Targeted Elk Brucellosis Surveillance Project
2020 Annual Report

EXECUTIVE SUMMARY

Montana Fish, Wildlife & Parks (MFWP) is conducting a multi-year targeted elk brucellosis surveillance project to evaluate 1) prevalence and spatial extent of brucellosis exposure in elk populations, 2) elk spatial overlap with livestock and interchange between elk populations, and 3) effects of brucellosis management hazing and lethal removal on elk distributions and spatial overlap with livestock. This report is an annual summary of the 2020 targeted elk brucellosis surveillance project. In January 2020, we sampled a total of 100 elk from the Ruby Mountains and screened blood serum for exposure to *B. abortus*. We detected exposure to *B. abortus* in the Ruby Mountains (prevalence = 2%, 95% CI = 0.6-7%, n = 100). We sampled a total of 51 elk in the southern Bangtail Mountains and screened blood serum for exposure to *B. abortus*. We sampled 56 elk in the southern Bangtail Mountains in 2019 and report estimates of brucellosis seroprevalence are based on the combined 2019 and 2020 sampling results. All Bangtail Mountains elk tested negative for exposure to *B. abortus* (prevalence = 0%, 95% CI: 0-3.5%, n = 107). Potential overlap with livestock and interchange between elk populations is being monitored with GPS radio collars. We collared 43 elk in the Ruby Mountains and 17 elk in the Bangtail Mountains and are currently collecting elk movement information. An additional 15 elk were collared in the Bangtail Mountains in 2019. During February 2017 - April 2020, we collected data to evaluate the effects of brucellosis management hazing and lethal removal on elk distributions in the Sixmile and Madison Valley study areas. In both study areas, we defined high risk zones as areas with livestock where elk presence was not desired by private landowners due to transmission risk concerns, and we evaluated how management hazing and lethal removals (i.e. management hunts) affected use of the high-risk zones. We collected location data during the management hazing and lethal removal period of December through April from 40 individuals and 83 animal-years in Sixmile and from 40 individuals and 81 animal-years in Madison. We recorded information on 142 hazing events and 77 hunting days in Sixmile, and 137 hazing events and 144 hunting days in Madison. On average, in Sixmile, 80% of collared animals used a high-risk zone during the management period each year and individuals that used the high-risk zone used it for an average of 6 days (min = 1, max = 24). On average, in Madison, 88% of collared animals used a high-risk zone each management period and individuals that used the high-risk zone used it for an average of 12 days (min = 1, max = 30).

INTRODUCTION

Montana Fish, Wildlife & Parks (MFWP) has conducted surveillance for brucellosis in elk populations since the early 1980s. Surveillance consists of screening blood serum for antibodies signifying exposure to *Brucella abortus*, the bacterium that causes the disease brucellosis. Brucellosis typically causes abortion in pregnant elk, from February through May (Cross et al. 2015) and is primarily transmitted through contact with infected fetuses, birthing fluids and material. Elk that test positive for exposure to *B. abortus* (seropositive) may or may not be actively infected with the bacteria. Although not a true indicator of infection or the ability of an animal to shed *B. abortus* on the landscape, detection of seropositive elk indicates brucellosis is present in the area and demonstrates the potential for elk to transmit the disease to livestock or other elk.

In an effort to increase understanding of brucellosis in elk populations, MFWP initiated a targeted elk brucellosis surveillance project in 2011. The goals of the project are to 1) evaluate the prevalence and spatial extent of brucellosis exposure in elk populations, 2) document elk movements to evaluate the extent of spatial overlap with livestock and interchange between elk populations, and 3) evaluate the effects of brucellosis management actions, such as hazing and lethal removal, on elk distributions and spatial overlap with livestock. In order to achieve these goals, MFWP has conducted targeted sampling efforts focused on 1 – 2 elk populations per year since 2011. Elk populations are identified through collaborative discussions between MFWP, the Montana Department of Livestock (DOL) and landowners. Selection is based on proximity to the known distribution of brucellosis and/or significant livestock concerns. Surveillance areas are both inside and outside the State of Montana brucellosis designated surveillance area (DSA, Figure 1).

SAMPLED POPULATIONS

Since 2011, we have sampled 19 elk populations (Figure 1). In January-March 2020, we sampled elk in the Ruby Mountains (HD322) and in the southern Bangtail Mountains (HD 393). The purpose of sampling was to evaluate brucellosis presence and prevalence in the elk populations and identify elk movement patterns and interchange among populations.

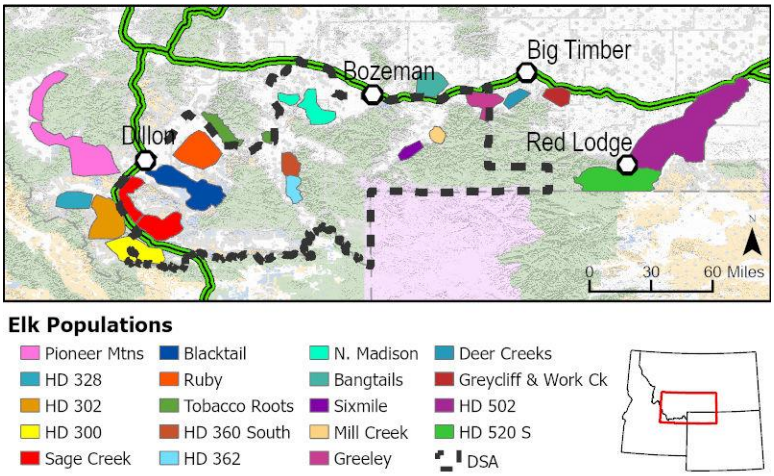

Figure 1. Populations sampled during the 2011 – 2020 targeted elk brucellosis surveillance project. The area inside the gray dashed line is the current Montana brucellosis DSA.

METHODS

To evaluate brucellosis presence and prevalence in the Bangtail and Ruby Mountains populations, we captured adult female elk using helicopter net-gunning and collected a blood sample to screen animals for exposure. We also opportunistically collected blood samples from hunter harvested animals within the surveillance areas. Exposure was determined by the presence of antibodies to *B. abortus* in an animal's blood serum. Blood serum samples were tested at the Montana Veterinary Diagnostic Lab (MVDL) using the Fluorescence Polarization Assay (FPA) plate test or a Buffered Acidified Plate Antigen (BAPA) test. Suspect or reactors to these screening tests were further tested with the FPA tube test. Final classification of serostatus (i.e., seropositive or seronegative) was based on test results received from the MVDL.

