Montana Fish, Wildlife & Parks

Project Background and Objectives

The purpose of this project was to investigate large-scale and fine-scale movements of hunting district (HD) 314 elk with goals of better understanding two key aspects of elk management: risk of brucellosis transmission from elk to livestock and elk availability to hunters. HD 314 is classified within the Gallatin-Madison Elk Management Unit (EMU); however, little elk movement data exists in this hunting district. Elk in the north portion of HD 314 (north of Big Creek) may stay in that portion of the HD year-round due to high-quality winter range on private lands and high-quality summer range on public National Forest lands in the area. Elk in the southern portion of HD 314 (south of Big Creek) may migrate south to Yellowstone National Park (YNP), most likely into the Upper Gallatin and Upper Gardiner River drainages, and mix with northern range elk. If present, such migratory movements may place these elk in contact with potential sources of *B. abortus*. The degree of interchange between HD 314 and adjacent herds is unknown but does have important implications for elk to elk and elk to livestock brucellosis transmission risk.

Transmission of brucellosis within and among wildlife and livestock may occur when individuals ingest or feed near infected fetuses, placentas, or birthing fluids. Infected individuals may experience late-term abortions or carry fetuses full term; therefore transmission risk occurs during late pregnancy and the calving period. Abortion in elk may occur February through June, and live births generally occur in late May to early June. The risk of elk to livestock transmission risk is a function of the seroprevalence rate for an elk herd and the degree of overlap between elk and livestock during the transmission risk period. Two objectives of this project were to 1) estimate the level of interchange between elk herds in this region and 2) estimate seroprevalance in HD 314 female elk.

Recently, Montana Department of Fish, Wildlife, and Parks (MFWP) used elk telemetry data collected from adult female elk in the Madison Valley to develop predictions for elk distributions during the brucellosis transmission risk period for the Montana portion of the Greater Yellowstone Ecosystem (GYE). Predictions from these models suggested that the distribution of HD 314 elk during the transmission risk period overlaps livestock grazing areas, and risk of elk and livestock spatial overlap was high relative to other areas within the Montana portion of the GYE. However, the accuracy of these predictions in HD 314 was unknown and needed to be validated. Using GPS location data collected from telemetry-collared female elk in HD 314, we validated predictions regarding elk distribution during the brucellosis transmission risk period and the risk of elk and livestock spatial overlap.

Additionally, this project investigated elk movement patterns in relation to land ownership with the goal of estimating the effects of hunter access on elk distributions during the hunting season. Hunter access to elk is requisite for hunting to be an effective tool to reduce elk populations. However, hunter access to elk may be limited on private lands that do not allow, or that significantly restrict, public access, as well as on public lands such as YNP where hunting is not allowed. Elk exploitation of these refuges may limit the ability of MFWP to manage elk populations in order to maintain them at population objective.

Study area

HD 314 is located north of Yellowstone National Park on the west side of the Yellowstone River. HD 314 is bordered to the south by YNP, the divide between Tom Miner and Cinnabar Basin, and Sphinx Creek as it flows into the Yellowstone River (Figure 1A). It is bordered on the west by the Gallatin Range divide and to the north by Interstate 90. HD 314 is approximately 45% public land. The maximum elk objective for HD 314 is 3,600 animals. The February 2008 elk count was 4,852, the February 2009 count was 3,722, and the March 2010 count was 3,091. Animals in this study were captured between Eightmile Creek and Rock Creek (Figure 1B). In this area, the February 2008 elk count was over objective (1,908 elk counted, compared to maximum objective 1,440).

Results

Forty-five adult female elk were captured and collared between March 21 and March 27, 2009. There were no capture mortalities. One collar failed shortly after capture and was never relocated. One collar is still attached to an animal. Of the 43 elk with functional collars, there were 7 mortalities and 1 management removal. One animal was killed by a bear on May 1, 2009. One animal died due to poor body condition or natural causes on June 1, 2009. One animal died July 1, 2009 of undetermined causes – bears fed on the carcass and may or may not have killed the animal. One animal died on August 15, 2009 after being hit by a vehicle on HWY 89 between Emigrant and Point of Rocks. Three animals were harvested during the 2009 hunting season. One animal was killed by MFWP in January 2010 after testing positive for brucellosis.

GPS location data collected from winter 2009 (Feb 27, 2009 – April 1, 2009) and 2010 (Jan 1, 2010 – April 1, 2010) showed that winter ranges were concentrated primarily on lower-elevation, privately owned ranchlands between Eightmile Creek and Tom Miner Creek (Figure 1A). Calving areas, which we broadly defined by elk locations during the last 2 weeks in May and first two weeks in June, were primarily on privately owned ranchlands in HD 314, but also included USFS lands in HD 314 and HD 301. Additionally, one animal moved into Yellowstone National Park during the end of the calving season (Figure 1B). Calving areas in HD 301 included the ridgeline between Swan Creek and Squaw Creek and the south facing slopes north of Swan Creek near the confluence with South Fork of Swan Creek. Calving areas in HD 314 extended from the Eightmile drainage in the north through Tom Miner Basin in the south, with the greatest number of animals calving between Fridley Creek and Big Creek.

Summer ranges were located primarily near the Gallatin Crest in Gallatin National Forest, as well as in the northwest portion of Yellowstone National Park (Figure 1C). Eleven of 43 animals' summer ranges were located primarily within HD 301, the west side of the Gallatin Crest, and an additional 5 animals' summer ranges included portions of HD 301. Summer range extended west in HD 301 as far as Rat Lake. Three animals summered in the northwest portion of Yellowstone National Park, an area documented as summer range for the northern range elk herd. One of these animal's range was centered on Fawn Pass and two animals' ranges were centered along the East Fork of Specimen Creek. One animal summered on Wineglass Mountain, 3 in the Eightmile drainage, 3 in the upper Donahue drainage, 13 in the Fridley drainage, and 2 in the upper Big Creek drainage. During the general rifle hunting season, animals were primarily located on privately owned ranchlands within the winter range (Figure 1D).

