Northern Yellowstone Elk (HD 313)

2008 Annual Report

Montana Fish, Wildlife and Parks

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Photo courtesy Steve Collins

TABLE OF CONTENTS

BACKGROUND AND OBJECTIVES

The Northern Yellowstone elk herd is not only of great importance to the people of Montana and Wyoming, but is often in the national spotlight. The Northern Yellowstone elk herd and its management have been controversial for more than a century. Questions have ranged from the appropriate numbers of elk for the amount of forage available (including appropriate level of late hunt harvest), to “natural regulation” of elk numbers, to risk of brucellosis transmission to domestic livestock. Since 1994, there also has been widespread questioning of the impacts of wolf restoration on the elk herd.

Although the amount of data collected on this elk population and the number of articles written have been enormous (see Houston 1982, Lemke et al. 1998, literature cited in National Research Council 2002, etc.), little substantial information is available on movements and distribution of the elk. Early studies within YNP did not use radio-telemetry. More recently, many elk have been captured and marked with radio-telemetry collars within YNP (Barber-Meyer et al. 2008), but there has been no recent information for the portion of the elk herd wintering outside YNP. Vore (1990) reported on the movements of 32 elk (28 cows) captured and marked with radio collars outside YNP during January 1984 – May 1987. This study of Vore’s has been the only information available for elk wintering outside YNP and much has changed since 1987 (Lemke et al. 1998).

The availability of movements and distribution information for the portion of NY elk wintering outside YNP, especially with the current availability of GPS technology, would help answer several research and management questions. Information gathered was used by Montana’s Wolf-Ungulate Research Project that includes cooperators from Montana Fish, Wildlife, and Parks, Montana State University, Yellowstone National Park, and the U. S. Fish &

Wildlife Service (Hamlin and Cunningham 2009); cooperative studies with Montana Department of Livestock of brucellosis transmission risk; and for annual management recommendations and decisions.

STUDY AREA AND CAPTURE EFFORTS 2007-2008

Captures occurred on winter ranges during February in 2007 and 2008. The capture areas included the portion of the Northern Yellowstone herd wintering outside of Yellowstone National Park in hunting district 313. The capture area was south of Livingston, Montana and north of Gardiner, Montana along Highway 89. The eastern boundary was the front of the Absaroka-Beartooth Mountain Range, generally extending only 2-3 miles east of Highway 89. The western boundary of captures included the Mulherin and Cinnabar Basins, 2-3 miles west of Highway 89. This perimeter included Dome Mountain Wildlife Management Area, approximately 4,680 acres of winter range for Northern Yellowstone elk. From the capture areas, the study area was extended to include the summer ranges of the individual captured elk (Figure 1). Using both 2007 and 2008 data, the final study area encompassed most of Yellowstone National Park from the Madison-Gibbon-Firehole drainages on the west to the southern boundary to the eastern boundary to Slough Creek and the Buffalo Plateau to the north. Where appropriate, we compared our data with movement data collected from 28 cow elk during 1984-1987 (Vore 1990).

In the first stage of the 2-year project, we used helicopter darting and drugging to capture and mark 13 adult cow elk with GPS radio-transmitter collars on Dome Mountain Wildlife Management Area and 2 in the Mulherin Creek drainage on 26 February 2007. These collars were equipped with blow-off mechanisms set for 52 weeks (one year) after capture. We aged elk on capture using tooth eruption and wear patterns (Quimby and Gaab 1957), we collected blood samples to determine pregnancy using pregnancy-specific protein B (PSPB; Sasser et al. 1986), brucellosis seroprevalence and other disease exposure, and we collected fecal samples. After capture, we monitored elk bi-weekly from the ground and air until elk established their summer ranges. At that point, we monitored elk monthly until they began migration back to their winter ranges, where we retrieved their GPS collars. Detailed results from this first year of study appear in the 2007 annual report (Cunningham et al. 2008).

The second and final year of the project has now been completed. Using the same methods described above, we captured 31 cow elk by helicopter darting 4-6 February 2008, and fit 30 with GPS collars as described above. Unfortunately, 1 cow elk died at capture as a result of an accidental fall on steep terrain shortly after emerging from the effects of the drug used. We captured 13 elk in the Dailey Lake area (Dailey Lake WMA, Dome Mountain Ranch, Carbella), 2 in Cedar Creek, 4 in Bassett Creek, 1 in Cinnabar Basin, 1 near Aldridge Lake, and 9 between Little Trail and Phelps Creek.

RESULTS

We have retrieved 29 of the 30 deployments from 2008. The remaining collar appears to be a VHF (radio-beacon) failure. The collar had been heard readily throughout the study from the ground and air, and had been located in Stephens Creek from the ground in mid-January. However, the collar was never heard again over multiple flights and ground-based telemetry, and we assume that the VHF beacon has failed. We also had 1early-season mortality that was censored from this final report, and 1 GPS failure. The remaining 27 individual collars performed well, with average fix success rate of 96%.

There were 2 mortalities among the 30 marked cow elk. The first mortality (censored from this report) occurred in March and was apparently due to capture-related stress or injury. The retrieved collar demonstrated linear movement into a densely forested area of Bassett Canyon, and died approximately 17 days later. Exact day of death is uncertain, as the elk moved less than 50 meters from her resting location in Bassett Creek, and because there was heavy grizzly and black bear foraging upon the carcass, which could have triggered the collar's mortality switch returning it to live signal. Due to the bear scavenging, we could not determine exact cause of death, but the movement pattern clearly demonstrated the elk was moribund. The second mortality occurred in January 2009, when the cow elk was shot during the Gardiner (HD 313) late-season hunt. This hunter-killed elk had the collar with the GPS malfunction. The malfunction occurred due to the advanced age of the radio collar belting material: the radio collar was in its fourth year of use, and the mechanical components of this collar had been refurbished, but the collar belting material had not. Moisture had seeped into the mechanical workings of the collar and corroded the antenna, rendering the unit unable to take GPS locations.

<u>Brucellosis Sampling Results.</u>

All elk captured were tested for brucellosis exposure using serology and western blot tests to identify whether exposure was to *Brucella* and/or *Yersinia*. In 2007, western blot tests suggested 1 of the 15 elk captured had been exposed to brucellosis. This individual elk disappeared in April 2007 and was either a VHF failure or it moved beyond the study area, and we have no further information. Western blot tests from blood samples from two cow elk (Ear Tag IDs 50242 and 50248) captured on Dailey Bench on 4 February 2008 indicated probable exposure to brucellosis. These elk were euthanized and removed from the Dailey Lake area on

13 January 2009. Elk were necropsied at a central field location under supervision of MFWP veterinarian Dr. Jennifer Ramsey. Carcasses and eviscera were removed from the site, and the site was sterilized. Tissues from these elk were sent for culture at the National Veterinary Sciences Laboratory. The laboratory was unable to culture *Brucella* from the tissues, but *Brucella* is notoriously difficult to culture, even from seropositive elk. From 46 elk captured 2007-2008, (including the 1 capture mortality that was not collared), 3 total indicated exposure to brucellosis by serology, representing a 6% seropositive rate (95% C.I. = 0.01, 0.18)

