Winter Effects on the National Elk Refuge and Jackson Elk Herd in 2017 and 2018: Comparison of a Heavy-Feeding versus No-Feeding Winter

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Summary:

Winter severity as measured by the depth, density, and snow-pack distribution has significant effects on ungulate migration timing, survival and distribution. The National Elk Refuge (NER) in Jackson Hole, Wyoming provides winter habitat for 50-95% of the Jackson elk herd and 80-95% of the Jackson bison herd each winter. During most winters, elk and bison are fed supplemental alfalfa pellets on NER to minimize elk winter mortality, support Wyoming elk population objectives, and prevent elk and bison from causing damage on private land adjacent to NER.

Although 2017 was a severe winter in Jackson Hole for wintering ungulates based on valley snow accumulation, 2018 was one of the mildest. 2018 was one of only 10 winters where no supplemental elk feeding occurred since the National Elk Refuge (NER) was established in 1912. The contrast in conditions between 2017 and 2018 provides an opportunity to examine winter severity relative to key metrics such as elk numbers, elk winter mortality, elk movements, and NER visitation. Table 1 summarizes key metrics during the severe winter of 2017 compared to the mild winter of 2018.

In general elk numbers on NER were above average in both 2017 and 2018 winters, largely due to a high percentage of the overall Jackson Elk Herd wintering on the Refuge. However elk distribution on NER differed markedly between the 2 years, with almost all elk use confined to lower elevations on the southern half of the Refuge during the severe winter of 2017. In contrast there was significant elk use of the higher elevation areas on the north end of NER during the mild winter of 2018. Preliminary analysis of elk GPS collar data suggests that elk were more densely congregated during the severe winter of 2017 compared to the mild winter of 2018.

Although supplemental feeding generally reduces overall winter mortality in the Jackson Elk Herd, it does not entirely mitigate the effects of harsh winter conditions on wintering elk. Despite feeding earlier and at a higher rate than average in 2017, total elk winter mortality was well above average, and calf elk winter mortality was the highest in 36 years of comparable measurements. In contrast, there was no supplemental feeding in 2018, yet total elk winter mortality was below average and calf elk winter mortality was among the lowest on record.

NER visitation as measured by the number of people using the sleigh ride concession was a record high in 2017. Although lower in 2018, sleigh ride visitation was still the 5th highest on record in 53 years of measurement. The average number of elk counted in the sleigh ride area was approximately 1,000 fewer in 2018 compared to 2017, but on most days elk were present in the area where the sleigh rides operated despite the absence of supplemental feeding. There was surprisingly little public comment regarding the lack of feeding in 2018. A common theme to public comments was that people saw

many elk on the Refuge in 2018, and because many elk were visible, they erroneously assumed that supplemental feeding operations were occurring.

The winter of 2018 provides evidence that under mild conditions supplemental feeding is not necessary. In winters with low snow cover and no supplemental feeding, large numbers of elk and bison can find sufficient forage on the Refuge with minimal winter mortality and minimal conflicts on surrounding private land. Even in the absence of feeding, NER provides critical winter habitat for elk and other ungulates and can still provide ample opportunities for wildlife observation and interpretation.

In contrast, the severe winter of 2017 suggests that under deep, dense snow conditions supplemental feeding partially mitigates for winter mortality in elk and likely prevents large numbers of elk and bison from moving onto roadways and surrounding private lands. Future efforts to reduce reliance on supplemental feeding by shortening feed season length and increasing the frequency of years without feeding will require reduction in the number of elk wintering on NER and mitigating the effects of elk and bison moving to surrounding private land. Recent changes in elk winter distribution patterns (an increasing proportion of the Jackson Elk Herd wintering on NER) will complicate these efforts.