We collared a sample of elk in the Bangtail and Ruby Mountains populations to track movements and evaluate risk of brucellosis transmission to livestock and other elk populations. We deployed satellite upload collars that allow for real-time movement tracking. The collars are programmed to record locations every hour and have a timed-release mechanism that releases the collar after 62 (Bangtails) or 104 (Ruby) weeks, allowing collars to be retrieved and redeployed. All collars have a mortality sensor that detects if the collar is stationary for > 10 hours.

To evaluate the effects of brucellosis management hazing and lethal removal on elk distributions and spatial overlap with livestock, we monitored elk movements and brucellosis management actions in the Sixmile Creek and Madison Valley areas. Data collection was completed in April 2019 for Sixmile Creek and in April 2020 for Madison Valley. During 2020, brucellosis management included hazing elk from high-risk areas. Hazers conducting brucellosis management carried GPS units and recorded track logs during elk hazing events. In addition, lethal removal occurred in the Madison Valley area during damage hunts that ended on February 15th. We are currently evaluating the effects of brucellosis management actions (i.e. hazing and hunting) on elk movements to determine if and how these management actions affected elk use of high-risk areas.

RESULTS

Brucellosis surveillance

Brucellosis sampling in the southern Bangtail Mountains northwest of Livingston occurred in both 2019 and 2020 (Figure 2). In January 2019, we sampled 49 elk and tested 7 blood samples from hunter harvested elk, for a total sample size of 56. In February and March 2020, we sampled 51 additional elk. In the Bangtails, 0 of 107 elk tested positive for exposure to *B. abortus*, giving the population an estimated seroprevalence of 0% (95% CI = 0-3.5%; Table 1). Previous hunter harvest samples of adult female elk from the Bangtail Mountains (n = 18; 2009-2019) all tested negative. We deployed collars on 15 elk in 2019 and 17 elk in 2020 (Table 1).

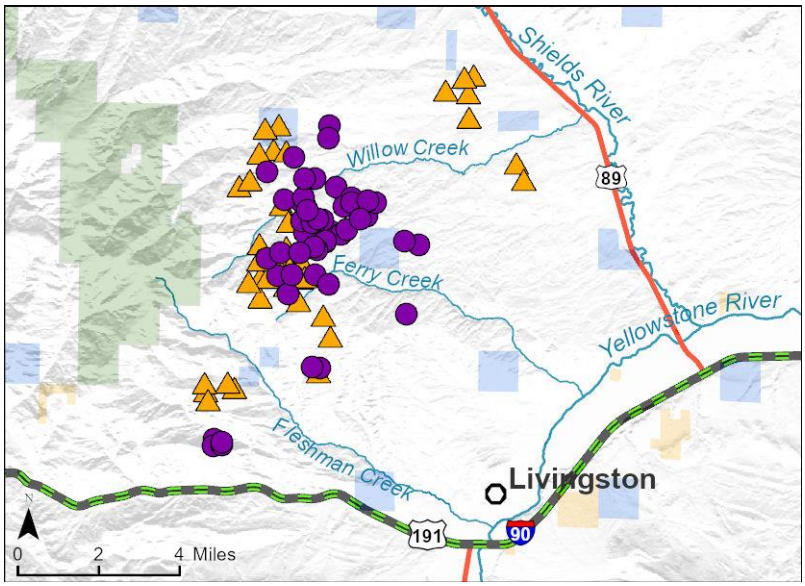

Figure 2. Capture and sampling locations of elk from the Bangtail Mountains population during January 2019 (orange triangles) and February and March 2020 (purple circles).

In January 2020, we sampled 98 elk in the Ruby Mountains and deployed collars on 43 elk (Figure 3). In addition, we tested 2 blood samples from hunter harvested elk, for a total sample size of 100. In the Ruby Mountains, 2 of 100 elk tested seropositive indicating an estimated seroprevalence of 2% (95% CI: 0.6-7%; Table 1). Previous hunter harvest samples of adult female elk from the Ruby Mountains (n = 10; 2008-2018) all tested negative.

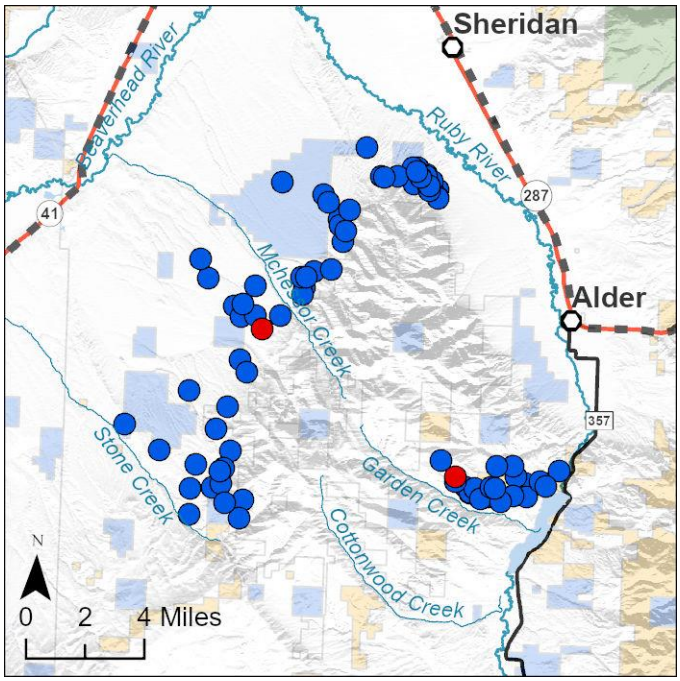

Figure 3. Capture and sampling locations of seropositive (red) and seronegative (blue) elk from the Ruby Mountains population during January 2020.

Table 1. The elk populations, number of elk sampled for *B. abortus* exposure, years sampled, number of elk testing seropositive for exposure, and the estimated seroprevalence with 95% confidence intervals (in parentheses).

Population	Number Sampled	Years Sampled	Number Seropositive	Estimated Seroprevalence
Bangtails	107	2019, 2020	0	0 (0, 0.035)
Ruby Mtns	100	2020	2	2 (0.006, 0.07)

Based on data from the last 10 seasons of hunter harvest and targeted sampling, we estimate brucellosis seroprevalence in elk varies spatially across southwest Montana and ranges from 0 – 39% (Figure 4).