These seropositive elk showed movement patterns typical of Northern Yellowstone elk studied to date. The GPS collars indicated movement well within the Minimum Convex Polygon (MCP) derived from radio-collared elk 1985-1987, GPS collars from 2007, and VHF locations 2008. Neither elk extended as far to the south or east as other collared (seronegative) elk have moved. Cow elk 50242 and 50248 were 12.5 and 14.5 years old, respectively, and both were pregnant with male fetuses at time of necropsy. Elk 50242 was a late migrant away from its wintering range. She left the Dome Mountain Area and crossed into Yellowstone National Park on 10 July 2008. She spent the rest of July, August and September in Astringent Creek in the Pelican Valley, YNP. She returned to the Tower Junction area during October, and left Yellowstone National Park 18 November 2008. Cow elk 50248 migrated into Yellowstone National Park 26 May 2008. She resided in the Tower Junction area until late June, when she moved along the Yellowstone River and into the Hayden Valley where she remained until early August. She returned to the Mirror Plateau area during late August and September. In October, she moved through the Lamar Valley and left Yellowstone National Park 11 November 2008. This elk had multiple lung cysts, believed to be hydatid disease (*Echinococcus granulosis*). Lung tissue and other samples were collected for culture. This elk represented a lower risk of brucellosis transmission to livestock than 50242, as more of her time during February-June occurred on NPS and MFWP lands or on private lands south of Dailey Lake that do not run cattle.

Calving Areas

Elk locations during calving season (May 16-June 15) were generally similar between 2008 and 2007, with the majority of locations on National Park Service (59%, 78%), private land (18%, 16%), and U.S. Forest Service lands (15%, 6%). The 2008 data also included 7.5% of total locations on MFWP, BLM, or state lands. Notably, 1 elk spent a portion of calving season in Wyoming on Forest Service lands outside Yellowstone National Park along the North Fork of Shoshone River towards Cody. The apparent weather-related delay in spring migrations (see pages 8-10) nonetheless did not largely increase the proportion of locations on private lands, but did increase the amount of locations on U.S. Forest Service lands. Elk distribution during the 2007 and 2008 calving seasons were similar to the VHF distributions from 28 cow elk monitored over 1984-1987, suggesting no apparent behavioral shifts in calving behavior over the last 25 years (Figure 2). Radio telemetry studies in other areas within southwest Montana have documented a recent trend toward elk calving and remaining for longer periods of time on lower elevation agricultural areas in private ownership (Cunningham and Hamlin, unpublished data).

Summer Ranges

Although elk calving areas showed little difference between 1984-1987, 2007, and 2008, different summering (July-August) areas were detectable (Figure 3). Summer home ranges differed across individuals, and sampling was a key consideration. During 1984-1987, counts of the Northern Yellowstone elk herd ranged from 16,000 to 17,000, whereas by 2007 and 2008, the population counts ranged from 6,300 to 6,700. Therefore, the 28 elk followed 1984-1987 represent a smaller proportion of the overall Northern Yellowstone herd than the 42 followed 2007 and 2008 (Figure 4). Similarities between 1984-1987 and 2007-2008 included summer ranges in Slough Creek, the Upper Gallatin, the Mirror Plateau, and the east side of Yellowstone Lake. Differences included the identification of 5 resident Dome Mountain elk in 1984-1987 compared with none during 2007-2008, as well as the higher diversity of summer locations in 2007-2008, including several areas in the south and west portions of Yellowstone previously not associated with the Northern Yellowstone herds.

Migration Dates and Pathways

We defined spring migration dates by the day elk left their winter range to move towards summer range, and we defined fall migration dates by the day elk left their summer range to return to their winter range or to a staging area. Spring migrations occurred an average of 27 days later in 2008 than in 2007. During 2007, the start of spring migrations was 14 April and the end was 14 June with an average day of departure of 4 May. During 2008, the start of spring migrations was 27 April and the end was 20 July with the average day of departure 31 May. We believe this was attributable to the late spring and the heavy snow pack still present across much of Yellowstone National Park into June 2008. In 2007, the Tower Falls weather station in Yellowstone recorded 103 inches of snowfall during March and April with no snowfall during May. In 2008, the Tower Falls station recorded 342 inches of snowfall during March and April, with an additional 34 inches in May.

Individual variation in timing of spring migration is notable, and timing of spring migrations appear to be more uniformly distributed across April through June than fall migrations (Figure 5). Fall migrations occurred in pulses that likely relate to weather events on the high-elevation plateaus in Yellowstone. During 2007, 78% of elk left summer range to return to the staging area in the Lamar Valley during October, whereas during 2008, only 30% of elk left fall ranges by October with the remaining 70% leaving over a 17-day time window during November. The Tower Falls weather station indicated heavier snowfall in October 2007 (112 inches) than in 2008 (66 inches), suggesting elk responded to weather conditions by an earlier fall migration in 2007 than 2008.

Elk migrations during 2007-2008 were comparable to those documented 1984-1987 although the earlier study relied on periodic VHF relocation flights and did not benefit from the more frequent 30-minute interval relocations made possible with the newer GPS collars. During 1984-1987, spring migrations began as early as April and generally extended through June and July. During October and November, elk moved to the same fall staging area in the Lamar Valley, moving out of the Park and back to winter range by December and January.

The 30-minute interval between GPS locations provided fine resolution to determine elk migratory pathways. We identified several corridors that elk used in spring and summer migrations. One key corridor occurs between Tower and Canyon, where 7 elk moved along a very thin route over Tower Creek to Dunraven Peak (Figure 7). Elk using this pathway spent summer in the Hayden Valley (n=1), near West Thumb (n=2), Grant Village (n=1), Heart Lake (south arm Yellowstone Lake, n=1) or Lewis Lake (n = 2). Interestingly, the seven elk using the same trail did so on different days, indicating this route is preferred by many elk/groups and not just a one time movement by one large group. In spite of the different days traveled, the elk movements occurred over a distinct, narrow trail. Spring use dates included 5 May, 16 May, 31 May, 5 June, and 14 June (2 elk did not use the trail in spring but did in fall). Fall use dates included 8 October, 11 October, 12 October, 16 October, 10 November, 11 November, and 16 November.

Another pathway existed between Specimen Ridge and Pelican Cone, used by 5 elk in spring and fall (Figure 8). These elk spent the summer at Lewis Lake (n = 1), the Pelican Valley (n = 3), and the southeast arm of Yellowstone Lake (n =1). The Yellowstone River and the Lamar Valley were also key migration pathways in spring and summer for elk moving across Yellowstone. Elk followed the river bottoms to "exit points", where they moved across mountain pathways to summer ranges. The individuals monitored also used the same trail on different dates, ranging from 5 May to 26 July for the spring migration and 10 October to 11 November for the fall migration.

Perhaps the most important migration pathway is the corridor between Yellowstone National Park and Dome Mountain Wildlife Management Area (Figure 9). This corridor exists largely on the east side of Highway 89, and was used by 37 of the 42 elk collared. The corridor extends for approximately three miles east of Highway 89 and runs for a north-south distance of about 11 miles between Dome Mountain Wildlife Management Area and the Yellowstone National Park boundary. This crucial corridor occurs primarily on U.S. Forest Service lands within the Northern Yellowstone Elk Herd Management Area, which was expanded through an interagency public land acquisition of 8,900 acres in the early 1990s. Public landownership and management direction should protect this important migratory corridor into the future.

