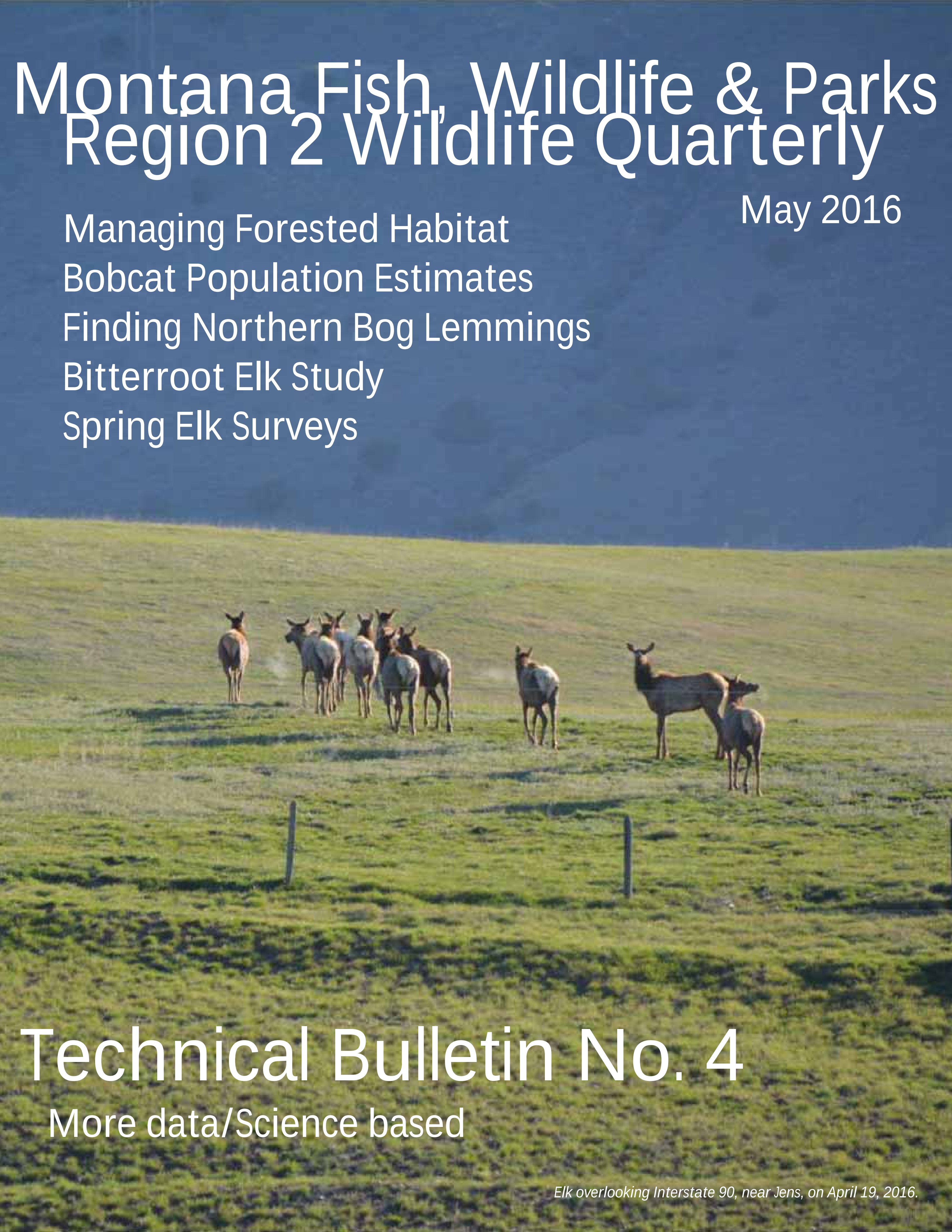
# Montana Fish, Wildlife & Parks
# Region 2 Wildlife Quarterly

May 2016

Managing Forested Habitat
Bobcat Population Estimates
Finding Northern Bog Lemmings
Bitterroot Elk Study
Spring Elk Surveys



# Technical Bulletin No. 4

More data/Science based

*Elk overlooking Interstate 90, near Jens, on April 19, 2016.*

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May 2016

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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.

# *Forest Habitat Management*—*Threemile Wildlife Management Area*

by the Region 2 Wildlife Staff

## PROJECT DESCRIPTION

Over the past winter (2015-16) Montana Fish, Wildlife & Parks (FWP) performed the first forest habitat treatment on the Threemile Wildlife Management Area (WMA) in more than 40 years. About 342 forested acres in the northwest portion of the WMA, near the main entrance, were commercially thinned. The purpose for thinning the forest was to restore its natural resistance to wildfires and to mimic the beneficial effects of the natural fire cycle with which the forest and its native wildlife evolved.

*Figure 1. An aspen tree used by black bear within the forest habitat treatment on Threemile WMA. The pre-treatment photograph was taken on 8 June 2015 (top) and the post-treatment photograph was taken on 8 March 2016 (bottom), which accounts for the difference in appearance due to the presence or absence of leaves. While these photographs are not the best for assessing the conifer treatment, they do demonstrate the presence of a sometimes overlooked wildlife resource on the WMA. Bears are thought to mark trees as a way of communicating to other bears. These views of this tree show no visible indications of bear visitation—bites or claw marks—during the 8-month interval between photographs. This tree is located along the open road near the 3,900-foot portion of the "cross-country road" that is being retired from motorized traffic, as one result of the forest habitat treatment, but will remain open to non-motorized travel. Motorized travel will shift to a new section of road that avoids the hills and rills that posed maintenance problems in the past. Bear trees are often located along travel ways.*