Two animals dispersed from the study area and spent the winter following their capture in the Paradise Valley at a different winter range. One animal migrated during spring 2009 to Swan Creek in HD 301 and spent the winter 2009-10 and 2010-2011 in Swan Creek. This area had not previously been identified as an elk winter range. One animal migrated during spring 2009 to Wineglass Mountain (south of Livingston, within HD 314) and spent the summer 2009 and winter 2009-2010 on Wineglass Mountain. This area is an established range of the Wineglass-West Pine Creek elk herd, which numbered 1381 animals in 2009.

There was not a well-defined migratory route that multiple animals used to travel from winter to summer range (Figure 2). Spring migrations were initiated from May 23 to July 27, 2009 with a mean initiation date of June 22, 2009. Spring migrations were initiated from May 23 to July 28, 2010 with a mean initiation date of June 20, 2010. Fall migrations were initiated from August 12 to October 31, 2009 with a mean initiation date of September 30, 2009. Sixteen of the animals that survived until the summer of 2009 did not have distinct summer and winter ranges. These animals slowly worked their way from winter range towards nearby summer ranges and a defined migration date and pattern was not obvious.

Blood samples were collected from each of the 45 elk during capture and tested for exposure to brucellosis. One animal tested seropositive for exposure. This animal was captured south of Big Creek and her age was estimated at 5 years old. Following capture, she remained South of Big Creek and wintered in the Donahue area. In spring, she moved to Tom Miner Basin. One June 26, 2009, she migrated through HD 313 and into the Fawn Pass area of Yellowstone National Park to her summer range (Figure 3). After she returned to the winter range, she was killed by FWP personnel in January 2010.

Validation of GYA-wide elk distribution predictions

In efforts to better understand elk distributions during the brucellosis transmission risk period, we developed predictive models based on available GPS location data collected from telemetry-collared female elk in the Madison Valley. Using a model generated from Madison Valley GPS data, we generated predicted elk distributions across the Montana portion of the GYA. We integrated predicted elk and domestic livestock distributions to estimate the relative probability of elk and livestock spatial overlap during the transmission risk period. These results were recently published in Proffitt et. al. 2011. Elk distribution and spatial overlap with livestock during the brucellosis transmission risk period, Journal of Applied Ecology 48:471–478. The abstract is below.

ABSTRACT The presence of *Brucella abortus* within free-ranging wildlife populations is an important conservation and management issue because of the risk of brucellosis transmission between wildlife and livestock. Predicting wildlife distributions is necessary to forecast wildlife and livestock spatial overlap and the potential for brucellosis transmission. We used Global Positioning System (GPS) data collected from telemetry-collared female elk to develop resource selection function (RSF) models during the brucellosis transmission risk period (the abortion and calving periods). We validated extrapolation of predictive models at two nearby elk ranges within the Greater

Yellowstone Ecosystem (HD301 and HD 313). Additionally, we integrated extrapolated RSF maps and domestic livestock distributions to estimate the relative probability of elk and livestock commingling during the brucellosis transmission risk period. The top ranked model predicted areas selected by elk had a lower probability of wolf occupancy, were privately owned and south facing, and had steeper slopes, lower road densities, and higher NDVI. Elk selected for forests and shrublands over grasslands; however, the strength of selection for forests and shrublands over grassland areas decreased as snowpack increased. Elk selection for privately owned lands may lead to spatial overlap with livestock and increase the risk of elk and livestock commingling. Further, if both elk and livestock concentrate in areas of higher NDVI, increased commingling may occur in these areas. Predictive accuracy was highest in the study area where the model was developed. When compared to the model development area, predictive accuracy of extrapolated RSF maps was similar or better in one of the elk ranges and lower in the other elk range. The extrapolated RSF and commingling maps provide a foundation for identifying the highest-risk areas of elk and livestock spatial overlap during the brucellosis transmission risk period. The degree to which spatial overlap may lead to actual transmission risk needs to be investigated. Our results also suggested predictive accuracy of extrapolated RSF and commingling maps may be reduced in different populations. Site-specific models of spatial overlap are needed to provide the most accurate estimates of elk and livestock spatial overlap during the transmission risk period. Our models also provide a foundation for improved models that would incorporate site-specific habitat differences and herd-specific brucellosis seroprevalance rates.

Using the data collected from telemetry collared female elk in HD 314, we validated the predictive models described above to determine applicability of the current elk distribution models in HD314 (Figure 6 and 7). We found that model predictions of elk distribution during the abortion risk period (February 15 – May 15) had average performance, but model predictions during the calving risk period (May 15- June15) performed well. In the HD314 data, 24% of abortion risk period locations occurred in >75% RSF interval and 67% of locations occurred in the >50% RSF interval. Forty-two percent of calving period locations occurred in >75% RSF interval and 80% of locations occurred in the >50% RSF interval (Table 1). Finally, we integrated predicted elk and domestic livestock distributions in the HD 314 study area to estimate the relative probability of elk and livestock spatial overlap during the transmission risk period (Figure 8).

Effects of hunter access on elk distributions

GPS location data collected here was used in a project investigating the effects of hunter access and other attributes on elk distributions during the fall hunting seasons. The Abstract for that manuscript is below. Please see Proffitt, K. M, J. Gude, and K. Hamlin. (in review) Effects of hunter access and elk habitat security on elk distributions in landscapes with a public and private land matrix. for additional information:

> **ABSTRACT** Traditional elk habitat management has focused on providing security habitat for elk to utilize during the hunting season, but has not considered patterns of land ownership and hunter access. We tested the hypotheses that during the hunting season: 1) elk selection for areas prohibiting or limiting hunter access is stronger than elk selection for publicly owned and managed elk security habitat, 2) these effects occur during the archery hunting period and intensify during the rifle hunting period, 3) the effects of hunter access on selection are similar between 2 herds that each occupy a landscape characterized by a matrix of public and private lands. Using global position system location data collected from females in 2 different Greater Yellowstone Ecosystem (GYE) elk herds, we evaluated effects of hunter access, security habitat as defined by the Hillis paradigm, and other landscape attributes on adult female elk resource selection during the pre-hunting period, archery period, rifle period, and post-hunting period. We found that elk selection for areas restricting public hunting access was stronger than selection for security habitat. In both study areas, elk increased selection for areas that restricted public hunting access during the rifle hunting season, but did not increase selection for security habitat. Increases in selection for areas that restricted hunting access occurred during the rifle hunting period and we did not find evidence these movements were triggered by the archery hunting period. Our results provide evidence that in landscapes characterized by a matrix of public and privately owned lands, traditional concepts of elk security habitat need to be expanded to also include areas that restrict hunter access. Future efforts need to investigate if elk use of areas that restrict hunter access are flexible behavioral responses to hunting risk, or if these behaviors are passed from generation to generation such that a learned pattern of private land use becomes the normal movement pattern rather than a behavioral response.

