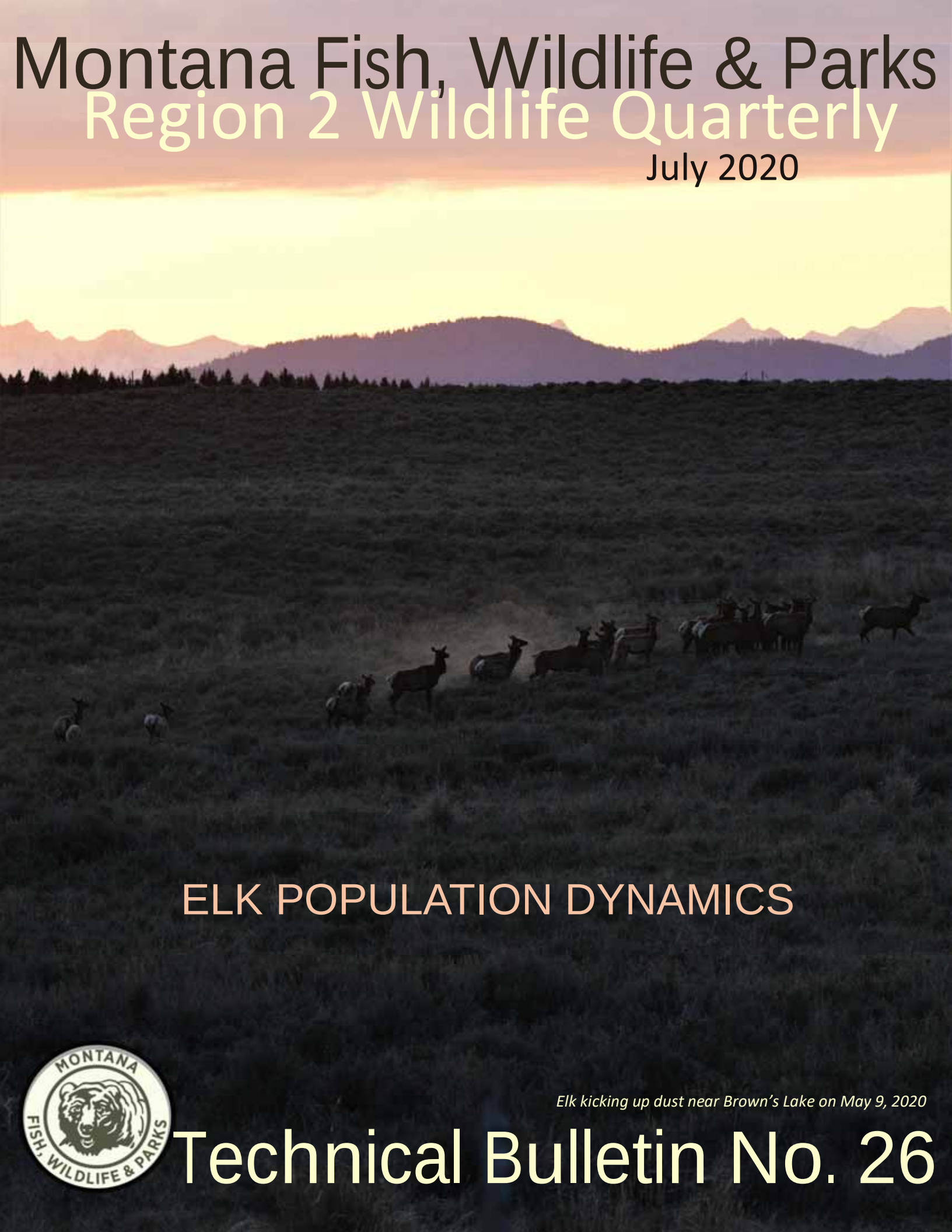
Montana Fish, Wildlife & Parks

Region 2 Wildlife Quarterly

July 2020



ELK POPULATION DYNAMICS

Elk kicking up dust near Brown's Lake on May 9, 2020

Technical Bulletin No. 26

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

Find the Quarterly online at fwp.mt.gov/regions/r2/WildlifeQuarterly

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Photographs are by Mike Thompson and Sharon Rose unless otherwise credited.

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.

ELK POPULATION DYNAMICS

This issue of the *Quarterly* is adapted from the FWP Final Report, cited as follows:

Proffitt, K., R. Garrott, J. Rotella, M. Forzley, J. T. Paterson, B. Jimenez, R. Mowry, and J. Gude. 2020. Evaluating carnivore harvest as a tool for increasing elk calf survival and recruitment. Final Report for Federal Aid in Wildlife Restoration Grant #W-163-R. Montana Fish, Wildlife & Parks, Helena, Montana.

This work is the product of a research collaboration between the Ecology Department at Montana State University and FWP.

Dr. Kelly Proffitt is the lead researcher on the project from FWP and Drs. Robert A. Garrott and Jay Rotella are the leads from MSU.

This is exciting work, covering a period of elk and carnivore research from 2011 to 2017 that touches all corners of Region 2, to varying degrees, as outcomes in the Upper Bitterroot led to questions in the Upper Clark Fork, and from there to other hunting districts.

In the end, we have a look "under the hood" at how elk populations work—the clearest look yet. And not just any elk. They are the elk closest to home—the ones out your back door.

Elk near Brown's Lake on May 9, 2020

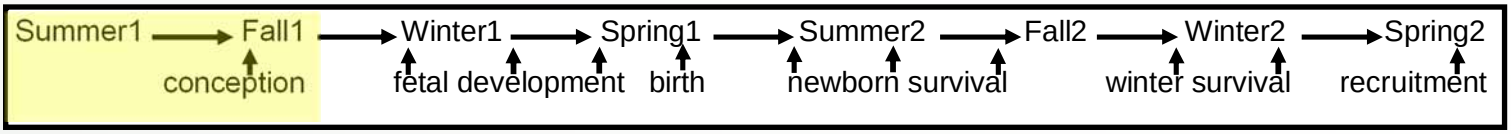
Elk Recruitment is:

Elk in the Blackfoot Valley on May 2, 2020

Elk recruitment is:

- an 11-month-old calf.
- the first elk behind the one standing (above).
- the age when a calf has almost attained the visual appearance of an adult.
- like the high school graduation of a calf elk.
- when the risk of death from natural causes decreases.
- a counterbalance to deaths in the elk population.
- typically measured by biologists as the number of 11-month-old calves per 100 older females (i.e., cows), which yields the recruitment rate for the population.
- 50 calves per 100 cows in this picture (above), if we want to practice calculating a calf: cow ratio.
- an unreliable metric if the rate is obtained from only a few elk or an unrepresentative portion of the larger population.
- affected by interacting variables such as climate, weather, nutrition, predation, security and maternal fitness.
- an important benchmark for wildlife biologists to consider in management.

The Process of Elk Recruitment:



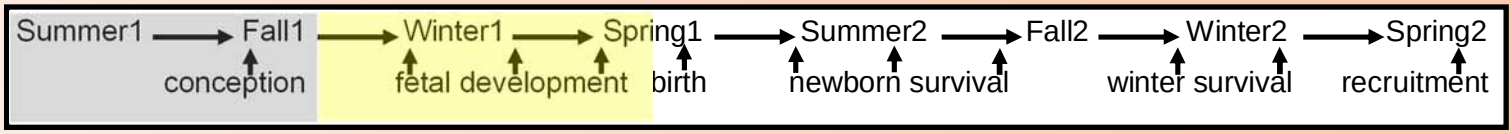
Summer1 - Fall1: conception

The process of elk recruitment:

- consumes nearly two full years (timeline above).
- begins in *Summer1* (highlighted above) with a healthy adult cow elk.
- originates in the summer of the year ***before*** the calf is born.
- proceeds with measurably better odds of successful recruitment when summer rainfall is relatively high.
- requires adequate, high-quality forage to build muscle and fat reserves in adult female elk.
- benefits from high pregnancy rates that come from good body condition in adult cows. The likelihood of conception is higher for females with higher fall body fat, as compared to females with lower body fat (Proffitt et al. 2016)
- proceeds only ***after*** the cow's baseline maintenance needs are met. The cow does not sacrifice itself to produce a future calf.
- proceeds only ***after*** the months-old calf at the cow's side is weaned. The cow does not sacrifice its current calf to produce a future calf.
- may begin with higher odds of success in a summer when the cow isn't nursing a calf.
- occurs with relatively few (about 20%) 1-year-old (yearling) females contributing to herd pregnancies.
- occurs with most (about 80-90%) prime-age (2-14 years) females contributing to herd pregnancies.
- moves toward its next phase with conception, which peaks in Region 2 at the end of September.