*Figure 2. Threemile WMA is located east of Florence, in Ravalli County, and is open to the public from noon on May 15th through November 30. It's closed to all public entry from December 1 until noon on May 15th to provide elk refuge on their winter range. The WMA is available as winter range for 210 elk that FWP counted from Eightmile to Ambrose Creek on March 25, 2015.*

*Figure 3. A load of logs coming off Threemile WMA on 23 February 2016, showing the relative size of material being harvested commercially. Generally, trees left standing were larger than trees that were harvested. Some larger conifers were harvested around aspen clones, where the prescription called for complete conifer removal to restore aspen reproduction and biodiversity.*

*Figure 4. Comparison of stand density and structure on 6 June 2015 (left) with changes due to harvest in the same stand on 23 February 2016 (right). The increased light reaching the forest floor is apparent post-harvest and should improve the production of grass forage and regeneration of shade-intolerant pine. Growth rates and, therefore, recruitment and density of mature pines and large snags should increase as a result of the treatment.*

*Figure 5. FWP wildlife biologist, Rebecca Mowry, (center, bottom) is dwarfed by a slash pile comprised of the understory and mid-story fuels that formed a fuel ladder to the tops of the larger pines (left standing) in this unit on Threemile WMA, prior to treatment. Forest management has released the moisture that this vegetation occupied pre-harvest for the benefit of larger, healthier conifers and deciduous habitat post-harvest. FWP welcomed the public to gather firewood for personal use from this and other slash piles resulting from the project.*

*Figure 6. Feller buncher working in a thicket of even-aged ponderosa pine. Almost all of this material was removed to manage the insect and fire risk represented by this anomalous condition that resulted from disruption of the natural fire cycle.*

*Figure 7. Mixed Douglas-fir (top, foreground) and ponderosa pine stand being marked by cooperating foresters from the Montana Department of Natural Resources and Conservation on 8 June 2015. The resulting treatment is shown in the bottom photograph (23 February 2016). The treatment was prescribed to favor the maturity and, to some extent, the regeneration of ponderosa pine, which is shade intolerant. Harvest was directed more heavily toward Douglas-fir, but some Douglas-fir were retained in the stand. Opening the forest floor to sunlight allows the ground to bare off earlier in the spring, for the benefit of wintering elk. In addition, wider tree spacing will allow the pines to attain a larger size by extending tree survival and growth rates. Robert Beall (1974) completed his PhD dissertation on "winter habitat selection and use" by elk on the Threemile WMA, and found that the boles of large trees provide bedding options with the benefits of solar reflectance and shelter from wind. Beall's research was initiated, in part, to document the effects of the last previous timber harvest accomplished by the prior owner of the WMA property in the early 1970s.*

*Figure 8. An example of conifer succession in a relic aspen stand (left) on Threemile WMA (10 September 2014) and the result of a site treatment in the same or similar area (8 March 2016) intended to release aspen from conifer competition and decrease predation on songbird nests.*

## ASPEN ECOLOGY

Elk use aspen stands, but aspen contributes relatively little to elk diets on Threemile WMA. In a study of elk diets on Threemile WMA (1996), FWP biologist-at-the-time, Mike Thompson, found aspen to be absent as an important winter forage detected in microscopic analysis of elk feces (*Northwest Science*, Volume 70, Number 1). Douglas-fir and spotted knapweed, among numerous other forage species, ranked higher as a percentage of elk winter diets than aspen. During the period of Thompson's study in the early 1990s, aspen was already uncommon on Threemile WMA, and forest management directed toward restoring aspen is unlikely to significantly affect its contribution to elk diets in the future.

FWP values aspen for the habitat it provides to a variety of other native wildlife species. Joseph LaManna and his coauthors, including FWP biologist, Vanna Boccadori (Butte), recently completed a study of wildlife use in aspen stands under FWP management on the Mount Haggin WMA, south of Anaconda. In a 2015 (Volume 96, pages 1670-1680) issue of the professional journal, *Ecology*, LaManna and his coauthors wrote:

> *Aspen (Populus tremuloides) forests hold a high diversity of organisms but are increasingly invaded and replaced by conifers. The consequences of this habitat change for diversity and demography of organisms, such as birds, remains poorly understood. Conifer encroachment of an aspen stand may increase bird diversity by increasing vegetation complexity. However, the presence of conifers may also impact the reproductive success of birds via addition of conifer-dependent nest predators or via changes in habitat structural complexity. We examined the effects of conifer encroachment on the diversity, reproductive success, and population growth rates of birds in fourteen aspen stands that differed in the extent of conifer encroachment in Montana, USA. Bird species diversity increased with aspen stand area but was not correlated with proportion of conifer trees in a stand. Nest predator density increased with proportion of conifer trees in a stand. Conifer encroachment directly increased nest predation rates for four of ten open-cup nesting species and indirectly increased nest predation rates for three additional open-cup nesting species. Furthermore, increased nest predation with greater conifer encroachment transformed source breeding habitat ($\lambda > 1$) into sink habitat ($\lambda < 1$) for these seven species. Based on these results, conifer encroachment into aspen stands has the potential to decrease diversity, reproductive success, and population growth rates of songbirds, which emphasizes the value of large, relatively pure aspen stands on the landscape.*
>
> http://www.coopunits.org/Montana_Wildlife/Research/Peer_Publications/6.694544384E10/

## DEMONSTRATION AREA

FWP will use the results of the recent forest management project to help guide future forest management on Threemile WMA and elsewhere. Prescriptions and practices will be evaluated over time to understand the aspects of the project that worked well and those that did not work as intended. FWP completed an environmental assessment (EA) with public involvement under the Montana Environmental Policy Act before beginning the recent project, and will undertake a new EA and public review process before proceeding with further forest management projects on Threemile WMA.

