AN ABSTRACT OF THE THESIS OF

Elizabeth M. Mulligan for the degree of Master of Science in Wildlife Science presented on October 16, 2015.

Title: Survival Rates and Cause-Specific Mortality for Mule Deer in South-central Oregon.

Abstract approved: _____

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It is critical for wildlife managers to understand the population dynamics of a harvested species, particularly for ungulates, which are a valuable wildlife resource. Due to concerns that mule deer (*Odocoileus hemionus*) populations in Oregon were declining, more comprehensive data on population vital rates and the factors potentially affecting them were needed by resource managers. To meet this research need, Oregon Department of Fish and Wildlife implemented a seven year study to investigate habitat use and survival of mule deer in eastern Oregon. From 2005-2012, the agency radio-collared 621 mule deer in south-central Oregon in order to gain more comprehensive information about seasonal movement, seasonal and annual survival, and changes in habitat use for the population. I used the radio-telemetry data from this larger study to investigate mule deer survival rates and cause-specific mortality and the effects of deer seasonal distributions, movement behavior, and environmental factors such as annual and climatic variation.

I used known-fate data for 408 adult female radio-collared mule deer to estimate monthly survival rates and to investigate a variety of factors that might affect these rates including seasonal distribution, temporal effects (seasonal, annual, and trends across season and year), movement behavior, and climatic covariates on differing scales. Variation in survival rates for this population of female mule deer in eastern Oregon was best explained by an additive effect of migration behavior, fall migration period, and precipitation levels on individual winter ranges. Survival was significantly higher for migratory deer than residents. Both groups had lower survival during the fall migration period (Oct-Nov) and a positive linear relationship between survival and winter precipitation in individual winter ranges. Annual survival estimates for

migrants ranged from 0.81-0.82, which is similar to other findings, but survival rates for residents (0.76-0.77) were low in comparison to survival rates for adult female mule deer in other parts of their range.

I used a nonparametric cumulative incidence function estimator (NPCIFE) to generate annual cumulative incidence functions separately for males and females due to differing risks associated with each sex. The four competing sources of mortality I included in this analysis for males were legal harvest, illegal harvest, predation, and starvation, disease, vehicle or fence-collision combined as one category (i.e., other). For females in investigated predation, human-associated mortality (vehicle or fence), illegal harvest, and natural causes (starvation and disease). Annual risk functions were pooled across all years of the study to maximize sample size. For males, the cumulative risk was highest for legal harvest (0.249, 95%CI=0.172-0.326), with predation the next highest cause of mortality for this sex (0.104, 95%CI=0.042-0.611). For females, the cumulative risk was highest for predation, (0.044, 95%CI=0.028-0.065) with anthropogenic causes (0.038, 95%CI=0.021-0.054) and illegal harvest (0.031, 95%CI=0.17-0.054) also important sources of mortality.

Higher monthly survival rates of migrants compared to residents (across all months of the biological cycle) suggested that leaving for potentially higher quality summer foraging grounds outweighed the cost of traveling through unfamiliar habitats and energy expenditure from migration. Conversely, it may also imply that the summer ranges for residents had a negative effect on survival due to habitat quality or human disturbance. Both migrants and residents had lower monthly survival during the fall migration period (Oct - Nov). Female mule deer were excluded from the state-managed bow and rifle hunting season during this study, but females may experience the negative effects of human disturbance associated with fall hunting activities. This time of year is also energetically costly for females, being that some may still be nursing, which could have an additive effect to the energy used to migrate or avoid human disturbance. Winter precipitation also had positive effect on survival for both groups, possibly because increased average winter precipitation resulted in increased winter forage quantity and quality.

My results suggest that female survival rates observed during my study are on the low end of the range reported for this species and may be contributing to population declines of mule deer in Oregon. Annual estimates of male survival were also low, but it is unclear how that might contribute to overall population declines without more information on annual and seasonal

variation in male survival. Surprisingly, I observed high levels of illegal harvest on female deer and evidence that female survival during the fall migration period, which overlaps Oregon's legal harvest season, was lower than other times of the year. It is unclear why the fall migration period negatively affects both migrants and resident deer similarly, but future research should attempt to determine the specific factors that are negatively impacting mule deer survival during this time period in south-central Oregon. In addition, as human development in the area continues to grow, it is important to consider migration paths and the habitat quality of both summer and winter ranges. My results suggested that conditions may differ between summer ranges in particular, for residents vs. migrants, and understanding these differences may be the key to increasing survival of female mule deer in Oregon. Sharing information from this study with law enforcement and the general public may be the first step towards increasing awareness of, and thereby reducing, the relatively high levels of illegal harvest I documented for the female population. Future research should focus on investigating the differences in habitat quality for residents versus migrants, the factors that decrease survival during fall migration for both groups, and the social and economic factors that contribute to the illegal harvest of female mule deer in eastern Oregon.