Elk in the Clark Fork Valley on September 28, 2019

The Process of Elk Recruitment:



Elk along the Clark Fork River in February 2020.

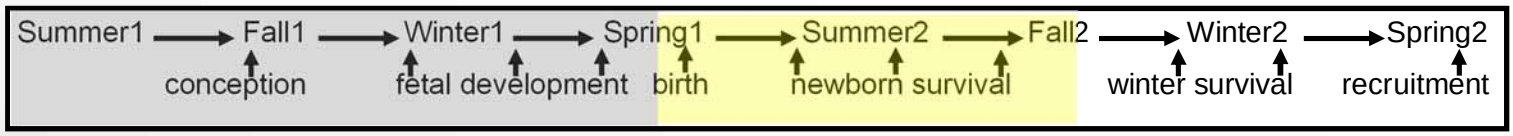
Winter 1 - Spring 1: fetal development

The process of elk recruitment:

- proceeds ***in-utero***—in the womb--from the point of conception (previous page) to the development of a fully grown fetus (timeline above).
- is challenged in the ***winter*** following conception, when forage quality drops while the cow is conserving energy for itself and its developing fetus.
- proceeds with better odds of successful recruitment in mild winters when snow density, measured by snow-water equivalent, is low.
- likely received a boost from the seemingly mild winter of 2020 (pictured above), which FWP will measure in the recruitment of 11-month-old calves in Spring ***2021***.
- was likely burdened by a prolonged period of severe winter weather in 2019 (pictured at right), which influenced the recruitment of 11-month-old calves that FWP documented in Spring ***2020***.

Elk near Potomac in February 2019.

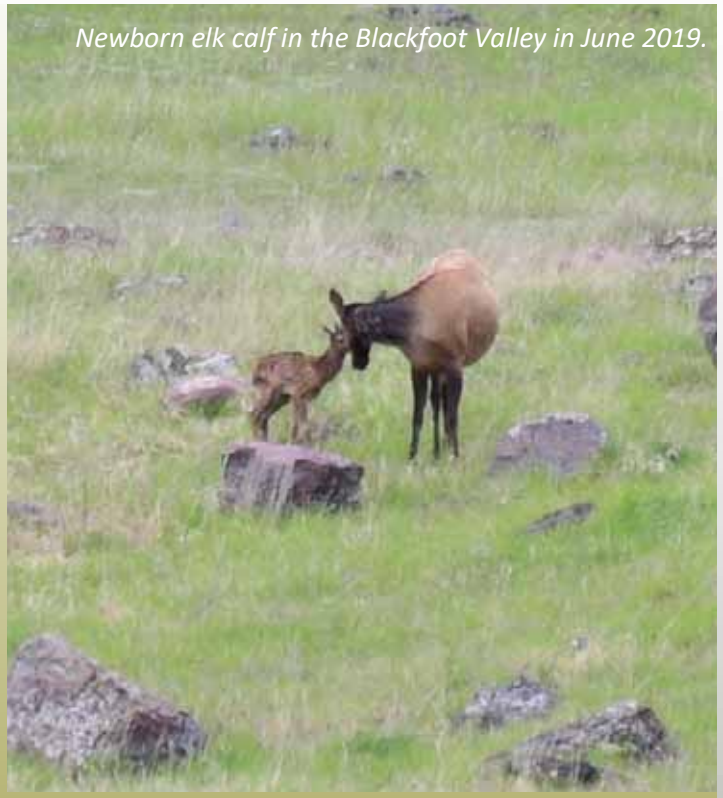
The Process of Elk Recruitment:



Summer2 - Fall2: newborn survival

The process of elk recruitment:

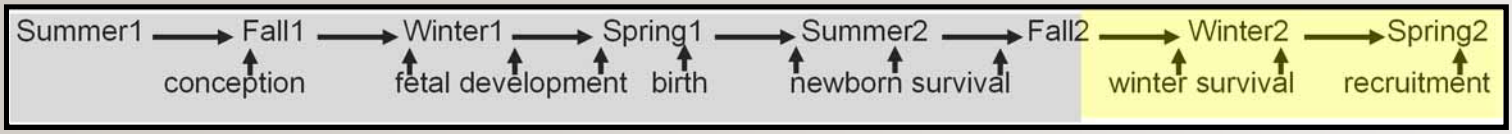
- becomes a visible thing with the birth of calves in late May and early June. But eleven months still lie ahead before recruitment is complete.
- proceeds with reduced odds of survival for newborn calves during springs with high precipitation. High precipitation includes persistent snowpack on summer ranges, which delays green-up. Also, cool, wet spring seasons foster disease and drowning in newborn calves, and are associated with higher predation risk.
- attracts black bear and, in the Blackfoot, grizzly bear predation during and shortly after the birthing period for elk calves, but resulted in only about 5% calf mortality during summer in the Bitterroot study area.
- involved predation by mountain lions year-round, which killed about 14% of elk calves in their first summer of life in the Bitterroot.
- involved very little predation by wolves in summer, amounting to about 1% calf mortality in the Bitterroot study area.
- introduced mortality risk during the calf's first summer from unknown causes; from natural, non-predation events (such as drowning, pneumonia); and from human-related causes (such as fences, hunting) at the rates of 19%, 4% and 1%, respectively, in the Bitterroot study area.
- would benefit from above-average rainfall in the calf's first summer, which is known to improve forage quality and nutrition heading into winter.
- would suffer from dry summers, especially if followed by a severe winter.



Newborn elk calf in the Blackfoot Valley in June 2019.

Elk calf in the Nevada Valley in June 2016.

The Process of Elk Recruitment:



Elk east of Bearmouth in January 2019, before severe winter weather yet to come.

Winter 2 - Spring 2: winter survival to recruitment

The process of elk recruitment:

- can produce stout and fit calves entering their first winter, like the three calves pictured above. This photo was taken in January 2019, about one month before the winter turned from mild to brutal.
- depends more heavily on a mild winter and early spring if preceded by a dry summer.
- is challenged by increased predation on elk calves in a severe winter, compared with a mild winter.
- introduced substantial mortality in elk calves during winter, but less than in the preceding summer in the Bitterroot study area.
- involved predation by mountain lions on about 12% of elk calves in their first winter of life in the Bitterroot study area.

Elk in the Blackfoot Valley in mid-April, coming out the other end of the severe late-winter of 2019, with calves and other elk looking gaunt and angular.

- involved predation by wolves on about 3% of elk calves in their first winter of life in the Bitterroot study area.
- introduced mortality rates from unknown causes and from human-related causes of 12% and 1%, respectively, in the Bitterroot study area.

Recruitment drives elk populations

Recruitment is the measurable potential of an elk population to sustain itself and grow, and to produce a surplus, as it were, for withstanding predation and supporting opportunity for hunter harvests.

From the 2005 Montana Elk Management Plan:

> *We do not list "goals" for calf recruitment in this revision of the elk plan because in many or most cases, we can do little by management action to affect recruitment level.*

It may have been more accurate to say ". . we don't understand recruitment well enough, or precisely enough, to direct management actions in ways that predictably affect recruitment levels."