*Figure 9. FWP forester, Jason Parke (right), addresses a class of future resource professionals from The University of Montana during the forest management operation on Threemile WMA (23 February 2016).*

# *Bobcat Population Status— Minimum Population Estimate*

by the Region 2 Wildlife Staff, and edited by Jay Newell and Kevin Podruzny, FWP Wildlife Division

## IDENTIFICATION

According to Kerry R. Foresman's *Mammals of Montana* (2012, Mountain Press Publishing Company):

> *From a distance, bobcats could be confused with the other medium-sized felid in Montana, the lynx (Lynx Canadensis). Up close, however, they can be distinguished by color (the lynx is predominantly gray), degree of spotting (spots on the lynx are far less numerous and distinct), ear tufts (those of the lynx are long and showy), and size of feet (those of the lynx are disproportionately large).*


*Figure 1. Bobcat photographed remotely by Mike Johnson, FWP, on 9 September 2015.*

The bobcat in Figure 1 was photographed by a remote camera set by FWP to monitor wildlife visits to a rub post located north of Missoula. Although gray in color, its spots are very numerous and obvious, ear tufts are relatively short, and the visible foot in the photograph does not appear extraordinarily large in relation to the rest of the animal's body. The bobcat pictured in Figure 2 shows how difficult it can be to distinguish between a bobcat or lynx in the quick glimpses and long distances that may occur in the field. This animal was observed in the Fish Creek watershed, and gives the gray appearance that might suggest a lynx. The spots are not as distinct from this viewing angle and distance as the spots on the bobcat in Figure 1 and the feet are not visible. Ear tufts do not appear to be prominent, and the assumption is that this animal was also a bobcat.

*Figure 2. Bobcat photographed by Ross Baty, wildlife biologist, Montana Department of Natural Resources and Conservation, Missoula.*

### DIET

Bobcat diets vary with the availability of prey. According to Terry Blankenship, who wrote on *Impacts of Small Predators on Deer* (http://texnat.tamu.edu/files/2010/09/010.pdf):

> *A compilation of bobcat food habit studies indicate rabbits (Lepus spp., Sylvilagus spp.) were the primary prey taken throughout their range. Deer were an important prey item in the northeast and northwest where winter snow increased the vulnerability to predation.*

*As a result the highest consumption of deer was usually found in winter (Anderson 1987). A study in Maine found deer in 40% of the scat collected in the winter compared to 19% in the summer (Major and Sherburne 1987). Snowshoe hares (Lepus americanus) were considered the major food item in Maine where they comprised 50% to 92% of the diet (Litvaitis and Harrison 1989).*

## ECOLOGY

In his PhD Dissertation to the University of Minnesota (2012), entitled *Bobcat (Lynx rufus) Spatial Ecology and Harvest in Minnesota*, Paul M. Kapfer reports:

> *. . the distribution of bobcat harvest in northeastern Minnesota is primarily determined by bobcat ecology rather than hunter effort and access. The probability that a male or female bobcat was harvested in a township increased with white-tailed deer (Odocoileus virginianus) density and decreased with coyote (Canis latrans) density; harvest of females was also positively related to the proportion of a township composed of a regenerating forest, an index of snowshoe hare (Lepus americanus) abundance. My results correspond with those of previous studies suggesting that bobcat populations can be suppressed by coyotes, that females are more reliant on snowshoe hare than males, and that white-tailed deer form an important component of the diet of bobcats at northern latitudes. Furthermore, my results suggest that reductions in winter-related mortality of white-tailed deer as predicted by climate change and consequent increases in deer density may remove one of the barriers to further colonization of the [study area] by bobcats . . .*

## MINIMUM POPULATION ESTIMATE

In recent years FWP has begun the process of using age data to reconstruct populations of bobcats in each trapping district in the state and although the numbers in Figure 3 are preliminary and not exact,