Table 1. Comparison of key metrics for the severe winter of 2017 and the mild winter of 2018 on the National Elk Refuge		
	2017	**2018**
Average snow-pack depth at NER HQ, 1 January-31 March	13”	4”
Peak snow-pack depth at NER H.Q.	27” on 2/7/2017	13” on 3/3/2018
Peak Snow Water Equivalent at the Jackson, WY Weather Station[1]	6.3”	1.9”
Supplemental Feeding Days	76	0
Refuge-Wide Herbaceous Forage Production in Prior Growing Season	14,480 tons	13,930 tons
Average Number Bison on South NER,	400	169
Average Number Elk on South NER, 1 January through 31 March	6,700	4,500
Classified Elk on South NER in Late February	8,879	8,188
Classified Elk on entire NER and Adjacent Forest Service in Late February	9,962	10,500
Average Distance (m) between GPS collared elk January through March[2]	2,667 m	3,261 m
Elk Winter Mortality, Total	312 (3.5% of classified elk)	92 (1.1% of classified elk)
Elk Winter Mortality, Calves	210 (19.6% of classified calves)	6 (0.5% of classified calves)
Elk Winter Mortality, Spike bulls	5 (1.2% of classified spikes)	1 (0.3% of classified spikes)
Elk Winter Mortality, Cows	41 (0.7% of classified cows)	20 (0.3% of classified cows)
Elk Winter Mortality, Mature Bull	56 (3.4% of classified bulls)	65 (8.4% of classified bulls)
Elk mortalities with foot rot symptoms	32	7
Elk mortalities with scabies symptoms	32	50
Elk mortalities, wolf-related	10	1
Average Number of Wolves Observed on NER per Observation	4 (10 observations)	1 (4 observations)
Average Elk Arrival Date on NER Based on GPS collar data	12/7/2016 (range 11/25/2016-1/29/2017)	12/16/2017 (range 11/6/2017-1/29/2018)
Average Elk Departure Date from NER Based on GPS collar data	4/17/2017 (range 3/26/2017-5/8/2017)	4/22/2018 (range 4/6/2018-6/13/2018)
Average Number of Elk in Sleigh Ride Area	2,200	1,220
Total Sleigh Ride Users	32,753	28,921

[1]Analysis courtesy of Phil Farnes, Snowcap Hydrology

[2]Analysis courtesy of Carson Butler, Grand Teton National Park

Winter Severity and Feeding Initiation Determination

Wyoming Game and Fish Department (WGFD) biologists and NER biologist Eric Cole cooperatively monitor snow and forage conditions each winter to determine if and when supplemental feeding is necessary. The recommendation to begin supplemental feeding is based on criteria that are mutually agreed upon between the Refuge and WGFD. These criteria state that when average available forage declines to 300 lbs. per acre at key index sites, supplemental feeding is typically warranted, but feeding start date can also be influenced by elk behavior or other factors.

Key index sites represent areas known to have received high elk and/or bison utilization in previous years, represent a range of geographic locations on the south end of the Refuge, and have been associated with elk movements off the Refuge to surrounding private land when average forage levels declined to approximately 300 lbs. per acre in previous years. During the severe winter of 2017, deep, dense snow accumulation occurred early in the season (Figure 1.), available forage approached the 300 lbs. per acre threshold in early January (Figure 2.), and some elk were attempting to leave the Refuge into the Town of Jackson. These conditions led to initiating feeding 2 weeks earlier than the average on 1/7/2017.