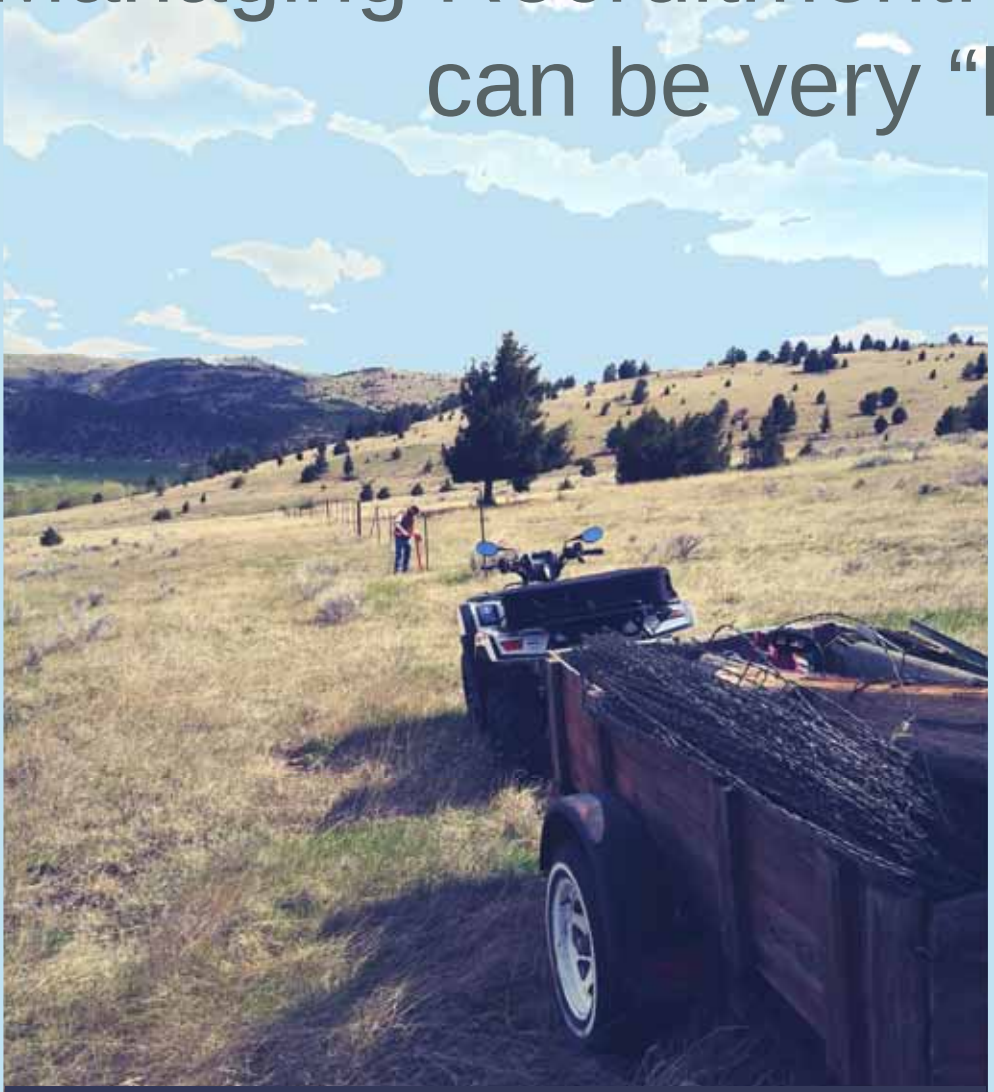
The recently reported research by Proffitt el al. (2020) strives to address that lack of information about elk recruitment, and to provide wildlife managers with the tools to set reasonable goals for elk recruitment and to prescribe management actions that tend toward desired future recruitment levels.

While much of the variation in elk recruitment from year to year remains at the mercy of weather and other variables beyond management control, we're now on a path toward more reliably forecasting elk recruitment and needed management responses in real time, while the snow is still falling or the rain is not.

Perhaps future management will be judged more on elk recruitment goals and trends, with elk population trend counts serving in more of a supporting role. Because recruitment can be predictive of population trend.

Elk skylined above French Basin in the Upper Bitterroot in April 2020.

Managing Recruitment: can be very "hands-on."



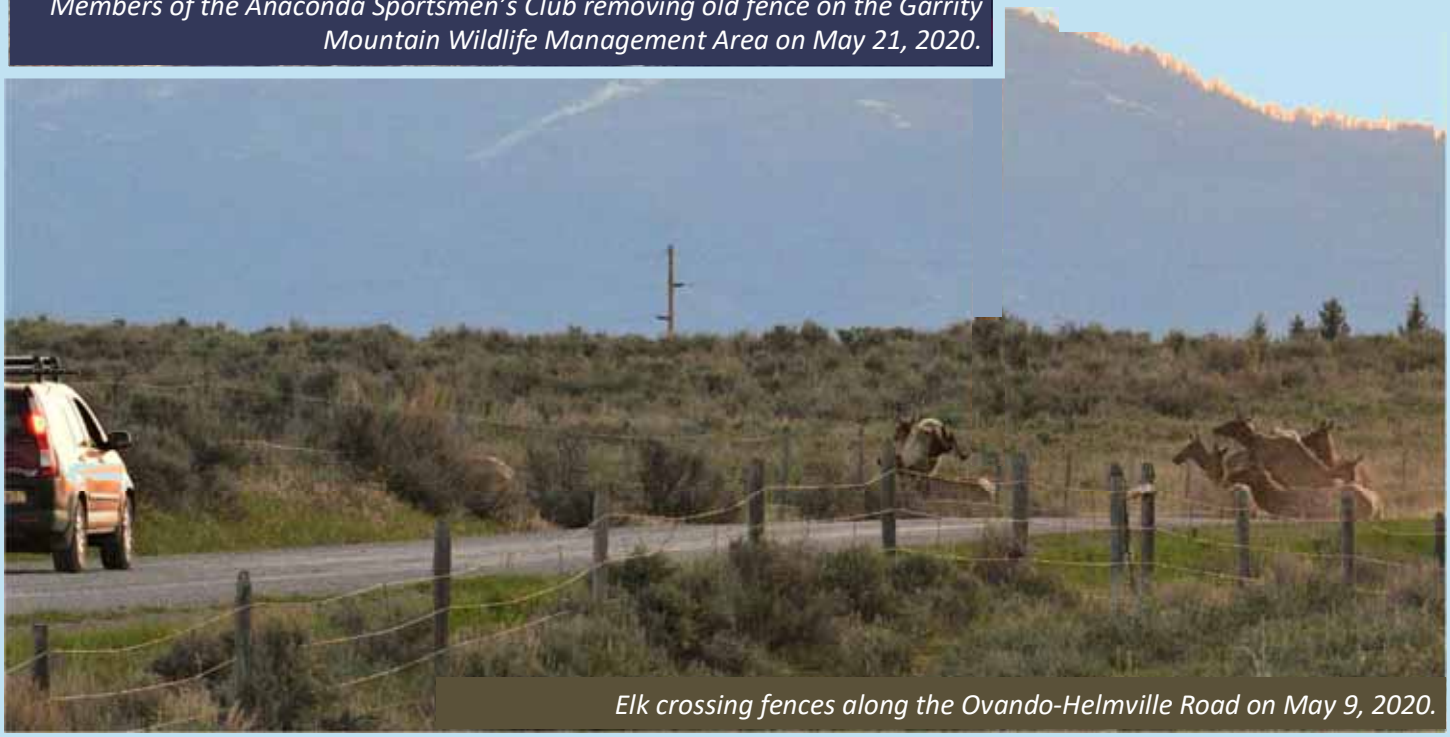
Members of the Anaconda Sportsmen's Club removing old fence on the Garrity Mountain Wildlife Management Area on May 21, 2020.

There is an academic and scientific side to understanding and managing elk recruitment, which illuminates practical opportunities for addressing recruitment issues as well.

Fence modifications or, ideally, fence removals can increase elk survival, especially that of elk calves.

On May 21, 2020, volunteers from the Anaconda Sportsmen's Club removed the last 3/4-mile of old and unnecessary fence along the boundary of Garrity Mountain Wildlife Management Area (pictured at left).

The Club's efforts intend to prevent wrecks like the one pictured below. In this case, near Helmville, an elk crossing event was aggravated by a motorist who failed to give the elk enough space and time to pick their ways over and under the fences.



Elk crossing fences along the Ovando-Helmville Road on May 9, 2020.

Cow elk jumping a fence while calves bunch-up against the wires along the Ovando-Helmville Road on May 9, 2020.

While adult cows jump more readily, often breaking the top wires in the process, calves tend to bunch-up and mill around at the fence, showing a reluctance to cross. Even calves as old as 11-months, like these calves (pictured above) on May 9, create a bottleneck that can turn bad for the elk when confronting fences. Entanglements and deaths sometimes occur.

Anaconda Sportsmen Dave Stone, Chris Nadarcie, Chris Marchion, Gary Ouldhouse and Chuck Otto completed a 3-mile fence removal project at Garrity Mountain WMA on May 21 to improve elk survival and recruitment. That's a lot of material retired from elk habitat (below).

Anaconda Sportsmen with fence materials they dismantled and hauled off the Garrity Mountain Wildlife Management Area on May 21, 2020.

Managing Recruitment: can be very "hands-on."

Other practical opportunities exist that can have more indirect positive effects on elk recruitment. We know that access to high quality forage throughout the year is important for determining nutritional condition of adult female elk and can affect pregnancy rates and recruitment.

Although spring, summer, and especially late-summer forage quality may be most important for an adult cow elk, easily accessible forage during winter can also lessen the impact to body reserves acquired during the summer.

Pre (above) and post (bottom) forest thinning and conifer expansion removal. Conifer expansion into shade-intolerant grasslands can transition these diverse bunchgrass and forb prairie ecotones to less desirable shade-tolerant pinegrass forest understories. Grasslands like this one on the Blackfoot Clearwater Wildlife Management Area provide high quality winter, spring, and fall forage for elk. Photos by Scott Eggeman. (The arrow points to the same tree in both photos.)

