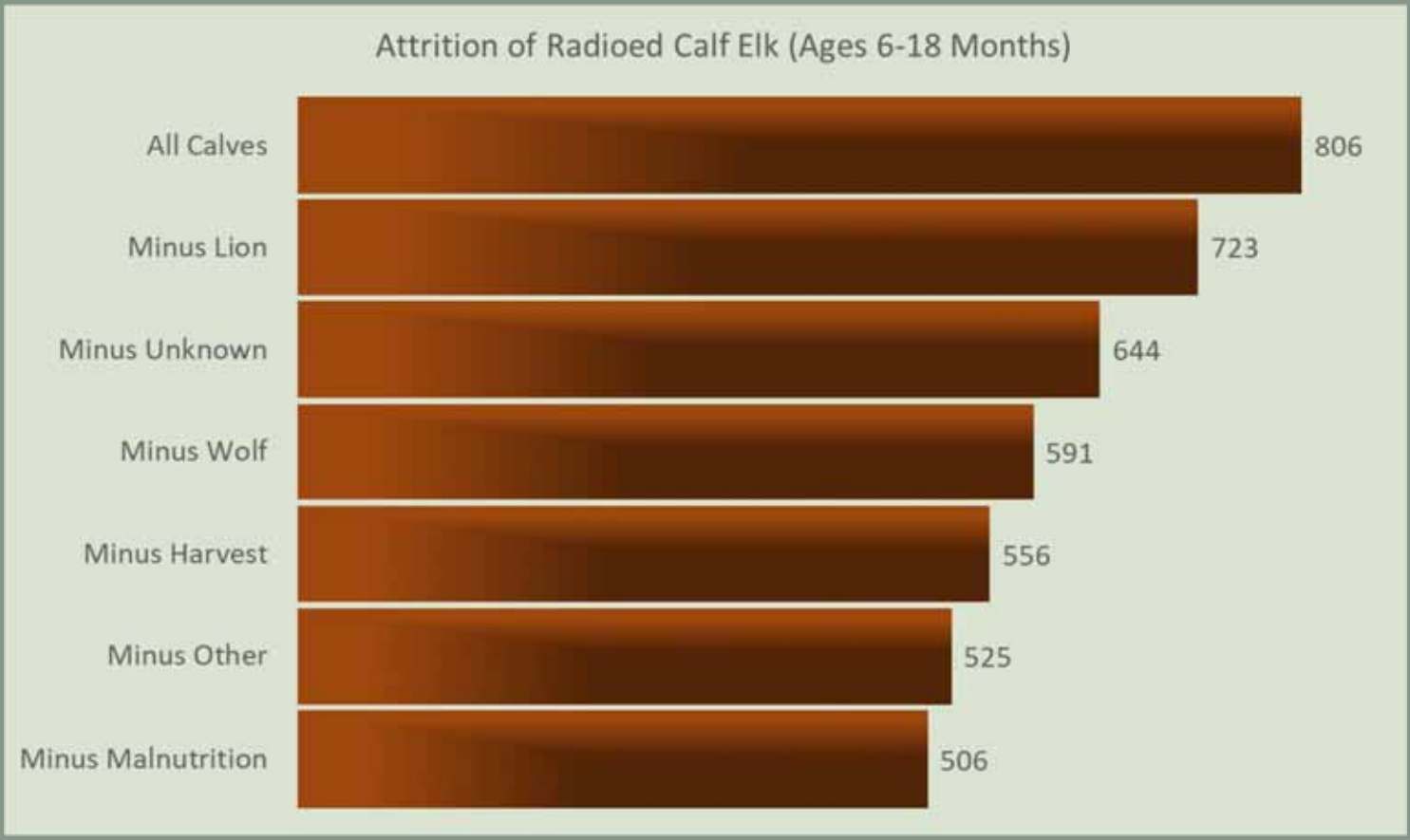
Notes based on Horne et al. 2019

Calves scatter (above) before a bull elk tending its harem on September 28, 2019, along the Clark Fork River west of Drummond, MT. Recall that the Idaho study did not look at mortality rates of calves of this age: approximately 4 months. The Idaho study (Horne et al. 2019) looked at elk calf mortality between ages 6 and 18 months. The calves in their study were the survivors of a period of relatively high mortality, known as the neonatal period, and therefore it might be inferred that their study sampled relatively fit calves.

