Ya Ha Tinda Long-term Elk Monitoring Project

J. Normandeau

Ecology of Calf Survival 2013 – 2016

The Ya Ha Tinda elk (*Cervus canadensis*) population is the focus of what is now the longest-running study of a partially migratory ungulate population, and one of the longest studies of elk in a predator-prey-montane system that includes grizzly bears (*Ursus arctos*), wolves (*Canis lupus*), cougars (*Puma concolor*), and human hunting. Population data on elk at Ya Ha Tinda (YHT) has been collected since 1972, and beginning in 2000, researchers at the Universities of Alberta and Montana, collaboratively with staff from Parks Canada, Alberta Environment and Parks, and other natural resource groups within Alberta, have been working to determine how changes in the YHT elk population, its trophic dynamics, and migratory behaviors are affected by both humans (harvest, recreation, and habitat management) and natural factors (predation, climate, and vegetation succession). Being partially migratory, determining the causes and consequences of migratory behavior by elk in this system has become a major focus in recent years. Historically, the majority (~90%) of elk migrated ~32 (25 – 80) km westward from the winter range to summer at high elevations (>2,000 m) in Banff National Park (BNP), but the proportion of elk migrating westward has declined, and there's been a proportional increase in elk remaining on winter range year-round. Concurrently, the overall population declined by almost 70% over the past 2 decades from a maximum count of ~2,200 elk in the early 1990s to a recent low of <400 elk. Over time, a new pattern of migration east from YHT to low-elevation (~1,400 m) industrial and recreational forest has emerged, and the average ratio of migrants to residents to eastern migrants is now ~1:10:5. Yet up until the start of our calf survival study in 2013, detailed information was lacking on (1) reproductive success of individual adult elk, including survival and cause-specific mortality of calves, and (2) the relatively new eastward migration. This highlight shares some of the results from the calf ecology component of our long-term work.


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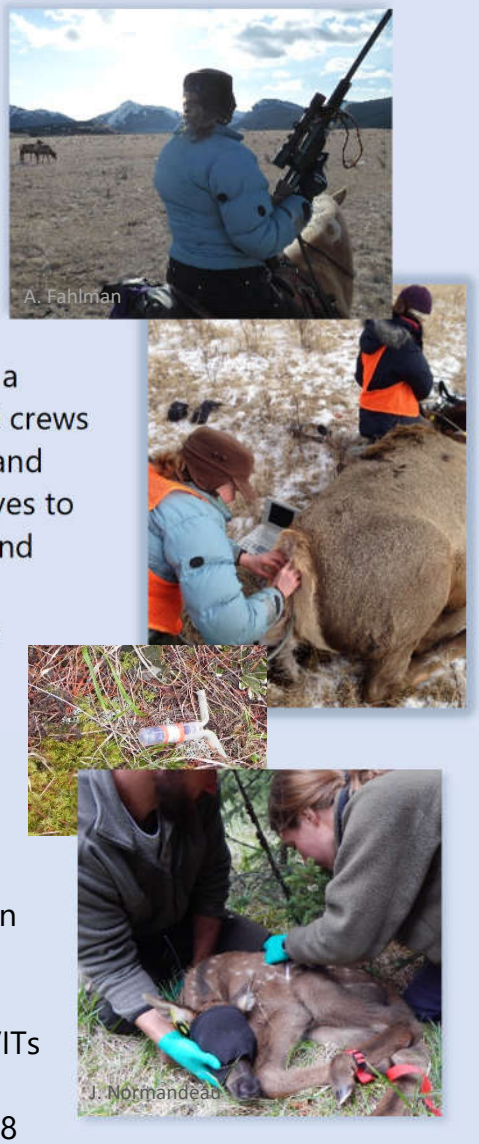
Adult Female and Calf Elk Capture