The results of this work provide evidence that in landscapes characterized by a matrix of public and privately owned lands, traditional concepts of elk security habitat need to be expanded to also include areas that restrict hunter access. During the rifle hunting period, female elk in both the Madison and Paradise Valleys increased selection for areas that restricted public hunting access, but did not increase selection for security habitat. Given the different behavioral patterns of male and female elk, male elk may utilize security habitat to a greater degree than reported here. Therefore, we may expect male elk to show a stronger preference for security habitat than observed here in female elk.

Differential harvest pressure in areas with public hunting access and restricted public access has the potential to selectively reduce the public lands segment of an elk herd. If migratory or movement behaviors are passed generation to generation, harvest may act as a selective force increasing herd segments using private lands and reducing survival of the herd segment using public lands. These results reinforce the need for wildlife managers to work closely with public land management agencies and private landowners to manage the size of elk herds. Focusing harvest pressure on private lands currently restricting hunter access while limiting harvests on public lands may be an effective strategy for redistributing elk onto public lands in areas where elk distribution is focused on private lands with limited public hunting access. The speed with which this happens depends largely on whether landscape-scale elk movements are passed between generations or are individual, flexible behavioral strategies. Additionally, management of motorized road access by land management agencies may influence female elk distributions onto public lands during the hunting periods. If these strategies are successful, and provided that adequate elk forage is available on public lands, publicly-managed security areas may become a more central part of adult female elk habitat use during hunting seasons than we documented here.

Acknowledgements

We thank the landowners in HD 314 for permitting access to their properties and the ranch managers that helped facilitate radio collar retrievals. We thank M. Ross for conducting the capture operations and J. Ramsey, J. Cunningham, and K. Hughes for assisting with animal capture. We thank N. Anderson, B. Brannon, J. Cunningham, C. Gower, K. Hughes, T. Lemke, J. Shamhart, J. Ramsey and T. Ritter for helping with collar retrieval. We thank A. Puls for helping generate Figures in this document.

Figure 1. The 95% kernel density distribution of radio-collared adult female elk locations during the winter (Panel A), calving period (Panel B), summer (Panel C), and general hunting season (Panel D).

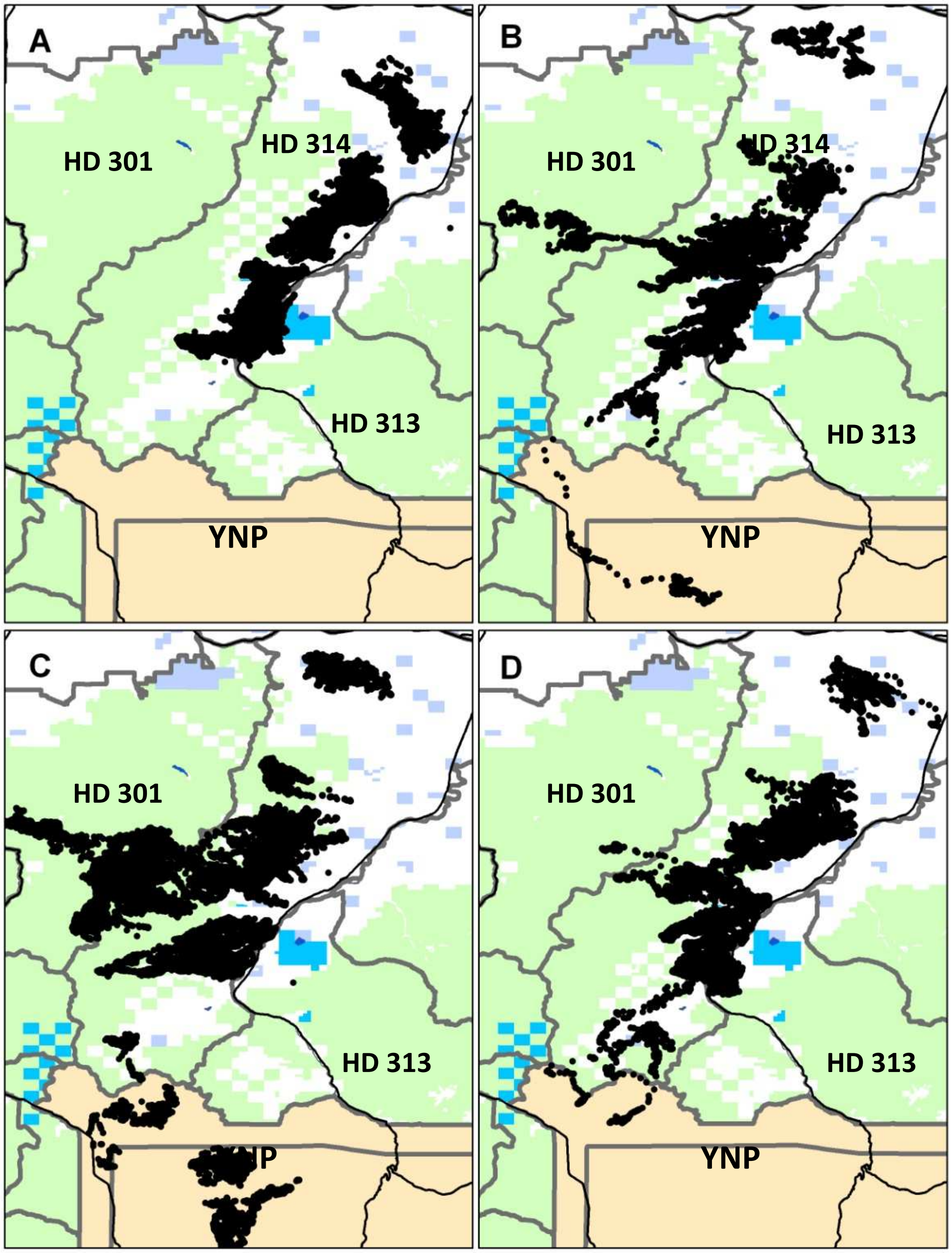

Figure 2. Year-round ranges of nonmigratory elk. Some elk in the Fridley Creek and Donahue drainages were considered non-migratory because they did not use distinct summer and winter ranges.