Pregnancy Rates and Calf-Cow Ratios

Pregnancy rates, based on PSPB blood tests, from 31 captured elk in 2008 (30 were radio-collared) indicated 1 non-pregnant yearling elk, 24 pregnant adults and 6 non-pregnant adults, for an adult pregnancy rate of 0.80 (95% C.I. = 0.61, 0.92). The pregnancy rates from 2007 included 1 non-pregnant yearling and 14 pregnant adults for an adult pregnancy rate of 1.00 (95% C.I. = 0.77, 1.00). Pooled across years, the pregnancy rate for 44 adults was 0.86 (95% C.I. = 0.73, 0.95).

We classified elk groups associated with elk radio collars during all flights June-August. This encompassed 7 flights, 50 elk groups, and 2,873 elk classified (Table 1). The average June calf:cow ratio was 0.22, declining to 0.19 in July and 0.14 in August. However, elk calf survival rates are known to vary widely across Yellowstone (Barber-Meyer et al. 2008), so we described calf:cow ratios observed during 3 flights in July to document variability in calf production across the study area (Table 2). We documented the highest calf:cow ratios inside Yellowstone and associated with Tower Falls and Specimen Ridge (0.62-0.65), the next highest outside Yellowstone in Rock Creek and Mulherin basin (0.36-0.43), low calf:cow ratios in the Gallatin Range and Obsidian Creek (0.13-0.17) and the lowest across Cache-Calfee, south arm Yellowstone Lake, and the Mirror Plateau (0.00-0.03). These ratios are in general agreement with Barber-Meyer et al. (2008), which suggested the highest calf survival rates associated with Stephens Creek and Mammoth (the north boundary of Yellowstone), the next highest in the Tower area, and lower survival rates in the Lamar Valley.

A large sample of 3,000-4,500 northern range elk are classified from a helicopter every year between late February and early April to monitor elk recruitment and adult sex ratios. Over the entire area calf to cow ratios at that time of year have ranged from 0.11-0.29 during the past

10 years (mean = 0.18). Calf recruitment in these surveys typically varies geographically across the winter range with the highest recruitment occurring north of Yellowstone Park and the lowest recruitment occurring in the upper Lamar winter range. Low elk recruitment rates have been a source of concern and a major factor in reducing Gardiner Late Hunt elk harvests over the last 10 years. Statewide Elk Plan criteria for the Northern Yellowstone elk population outlines a goal of maintaining a calf:cow ratio of at least 0.20, with a typical historic range of 0.20-0.30. Late winter/early spring elk calf:cow ratios have been < 0.20 in 6 out of the last 10 years.

MANAGEMENT IMPLICATIONS

Elk in the Northern Yellowstone have shown general consistency with winter and summer movement and migration patterns and timing over 1984-2008. This is important as it suggests natural processes continue to be major drivers in the spatial ecology of this herd, especially as compared with nearby herds that are largely affected by human processes such as agricultural practices, hunting seasons, and no-hunting private land refuges (Hamlin and Cunningham 2009). Hunting seasons showed only minor effects in spatial ecology of the Northern Yellowstone, but some individual animals remained within National Park boundaries until the end of the general hunting season.

The 2007-2008 data showed some key differences from 1984-1987 that will affect management of this herd. These data demonstrated much greater seasonal use of Yellowstone National Park than had been documented previously: the Northern Yellowstone herd used summer areas in western Yellowstone, southern Yellowstone, and northeast Yellowstone, placing them in some spring/summer distributional overlap with elk wintering in Wyoming. This overlap has implications for possible brucellosis transmission risk, given the calving season association with elk populations with higher brucellosis seroprevalence (e.g., Jackson Hole elk or Sunlight-Crandall Basin elk; Cross et al., *in press*).

Of the 42 radio collars on adult cow elk that lasted the full year of deployment (we censored 2 capture-related mortalities), we recorded only 2 mortalities: one from grizzly bear predation (autumn), and one from a late-season elk hunter. Survival rates of adult females were high (0.95, 95% C.I. = 0.84, 0.99), but summertime calf:cow ratios associated with the radio collars were often impressively low (9 calves associated with 258 cows in the Mirror Plateau) suggesting the importance of early-season calf mortality in some areas of Yellowstone. These data corroborate those in Hamlin and Cunningham (2009) and Barber-Meyer et al. (2008) suggesting that dwindling recruitment via predation may be an important factor in the documented numerical decline of the Northern Yellowstone elk herd.

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The elk capture crews deserve special thanks, for without their efforts, this study would have been impossible. Pilots Mark Duffy and Steve Collins provided excellent and safe services, wildlife veterinarians Dr. Mark Atkinson and Dr. Tom Roffe established capture protocols, "gunner" Mike Ross exhibited exceptional accuracy in darting and handling nearly every elk from this study, regional wildlife manager Kurt Alt provided coordination with pilots and crews, and Coleen O'Rourke provided essential services with sample collection and organization.

We would also like to thank the Montana Fish, Wildlife and Parks Wildlife Laboratory personnel for their devoted efforts in preparing and executing the biological sampling. Laboratory manager Neil Anderson provided guidance throughout the project regarding elk capture and brucellosis sampling. Laboratory assistants Jen Williams and Kevin Hughes prepared sampling kits and processed samples. Dr. Jennifer Ramsey performed necropsies and tissue collection from the brucellosis seropositive elk.

Finally, we thank the large crew of people who helped retrieve the elk radio collars in timely fashion for them to be re-deployed in 2009 along the west side Paradise Valley. These people include: Neil Anderson, Kevin Hughes, Tom Everett, Rose Jaffe, Ashley Beyer, Claire Gower, and volunteers Jesse DeVoe, Christine de Caussin, Elizabeth Flesch, Gry Gasbjerg and Arnstein Knutsen.