FWP works closely to partner with other private, state, and federal land management agencies to share the best available science and apply that knowledge to improve habitat and forage quality for elk across a diverse landscape. Knowledge gained from regional elk research projects has resulted in an increase in projects that target improved forage quality and quantity.

At right we see a prescribed burn conducted in the spring of 2019, following a forest thinning project on The Nature Conservancy's Baldy Mountain Forest Reserve in Greenough, Montana. This project was part of a larger scale Forest and Elk Habitat Restoration project partially financed with funding from the Rocky Mountain Elk Foundation. The habitat goals were to improve forage through a combination of understory forest thinning and prescribed fire on this transitional range. Photo provided by Michael Schaedel, TNC.

Below we see the Baldy Mountain Forest Reserve in spring 2020, one year following the prescribed burn that is shown above. Understory burns can improve grasses and forbs, providing some of the highest quality forage for cow elk during the calving season. Photo provided by Michael Schaedel, TNC.

Elk Recruitment Analysis

- The recent research project used data from 17 elk hunting districts in Region 2 (Figure 1) to analyze elk recruitment. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6927647/
- So the analysis is customized for the dynamics of our local elk populations and their local environments in west-central Montana.
- Data used in the analysis were from the period 2004-2016.
- Elk counts and calf/cow ratios came from FWP's regular aerial surveys.
- Elk harvests came from the FWP statewide harvest surveys.
- The researchers compared these data, mathematically, with spring and summer precipitation and an index of forage quality in each district.
- And, they compared these data, mathematically, with indicators of black bear, wolf and mountain lion abundance over time.
- The number of elk counted, observed age ratios, and harvested elk varied considerably among years and hunting districts.
- They found strong evidence for a series of relationships between weather variables and recruitment using the population model.
- For an average year and with all variables held to their average value, the model predicted an overall mean recruitment rate of 25 calves per 100 cows for Region 2 from 2004 through 2016.

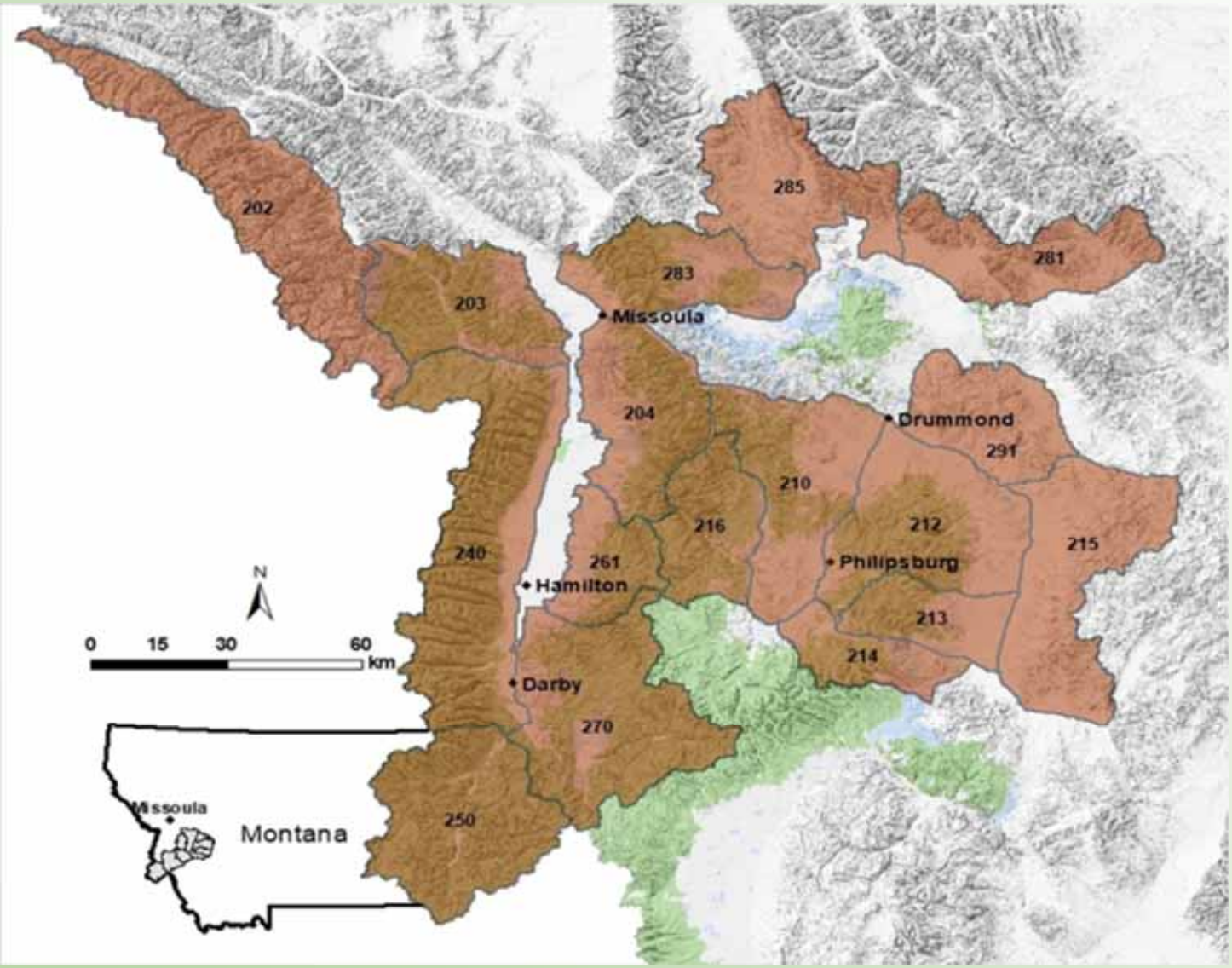


Figure 1. *The 17 elk hunting districts in west-central Montana used for analysis.*

Elk in the Blackfoot Valley in 2018 .

Elk populations, to a wildlife biologist, . . .

. . . are like classic trucks to a mechanic.

Near Anaconda Check Station.

While everyone appreciates the sights and sounds of restored elk populations and a classic truck, . . .

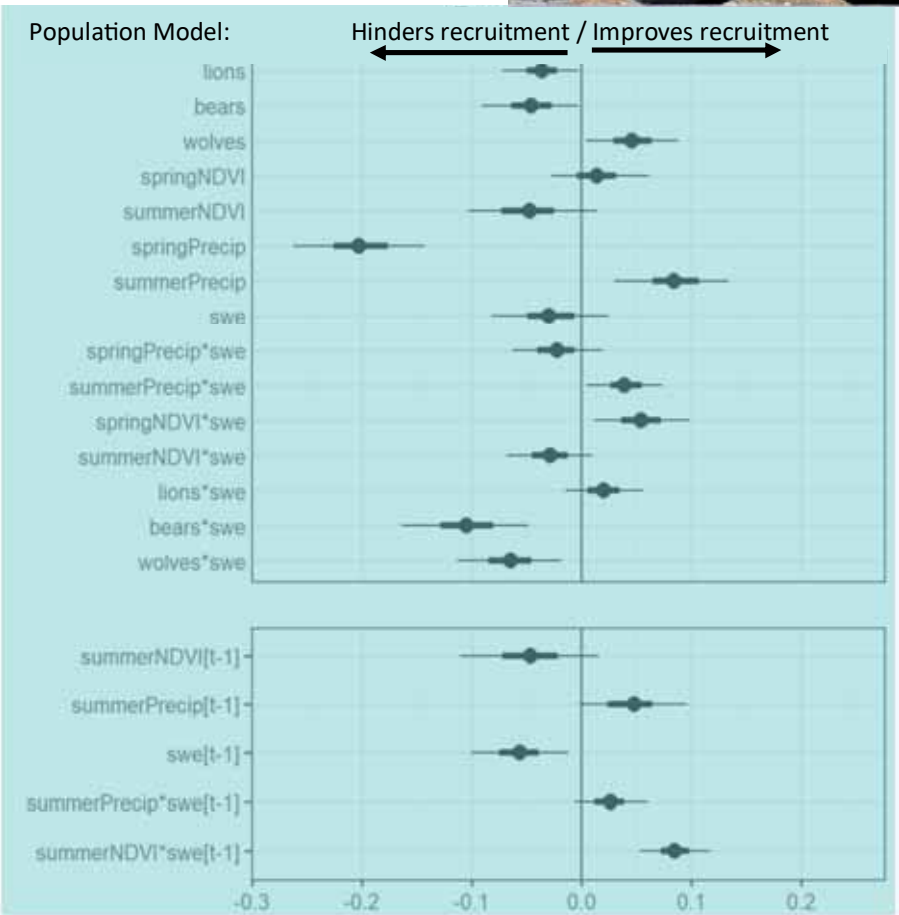


Figure 2. *Estimated regression coefficients for covariates representing their effect on recruitment. The top panel denotes covariates affecting the calf during its first year of life and the bottom panel denotes covariates affecting the calf prior to birth. The black dot denotes the median of the distribution.*

. . . biologists and mechanics need to know what's under the hood.