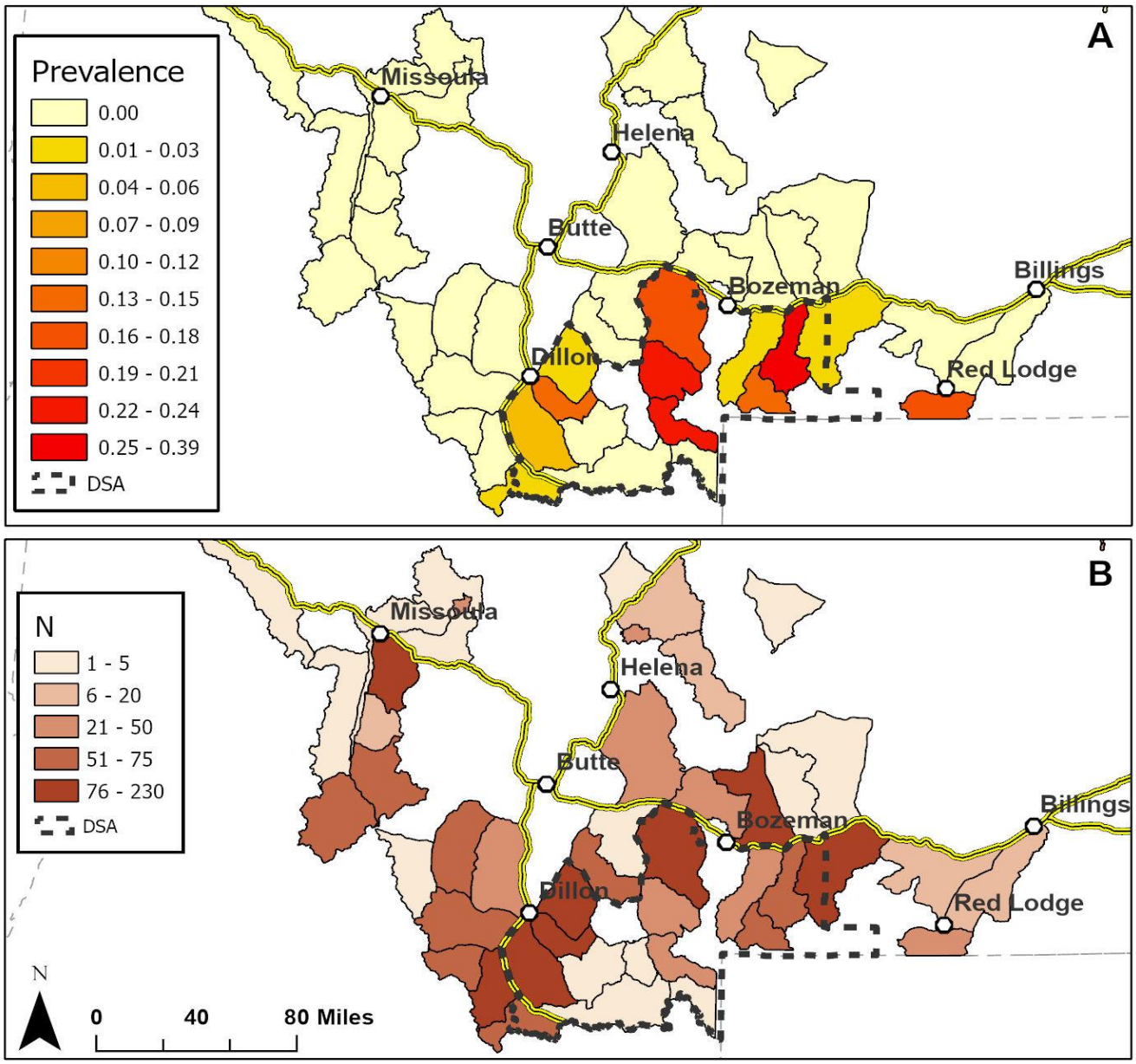

Figure 4. The estimated brucellosis seroprevalence (Panel A) and number of samples screened (n, Panel B) for adult female elk by hunting district during 2010 – 2020. Samples include those collected opportunistically during fall hunter harvest and during targeted winter sampling. Some seroprevalence estimates are derived from a low number of samples. The gray dashed line denotes the current boundary of the Montana brucellosis designated surveillance area (DSA). Hunting district 520, south and west of Red Lodge, is divided in two along a legally defined sub-district boundary because sampling has only been conducted in the southeastern portion of the district.

Elk movements

We deployed satellite upload collars in the southern Bangtail Mountains in 2019 and 2020. In January 2019, we deployed 15 collars. One collared elk was harvested 3 weeks after capture, and we did not include her limited movement data in subsequent analyses. A second collared elk was harvested in November 2019, after the GPS ability on the collar had failed in July 2019. Three collared elk died from unknown causes in November 2019 to January 2020. In February and March 2020, we deployed 17 collars. One collared elk from the 2020 deployment died shortly after capture and the collar on another elk failed, both in March 2020, and we did not include their collar data in subsequent analyses. In total, we have collar location data from 29 elk, representing movement data from January 2019 through 15 August 2020 (Figures 5 & 6).

In general, Bangtail elk winter in the foothills from Canyon Creek south to I90, and east to Hwy 89. Seventeen of the 29 elk were residents and remained in the southeastern Bangtails year-round; primarily along Willow, Ferry and Fleshman Creeks. The remaining 12 elk migrated, most to the west and primarily in May, with a couple cases each in June and April. Six elk migrated to Bozeman Pass, with all but 2 staying north of I90 in the Jackson and Spring Creek areas. One elk that summered south of I90 migrated to Paradise Valley in the fall of 2019 and wintered between Eightmile and Strickland Creeks. Two elk migrated to the Story Hills just outside Bozeman and 1 elk migrated to Bridger Canyon. Two