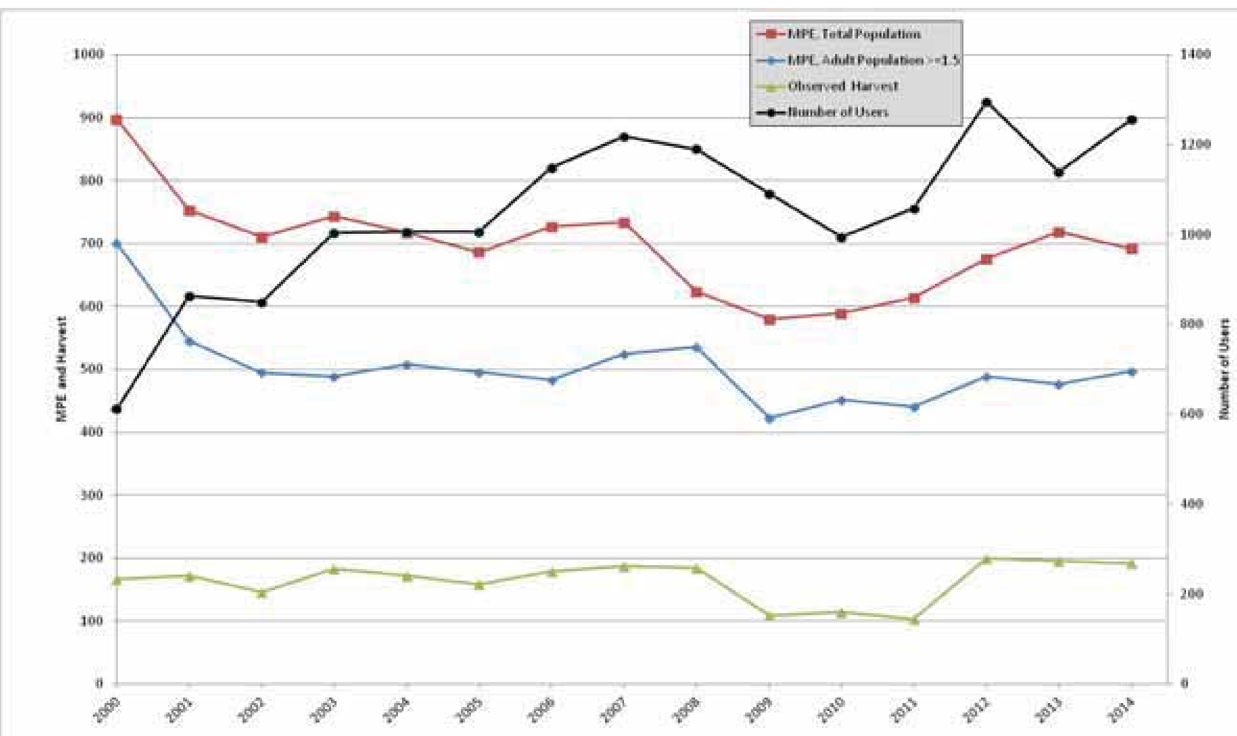



*Figure 3. Minimum population estimates (MPEs) for bobcats in Region 2 by reconstruction using age-specific harvest data and an effort function that is calculated by dividing the numbers of bobcat hunters and trappers (statewide) in the current year by the highest number of hunters and trappers observed for the period 2000-2014, then applying the inverse of that number. Bobcat harvest in Region 2 is also presented.*

we believe the trend depicted over time is realistic. The trend suggests that the minimum population estimate for bobcats in FWP Region 2 decreased to about 66% of its projected high between 2000 and the low observed in 2009. Since 2009 numbers have increased by approximately 20%. Bobcat harvest is limited by a harvest quota that FWP reviews annually, and as a result harvest has ranged from a low of about 100 in 2011 to a high of 200 in 2012 and 2013 (Figure 3). However, the estimated number of active hunters and trappers as well as hunter and trapper activity days increased steadily since 2000, which required that variability in hunter and trapper effort be factored into the reconstructed population estimates.

The two steep declines in the minimum estimate—from 2000 to 2002 and from 2007 to 2009—are of interest (Figure 3). Lacking data more specific to the question, Kapfer's (2012) findings regarding the bobcat population's connection with white-tailed deer suggest a starting point. White-tailed deer numbers were at modern-day highs in the years leading up to the severe winter of 1996-97, shortly before the starting year (2000) of the reconstructed bobcat population estimates in Figure 3. During and following the winter of 1996-97, white-tailed deer declined roughly by half across western Montana. Plausibly, bobcat numbers declined through an extended period of relatively low deer availability in the early 2000s, and then again in 2007-2009 when the white-tailed deer population declined significantly as a result of heavy antlerless harvest in 2006-2008.

**POPULATION RECONSTRUCTION**

For those seeking an understanding of population reconstruction techniques, a master's thesis by Mary K. Tilton (2005), completed at Virginia Polytechnic Institute and State University, provides a readable overview and assessment. It is entitled, *Evaluating the Effectiveness of Population Reconstruction for Black Bear (Ursus americanus) and White-tailed Deer (Odocoileus virginianus) Population Management*, and is available online:

> *Population reconstruction is a technique that estimates a minimum population size based on age-specific harvest data (Downing 1980, Roseberry and Woolf 1991). Population reconstruction techniques share the following characteristics: 1) utilization of catch-at-age data, and 2) backward addition of cohorts to estimate a minimum population size. Minimum input data include total number of animals in the harvest and age-specific harvest numbers (Williams et al. 2002). These data are readily available for most exploited species (Gove et al. 2002).*
>
> *. . Wildlife managers can be confident that virtual reconstruction is providing a minimum population estimate for all populations. Virtual reconstruction is appropriate for species that require conservative harvest strategies.*

*Figure 4. Bobcat feeding on a carcass in Region 2, by Bert Lindler.*

## HARVEST DATA

Hunters or trappers who harvest bobcats are required to submit a lower jaw from each harvested cat. FWP then sends the jaws to Matson's Lab in Milltown for aging. The ages obtained from harvested bobcats are used to mathematically reconstruct the bobcat population in each administrative region of Montana and guide harvest management.

# *The Northern Bog Lemming— Non-invasive detection techniques*

by Kristi DuBois, FWP Nongame Wildlife Biologist, Region 2

The northern bog lemming (*Synaptomys borealis*) is a boreal species that extends south into Washington, Idaho, and Montana in the west. It mainly inhabits bogs and fens dominated by peat moss (*Sphagnum* spp.) and other mosses, though it occasionally has been captured in moist, mossy conifer forests and other wet habitats. The distribution of this species is spotty, due to the limited distribution of its preferred habitats.

This species has not been extensively studied, and much of the information on it is inferred from work done on the only other species in the genus, the southern bog lemming (*Synaptomys cooperi*). The southern bog lemming is widespread in the eastern US, and is thought to use a wider range of habitats than the northern bog lemming. No mammalian species account has been completed for the northern bog lemming, and details about its life history and habitat use patterns remain a mystery. The northern bog lemming is very difficult to trap, especially using Sherman live traps which are the standard for capturing most small mammals.