- Of 806 calves captured and radioed when the calves were about 6 months old, the Idaho study documented 300 mortalities, which represented a 37% loss of radioed calves between the ages of 6-18 months. (Again, mortality from the time of birth to about 6 months of age, when substantial mortality risk has been documented in recent Montana studies, was not monitored in this Idaho study.)
- Predation by mountain lion was the leading cause of death among calves of 6-18 months of age, accounting for 83 deaths, involving 10.3% of the radioed sample.
- Unknown causes accounted for another 79 deaths of elk calves, or 9.8% of the radioed sample.
- Predation by wolf accounted for 53 deaths of elk calves, or 6.6% of the radioed sample.
- Harvest by hunters totaled 35 radioed calves, or 4.3% of the radioed sample. Most harvested calves were males and we assume that some were harvested as spikes between the ages of 15-18 months.
- "Other causes" was a catchall category with 31 entries (3.8%), including death from vehicle collision, disease and accidents.
- As with adult female elk, malnutrition ranked lowest among categorized causes of death in elk calves, with 19 instances documented, involving 2.4% of the radioed sample from 6-18 months of age.

Calf Mortality (Ages 6-18 Months)

Notes based on Horne et al. 2019



The elk calf above (far left) is approximately 11 months of age, located near the Blackfoot-Clearwater Wildlife Management Area. The trailing calf in the winter picture (above right) is approximately 8 months old. These calves illustrate the relative sizes and appearances of elk calves studied by Horne et al. 2019.

Tipping the Balance for Calves

Notes based on Horne et al. 2019

Smaller calves—as indicated by chest girth at the time of capture—were more likely to die in the year between their first and second Decembers than larger calves. Deeper snow predicted higher calf mortality than lower snow depths. Likewise, higher wolf pack size increased the probability of calf mortality, compared with smaller pack size. Differences in the sizes of calves affected the risk of calf deaths the most, followed by wolf pack size and then by snow depth.

Chest girth did not kill calves, nor did the size of wolf packs or snow depth. However, these are factors that made calf elk more or less vulnerable to mortality factors such as predation, malnutrition and the others discussed earlier.

Chest Girth

The average chest girth of calves at the time of capture ranged between 43.3 and 51.2 inches. All other factors being equal, the loss of 8 inches in girth between the high and low calf sizes resulted in a roughly 2-3% increase in the weekly probability of death over a period of several weeks around late March.

Factors that affect chest girth include birth date and forage quality in summer and fall. If wildlife managers could substantially reduce late calf births—which is a big "if"—by reducing bull harvest, increasing the breeding contribution of older bulls or decreasing hunting disruption during the rut, then the subsequent death of elk calves in their first winter and spring could be reduced by a percentage. However, these would be hard pills, and likely for small rewards.

Forage quality for elk calves in their second summer and fall is likely a more productive avenue for wildlife managers to pursue in hopes of elevating elk body condition and reducing the risk of mortality. This would involve the continued collaboration between FWP (in the case of Montana) and land managers to improve habitat quality for elk and other wildlife. FWP began research in the winter of 2018-19 to evaluate the response of forage, and of elk that winter on the Blackfoot-Clearwater Wildlife Management Area to the Rice Ridge Fire of 2017, which burned the majority of their summer and fall range, mostly on the Lolo National Forest. The results from this research will chart a course for elk forage enhancement in an environment that can anticipate a higher fire frequency and greater severity as the climate changes.

The annual mortality rate of calves (excluding calves harvested by hunters) in this Idaho study was 0.40 from December 15 to December 14 of the following year. Deaths were highest in mid-March when calves were about 9.5 months old. This study did not look at calf mortality from birth (on about June 1) through the first 6.5 months of life.

The elk calf at the far right in the picture (above) appears to stand taller and with greater chest girth than the calf standing in front of it, or the calf facing away from the camera on the left side of the picture. While chest girth affected the probability of calf mortality in the Idaho study, it did not predetermine the death of a small calf or exempt a larger one from risk. These elk were photographed in February, east of Missoula.

A pack of 6 wolves from the Inez wolf pack is located and counted from the an FWP fixed-wing aircraft January 16, 2017.

Wolf Pack Size

The average number of individuals in wolf packs ranged between 3 and 9 wolves in the Idaho study by Horne et al. 2019. If all other factors were held constant, the difference of 6 wolves in a pack resulted in a roughly 2-3% increase in the weekly probability of death over a period of several weeks around late March, similar to the magnitude of the effect of chest girth on mortality. Coincidentally, average wolf pack size in Montana has dropped from about 7 to about 5 from 2007 to 2018 (*FWP 2018 Montana Annual Wolf Report*), which should have moderated elk calf mortality rates in at least some parts of the state.