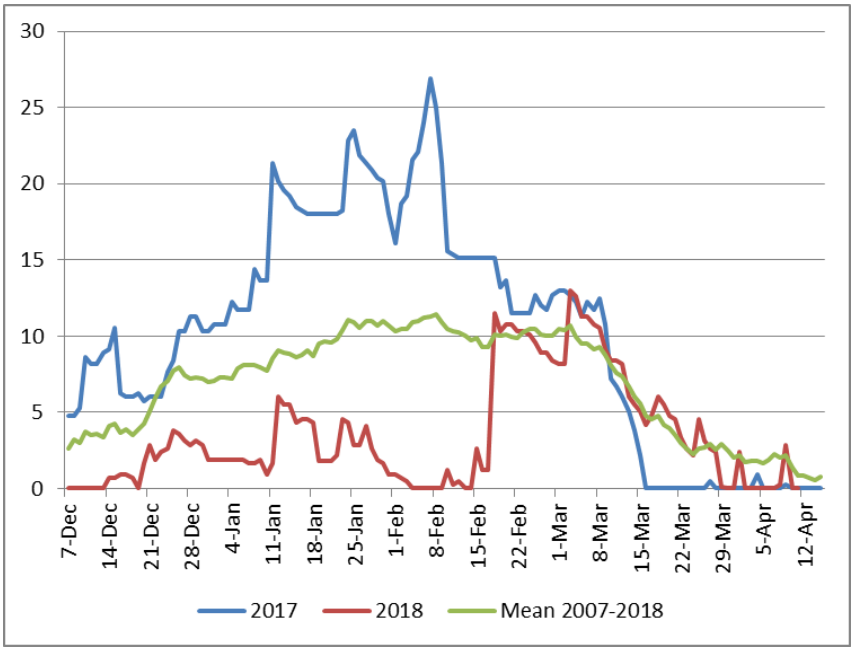

Figure 1. Daily snow-pack depth (inches) during the severe of 2017 (blue) and the mild winter of 2018 (red) compared to the 2007-2018 average (green) at National Elk Refuge Headquarters.

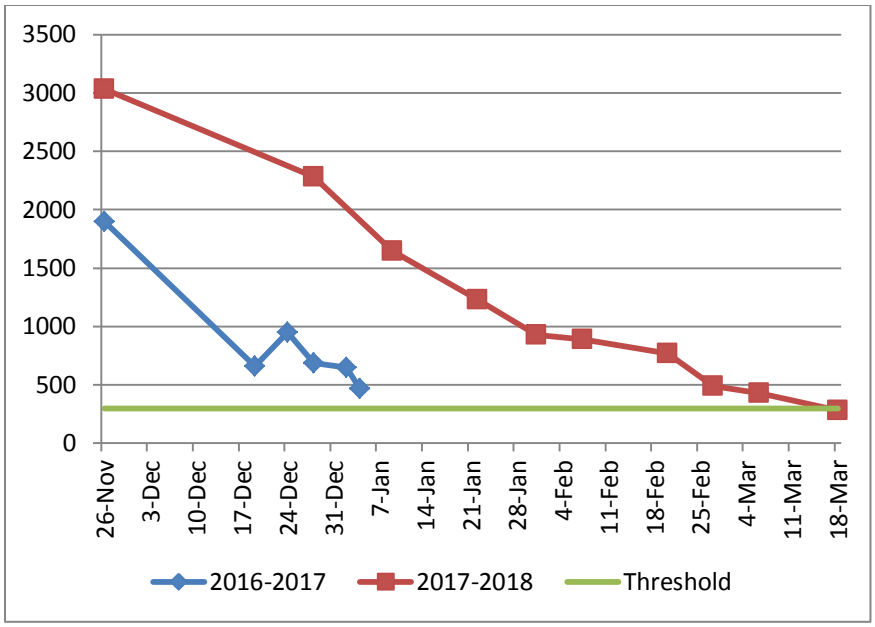

Figure 2. Average available forage at key index sites on the National Elk Refuge (lbs. per acre during 2017 winter in blue and 2018 winter in red) compared to the 300 lbs. per acre threshold level (green) where supplemental feeding is typically recommended.

In contrast, during the mild winter of 2018, snowpack depth was well below average until mid-February (Figure 1.). Baseline average available forage at key index sites measured in Fall 2017 by clipping, drying and weighing prior to any significant elk and bison utilization or snow accumulation was 3,163 lbs. per acre. WGFD and NER staff estimated available forage at these sites on roughly a weekly basis from 12/28/2017 to 3/18/2018 during which available forage declined from 2,283 to 283 lbs. per acre (Figure 2.).