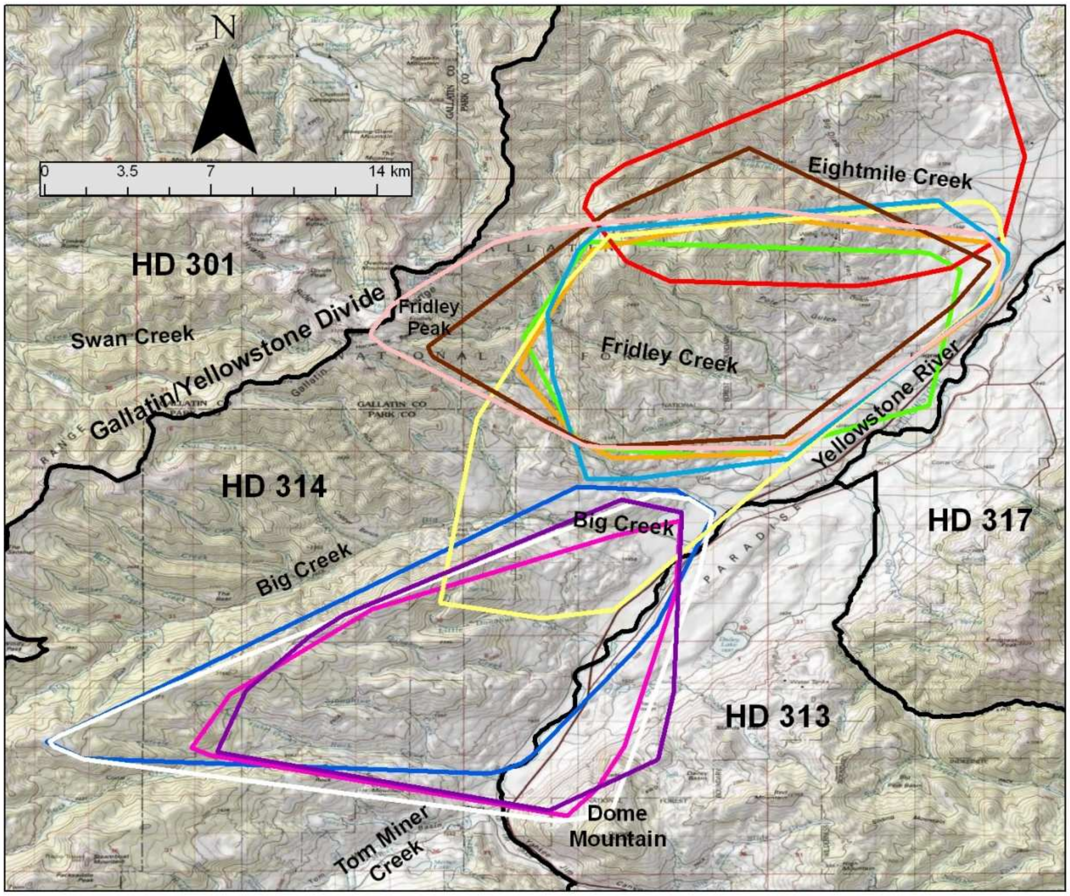

Figure 3. Summer range, winter range, and migratory routes of 4 migratory elk. Most of the migratory animals moving to the west side of the Gallatin Divide crossed the Divide near the headwaters of the South Fork of Swan Creek and summered in the South Fork of Swan Creek area.