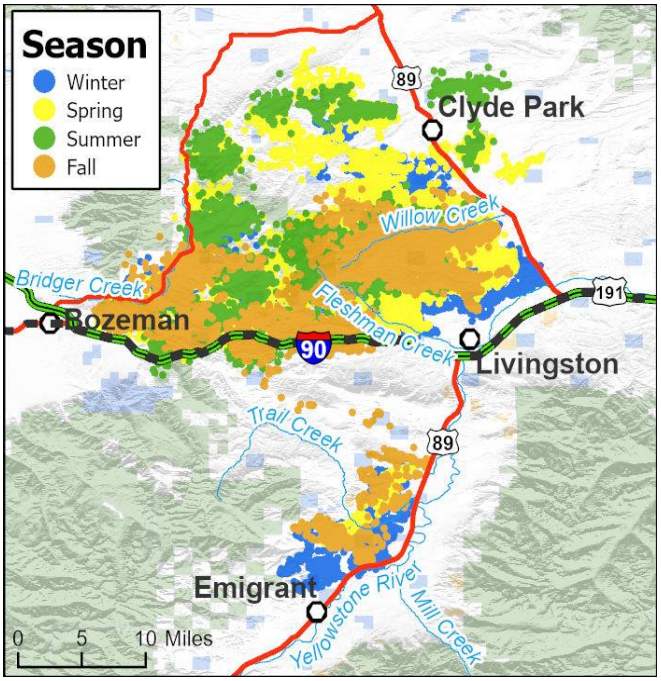

Figure 5. Annual locations (circles) by season of elk from the Bangtail Mountains population, 2019-2020.

elk made short migrations north and summered between Brackett Creek and Battle Ridge. One elk migrated east, crossing Hwy 89 and summered around Hammond Creek south of Clyde Park.

During the February through June risk period (Figure 6), Bangtail Mountains elk were primarily on their winter range, generally from Fleshman Creek north to Willow Creek. As the risk period progressed and migration began in late April, elk moved relatively short distances (6-8 miles) west, north and east to their summer ranges.

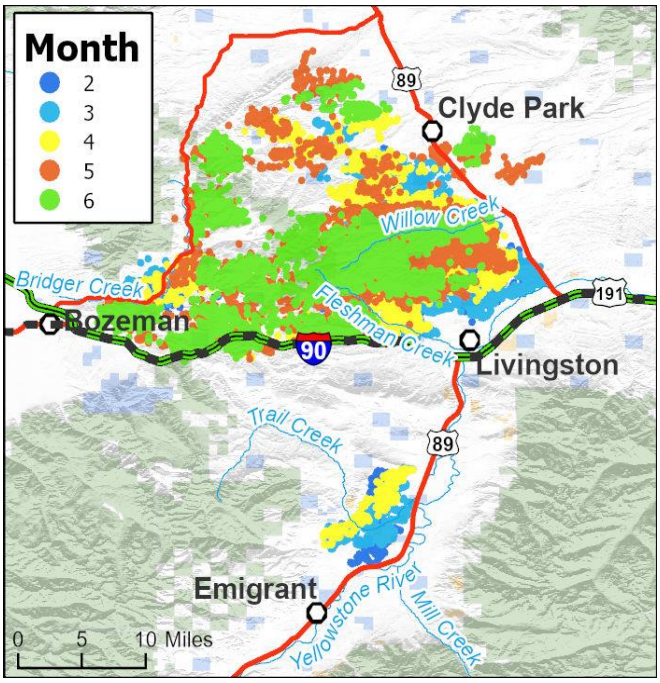

Figure 6. Risk period (Feb-June) locations (circles) by month of elk from the Bangtail Mountains population, 2019-2020.

In January 2020, we deployed 43 satellite upload collars in the Ruby Mountains. One collar malfunctioned shortly after capture and we did not include her limited movement data in subsequent analyses. Two additional collars failed in April and June. We are currently collecting data from the remaining 40 elk (Figure 7). Elk captured on the east side of the Ruby Mountains (n=11), near the Ruby Reservoir, tended to winter near the reservoir, from Dry Hollow south to Peterson Creek. One elk wintered just north of Sweetwater Basin. Most elk moved short distances in April and May to summer range southwest of the reservoir, between Garden Creek and Cottonwood Creek. Two elk summered in Sweetwater Basin and 3 elk moved north to summer between Hinch Creek and Taylor Canyon. Elk captured on the west side of the Ruby Mountains (n=32) tended to winter at low elevations from Stone Creek in the south to the Ruby River in the north. Two elk moved to just north of Sweetwater Basin and 1 elk moved east to the Ruby Reservoir. Movement to higher elevations and summer range occurred in April and May, with many elk moving to the center and the southern end of the Ruby Mountains between the Middle Fork of Stone Creek and Mormon Creek. Three elk moved to the northeast and summered near the Ruby River. One elk migrated north beginning on August 11th and since August 14th has been between Waterloo and Whitehall in the northwest corner of the Tobacco

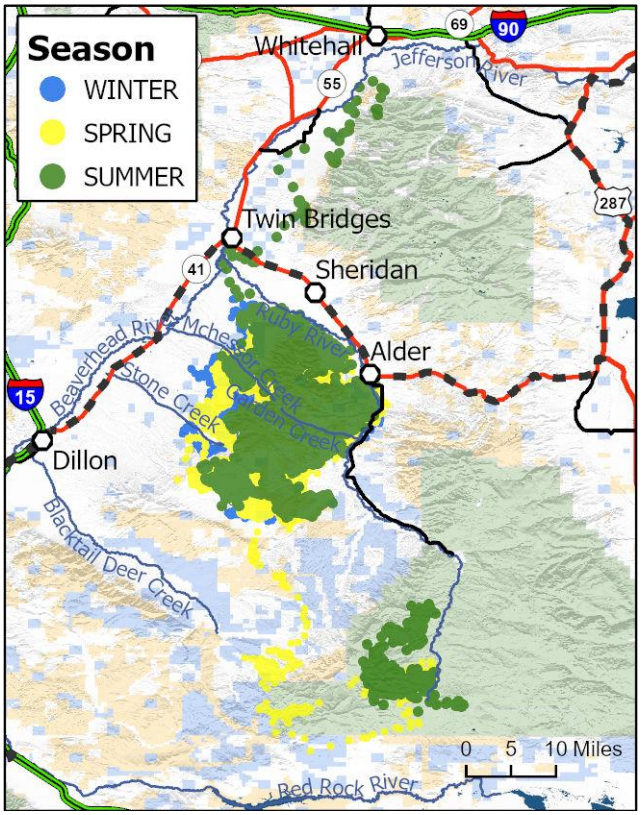

Figure 7. Annual locations (circles) of elk by season from the Ruby Mountains population, January – August 2020.

Root Mountains. Another elk migrated south to the east side of the Snowcrest Mountains near the headwaters of the Ruby River.