Proffitt and others (2020) translated nature into mathematics that an elk population mechanic can use (Figure 2). The rest of us can just close the hood!

What the model helps us see:

Elk ecology

1. The range of effects on elk resulting from the range of harvests, carnivore levels and environmental conditions experienced in Region 2 in a recent period of wide variation.
2. That levels and timing of precipitation and winter severity influence the degree to which carnivores and other environmental events alter elk recruitment and population performance.
3. That ratios of 11-month-old calves per hundred cow elk are linked, to varying degrees, with combinations of precipitation and winter severity experienced over the prior 2 years. (So, the calf: cow ratio may not always fit with expectations formed from conditions experienced in only the last 1-6 months.)

A predictive horizon

1. That elk recruitment and population dynamics can be forecast from variables such as the ones used so far in the elk population model (Figure 2).
2. That any need for temporary increases or decreases in harvests of elk and carnivores can be forecast and focused, based on the latest and previous environmental data.
3. That moderate adjustments in harvests can have the desired effects if they coincide well with the timing of other ecological factors.
4. That predicted climate trends for Region 2, if realized, may spur calf recruitment with increased summer precipitation, depress calf recruitment with increased spring precipitation and more intense summer heat, and add new model variables of unknown effect with warmer, wet winters.

Elk barely visible during spring classification survey in the Lower Clark Fork, April 2020. Photo by Liz Bradley.

What the model helps us see:

A supermoon in the Lower Clark Fork, April 2020. Photo by Liz Bradley.

Questions and needs

1. That the model is new and we've barely begun testing it and exploring its utility.
2. That the model's performance could be tuned-up considerably if and when more precise indices of environmental factors and carnivore abundance are available to fuel the model (Figure 2).
3. That the model will supplement, not replace, the observational data and interpretations that field biologists provide.
4. That the model will not replace observations and inputs by other outdoorspeople who we look to for insights and information.

A timely path forward

FWP Region 2 did not fly elk trend surveys in Spring 2020, due to the Covid-19 pandemic, which affected the Lower Clark Fork, Bitterroot and Blackfoot watersheds. The Upper Clark Fork hunting districts were flown in winter, prior to enactment of the State's Covid response.

With awareness of this research attention on elk recruitment, Region 2 biologists focused their monitoring this spring on obtaining representative calf: cow ratios from ground surveys. By surveying recruitment in this way, biologists were able to collect valid and repeatable information on population performance, as reflected in the survival rates of 11-month-old calves.

These data may be used to further refine the elk population model as we move forward, and can give us comfort or pause as to the status and resilience of the elk populations under present management.

In the long run, it's good to see the population trend. But, if you can't do aerial surveys for a year, like this year, the best indicator of population status and trajectory is the calf: cow ratio.

Along The Way

To the reader, this Killdeer serves as our halftime show—halfway through a dense Quarterly!

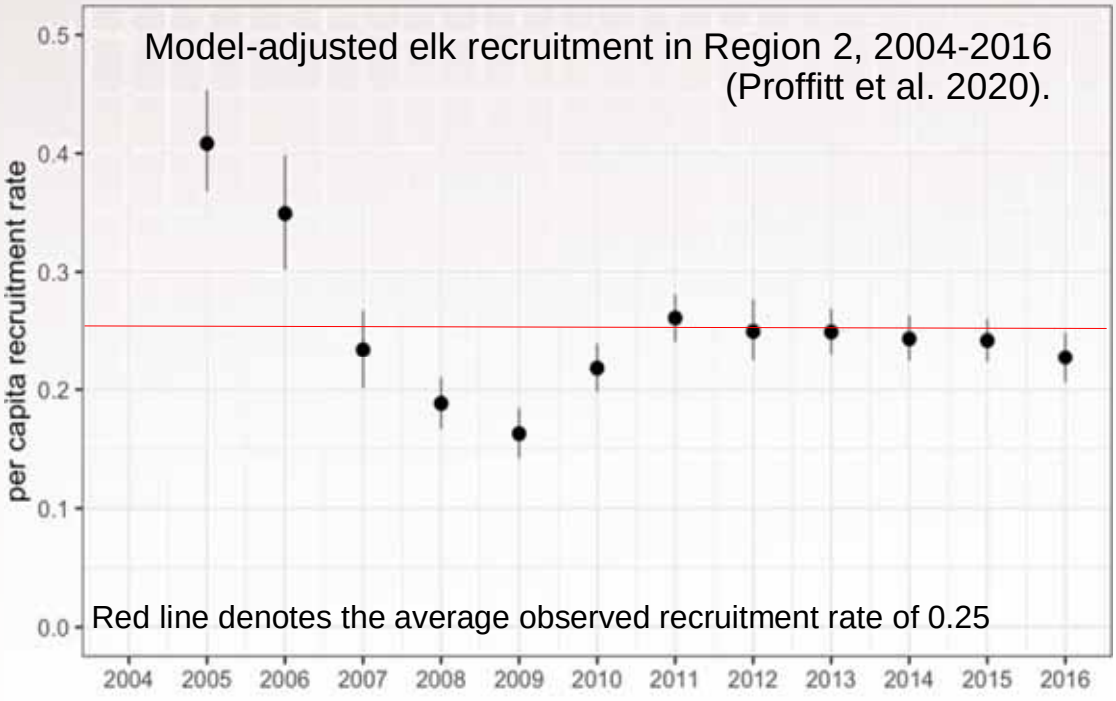
To learn the Killdeer dance moves, follow the pictures sequentially from 1 to 8.

Along The Way

But in the wild, the Killdeer hopes to distract the potential predator from its nest. "Follow me!"

Elk Recruitment in 2020

Three 11-month-old calves, with a cow, is the kind of recruitment we like to see during spring classification counts, like this group on May 9, 2020 (above). Biologists transform observations like these into points on a graph of average annual recruitment (calves per hundred cows), such as the one shown here.



However this graph incorporates more information than the observed ratios alone. It is the graph of predicted recruitment that incorporates the environmental and predation variables in the model developed by Proffitt et al. (2020).

Without the model, we might wonder whether observed calf: cow ratios in any given year were flukes, not meriting a management response. But with model confirmation, we gain confidence to act promptly, if action is warranted.

Elk Recruitment in 2020

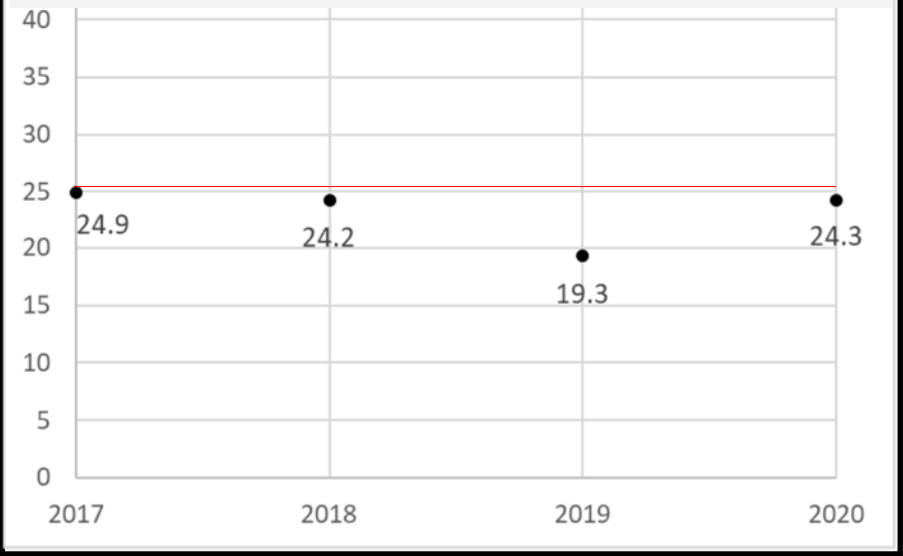
The chart on this page (below) displays the elk recruitment observed by FWP Region 2 biologists across the region in 2017-2020. Remember from the previous page that the elk recruitment model was derived from data collected in 2004-2016.