*Figure 1. Northern bog lemming detected in 2015 using a trail camera. Each camera was aimed at a 6x6 inch plywood board with metric rulers along 2 sides for reference. The boards were baited with E.J. Dailey's Muskrat Lure #1 at initial setup. Northern bog lemmings generally have much shorter tails than voles, but otherwise are similar in appearance to several species of voles.*

*Figure 2. Example of riparian wetlands and wet meadows sampled for northern bog lemmings in 2015, dominated by sedges and true mosses, with patches of bog birch and willow. In "Mammals of Montana" (2012) Kerry Foresman wrote: "Although the diet is mostly herbaceous, with green vegetation consumed, snails, slugs, and other invertebrates are frequently taken. The northern bog lemming is active throughout the year and throughout the day and night."*

Twenty-three northern bog lemming sites have been documented in Montana, primarily due to the extensive work done on this species by the late Dr. James Reichel for the Montana Natural Heritage Program. These sites range in elevation from approximately 3400 to 7400 feet, and are all located in the western half of Montana.  More information on the distribution and biology of the northern bog lemming can be found in the Montana Field Guide:
http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAFF17020.

## MANAGEMENT

The northern bog lemming is classified as a Species of Concern in Montana, a designation which has no regulatory authority, but is mainly used to alert State and Federal land management agencies to take rare or declining species into account when planning habitat management actions. The northern bog lemming was petitioned for listing under the Endangered Species Act in September 2014, primarily due to concerns about this species' habitat vulnerability because of climate change. The U.S. Fish and Wildlife Service completed a 90-day public comment period in November 2015, but has not yet issued a

*Figure 3.  The author holding a northern water shrew study skin for Missoula County Commissioner Jean Curtiss to inspect during a tour of the Marshall Creek Wildlife Management Area on 2 October 2015.  A northern bog lemming study skin is shown at right for comparison.*

decision on whether or not listing is warranted.  Whether northern bog lemmings are listed or not, data on the distribution, habitat requirements, and population demographics of this species are needed for the development of effective conservation measures. Cost-effective survey methods would help us get better information on distribution and habitat use. Without this basic information, formulating appropriate and effective management actions for this species may be difficult.

In 2012, Montana FWP technicians surveyed 6 northern bog lemming sites with Sherman live traps, as part of Species of Concern surveys. They only captured 2 bog lemmings at one of the sites, with a total sample effort of over 4,200 trap nights. Both bog lemmings died in the live traps. More effective, cost-efficient detection techniques are greatly needed, otherwise we cannot be sure if this species was absent or simply not detected during a site survey. For this study I focused on testing alternative survey techniques, in particular trail cameras and genetic testing of scat for detecting bog lemmings, because the tools we had used previously were neither effective or cost-efficient. Non-invasive techniques are highly desirable for studying species like the northern bog lemming, that occur in relatively small, isolated populations.

## TRAIL CAMERAS

In 2015, I focused on five wetlands in west-central Montana that were previously occupied bog lemming sites for camera surveys, plus two additional wetland sites that appeared to have suitable habitat. They were selected based on proximity to Missoula and accessibility. The trail cameras tested were the Bushnell NatureView trail cameras that come with 2 different sizes of close-up lenses. These new cameras from Bushnell are relatively inexpensive and can focus close enough to obtain good quality pictures of small animals. They were set facing down at a board baited with muskrat lure known to be somewhat attractive to bog lemmings and other small mammals. Sites were surveyed for 3 to 8 nights each with 5-10 cameras per site. Camera-nights at each site ranged from 15 to 38, and totaled 188 camera-nights overall (a camera-night of effort is one camera set for one night).

Trail cameras successfully detected northern bog lemmings and a variety of other recognizable small mammals. We obtained definitive and probable detections of northern bog lemmings (n=8) at three sites for a detection rate of 4.25 detections per 100 camera-nights. Definitive detections of northern bog lemmings were obtained at one site, where 3 clear picture sequences were obtained of northern bog lemmings, from 2 different cameras. Overall, 12 small mammal species (or genera), 2 amphibian and 1 reptile species were detected using these trail camera sets. Black bear and elk were also detected when they damaged or interacted with camera sets, though these camera sets are not designed to detect larger wildlife species. Shrews and chipmunks were difficult to identify from photographs, so they were only identified to genus. Longer-tailed voles such as southern red-backed voles and meadow voles could be distinguished in daytime (color) pictures, but not from black and white night shot pictures. Numerous pictures of vole-like animals without clear views of the tail were obtained, which could not be identified to species or genus.

My detection rate for northern bog lemmings using cameras was on par or better than detection rates from Sherman live traps reported in previous studies. Though their success rate was still relatively poor in a given wetland, trail cameras were much less time consuming to set and check than live traps. Detection rates for northern bog lemmings were likely affected by ambient factors, such as time of year, average temperatures, drought/wet conditions, moon phase, and populations of meadow voles. The number of cameras deployed per site was very low compared to standard trapping methods where 30-100 traps are usually deployed per site. Using more cameras per survey may help increase the probability of detecting northern bog lemmings if they are present. Further testing will be needed to determine the ideal number of cameras and number of survey nights needed to more definitively determine presence/absence of northern bog lemmings at a site.

*Figure 4. FWP's Dave Dickson balances on the mat of sphagnum moss that covers a pond beneath it. This small basin fen on the Blackfoot-Clearwater Wildlife Management Area is dominated by extensive sphagnum mats and sedges, with small areas of open water. Only a few shrubs grow on the perimeter of the fen, and it is surrounded by mixed conifer forest. This is typical northern bog lemming habitat, though we did not detect them at this particular site.*

*Figure 5. A northern bog lemming's view of the sphagnum moss mat that is pictured in Figure 4. In "Mammals of Montana" (2012) Kerry Foresman wrote: "Nests, constructed from grasses and sedges, are hidden in short underground burrows or under logs and stumps, in sphagnum mounds, or grass tussocks. Runways may be constructed through the vegetation, although the northern bog lemming will readily use runways of voles and other small mammals.*

Most probable bog lemming detections were made in the first 2-3 nights of the camera deployment. Although the sample size is small, most detections were under new moon (dark skies) conditions.