We deployed collars in the southern Tendoy Mountains in 2018 and the northern Tendoy Mountains in 2019. Movement data for 2018 collars and 2019 collars through August 2019 was detailed in the 2019 Annual Report. This is a brief summary of the annual collar movement. In January 2019, we deployed 13 collars in the northern portion of HD302 and 17 collars in HD328 in the northern Tendoy Mountains. In February 2018, we deployed 16 collars in HD300 and 14 collars in the southern portion of HD302. We recovered or downloaded collar location data from 50 total elk (12 HD300 elk, 21 HD302 elk, 17 HD328 elk; Figure 5).

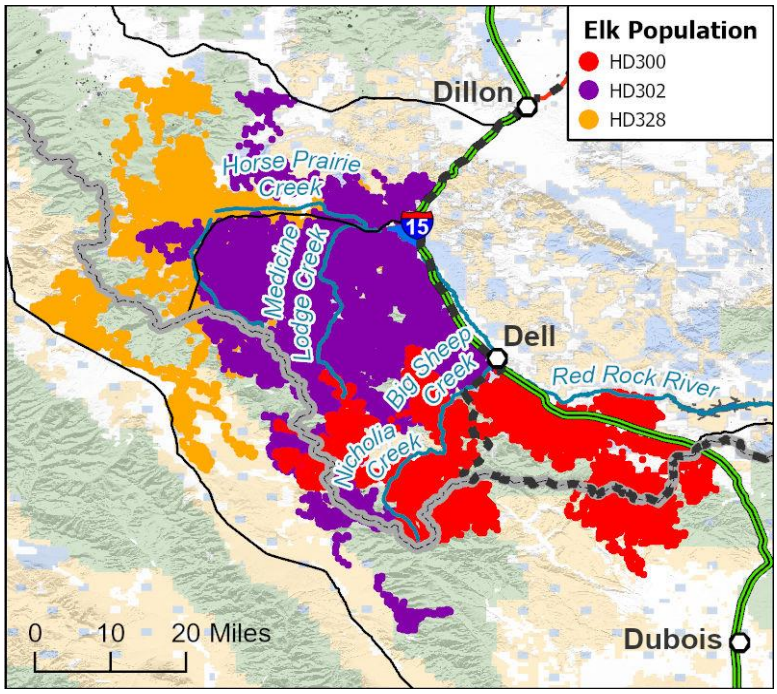

Figure 5. Annual locations (circles) of elk from HD300 (red), HD302 (purple), and HD328 (orange) populations in the Tendoy Mountains, 2018-2019. The light gray line represents the Montana-Idaho state boundary.

In general, HD300 elk winter on the southeast side of the Tendoy Mountains, between Big Sheep and Little Sheep Creeks, with occasional use of the Lima Peaks area farther south. Two elk were residents and never left the southeast side of the Tendoy Mountains, generally drifting farther south to the Lima Peaks area in summer. The remaining 10 elk migrated to summer ranges in April and May, returning to the same winter range sometime between October and January. Three elk migrated southeast through the Lima Peaks area to summer on the Montana-Idaho (MT-ID) border

southwest of Monida. Five elk migrated southwest to the MT-ID border between Nicholia Creek in Montana and Fritz Creek in Idaho. One elk migrated east across Interstate 15 in May and summered just south of Red Rock River, returning in late October.

Elk captured in HD302 typically wintered along the east side of the Tendoy Mountains, staying north of Big Sheep Creek, and in the northwest between Garfield Canyon and Medicine Lodge Creek. Two elk moved west shortly after capture into HD328, wintering west of Medicine Lodge Creek. Three elk spent some of the winter north of Hwy 324 in the Rocky Hills and Henneberry Ridge areas the first winter but remained south of Hwy 324 the second winter. Three elk captured in the southern portion of HD302 were residents, remaining between I90 near Dell and Muddy Creek year-round. The remaining elk began migrating to summer ranges in April and May. Elk that wintered in the northwest portion of HD302 tended to migrate west of Medicine Lodge Creek into HD328 and the eastern side of the Beaverhead Mountains, summering between Barrett Creek and Tepee Mountain. Two elk summered on the west side of the Beaverhead Mountains in the Maiden Creek area. Seven elk migrated west to the MT-ID border stretching from Deadman Pass south to Nicholia Creek, with most spending time in Idaho. One elk that wintered in the north migrated south to Muddy Creek for the summer. Most elk migrated back to winter range sometime between October and January, but 2 elk remained in Idaho's Birch Creek and Lemhi Valleys.

HD328 elk largely wintered from Barrett Creek west to Magpie Gulch and along Horse Prairie Creek south to Maiden Creek. Most elk were residents, with a slight shift to the lower riparian areas of Bloody Dick Creek and Horse Prairie Creek for the summer. Six of the 17 elk did migrate in April and May. Three elk migrated north to summer between Grimes and Painter Creek. One elk migrated south of Maiden Creek to Deadman Pass, with some time spent in Idaho. A second elk migrated south to upper Horse Prairie and Divide Creeks. A third elk migrated south to the Lemhi Valley of Idaho in

March but turned around and migrated north in May to summer between Fox and Andrus Creeks just south of Hwy 278. This same elk then migrated back to the Lemhi Valley in October and wintered there. One elk remained along the MT-ID border near Deadman Pass until February before returning to lower elevations along Horse Prairie Creek. All other elk returned to their previous winter ranges along Horse Prairie and Medicine Lodge Creeks sometime in October to December.

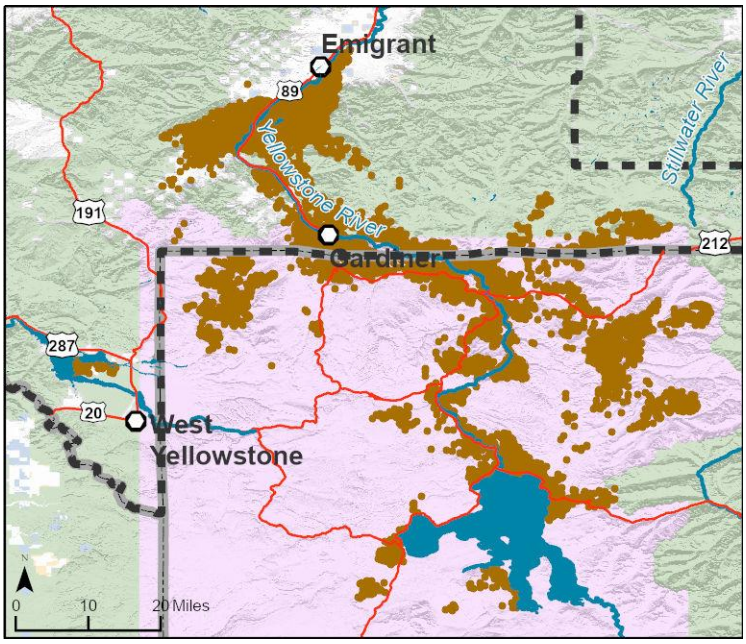

Figure 8. Annual locations (circles) of elk from the Sixmile Creek population.