FIGURES

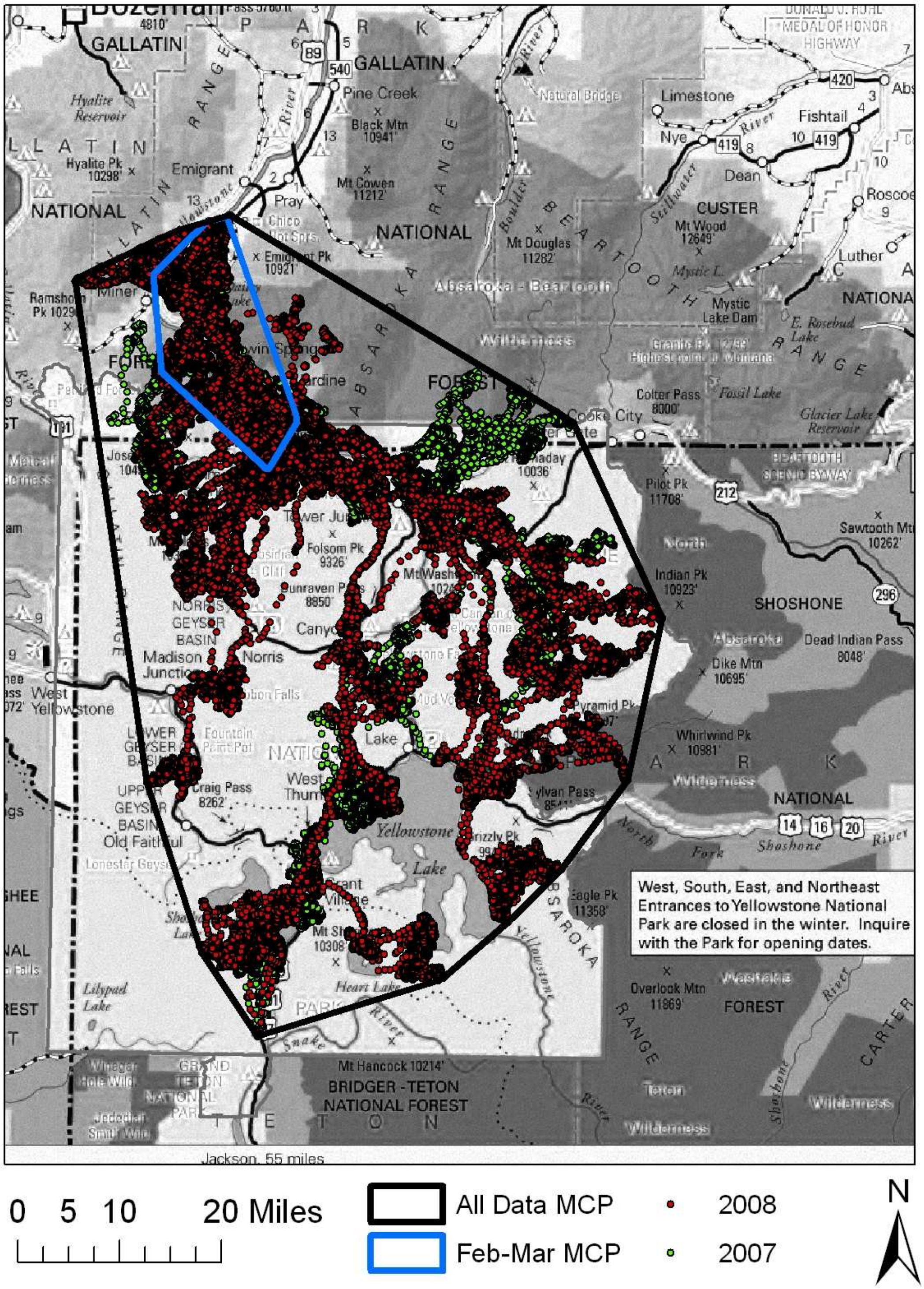


Figure 1: All elk locations from 2007 (13 elk, green), and 2008 (27 elk, red). The capture areas fall within the February-March minimum convex polygon (blue) and the entire study area is encompassed by the black minimum convex polygon.

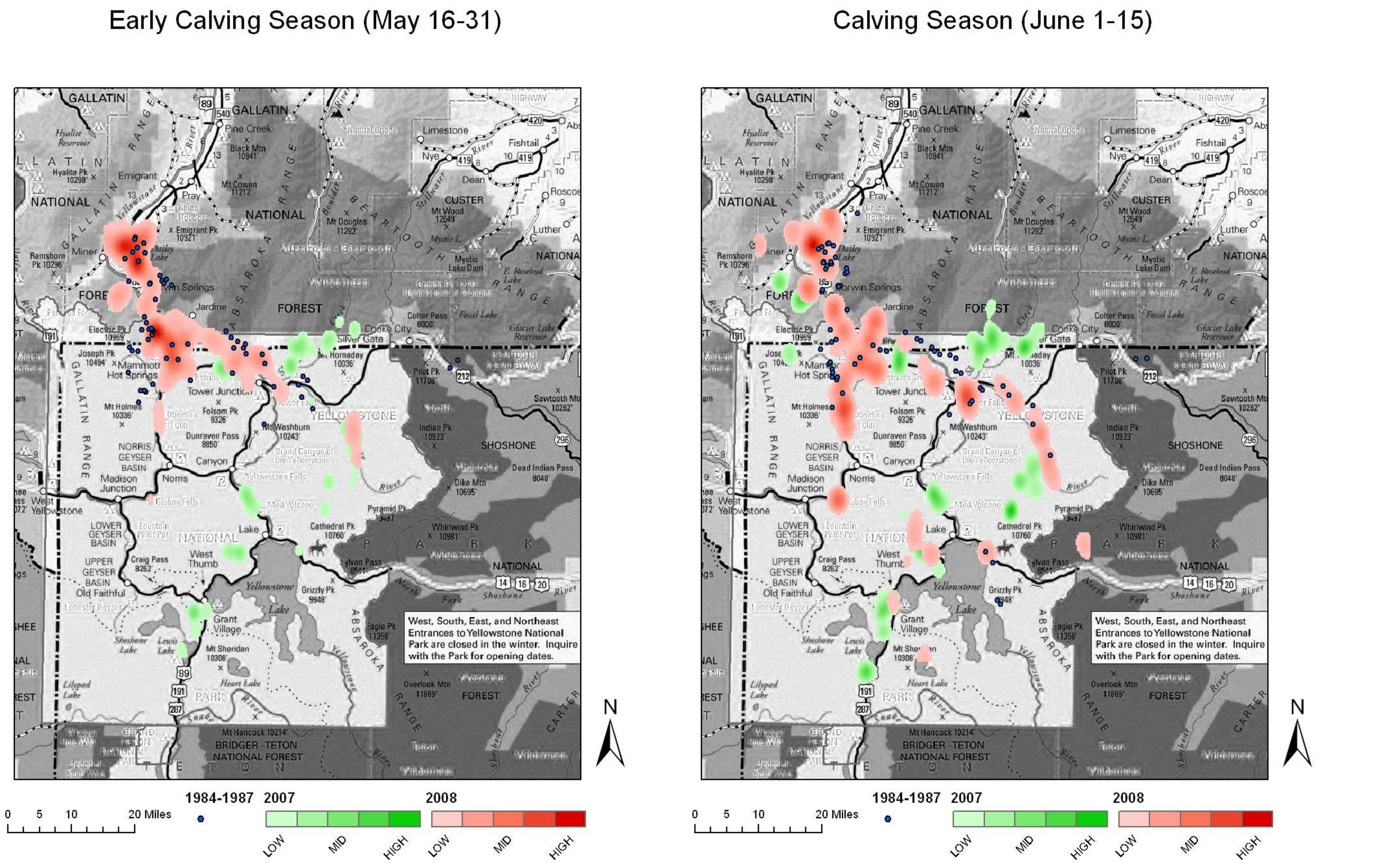


Figure 2: Early (May 16-31) and calving (June 1-15) seasons using 2007, 2008 and 1984-1987 cow elk captured in Montana hunting district 313.