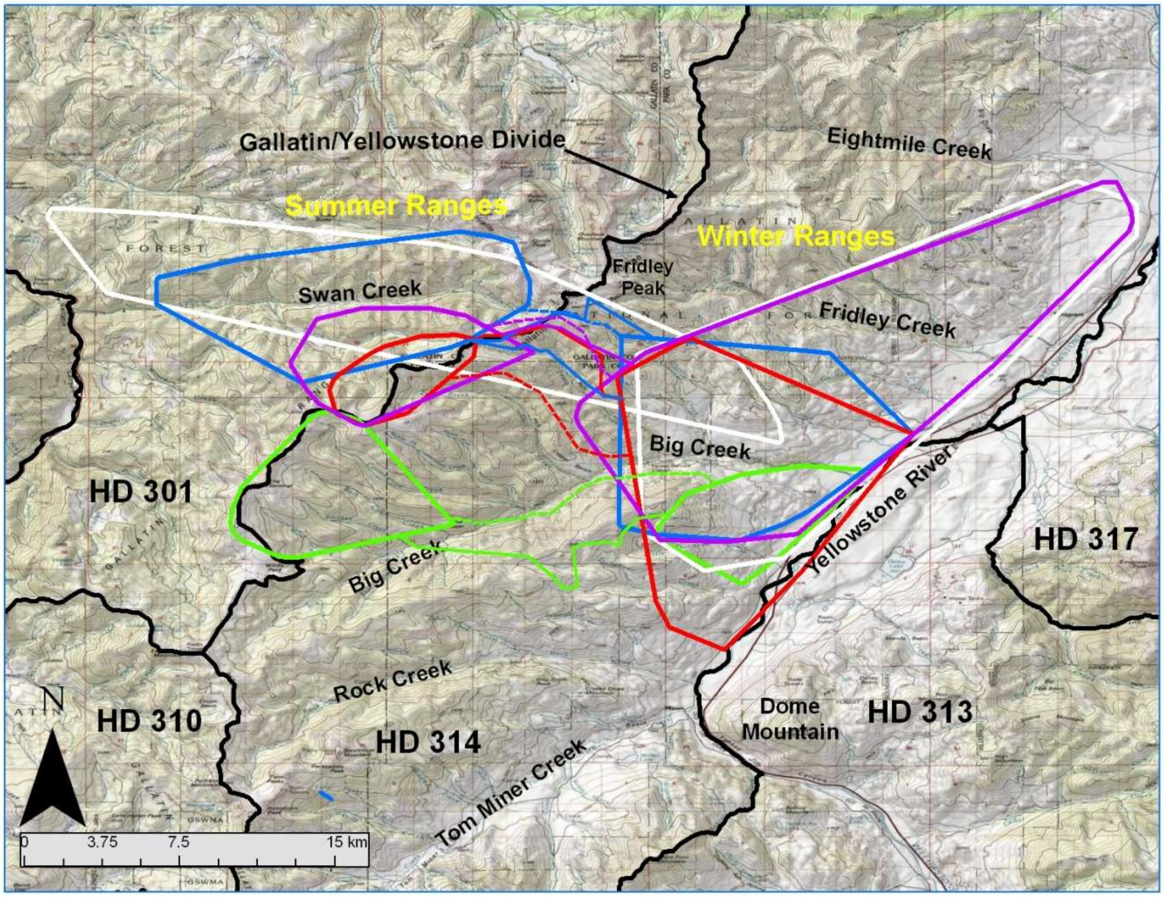

Figure 4. Seasonal ranges and migratory routes of two animals that summered in Yellowstone National Park.

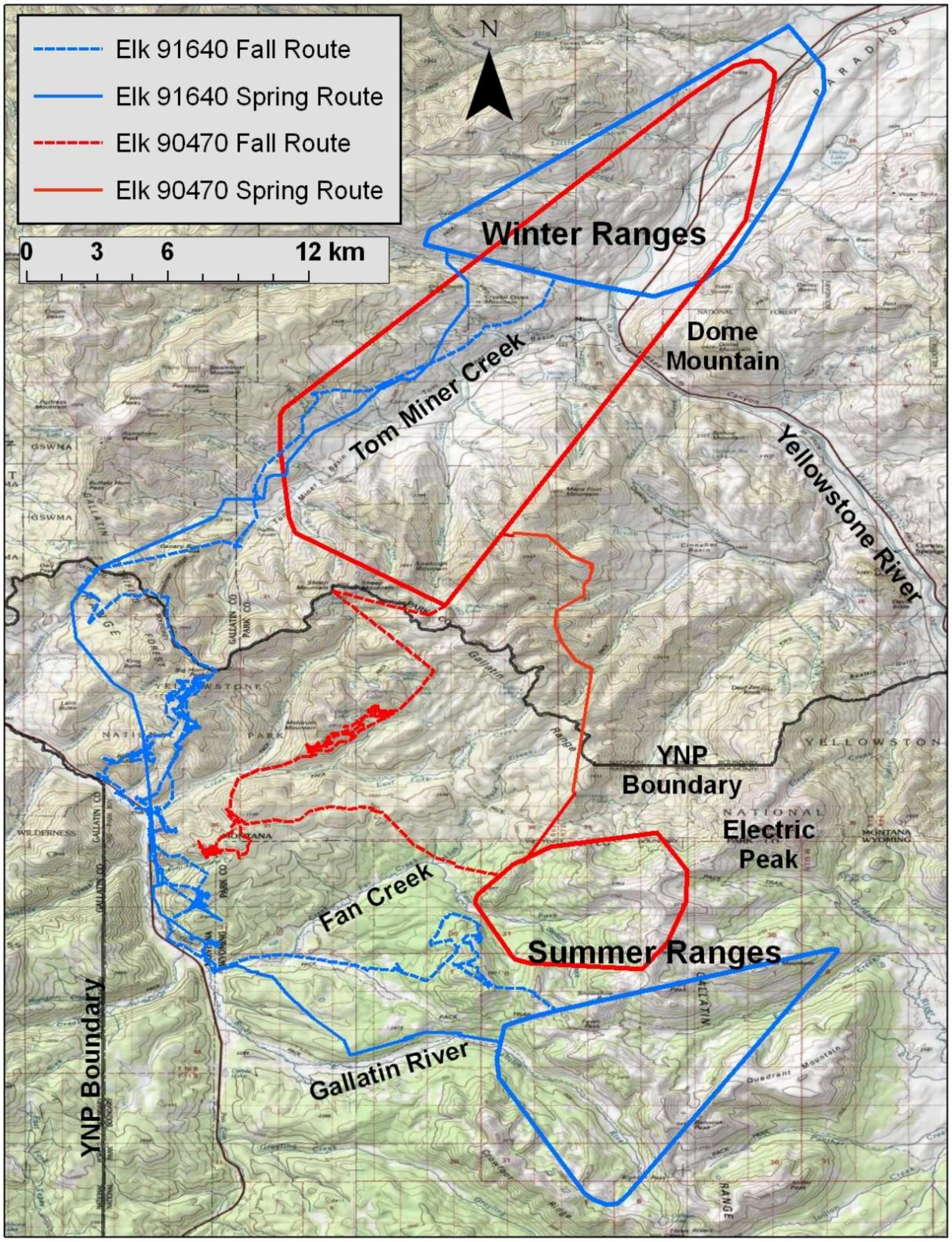

Figure 5. GPS locations from the telemetry-collared elk that tested brucellosis seropositive. This animal was captured south of Big Creek in March 2009. She wintered in the Big Creek – Rock Creek area, spent the spring in Tom Miner Basin, and then moved into Yellowstone National Park during the end of the calving period. During fall 2009, she returned to the Rock Creek winter range and was removed from the population in January 2010.