On average, the 300 lbs. per acre available forage threshold is reached by the third week of January. Although feeding is typically recommended when average available forage declines below 300 lbs. per acre at key index sites, and we estimated 283 lbs. per acre on 3/18/2018, WGFD and NER staff determined that supplemental feeding was not necessary in 2018. Elk GPS collar data and concurrent observations by WGFD staff suggested that despite the decline in available forage below the 300 lbs. per acre threshold, elk were remaining on the Refuge and not co-mingling with livestock or causing other problems on surrounding private land. Likewise, there was no evidence that large numbers of elk were nutritionally stressed in 2018, and elk winter mortality was well below average in most age and sex classes. There is also evidence that feeding operations cause stress to elk (Forristal et al. 2012) and that some elk cannot adjust to the rich alfalfa diet leading to increased mortality once supplemental feeding begins (NER unpublished data). Therefore, WGFD and NER staff decided that under mild winter conditions, starting feeding in March would likely cause more elk mortality than it would prevent and decided not to initiate supplemental feeding operations in 2018.

Elk Winter Mortality

NER staff has consistently monitored winter elk mortality using comparable methods and effort since 1981. Elk winter mortality was among the highest on record in 2017 (Figure 3). In contrast elk winter mortality was below average in 2018, even in the calf segment (Figure 3). Because of their relatively small size and lack of fat reserves, elk calves are particularly vulnerable to severe winter conditions (Singer et al. 1997). However, only 6 elk calf mortalities (0.5% of elk calves classified on southern NER) were documented on NER during winter 2018. Very low elk calf mortality provides further evidence that supplemental feeding was not necessary in winter 2018.

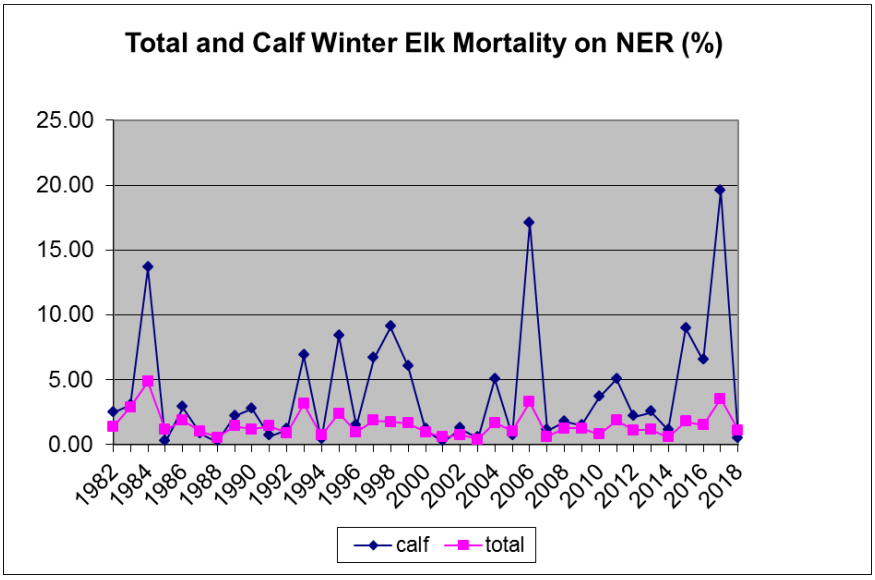

Figure 3. Total winter elk mortality (percent of classified population on southern NER) and calf elk winter mortality (percent of elk calves classified on southern NER) on the National Elk Refuge, 1982-2018.