Northern bog lemmings visited boards that were also visited by meadow voles and other species. Visits to boards by the more aggressive meadow vole, or predators such as short-tailed weasels may reduce the likelihood of detecting northern bog lemmings. Meadow vole populations appeared to be very high in 2015, and their high populations may have impacted bog lemming activity patterns. This was also observed by Dr. Reichel and other researchers, who detected fewer northern bog lemmings during years when more meadow voles were present.

## DNA FROM SCAT SAMPLES

We submitted 20 scat samples for DNA identification to the National Genomics Laboratory for Wildlife and Fish Conservation, at the Rocky Mountain Research Station in Missoula, Montana. The scat samples included scat collected in 2014 and 2015 from scat boards under cameras, scat boards out in open areas (set without bait), and from small mammal latrine sites and runways. The Genomics lab was able to extract small mammal DNA from 19 of the scat samples. One scat sample collected from a board under a camera was verified as northern bog lemming. We also captured this particular bog lemming on the camera set over this board. The other 18 scat samples were identified as meadow vole.

The board where the northern bog lemming scat was confirmed was also visited by a meadow vole later that same night. Visits by multiple species can result in genetic contamination of scat samples. This can be monitored with camera sets, but not on boards set out to collect scat without cameras.

## DISCUSSION

Both cameras and scat genetics were successful in detecting northern bog lemmings, though neither definitively documented bog lemming presence at all northern bog lemming sites during 2015.

Cameras can help monitor the species visiting the boards and leaving scat; however, scat boards without cameras would not be monitored for multiple species visits. Cameras obtained numerous pictures of animals that may have been bog lemmings, but the definitive short tail was not always visible.

*Figure 6. Greenish scat that was subsequently identified as northern bog lemming.*

Contamination from urine or feces of meadow voles or other species may complicate detection of northern bog lemmings from scat. The number of scat samples needed to verify northern bog lemming presence in a wetland is unknown, and may vary depending on the relative populations of meadow voles and other species that can leave greenish scat.

If DNA identification works consistently, scat collection from scat boards would likely be the most cost and time efficient method for detecting northern bog lemmings. Scat boards are very cheap to make and easy to deploy and check. Fifty or more scat boards can easily be deployed by 1 person with a large pack. They can be deployed in areas with high public use, and are cheap to replace if lost. Scat boards can be left for a long period of time, but they need to be checked every other day or so, as scat blows or washes off boards over time. Scat boards need to be cleaned between wetlands, to remove DNA and diseases such as chitrid fungus. Efficiency could possibly be increased by using lure on all of them.

Further testing of cameras, scat boards, and other techniques is planned for 2016.

Literature Cited:

Foresman, K.R. 2012. Mammals of Montana. Mountain Press Publishing Co., Missoula, MT. 429 pp.

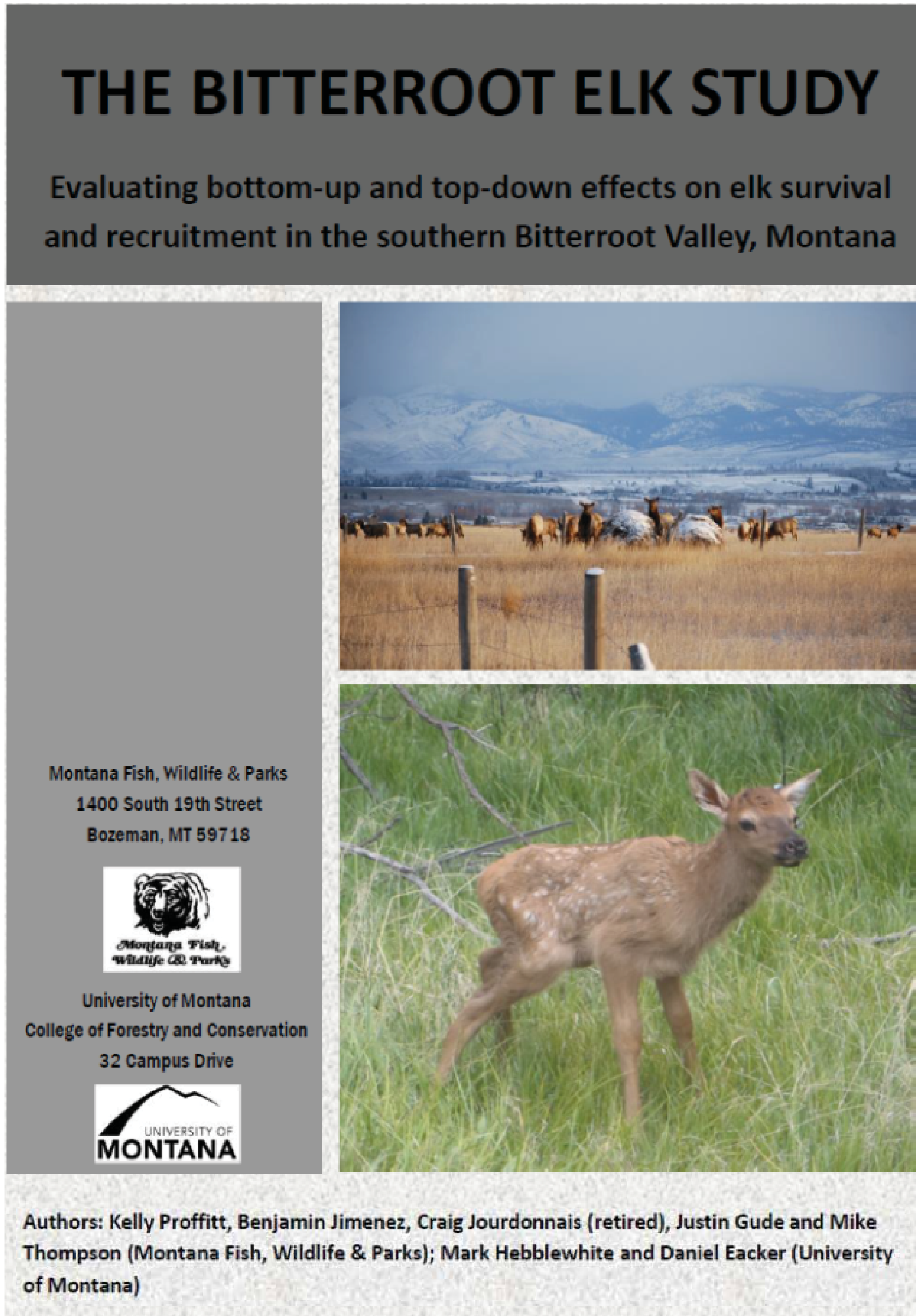
## *Bitterroot Elk Study— Phase One Completed, Phase Two Beginning*