Brucellosis management actions

To study the effects of brucellosis management hazing and lethal removal on elk distributions and spatial overlap with livestock we deployed satellite upload collars on adult female elk in two areas that regularly receive management actions. In 2017, we collared 40 elk in the Sixmile Creek population (Figure 8) and in 2018 we collared 40 elk in the Madison Valley population (Figure 9). The collars were

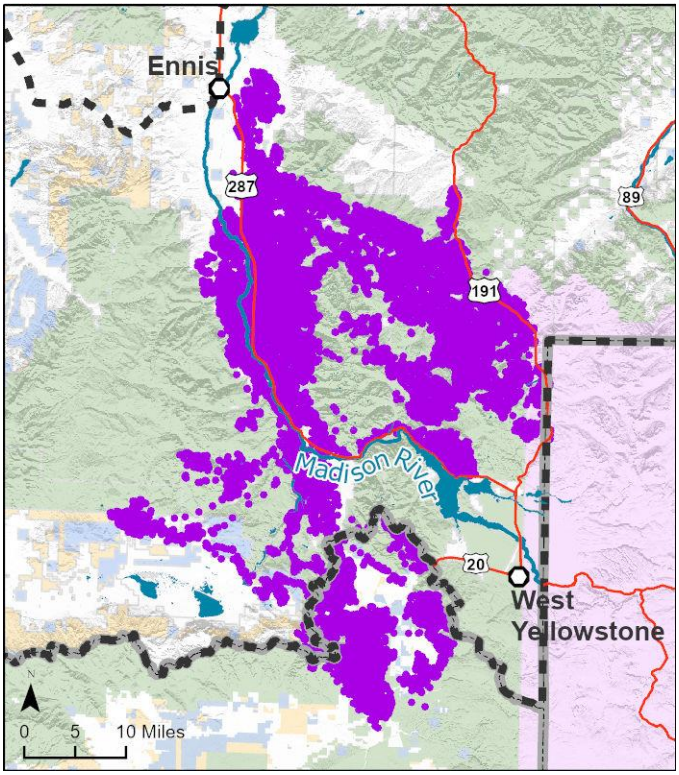

Figure 9. Annual locations (circles) of elk from the Madison Valley.

programmed to record location data for 3 years, with more locations recorded during the management period of December – April.

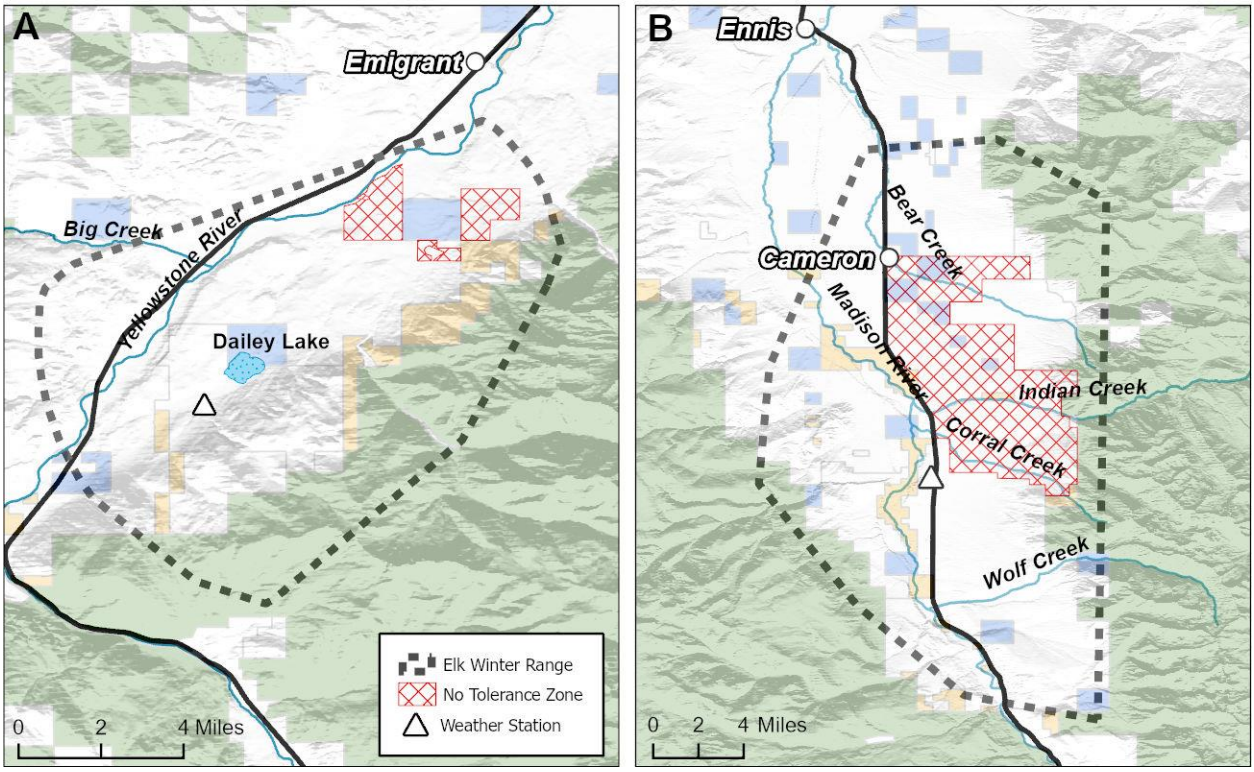

Figure 10. High-Risk Zones for A) Sixmile and B) Madison elk populations used to evaluate elk response to hazing and management hunting pressure.

In both study areas, we defined high-risk zones as areas with livestock where elk presence was not desired by livestock producers on private lands December – April due to transmission risk concerns, and we evaluated how management hazing and lethal removals (i.e. management hunts) affected use of the high-risk zones (Figure 10). We recorded information on 142 hazing events and 77 hunting days in Sixmile, and 137 hazing events and 144 hunting days in Madison (Figure 11). We collected location data during the peak management hazing and lethal removal period of December - April from 40 individuals and 83 animal-years in Sixmile and from 40 individuals and 81 animal-years in Madison. On average, in Sixmile, 80% of collared animals used a high-risk zone each management period (range = 65% to 90%) and individuals that used the high-risk zone used it for an average of 6

days (min = 1, max = 24). On average, in Madison, 88% of collared animals used a high-risk zone each management period (range = 80% to 95%) and individuals that used the high-risk zone used it for an average of 12 days (min = 1, max = 30).