Mature bull elk mortality was much higher than average during winter 2018 (Figure 4), and in both 2017 and 2018 most bull elk that died exhibited hair-loss symptoms consistent with scabies. Scabies-related mortality is common on the National Elk Refuge (Samuel et al. 1991, Smith 1998), and may be associated with high bull ratios in the Jackson Elk Herd (Smith 1985). Because of the high prevalence of scabies, neither winter severity nor supplemental feeding intensity appears to have much influence on mature bull elk winter mortality rates on NER. Further analysis of the factors that affect elk winter mortality for all age and sex classes is warranted.

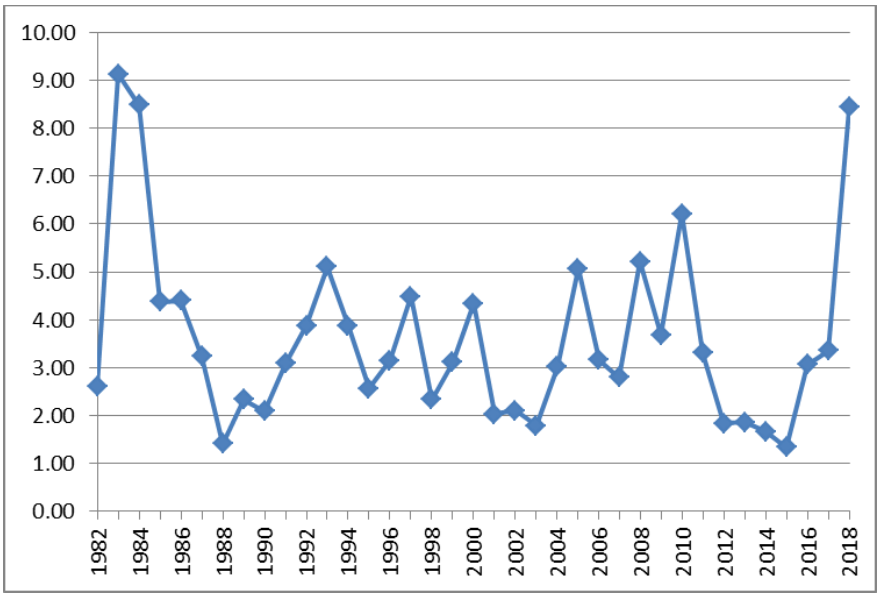

Figure 4. Mature bull elk winter mortality (percent of bull elk classified on southern NER) on the National Elk Refuge, 1982-2018.

Wolf activity was relatively low in both winters, and NER staff detected only 10 wolf-related elk mortalities in 2017 and 1 wolf-related mortality in 2018. Although scavengers rapidly consume most ungulates on NER which makes determining cause of death difficult, we are confident that relatively fewer wolves were observed and fewer confirmed wolf predation events were documented in both 2017 and 2018 compared to previous years.

Winter Elk Distribution and Aggregation Patterns

The proportion of the overall Jackson elk herd that winters on NER has increased significantly in the past 2 decades (Figure 5). In recent years this phenomenon has largely been associated with movement of elk from the Gros Ventre drainage to the National Elk Refuge. Further analysis of the factors that affect winter distribution of the Jackson Elk Herd is warranted.