While the data from 2017 to 2020 are not adjusted for the model parameters, we can use these raw calf: cow ratios to give us a general impression of recruitment for the time being and make general comparisons with the modeled ratios from 2004-2016.

We can see that three of the past four years of average annual recruitment in Region 2 have closely approached the long-term average of 25 calves per hundred cows.

The calf-cow ratio in 2019 represents quite a drop from the norm, when compared with the historic ratios that are plotted to the same scale on the previous page. It's possible that the model adjusted figures for 2019, when available, might cause us to adjust our thinking somewhat, but it looks like 2019 was a biologically significant event.

Calves per hundred cows (Region 2 average) observed in 2017-2020. Red line denotes the 2004-2016 annual average for Region 2.



Tale of Two Winters

Before receiving and digesting the final report by Proffitt and others (2020), some of us had been let down by elk recruitment in 2020.

The low recruitment in 2019 seemed logical and matched our impressions that it resulted from a hard winter. Quite a few 8– or 9-month-old calves must not have survived the hard winter of 2019.

More unexpected was the somewhat lackluster-appearing response of recruitment to the mild winter of 2020. Sure, recruitment bounced upward from 2019 levels, but it did not reach the long-term average. How mild does a winter have to be for recruitment to exceed the average?

Results reported by Proffitt et al (2020) offer the concept of an explanation. Their data demonstrated that one hard winter can dampen two years of recruitment, due to the lingering effect of winter on pregnant cows and fetal development.

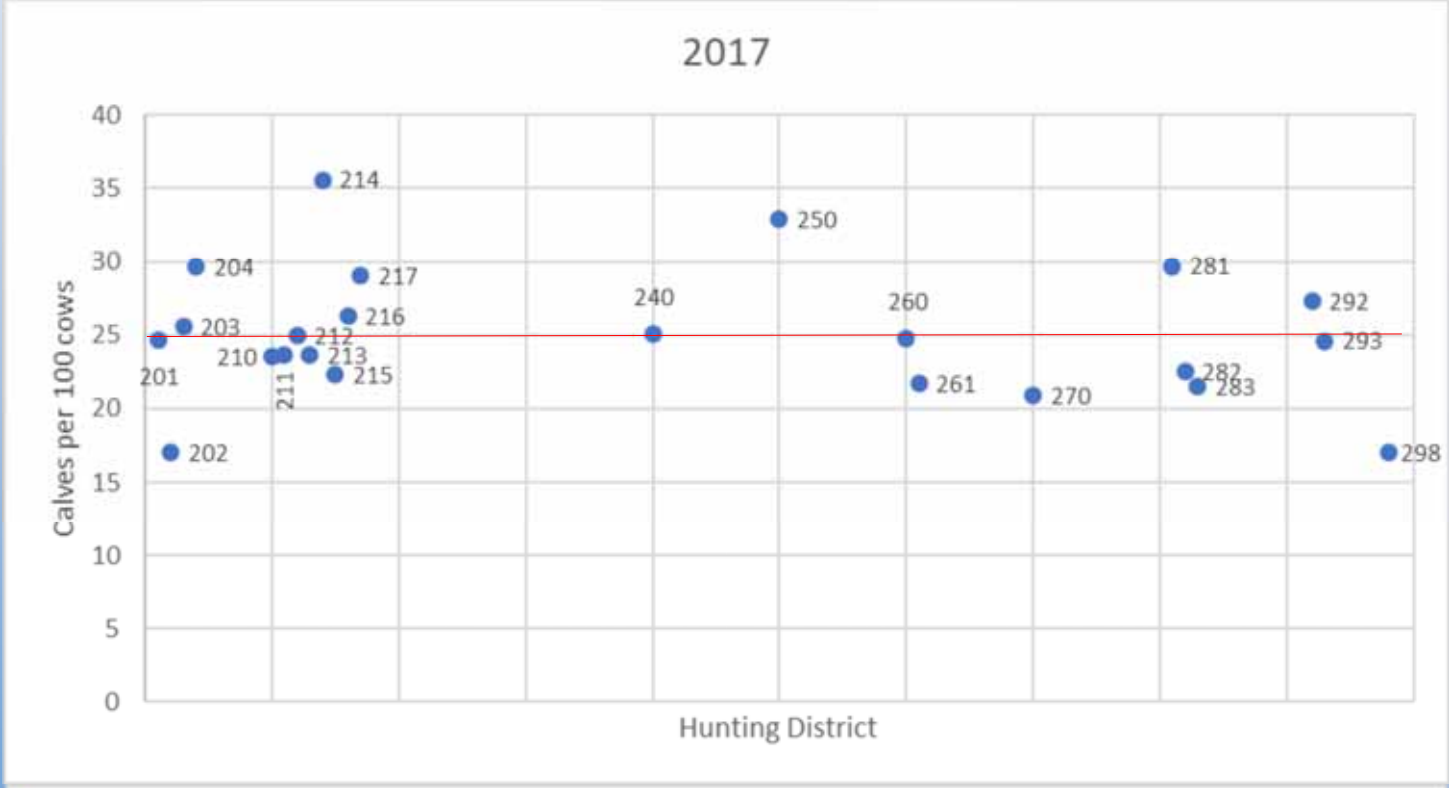
And it's not just one thing—not just winter—but a combination of several factors that may enhance or cancel each other by the time a calf is recruited into the breeding population.

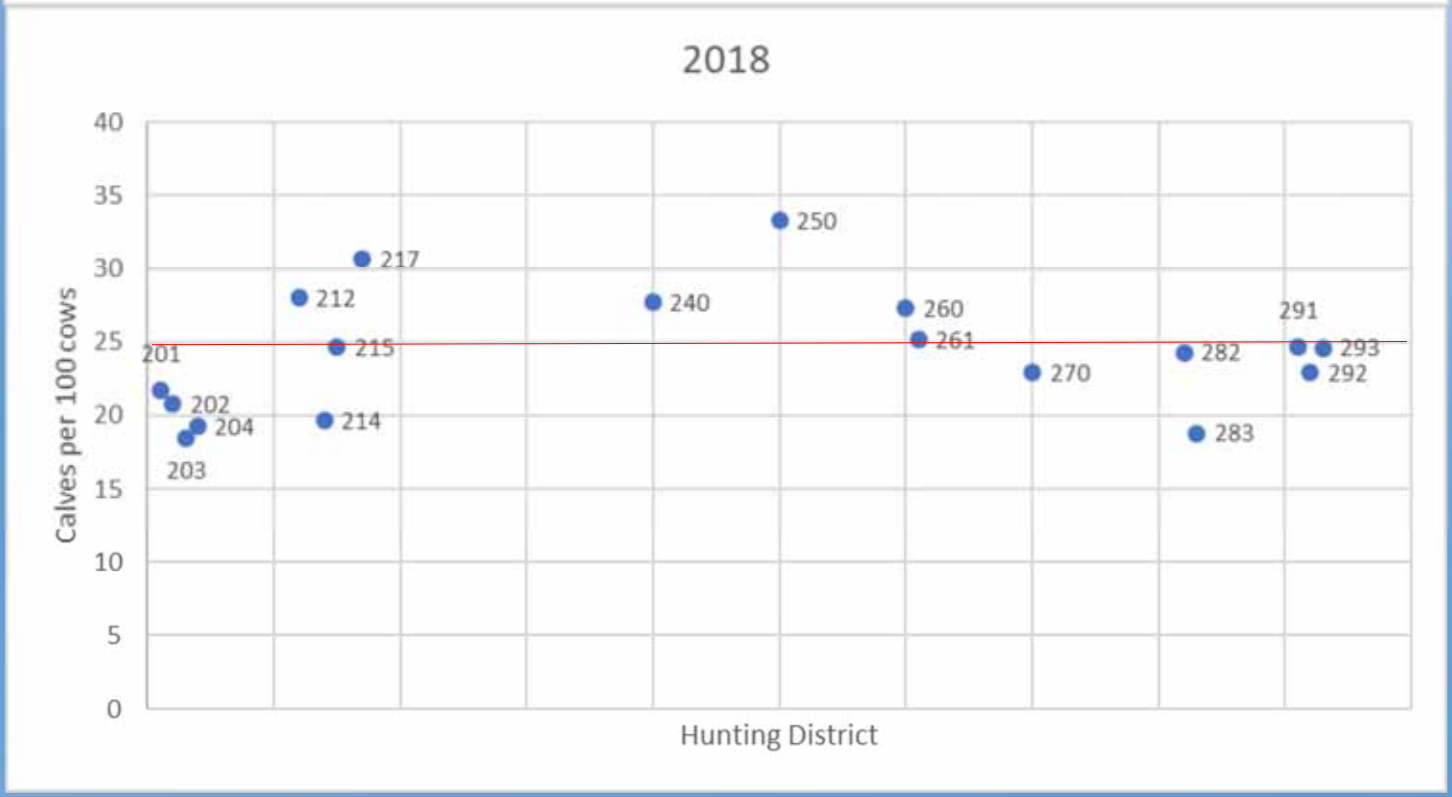
Elk Recruitment in 2017-2018

“Oh no, not more graphs!”