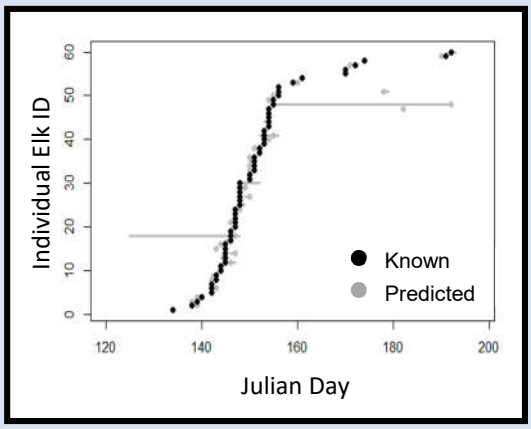


During February and March, 2013 – 2016, we immobilized adult female elk by darting from horseback. We fit elk with VHF and GPS collars, and determined whether elk were pregnant or not, as well as assessed body condition with ultrasonography. In order to better understand elk reproduction and calf survival, we fit pregnant adult females with small vaginal implant transmitters (or VITs, which are similar to systems used for intravaginal hormone delivery in cattle). VITs are expelled when an elk gives birth, emitting a signal that allows birth sites to be precisely and quickly located. Field crews captured calves from the ground, equipped them with VHF ear tags, and took body measurements to help us identify factors predisposing calves to risk of mortality. Calves were released quickly at their capture sites, and monitored several times daily from a distance. When the VHF signal indicated a calf remained unmoved for >4 hr, we attempted to locate the calf and investigated mortality sites to assess cause of death based on predator scat and sign at the site.

Adult Female Habitat Selection during Calving Over Time

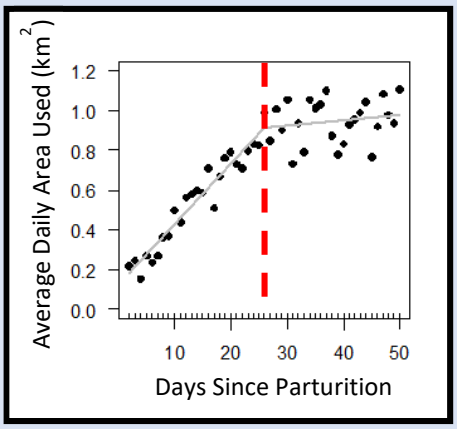
During two time periods (2002 – 2006, 2013 – 2016), we assessed whether differences in selection for forage and avoidance of predation risk during calving might contribute to shifts in migratory behavior across time. We employed a machine-learning algorithm to predict dates of parturition based on GPS movements of elk equipped with VITs (n = 60) and found predictions were within 1.43 ± 0.85 days of the known date. We applied the model to past data from an additional 58 GPS-collared elk with unknown birth dates. Parturition across all elk occurred 8 May – 11 July with dates differing among migratory tactics and residents shifting towards an earlier date over time. We determined elk remained relatively localized in their post-parturition movements for 26 days, and used this time to compare habitat characteristics of calf-rearing areas to 10 unused areas centered on random summer telemetry locations. All elk, regardless of migratory tactic, consistently selected for forage resources during calving more than during summer, with limited evidence for trading off forage due to predation risk. Selection for forage exposed western migrants to high risk of bear predation, residents to