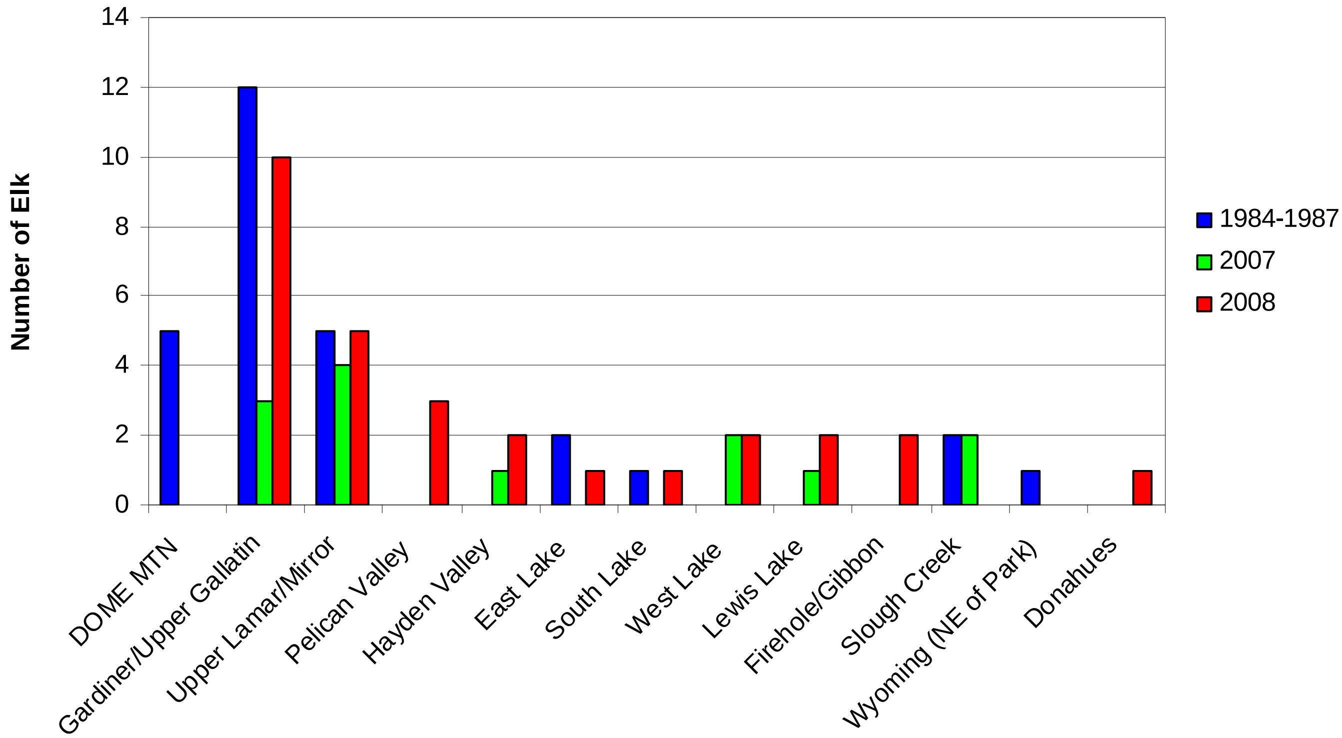


Figure 3: Summer locations of 28 cow elk captured 1984-1987, 13 during 2007 and 29 during 2008.

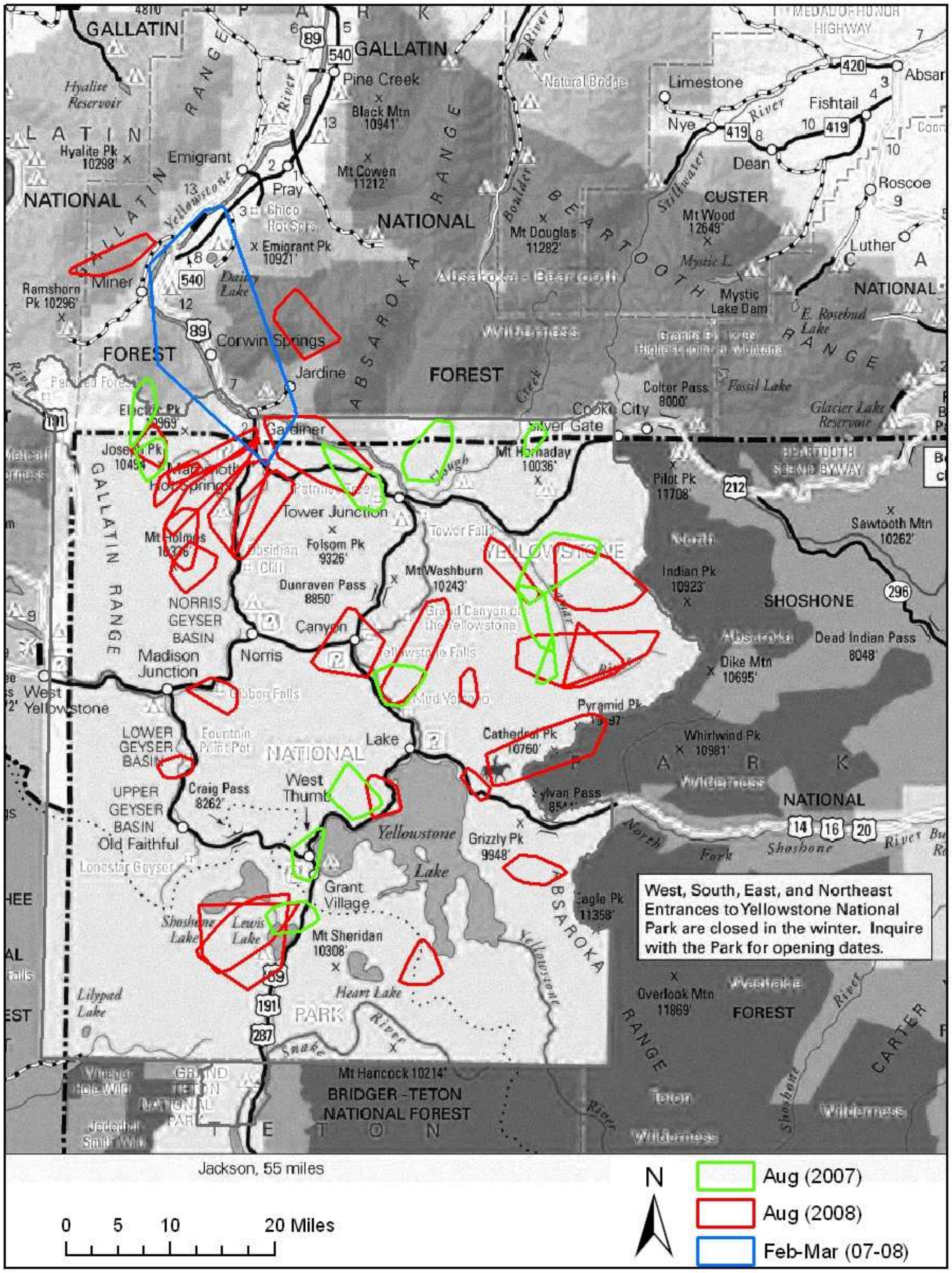
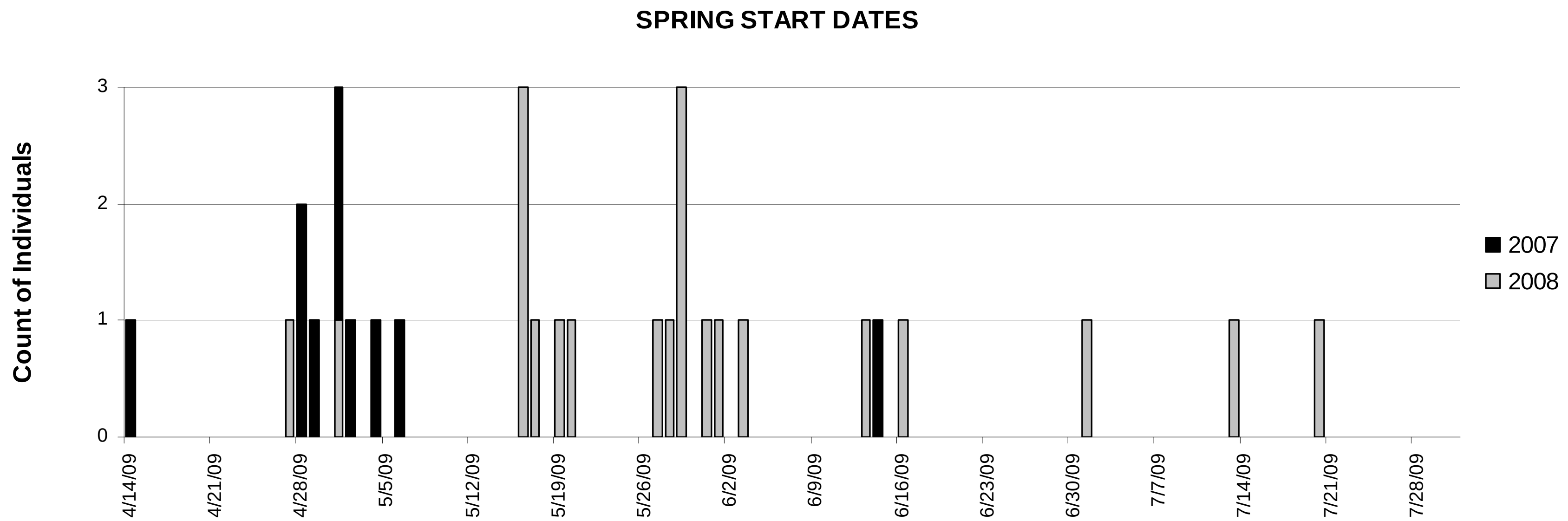