by Kelly Proffitt, FWP Wildlife Research Biologist

The Final Report of the Bitterroot Elk Study, Phase One, is now available online at *http://fwp.mt.gov/fishAndWildlife/diseasesAndResearch/research/elk/default.html*

Phase Two of the study begins with the capture and radiotagging of newborn elk calves in May-June 2016. The survival of calves radiotagged during this effort and in 2017-2018 will be monitored to document survival rates in response to moderately expanded harvest opportunities that have been prescribed for cougar, black bear and wolf.

Following is the Executive Summary reprinted from the Final Report, with minor edits to save space. We ask that readers of the Final Report pause for a moment to reflect on the Funding and Acknowledgements sections, where the organizations and individuals responsible for the Bitterroot Elk Study are credited for their enabling contributions. This was truly a collaborative project, in close cooperation with the people who live in the Bitterroot.


THE BITTERROOT ELK STUDY

Evaluating bottom-up and top-down effects on elk survival and recruitment in the southern Bitterroot Valley, Montana

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## PURPOSE

Elk populations in the Bitterroot Valley steadily increased throughout the 1980s - early 2000s. Changes in management objectives and harvest levels, increasing and expanding carnivore communities, and large-scale changes in fire activity, timber harvest and land use coincided with changes in overall elk population size and calf recruitment trends from 2000-2010. From 2005-2009, elk population counts in the 6 Bitterroot Valley hunting districts declined by 25%, and calf recruitment reached a historic low. Low recruitment and elk population declines raised concerns that increasing carnivore populations, and in particular, increasing wolf populations, may be reducing elk populations and hunting opportunities in the Bitterroot Valley. With a goal of better understanding the causes of declining elk numbers and calf recruitment, Montana Fish, Wildlife & Parks (FWP) and the University of Montana initiated a research project in 2011 designed to evaluate factors affecting elk survival and calf recruitment in the Bitterroot Valley. The purpose of the project was to evaluate bottom-up habitat and top-down predation factors, as well as weather, that may affect elk vital rates and population dynamics.

## STUDY AREA DESCRIPTION

The study area included the West Fork of the Bitterroot (Hunting District [HD] 250), an area that experienced severe declines in elk numbers and recruitment, and the East Fork of the Bitterroot (HD 270), an area that experienced relatively stable elk numbers and only moderate declines in recruitment. The West Fork area is more forested and mountainous, while the East Fork area contains a mosaic of lower elevation grasslands and higher elevation forested areas. Both areas support mountain lion, black bear, coyote and wolf populations.

## SURVIVAL OF ADULT FEMALE ELK

From 2011-2014, we sampled and radio-collared 120 adult female elk to collect information about elk movements, and estimated adult female survival and cause-specific mortality rates. In the East Fork, elk were primarily migratory (78%), but in the West Fork only 32% of elk were migratory. Average adult female survival from February 2011 through February 2014 was 0.90 in both the West Fork and East Fork. Adult female survival was lower in winter than in summer, and 77% of all adult female mortalities occurred between March and May. Of the 13 adult female mortalities that occurred, 5 were due to predation (3 killed by mountain lions, 2 by wolves); 4 were due to natural, non-predation causes; 1 was due to a vehicle collision; and 3 died from unknown causes.

## SURVIVAL OF CALF ELK

To better understand the factors affecting calf elk recruitment, we radio-tagged 226 neonatal and 60 6-month-old calf elk to estimate calf survival and cause-specific mortality rates. Average annual survival for calf elk throughout the study area was 0.41. The summer calf elk survival rate was 0.55, and was lower for calves born later in the calving period. Overwinter survival rate was 0.74, and was unrelated to birth weight or date. Calves born in the East Fork had a higher survival rate (0.47) than elk born in the West Fork (0.32). Overall, female calf elk survived at a higher rate (0.50) than males (0.32). Despite the recent recolonization of the study area by wolves, mountain lions caused more elk calf mortality than wolves in summer and winter.