Ah, but you’ll like these. The Y-axis on each of the following 4 graphs is the ratio of calves per hundred cows. The X-axis is the range of possible hunting district numbers in Region 2. The red line is the average annual recruitment from 2004-2016. The number beside each point on the graphs is the Hunting District number for each point.

There’s a lot of similarity in geographic patterns of recruitment between 2017 and 2018. This stands out when viewing the recruitment levels for Bitterroot districts 240, 250, 260, 261 and 270 in each of the two graphs below. The two years for those districts look almost identical. In most districts around Region 2, recruitment in 2017 and 2018 was largely clustered around the long-term average (below).



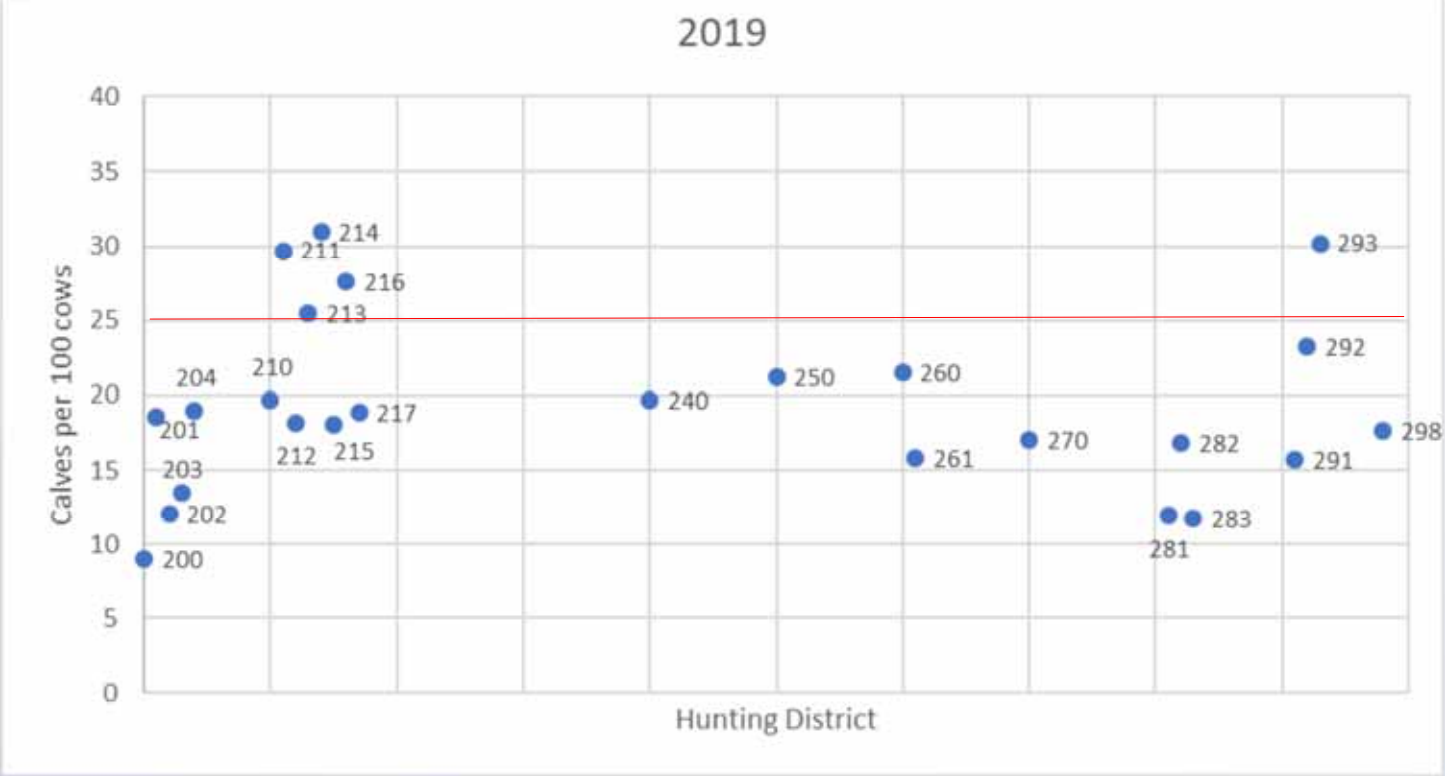


Elk Recruitment in 2019-2020

“See? Graphs are okay.”

Calf recruitment in 2019 (below) pretty much followed the pattern seen in 2017, but with the majority of districts falling below the long-term average in 2019. In 2019 we see a number of districts falling solidly below 15 calves per hundred cows, which we did not see in 2017 or 2018. Among the four years of recruitment that are graphed below and on page 22, 2019 stands out as a year of poor recruitment, likely at a level of biological effect.

In 2020, the prevailing pattern of calf recruitment across Region 2 hunting districts returned to 2017 and 2018 levels (below). Average recruitment levels returned to near the long-term average of 25 calves per hundred cows.



Elk Recruitment in 2021

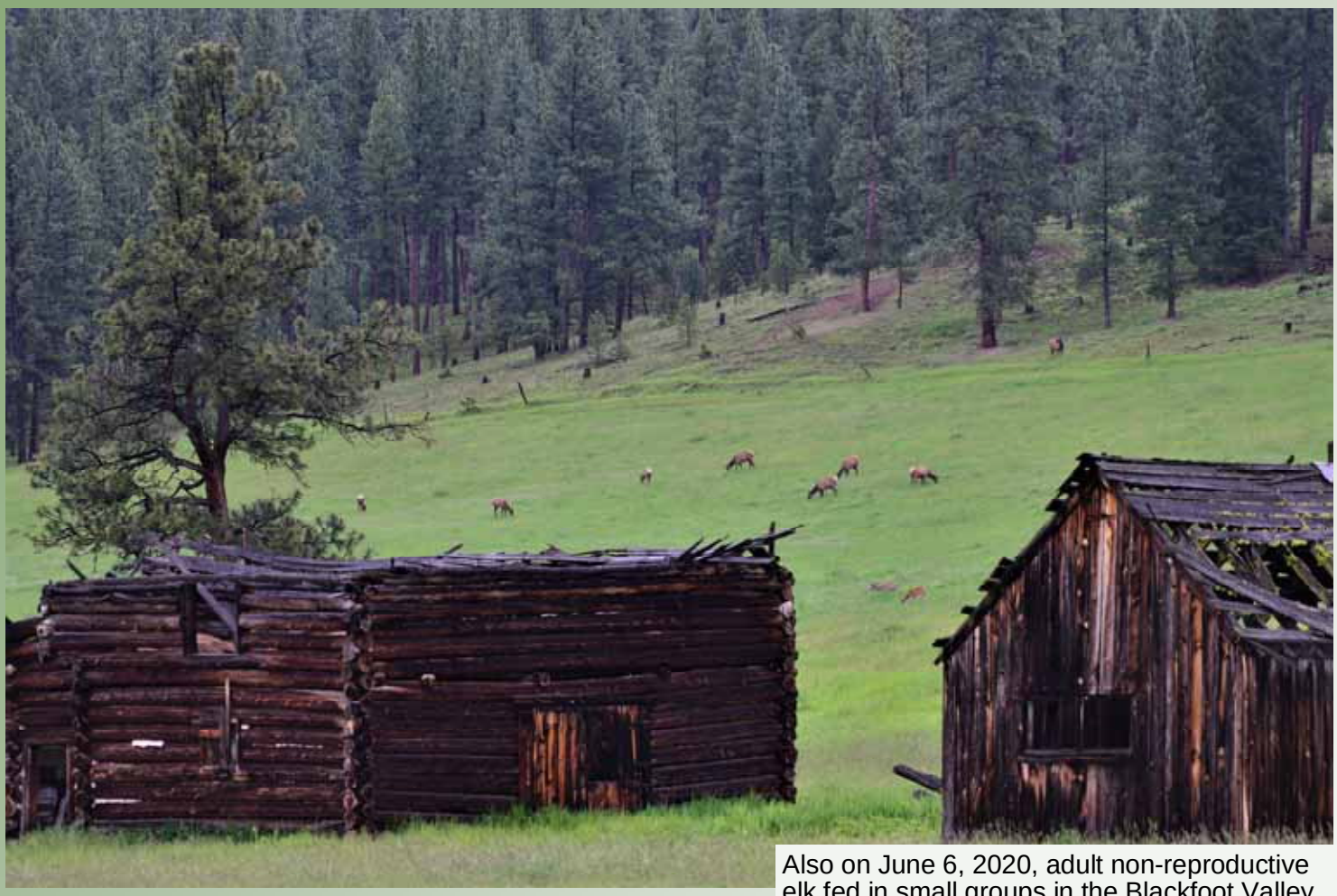
On June 6, 2020, the 2-year process of recruiting elk into the 2021 breeding population was half complete, with calving season upon us.