Figure 4: Minimum convex polygons surrounding point locations from the August locations of 12 elk captured in 2007 (green), the August locations of 27 elk captured in 2008 (red) and the cumulative winter time (February-March) locations of 39 elk captured 2007-2008 (blue).



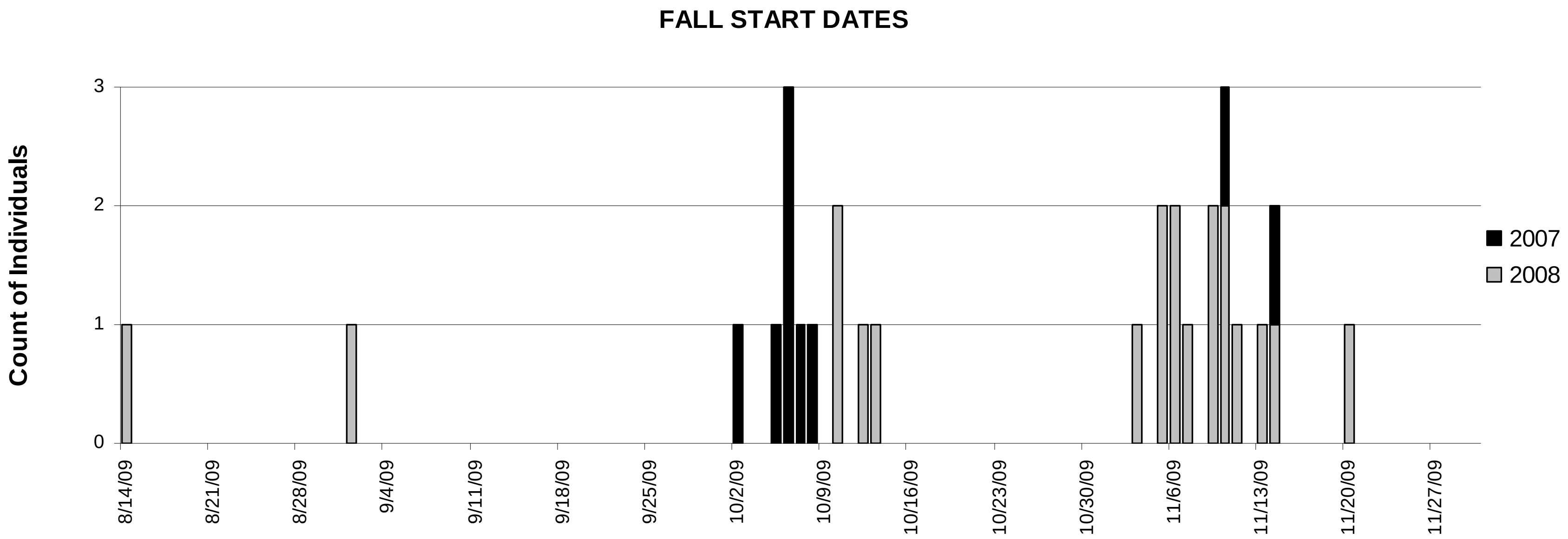


Figure 5: Elk migration dates in 2007 and 2008. Spring start dates are the day that movement to summer ranges began, fall start dates are the dates that movement away from summer ranges began. Note that data from the two years are stacked: 2007 atop 2008 for the same calendar date.