Snow Depth

The variations between extremes in average snow depth in this study resulted in a roughly 1% variation in the weekly probability of death for elk calves over a period of several weeks around late March—less of an effect on calf mortality than chest girth or wolf pack size, but a contributor nonetheless.

This elk calf sheltered under conifer canopies during a late-winter snow and cold event in February-March 2019. Snow depth alone was a significant factor in elevating the risk of calf mortality, but to a lesser degree than chest girth or wolf pack size. They also found that deep snow enhanced the effect of wolf pack size, presumably by slowing prey and aiding predation success.

Rut before the storm, September 28, 2019, east of Missoula.

Tipping the Balance for Adult Females *Notes based on Horne et al. 2019*

Deeper snow predicted higher mortality risk for adult female elk than lower snow depths. Likewise, larger wolf pack size increased the probability of adult female mortality, compared with smaller pack size. Interestingly, prime age cows—around 7 years of age—enjoyed a lower risk of mortality than younger or older cows.

As with calves, snow depths, sizes of wolf packs or the ages of adult female elk did not kill adult female elk directly. However, these are factors that made adult female elk more or less vulnerable to mortality factors such as predation, malnutrition and the others discussed earlier.

Although deeper snow, larger wolf packs and younger or older ages (than 7) of adult female elk were significant factors that increased the weekly risk of death for adult females, the increase was less than 1% in all cases. Remember from pages 10-11 that these variables affected average weekly mortality risk in calf elk by as much as 3% per variable. Even the combination of deep snow and an average pack size of 9 wolves only elevated the weekly risk of mortality in adult female elk by less than 1% in the Idaho study.

Interestingly, when looking at the data presented by Horne et al. 2019, the peak time period for adult female deaths looks to be around mid-April when the combination of deep snow and large pack sizes is in play. To be fair, there is a bump in weekly mortality that shows up in January-March on that graph—a bump that does not appear or appears to a lesser degree for any of the risk factors taken separately. This infers that direct mortality of adult female elk is occurring from wolves with large pack sizes operating with the advantage of deep snow. But, direct mortality does not explain the peak of weekly mortality that appears in mid-April, or so it would seem. Is it wolf mortality in mid-April, and is it the delayed cumulative effect of pack size and elk weakened over the winter by deep snow?

As a matter of curiosity, the weekly risk of death for adult cow elk elevates ever so slightly in the older age classes in September and through the fall in the Idaho study. Remember, this pertains to the risk of nonhunting mortality—not hunting. The effect is miniscule and not of management concern, but it's interesting to think about.

Leading Causes of Nonhunting Mortality for Calves

Notes based on Horne et al. 2019

On pages 10-11, we summarized the factors that increased or decreased the probability that elk calves would die of causes other than hunting. Here, we summarize the leading direct causes of death, other than hunting, for calves aged 6-18 months in Idaho.

Mountain Lion

Although the principal motivation in undertaking this research was to investigate wolf-elk interactions, the leading cause of mortality for calf elk (ages 6-18 months) was predation by mountain lions. "Mountain lion predation accounted for most known-fate deaths (45%), followed by wolf predation (28%) and malnutrition (10%). The catchall category of "other causes", such as accidents, diseases, and unknown predation made up 17%. Horne et al. 2019 estimated a 14% average probability that a calf would die from mountain lion predation alone in the 12-month period between 6 and 18 months of age.

The photos on this page are from remote cameras placed by FWP in Region 2 for a variety of purposes. In the top right, a lion is on an elk carcass, with wolves present as well. The bottom two photos show lions visiting bait stations set for fisher.

Wolf

Predation by wolves was the second-leading cause of death for calf elk (ages 6-18 months). While calf elk faced a 14% average probability of death by mountain lion predation between the ages of 6 and 18 months, wolf predation added a 9% probability of death within that age range.

Horne et al. 2019 found that wolves preferentially selected the smallest calves, and that calves of average or larger size faced a lower probability of mortality, spread fairly evenly across these average or larger calves. Mountain lions "generally killed calves in proportion to their availability" and did not favor smaller calves over larger calves.

A wolf caught on a remote camera set last winter for detecting fishers in Region 2. The picture was taken on Christmas Day, 2018.

Malnutrition and Other Causes

Malnutrition was not a leading cause of death for calf elk (ages 6-18 months). While calf elk faced a 14% average probability of death by mountain lion predation between the ages of 6 and 18 months, and wolf predation added a 9% probability of death within that age range, malnutrition added a 3% probability.

"Other causes" added a 5% probability of death for elk calves in this age range, and unknown causes represented another 11% probability of death.