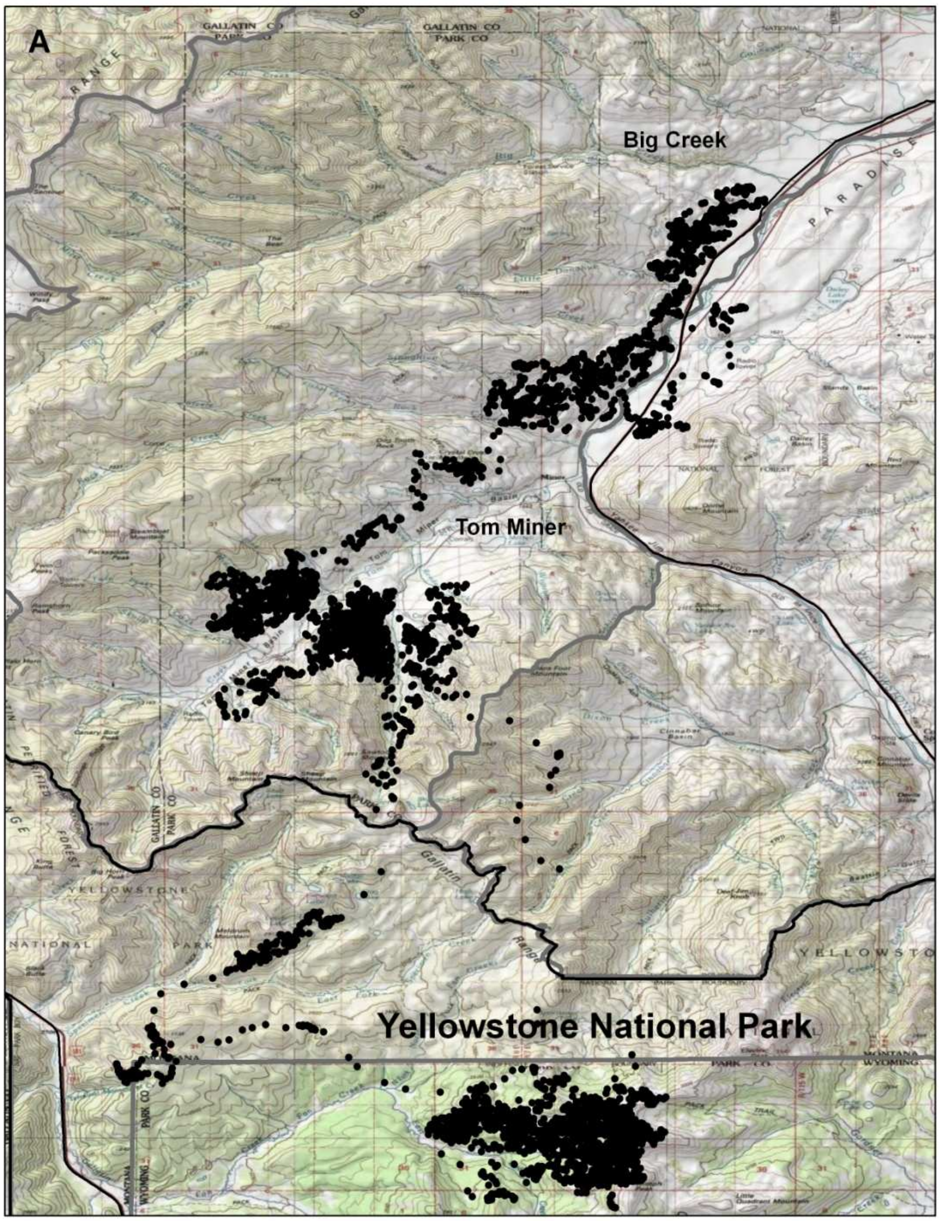

Figure 6. Predicted elk distributions (Panel A) and actual locations (Panel B) during the abortion risk period (February 15 – May 15) in the HD 314 study area. Areas of highest relative probability of use are shown in red and areas of lowest relative probability of use are shown in green.