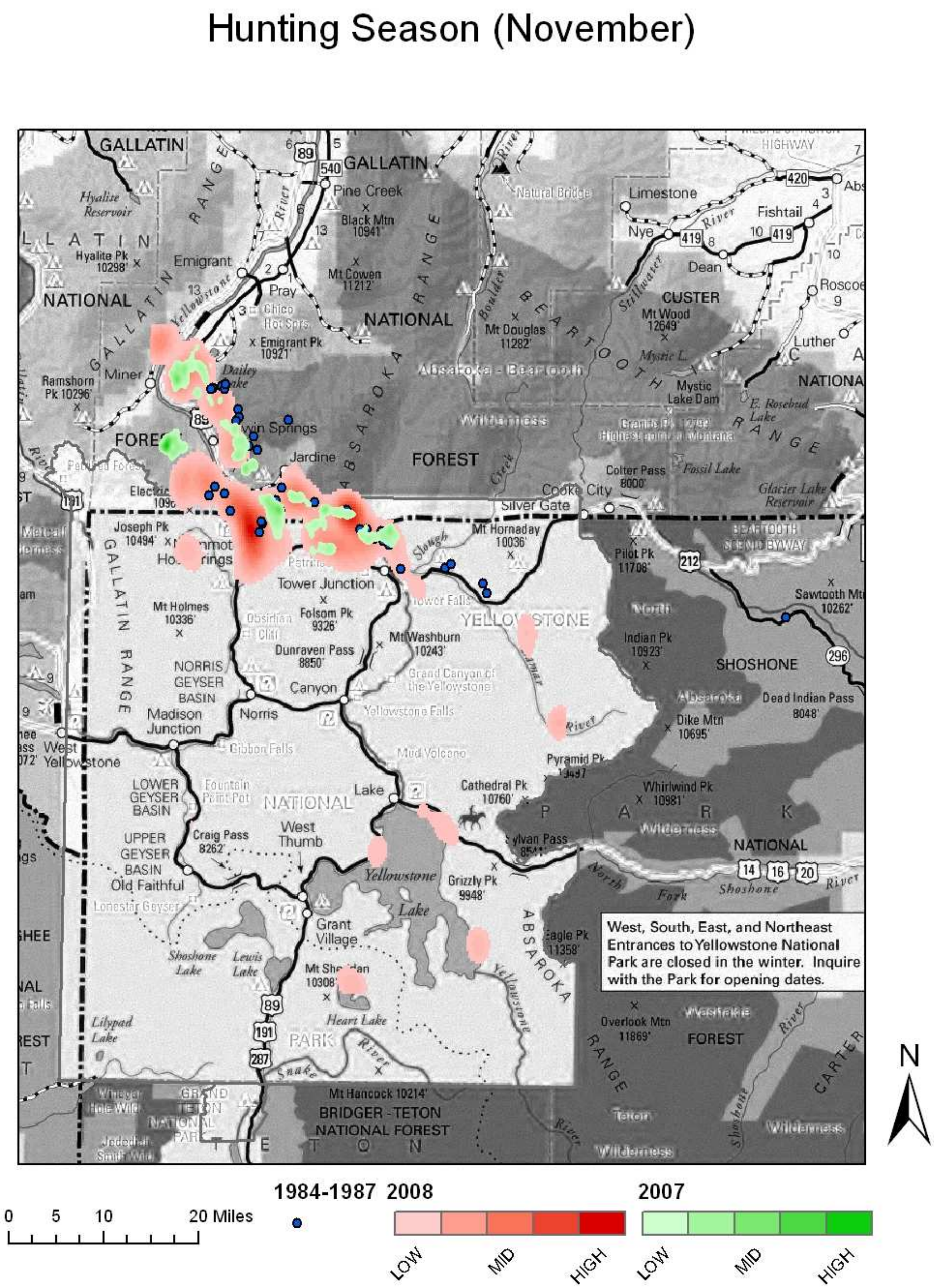


Figure 6: Elk locations during November 2007, 2008 and 1984-1987. Red and green colors are kernel density estimators showing elk distribution centers.

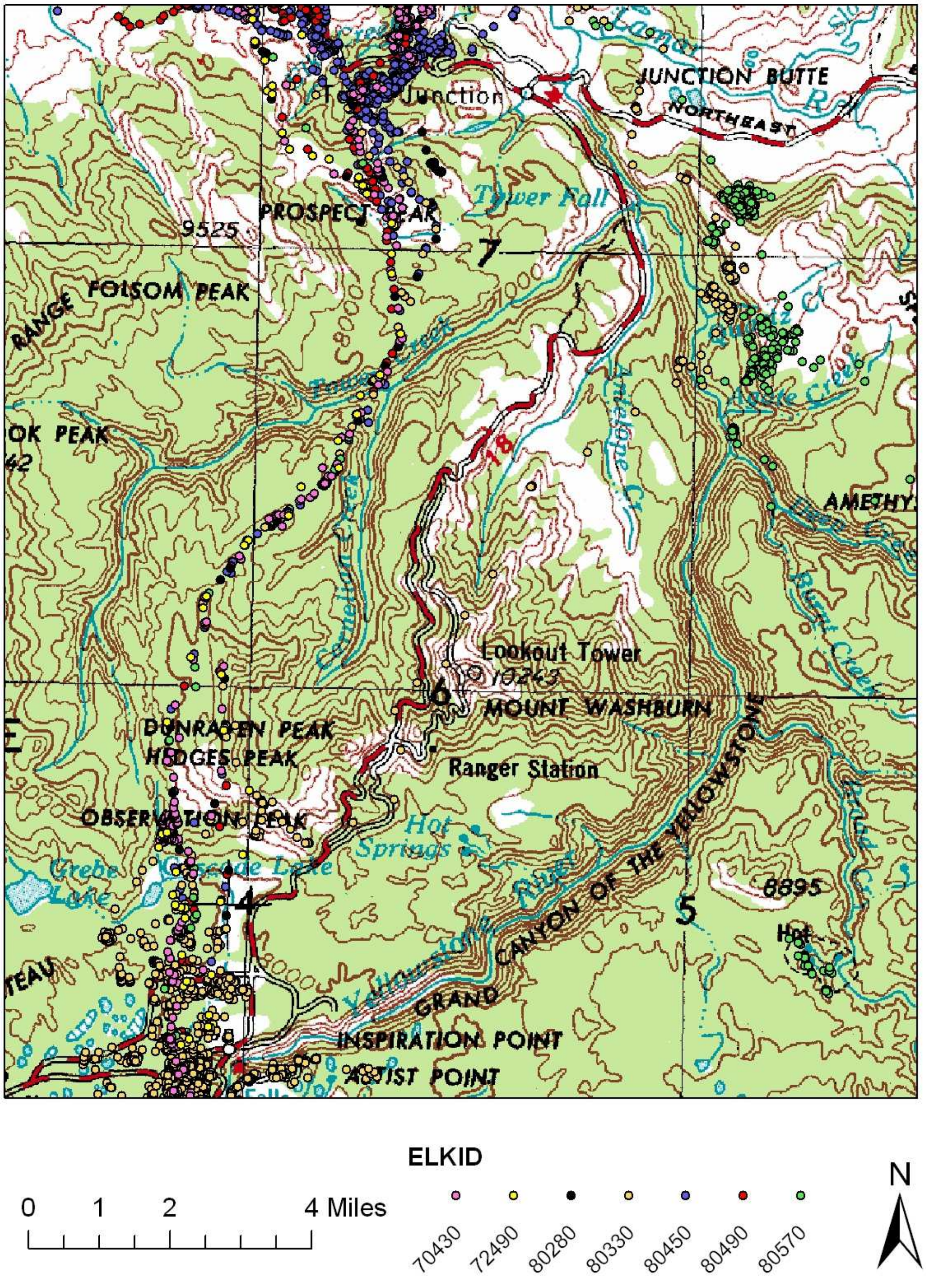


Figure 7: Elk migratory movement (fall and spring) between Tower and Canyon 2007 and 2008.