## HABITAT EFFECTS ON ELK POPULATIONS

To evaluate the effects of habitat on elk populations, we first developed a spatial modeling approach to estimate landscape-level nutritional resources for elk. Second, we tested the effects of nutritional resources on elk body condition and pregnancy rates. We measured the available biomass, phenology, and digestibility of forage plant species and then used this information together with spatial data on landscape attributes to estimate forage quality at the landscape scale. We then tested for the effect of East Fork and West Fork summer range forage quality on the body condition and pregnancy rates of elk during fall in the East Fork and West Fork. We found forage quality varied across landcover types and between East Fork and West Fork summer ranges as a function of differences in land cover and recent fire history. These differences in nutritional resources resulted in differences in elk body fat levels and pregnancy rate, with average pregnancy rates of 89% for East Fork elk exposed to higher forage quality and 72% for West Fork elk exposed to lower forage quality. Our results suggest that the nutritional resources on summer range limited West Fork elk pregnancy rate and calf production. These nutritional limitations may predispose the West Fork population to be more sensitive to the effects of harvest, predation, weather events or other factors.

## POPULATION GROWTH RATES

Because multiple factors such as pregnancy rates, calf survival and adult survival interact to drive elk population trajectories, predicting the effectiveness of various management actions at increasing elk survival and recruitment is challenging. To address this challenge, we developed a population model to 1) estimate East Fork and West Fork elk population growth rate, 2) investigate the relative importance of different vital rates on elk population dynamics, and 3) simulate the effects of various hypothetical management scenarios on elk population growth rate. We estimated that the average population growth rate for the East Fork population (1.06) was about 3% higher than the West Fork population (1.03). The East Fork population was increasing during all study years except 2010-2011 when the growth rate was near stable at 0.99. The West Fork population was stable during 2010-2011 (1.00), declined in 2011-2012 (0.95), and increased during the latter half of the study.

## DRIVERS OF POPULATION GROWTH

Our analysis of the relative importance of different vital rates on population growth rate revealed that in the East Fork population, the most important vital rates were first adult female survival, followed by calf survival, then pregnancy.  Similarly, in the West Fork, adult female survival was the most important, followed by calf survival and pregnancy.  Our analysis also revealed differences in the relative importance of summer and winter calf survival on population growth rate.  In the East Fork, summer and winter calf survival contributed similarly to population growth, but in the West Fork, summer calf survival was more than twice as important as winter calf survival.  The relative magnitude of the differences in adult female and calf survival also varied between populations.  In the East Fork, adult female survival was only about 5% more important than calf survival, whereas in the West Fork, adult female survival explained about 23% more of the variance in population growth rate compared to calf survival, highlighting an important population difference.

## MANAGEMENT IMPLICATIONS

Our population modeling suggests that management actions aimed at increasing adult survival would have the greatest impact on population growth rate, especially for the more nutritionally limited West Fork population.  However, it may be more difficult for managers to make changes in adult survival compared to calf survival, because nearly half of adult mortality was due to causes beyond management control, and because adult female survival varied little.  Instead, focusing management actions on increasing calf survival may result in similar increases in population growth rate compared to adult survival, and be more practical to achieve because calf survival was largely driven by predation.  Calf survival was most affected by mountain lion predation, and therefore management actions aimed at reducing mountain lion densities to increase calf survival may result in increasing population growth rate.  Although adult survival and calf survival were predicted to be more influential on population growth than pregnancy rates in both populations, our simulations support the potential to achieve moderate increases in elk productivity from habitat treatments that improve forage for elk and result in higher pregnancy rates for adult females.

Calf survival was largely driven by mountain lion predation, indicating that management actions aimed at reducing mountain lion densities may result in higher calf survival, thus increasing population growth rates.  Overall, the annual rate of predation-caused mortality for elk calves was 0.28 and mountain lion caused mortality dominated over wolf caused mortality and black bear caused mortality.  Given the strong effect of predation on elk calf survival and the strong effect of calf survival on elk population growth rate, reducing the level of predation on calf elk is predicted to increase calf survival to age 1 and increase elk population growth rate.  Although our results regarding the important impacts of carnivores on elk populations through effects on calf survival are generally consistent with previous carnivore-elk studies conducted in the Greater Yellowstone Area (GYA) of southwest Montana, our results differ in that the primary predator of elk in the Bitterroot Valley was mountain lion, rather than wolves or bears.  Together, the GYA and Bitterroot elk studies highlight that carnivores have an important impact on elk populations, but that carnivore communities and the relative effects of different carnivore species on elk populations vary across ecosystems.

# *Flying Season*— *Counting Elk on Spring "Green-up"*

by the Region 2 Wildlife Staff

Montana Fish, Wildlife & Parks (FWP) wildlife biologists, FWP pilots, and expert mountain pilots contracted by FWP have taken to the air to count elk in every spring since 1956. For 61 years, the protocol has been the same, and as prescribed by Fred Hartkorn, pioneering FWP biologist in Missoula during the 1960s and 1970s: "Start flying when the buttercups bloom," usually around April 1, but sometimes in early March. This year, biologists finished their flights by the end of April and are now compiling their data for comparison with previous years.

*Top: FWP pilot, Trever Throop, with his trusty Super Cub, a bit ahead of green-up.*

*Center: Elk being counted by FWP biologist, Liz Bradley, from a Cub near Missoula. Elk are classified as cow, calf or bull.*

*Bottom: Buttercups blooming right on schedule, April 1, 2016, at Council Grove State Park.*

It is reasonable to question whether it's wise to fly low over elk in the spring, when they are carrying calves that will be born on about June 1. Often the elk don't stop feeding while being counted from above, though occasionally they will run a short distance. An elk is typically affected for less than 5 minutes per year by green-up flights. And, elk numbers in Region 2 have grown from several-thousand to near 30,000 during the 60 years of spring green-up surveys.

How would we know if FWP didn't count them.