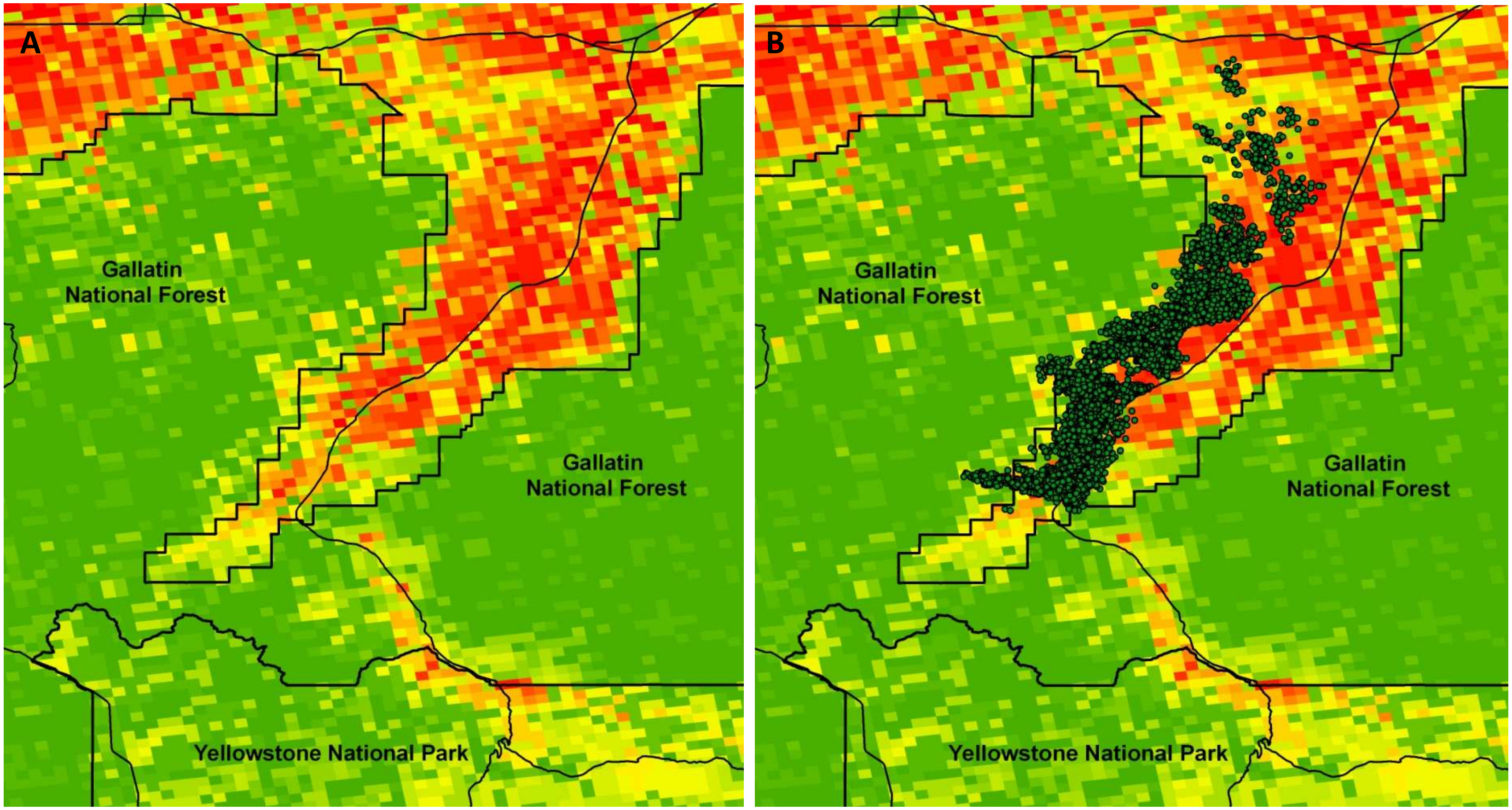

Figure 7. Predicted elk distributions (Panel A) and actual locations (Panel B) during the calving risk period (May 15 – June 15) in the HD 314 study area. Areas of highest relative probability of use are shown in red and areas of lowest relative probability of use are shown in green.

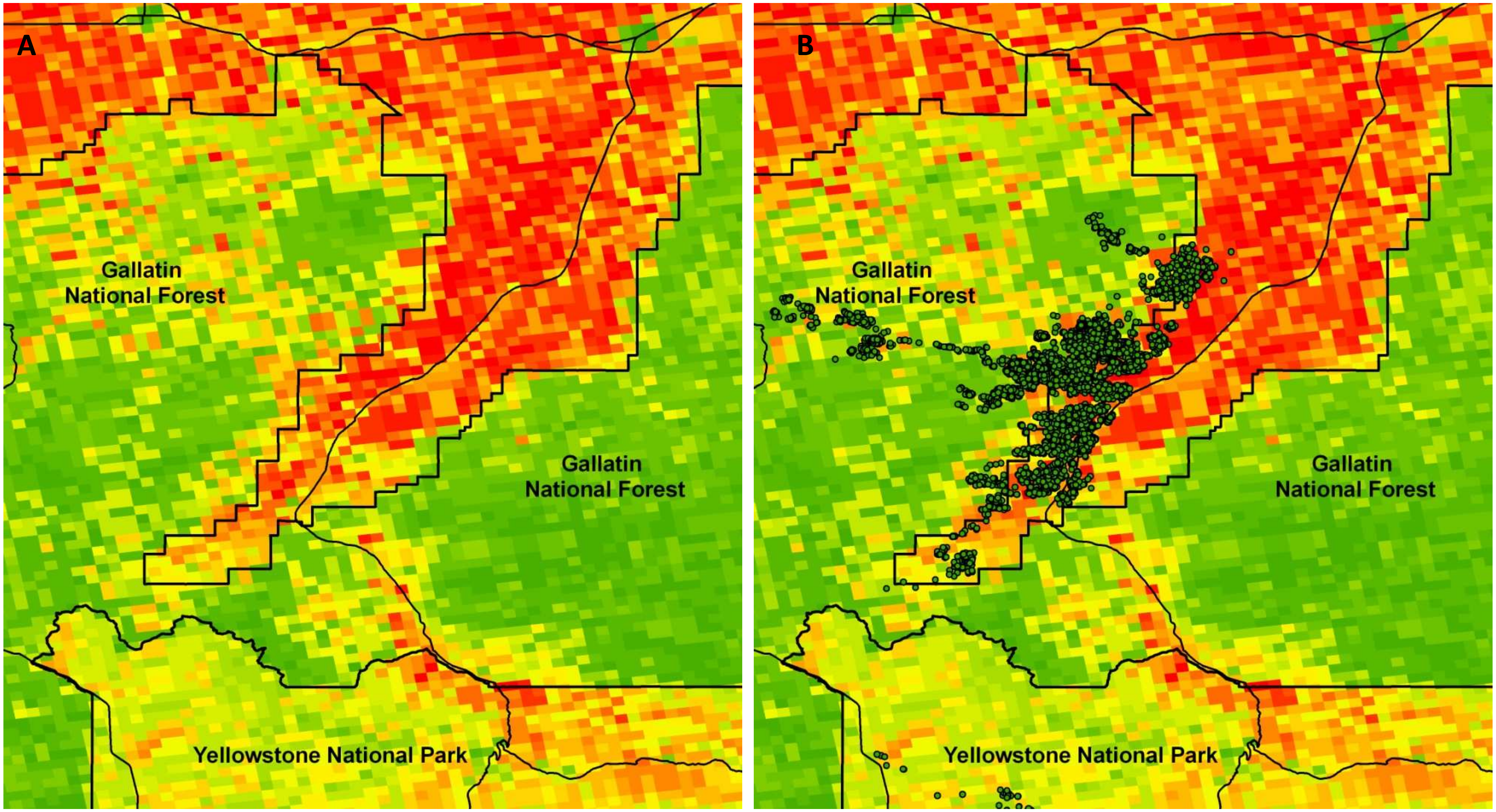

Figure 8. The predicted relative probability of elk and livestock spatial overlap in the HD 314 study area during the abortion risk (Feb 15 – May 15, Panel A) and calving risk (May 15 – June 15, Panel B) periods. Areas of highest relative probability overlap are shown in red and areas of lowest relative probability of overlap are shown in green.