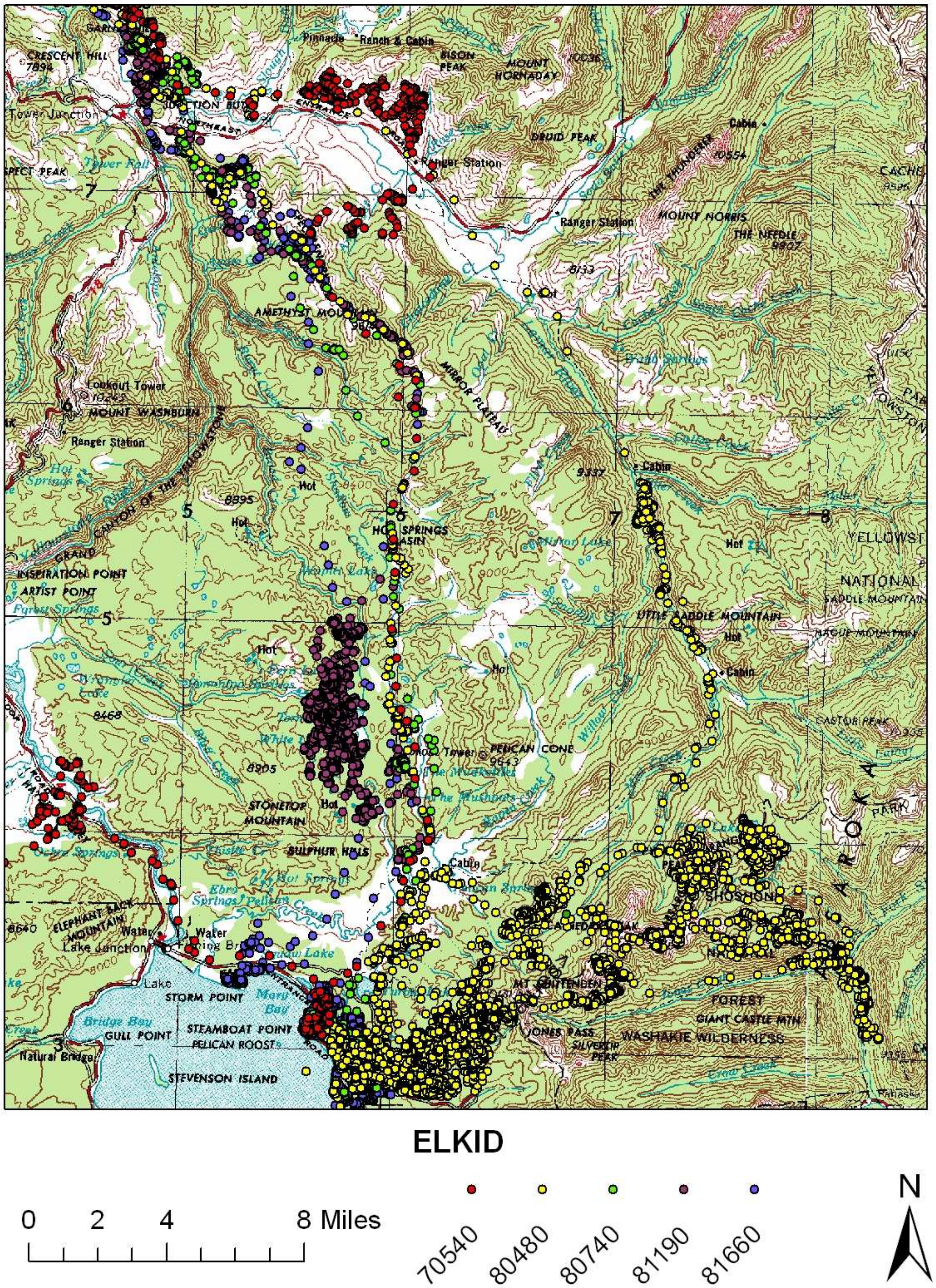


Figure 8: Migration pathway used between Specimen Ridge and Pelican Cone by elk in 2007 and 2008.

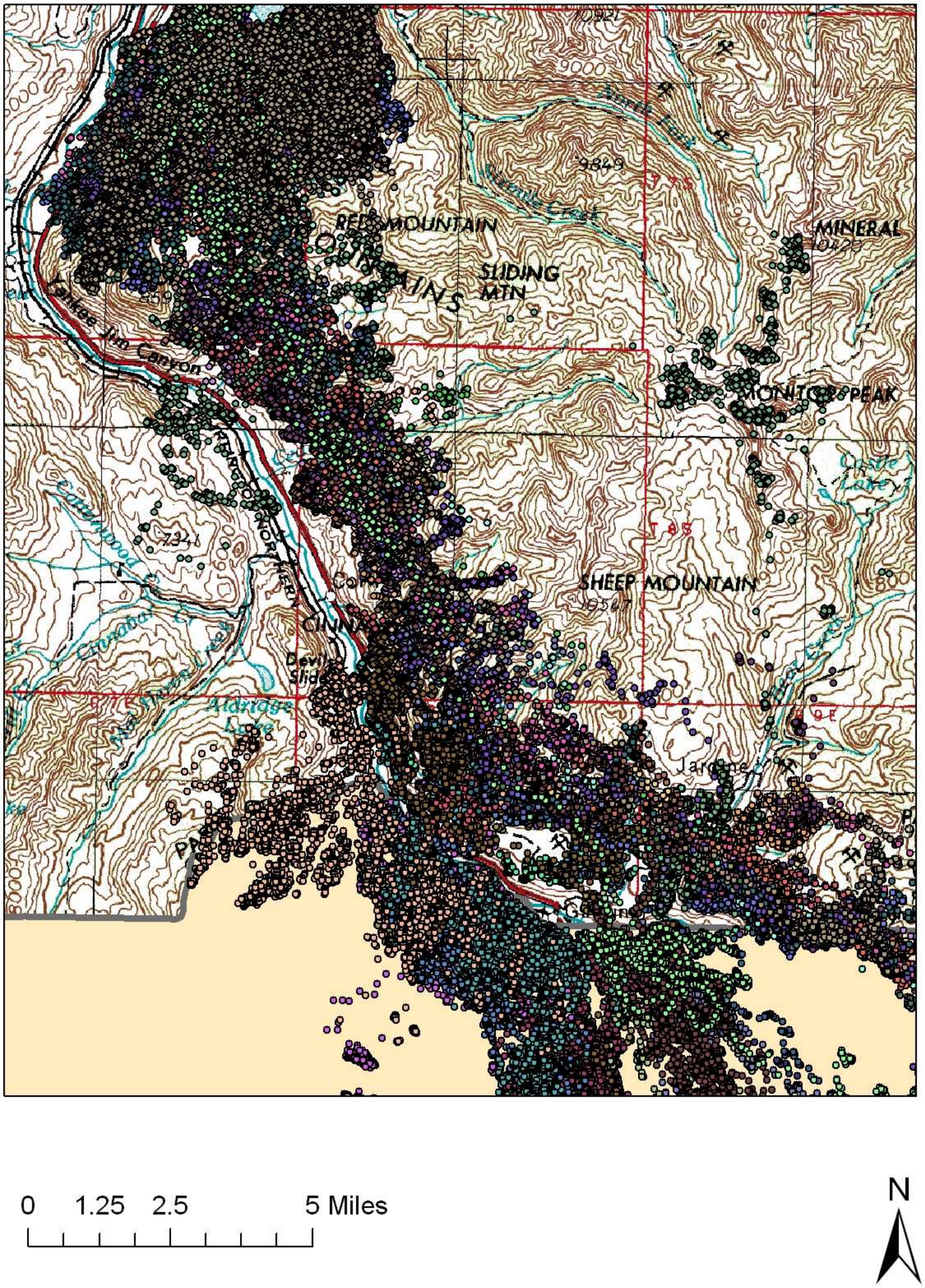


Figure 9: Elk migration corridor during fall and spring, using 2007 and 2008 GPS collar data. Different colors display 37 different individual elk that use the approximately 11 mile long by 3 mile wide corridor between Dome Mountain WMA (cluster of locations at top left) and Yellowstone National Park (tan color, solid fill at bottom of map).

TABLES

Table 1: Cumulative calf:cow ratios across the study area during flights June-August 2008.

	June	July	August
Cows	645	1060	671
Calves	141	204	91
Bulls	31	30	0
Total	**817**	**1294**	**762**
Calf:Cow	0.22	0.19	0.14
LCI, UCI	0.19, 0.25	0.17, 0.22	0.11, 0.16
# Flights	2	4	1
# Groups	26	17	7

Table 2: Classifications of elk groups seen in specific summering areas during three flights in July 2008.

Approximate Loc	Calf:Cow	LCI	UCI	Calves	Cows
MULHERIN CR – HD 313	0.43	0.30	0.57	24	56
ROCK CR – HD 314	0.36	0.30	0.43	82	228
GARDINER	0.00	0.00	0.25	0	13
GALLATIN RANGE	0.13	0.09	0.17	42	325
OBSIDIAN CR	0.17	0.08	0.30	9	53
TOWER	0.62	0.32	0.86	8	13
SPECIMEN RIDGE	0.65	0.50	0.79	30	46
MIRROR PLATEAU	0.03	0.02	0.07	9	258
CACHE-CALFEE	0.00	0.00	0.09	0	37
S.ARM YELLOWSTONE LAKE	0.00	0.00	0.11	0	31
TOTAL	**0.19**	**0.17**	**0.22**	**204**	**1060**