We've noticed a pulse in deaths of adult female elk around calving time, over the years, and adult female elk deaths peaked around May 1 in a recent Idaho study (Horne et al. 2019).

So, it was not surprising to see this cow elk, freshly dead, on June 6 in the Blackfoot Valley. Sagebrush obscured the details of the mortality, as did our reluctance to cross private land.

It illustrates the point that calves are lost to elk populations in numbers and ways that go undocumented by research.

Elk Recruitment in 2021



Also on June 6, 2020, adult non-reproductive elk fed in small groups in the Blackfoot Valley. In the picture at left, we see an adult bull in velvet, along with young cows—possibly 2-year-olds—that were likely not bred as yearlings. Again, only about 20% of yearling cows are normally bred.

Visible as part of the larger group pictured above, but not pictured at left, was at least one yearling calf.

Scattered around the fringes of the timber and apart from the group were single adult cows. We watched these for signs of newborn calves, but weren't lucky enough to see any on this occasion.

On this day and on other days in the 2020 calving season, steady rains fell. The research by Proffitt and others linked above-average spring precipitation with suppressed calf recruitment one year later. It presents us an opportunity to remember that the effect of this rainy calving season, pertaining to pneumonia and drownings of newborn calves, is only one of many environmental inputs into the 2-year process of elk calf recruitment, which may or may not balance each other in the long run.

Elk Recruitment in 2021

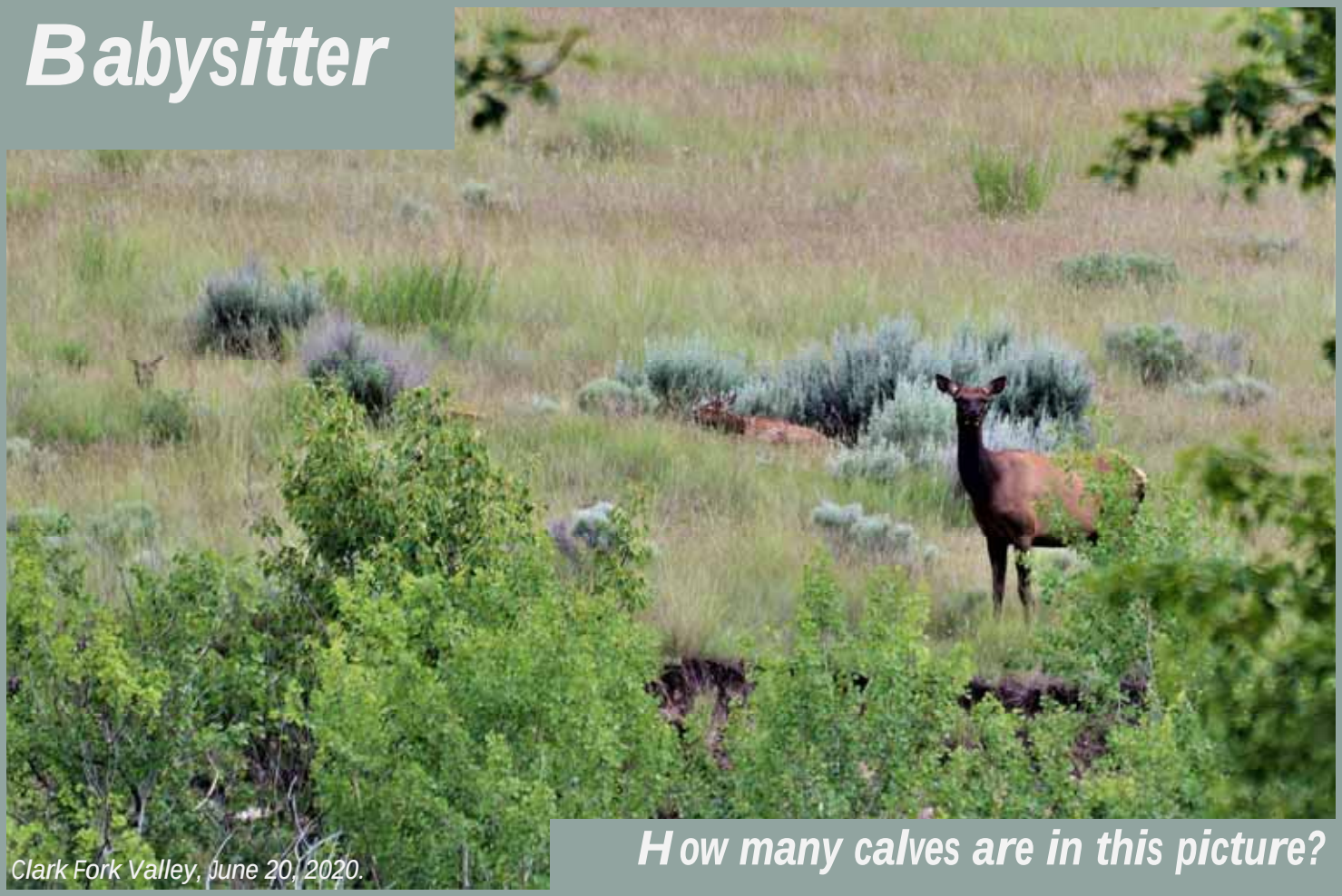
Elk Recruitment in 2021

Previous Page: An elk visible in the distance at the base of a large ponderosa pine in the Blackfoot Valley (top); a close-up of the scene reveals a cow elk licking its calf (bottom). Odds are that calf was 2 weeks old when the photo was taken on June 13, 2020.

This Page: Cows and calves feeding in a ranch field in the late-evening of June 13, 2020, in the Blackfoot Valley (top). Earlier that evening, an adult cow appeared ready to give birth along the Ovando-Helmville Road (bottom). A challenging year lies ahead between birth and recruitment.

Clark Fork Valley, June 20, 2020.

Babysitter



Clark Fork Valley, June 20, 2020.

How many calves are in this picture?

Clark Fork Valley, June 20, 2020.

Management Summary

Elk in the Blackfoot Valley, June 2020.

Our current understanding

Our current understanding

Calf Recruitment in Region 2:

- was estimated in 2020 from ground classifications of 1,012 elk in the Lower Clark Fork, 2,385 elk in the Blackfoot and 3,300 elk in the Bitterroot, for a total of 6,697 elk classified on spring green-up from the ground in 2020.
- was estimated as usual from winter aerial classifications in the Upper Clark Fork in 2020.
- did not include additional elk that were counted but could not be classified as cows, calves or bulls.
- rebounded in 2020 from a low in 2019.
- is fueling the elk population at levels near the long-term average.
- is variable by hunting district.
- varies by hunting district in predictable patterns.
- held to those same predictable patterns in 2020 even though calf: cow ratios were obtained from ground surveys rather than aerial surveys in much of Region 2 in 2020.
- is sufficient to sustain the elk population (with local variation) given the harvest levels indicated by check station data in 2019 and by reports from Region 2 Access staff after the late shoulder season of 2020.
- remains under the positive influence of the mild winter of 2020 as we look forward to recruitment in 2021, but that may be tempered by the cool, wet calving season we've just experienced, and other factors.

Elk Population Trend in Region 2:

- was not sampled with aircraft in much of Region 2 in 2020, due to the Covid crisis.
- was bolstered by near-average numbers of 11-month-old calves in 2020.
- was subject to a moderate, average harvest in 2019, based on check station data and Access staff reports.
- is predictable and can be modeled in the coming months using harvest, recruitment and environmental data as demonstrated by Proffitt et al. (2020).
- still benefits from a stable biological and ecological system as indicated by calf recruitment in 2020.

Calliope Hummingbird, Council Grove State Park, June 2020.

Clark Fork Valley, June 20, 2020

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