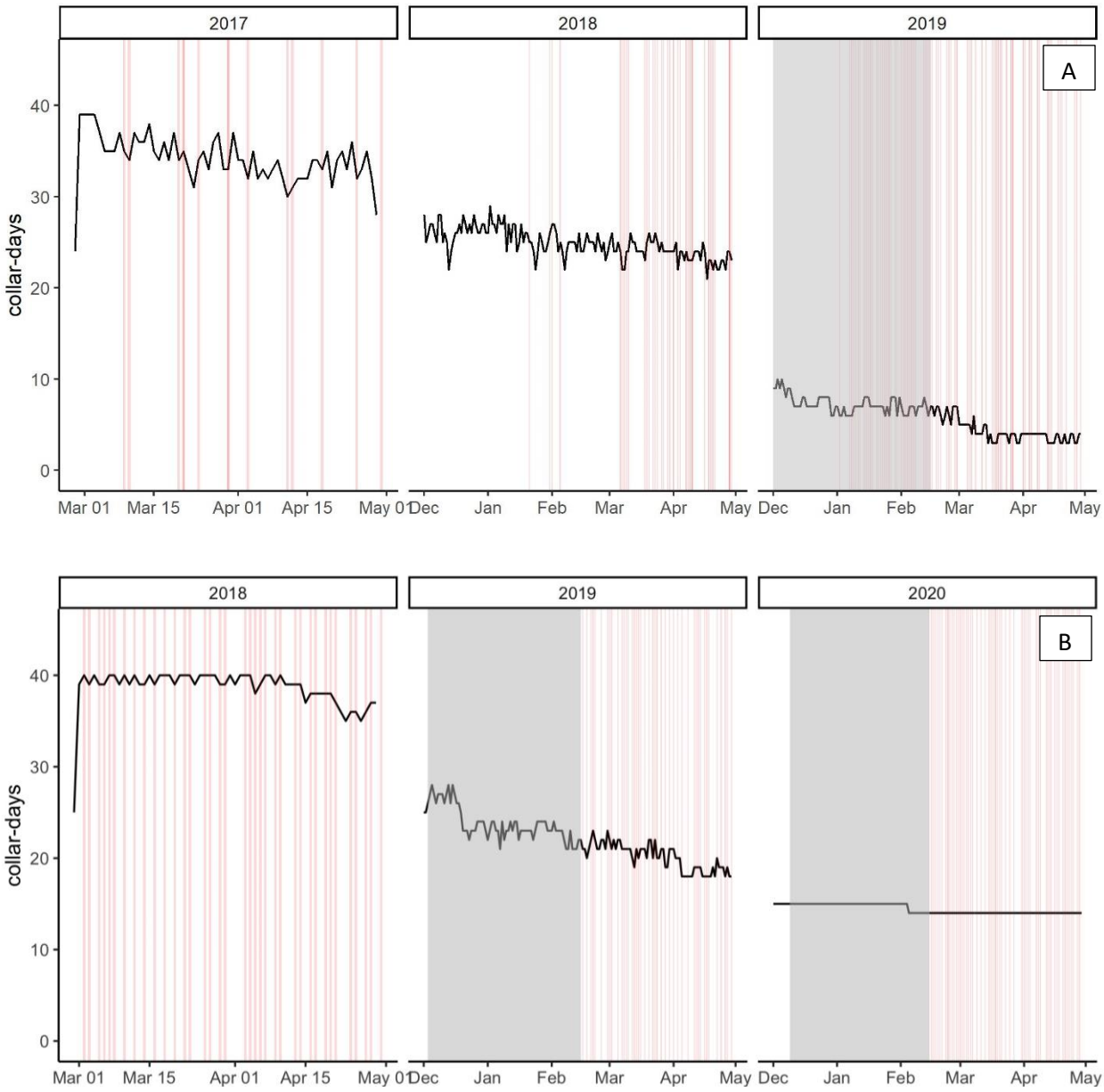

Figure 11. The number of functioning collars (black line), hazing events (red line), and hunting days (gray rectangle) for the Sixmile (Panel A) and Madison (Panel B) areas.

We are currently evaluating factors including weather and management activities affecting the number of collared individuals using a high-risk zone and the duration that individuals remain away from the high-risk zone.

DISCUSSION

Brucellosis surveillance efforts detected exposure to *B. abortus* in elk from the Ruby Mountains, but not in the southern Bangtail Mountains. In response to the documented exposure in the Ruby Mountains, at the suggestion of the Montana Department of Livestock, the Board of Livestock expanded the brucellosis DSA boundary in July 2020 to include HD322 where the Ruby Mountains are situated. The boundary now extends north from Dillon along MT-41 to Twin Bridges and then southeast along MT-287 to Alder where it reconnects with the previous boundary (Figure 1).

Brucellosis surveillance efforts did not detect exposure to *B. abortus* in the Bangtail Mountains elk population. However, the movement of 1 elk south of I90 and into Paradise Valley represents the potential for interchange between the Bangtail and HD 314 (where elk have been exposed to *B. abortus*) elk populations. This elk summered with the Wineglass Mountain elk in HD 314 and then migrated southeast in the fall of 2019 and wintered in Paradise Valley in the same area as the Big Creek elk in HD 314 (Figure 12) where brucellosis has been detected. Interchange between the southern Bangtails elk and exposed HD 314 elk would represent a potential transmission route for brucellosis to expand north.