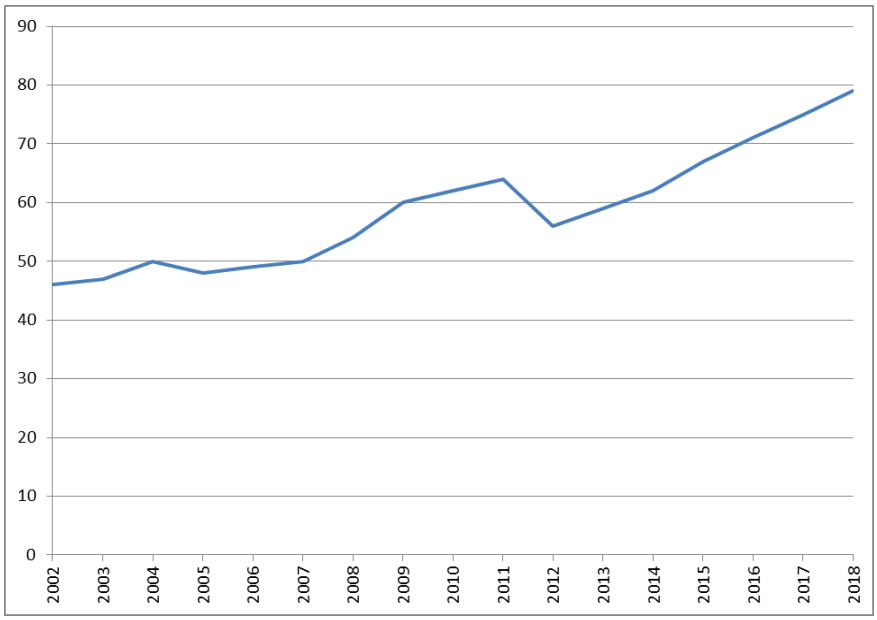

Figure 5. Percent of the Jackson Elk Herd that winters on the National Elk Refuge (3-year moving average derived from herd wide classification counts and the number of elk concurrently classified on the southern portion of NER), 2000-2018.

Elk counts and data from elk collared on the National Elk Refuge indicate that elk were more densely concentrated during the severe winter of 2017 compared to the mild winter of 2018. WGFD and NER staff conduct classification counts via helicopter and on NER feedgrounds in late February each year. In 2017 89% of elk classified on or in the immediate vicinity of NER were on the low elevation areas of southern NER associated with feedgrounds. Only 78% of elk were classified in these areas in 2018. Similarly, GPS collar data showed no use of the north end of NER during the 2017 feed season, but there was widespread use of northern NER during the comparable time period in 2018 (Figure 6).