VITs and Machine Learning (n = 60)**:**

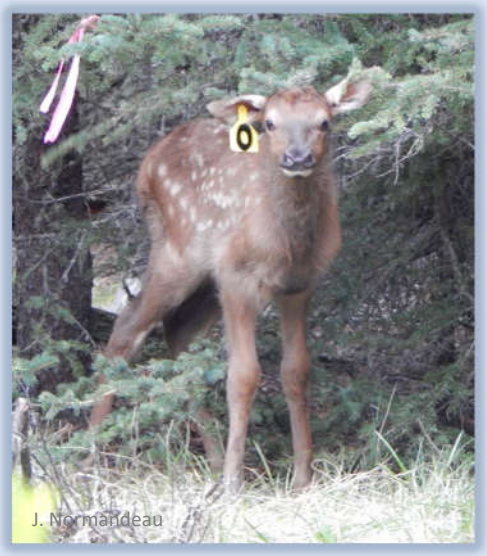


Accuracy: -1.43 ± 0.85 days

Broken-stick Model (n = 131)**:**



Breakpoint: 26.0 (SE: 2.03) days

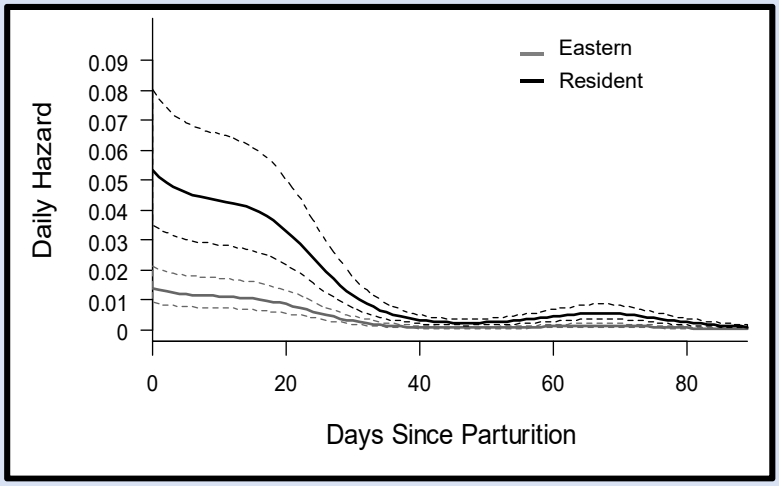


high risk of wolf predation, and eastern migrants to low bear and wolf predation because they avoided risk by using areas of high human activity. Patterns of spatial use during calving were consistent with the recent decline in western migrants and increase in eastern migrants, implying that conditions on calving areas contributed to these changes.

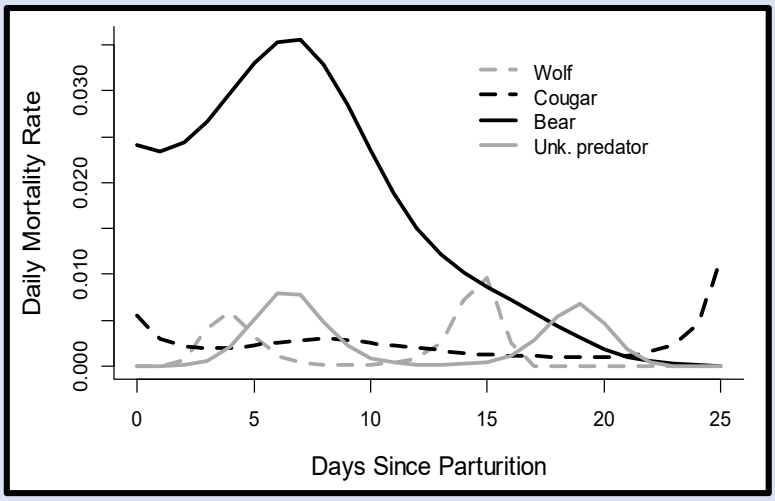
Risk of Mortality to Elk Calves

We estimated timing and causes of mortality and the biological and environmental factors related to risk of mortality for elk calves. We captured >94 neonatal elk, monitored risk of mortality to 90 days of age, and assigned cause of death based on field evidence. The overall mortality rate to 90 days of life for all calves regardless of cause of death was 0.61 (95% CI: 0.52, 0.70). The mortality hazard peaked at ~3 – 7 days of life and remained high in the first 20 – 30 days of life when 90% of deaths occurred. The overall mortality rate to 90 days of life for calves of resident females (0.69, 95% CI: 0.13, 0.99) was over 80% higher than for calves of eastern migrants (0.37, CI: 0.03, 0.97). Of 57 mortalities, we attributed 29 deaths to bears (51.7%), 7 to cougars (11.7%), 4 to wolves (6.7%), 8 to unknown predators (15.0%), and 9 to other causes (15.0%). Daily risk of mortality was most influenced by available forage biomass and low predation risk associated with human infrastructure on the summer range. Differential exposure to these environmental factors on summer ranges resulted in variable predator-specific mortality and higher calf survival of eastern migrants, consistent with the shift in the number of elk migrating east of YHT. This study is one of the few that documents factors contributing to emerging migratory behavior in maintaining a partially migratory population.

Overall Risk:



Predator-Specific Risk:



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