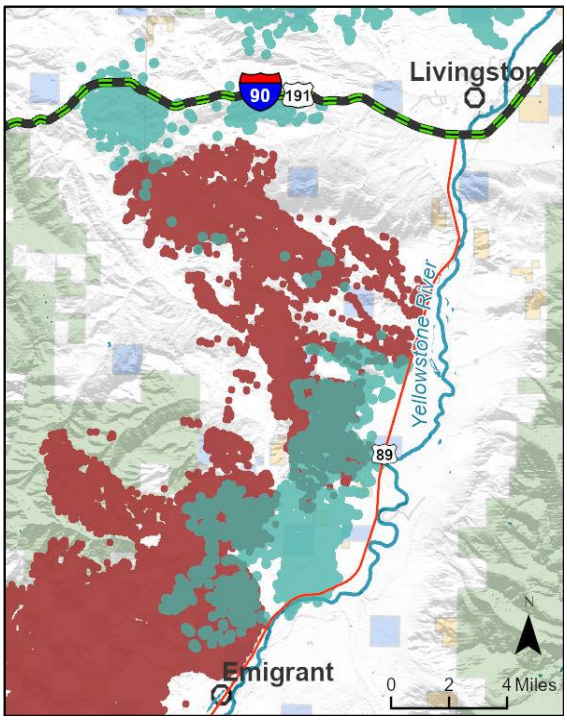

Figure 12. Annual locations (circles) of elk from the Bangtail (teal) and HD 314 (maroon) populations.

Data from elk collars has improved our understanding of elk movement and potential routes for the spatial spread of brucellosis or other diseases among elk populations (Figure 13). Elk movements have been and will continue to be used to determine the timing and degree of spatial overlap between elk and livestock in focused analyses.

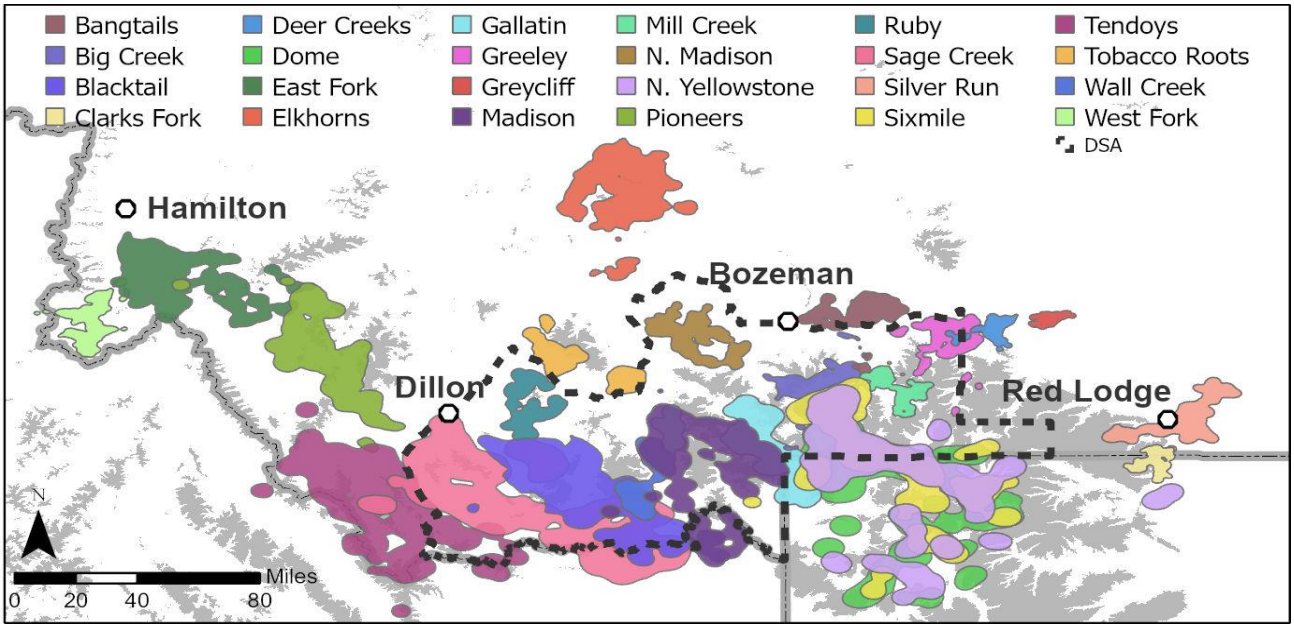

Figure 13. Annual kernel density distributions of elk populations in SW Montana with GPS collar data showing the potential overlap and interchange between populations. Gray polygons represent mountain ranges.

Next Steps

In 2021, we plan to capture 100 elk in the Horseshoe Hills (HD312; Figure 13) north of Manhattan, MT. The Horseshoe Hills are just outside the brucellosis DSA and movement data from the seropositive N. Madison population sampled in 2014 shows potential for interchange (Figure 14). The focus of next year's effort will be to 1) continue to document the spatial extent of the disease, and 2) to finish evaluation of the effectiveness of elk management actions designed to affect elk distribution and elk-cattle spatial overlap at reducing transmission risk within the DSA.

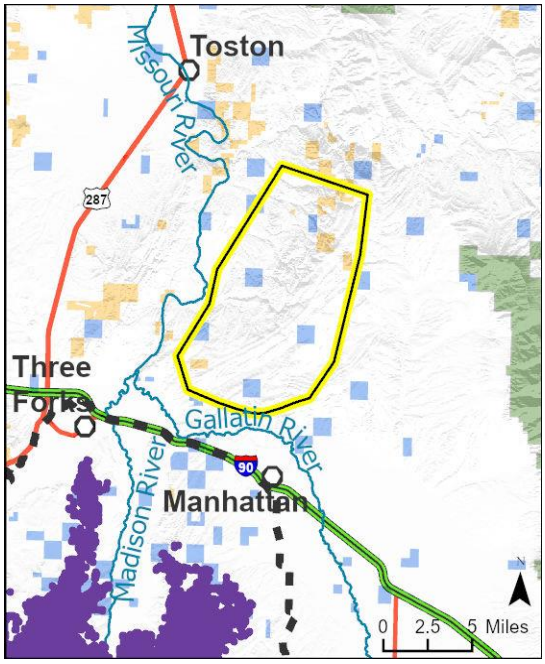

Figure 14. Planned sampling area (yellow & black polygon) for 2021 in the Horseshoe Hills north of Manhattan, MT. Locations of collared elk from the N. Madison population (purple circles) are displayed.

Acknowledgements

We would like to thank the landowners and hunters that supported this project. Without landowner cooperation, this project would not be possible. Funding for the project was supplied by USDA-APHIS through an agreement with Montana Department of Livestock and MFWP, a Federal Aid in Wildlife Restoration grant to MFWP, the sale of hunting and fishing licenses in Montana, and the Rocky Mountain Elk Foundation. We would also like to thank the MFWP biologists, pilots, and wardens for their efforts in helping with landowner contacts, capture and field operations, collar retrieval, and continued support of the project. Drs. M. Zaluski, E. Liska and T. Szymanski from Montana Department of Livestock provided important insights and advice throughout the project.

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