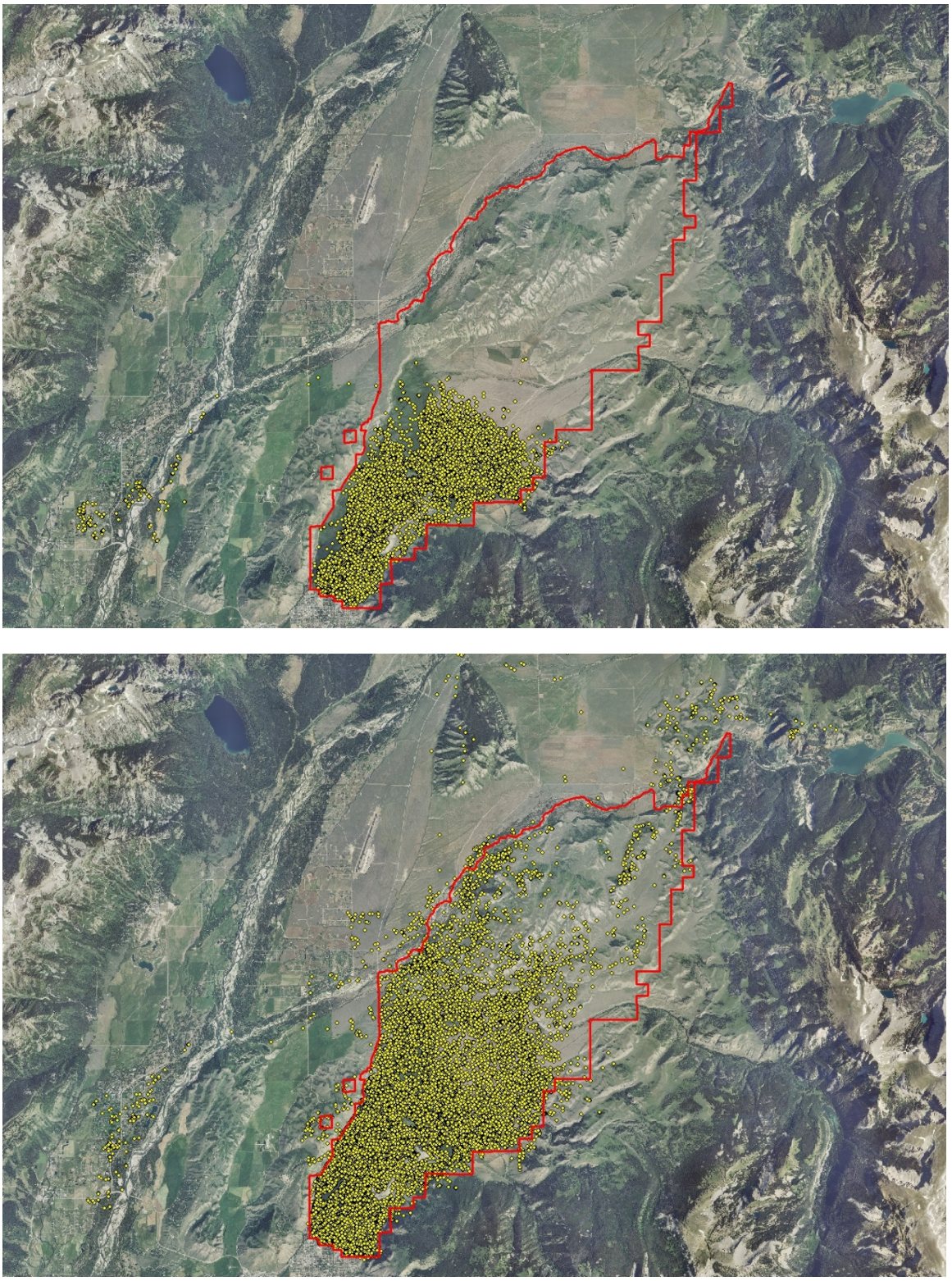

Figure 6. Elk GPS collar locations (yellow) in the vicinity of the National Elk Refuge (boundary in red) during the period when elk were fed (1/7/2017 - 3/23/2017 top image) and during the comparable season when elk were not fed (1/7/2018 - 3/23/2018 bottom image).

For most of the January to March time period, the average distance between GPS collared elk was lower in 2017 compared to 2018, suggesting that elk were more densely congregated during the severe winter of 2017 compared to the mild winter of 2018 (Figure 7). Further analysis of the factors that affect elk aggregation patterns in warranted.