Cumulatively, calf elk faced a 40% probability of dying between the ages of 6 and 18 months. (While the above-noted probabilities by individual category add to 42%, each is the average in a range of probabilities, so we assume that the mathematical process of arriving at the various sets of values accounts for that "rounding" difference in the sum.)

Leading Causes of Nonhunting Mortality for Adult Female Elk

Notes based on Horne et al. 2019

On page 13, we summarized the factors that increased or decreased the probability that adult female elk would die of causes other than hunting. Here, we summarize the leading direct causes of death, other than hunting, for adult female elk in Idaho.

Mountain Lion

As with calf elk (ages 6-18 months), the leading cause of known-fate deaths for adult female elk was predation by mountain lions. "Mountain lion predation accounted for most known-fate deaths (39%), followed by wolf predation (36%) and malnutrition (10%). The catchall category of "other causes", such as accidents, diseases, and unknown predation made up 15%. Horne et al. 2019 estimated a 1.8% average annual probability that an adult female elk would die from mountain lion predation. Thus, while mountain lion predation was the leading cause of known-fate, adult female mortality, predation presented a low probability of death for adult females in any given year.

Wolf

Predation by wolves was the second-leading cause of death for adult female elk. While adult females faced a 1.8% average probability of death by mountain lion predation in any given year, wolf predation added a 1.7% average probability of death per year.

Horne et al. 2019 found some evidence that wolves preferentially selected the oldest adult females, and that adult females of average or younger age faced a slightly lower probability of mortality, spread fairly evenly across these average or younger cows. Mountain lions "generally killed adult females in proportion to their availability" and did not favor older cows over younger cows.

Early winter, 2019, east of Missoula.

Malnutrition and Other Causes

Malnutrition was not a leading cause of death for adult female elk. While adult females faced a 1.8% average probability of death by mountain lion predation, and wolf predation added a 1.7% probability of death, malnutrition added only a 0.4% probability.

"Other causes" added a 1.3% probability of death for elk calves in this age range, and unknown causes represented another 4.2% probability of death.

Cumulatively, adult female elk faced a 9% probability of dying between the ages of 6 and 18 months.

Management Implications—*Quoted in full from Horne et al. 2019, page 1114*

For elk populations where managers have concerns over declines or for those that are below objectives, our study suggests that elk survival can be increased by reducing pack sizes on surrounding winter ranges, especially in areas where, or during years when, snow depth is high. Although managers can expect increased survival with smaller pack sizes, it is important to recognize that wolves were not the only cause of death and mountain lions killed more elk than wolves. Additionally, there are several mechanisms for summer and autumn nutritional resources on the landscape to affect calf sizes and subsequent calf survival. Thus, the most effective strategy for improving elk populations will likely be one that recognizes multiple factors that influence elk survival including wolf and mountain lion predation and the nutritional quality of summer and early fall forage resources.

Elk rutting in the West Fork Bitterroot in September 2019.

Literature Cited

Horne, J. S., M. A. Hurley, C. G. White and J. Rachael. 2019. Effects of wolf pack size and winter conditions on elk mortality. The Journal of Wildlife Management 83(5):1103-1116.

Postscript

This published research from Idaho builds upon and confirms the findings of numerous studies in North America, including Montana. By now, we could have predicted the results and come quite close (which is always easier after you've read the paper), but this is one of the first times, if not the first, that the results and concepts emerging from more local studies and experiences have been tested and compiled on a broad scale. The effort and rigor that Horne et al. 2019 invested to demonstrate the effects that we've seen and gleaned on smaller scales is of great benefit to us in western Montana. Further, their focus on the mortality of older calves and adult females is an advancement of the science. When people rightly ask us to use the science, this will be some of the science we will bring to bear.

Montana long ago set a course to maintain a recovered wolf population and recently adopted a new lion management strategy that recommits Montana to the conservation of lions. In both cases, wolf and lion management are part of that commitment, for balancing both predator and prey.

Dr. Mark Hurley is second author on the featured science in this issue of the Quarterly, and is Wildlife Research Manager for Idaho Fish and Game. But we knew him way back when, in 1988-1994, when he worked on his master's project on the summer-fall ecology of the Blackfoot-Clearwater elk herd, based out of the Wildlife Management Area bunkhouse near Ovando. That's Mark at far right (above), helping melt rhyme off the chopper blades, and on the right side of the squeeze chute (below left). John Grant walks up on one of Mark's study animals (center) and Mike Thompson swings the door of the chute open. We place a lot of trust in work that Mark would put his name on.

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