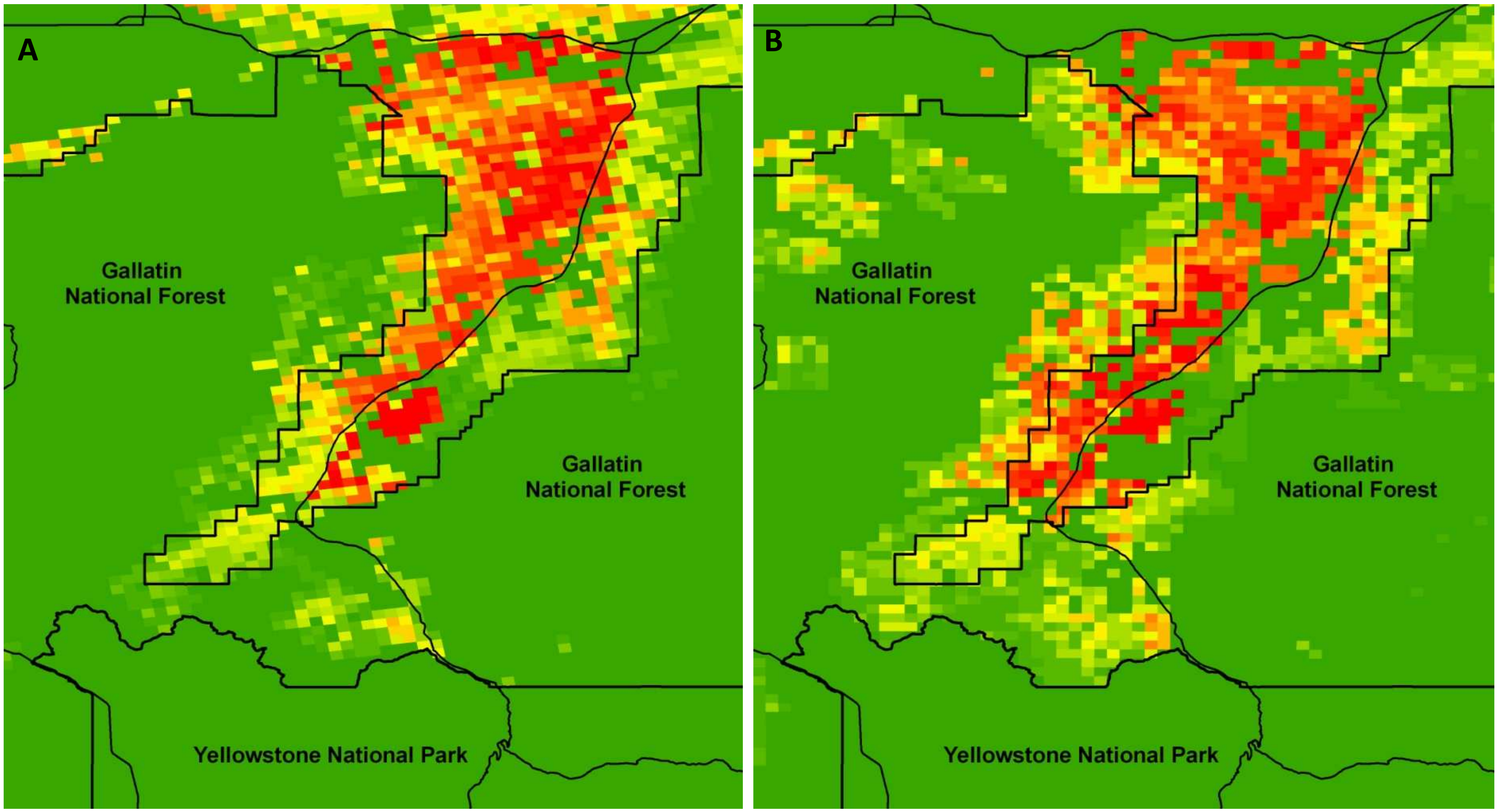

Table 1. Frequency distributions and percentage of HD 314 elk locations within RSF intervals during the abortion risk (Feb 15 – May 15) and calving risk (May 15 – June 15) periods. Approximately 5% of elk locations are expected to occur in each RSF interval by random chance. Values greater than 5% in the higher RSF interval and values less than 5% in the lower RSF intervals indicate that the model possessed the ability to distinguish resource selection.

RSF interval	Abortion Period			Calving Period		
	Number of locations	Percentage locations	Cumulative percentage	Number of locations	Percentage locations	Cumulative percentage
0 – 5%	465	2.3	2.3	0	0.0	0.0
5 – 10%	17	0.1	2.4	10	0.1	0.1
10 – 15%	289	1.4	3.8	20	0.2	0.4
15 – 20%	0	0.0	3.8	183	2.2	2.6
20 – 25%	456	2.2	6.0	86	1.0	3.6
25 – 30%	1713	8.4	14.5	372	4.5	8.1
30 – 35%	1696	8.4	22.9	533	6.4	14.5
35 – 40%	584	2.9	25.7	153	1.8	16.3
40 – 45%	398	2.0	27.7	113	1.4	17.6
45 – 50%	939	4.6	32.3	216	2.6	20.2
50 – 55%	1993	9.8	42.1	921	11.1	31.3
55 – 60%	2248	11.1	53.2	459	5.5	36.8
60 – 65%	987	4.9	58.1	539	6.5	43.3
65 – 70%	2262	11.2	69.2	568	6.8	50.1
70 – 75%	1422	7.0	76.3	666	8.0	58.1
75 – 80%	1288	6.3	82.6	952	11.4	69.5
80 – 85%	1247	6.1	88.8	776	9.3	78.8
85 – 90%	516	2.5	91.3	716	8.6	87.4
90 – 95%	707	3.5	94.8	523	6.3	93.7
95 – 100%	1058	5.2	100.0	525	6.3	100.0
Total	20,285	-	-	8,331	-	-