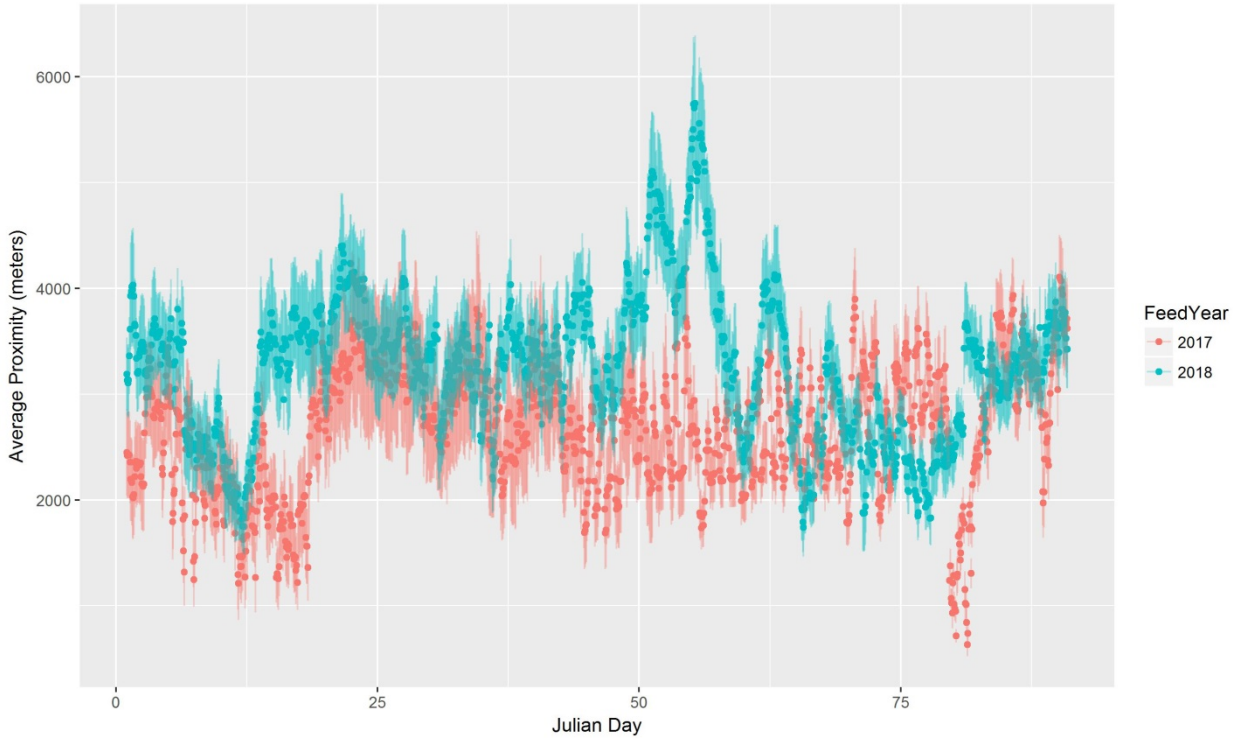

Figure 7. Average distances in meters (+- SE) between GPS-collared elk on NER (plus immediately adjacent areas) for all unique timestamps shared by 10 or more collars during the months January, February, and March. January 1 is represented by the Julian Day 1 and March 31 by the Julian Day 90. Analysis and figure courtesy of Carson Butler, Grand Teton National Park.

Discussion and Management Implications

Supplemental feeding of elk has occurred in all but 10 winters since the establishment of the Refuge in 1912. Supplemental feeding reduces overall elk winter mortality by reducing nutritional deficits (Boyce 1989, Smith 2001), but concurrently increases elk stress levels (Forristal et al. 2012) and is associated with higher incidence and prevalence of diseases such brucellosis (Cotterill et al. 2018), foot rot (Murie 1951, NER unpublished data), scabies (Murie 1951, Smith 1985, Samuel et al. 1991), necrotic stomatitis (Murie 1951), and septicemic pasteurellosis (Franson and Smith 1988). Most evidence suggests that higher incidence and prevalence of these diseases are related to unnatural elk aggregation patterns associated with feeding operations. Higher prevalence of these diseases in feedground situations implies greater potential for significant negative population-level impacts when chronic wasting disease arrives in western Wyoming elk herds (Galloway et al. 2017).

Largely to mitigate disease risk but also to facilitate recovery of NER plant communities (Smith et al. 2004), NER has proposed reducing reliance on supplemental feeding (USFWS and NPS 2007) through a

combination of habitat enhancement and reduction in the number of elk wintering on the Refuge to 5,000 and the number of bison to 500. These population objectives are consistent with the estimated carrying capacity of NER under average winter conditions in the absence of supplemental feeding (Hobbs et al. 2002). Although winter habitat and bison population objectives have been achieved, the number of elk wintering on NER has averaged 47% above the 5,000 objective since the Bison and Elk Management Plan was implemented in 2007. This is largely due to an increasing proportion of the Jackson Elk Herd wintering on NER (WGFD winter elk classification data).

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Opportunities for Further Research

- Retrospective modeling of the factors that affect elk winter distribution in the Jackson Elk Herd
- Retrospective modeling of the factors that affect elk winter mortality on NER
- Analysis of elk GPS collar data to quantify elk proximity and density relative to supplemental feeding, weather and other covariates

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