# FEDERAL AID ANNUAL RESEARCH PERFORMANCE REPORT

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**PROJECT TITLE:** Habitat use and survivorship of Sitka black-tailed deer in Southeast Alaska: a regional meta-analysis and synthesis.

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**FEDERAL AID GRANT PROGRAM:** Wildlife Restoration

**GRANT AND SEGMENT NO.** W-33-3

**PROJECT NO.** 2.13

**WORK LOCATION:** Ketchikan

**STATE:** Alaska

**PERIOD:** July 1, 2008 – June 30, 2009

## I. PROBLEM OR NEED THAT PROMPTED THIS RESEARCH

Land and wildlife managers in Southeast Alaska would benefit greatly from comprehensive analyses of deer habitat use and survivorship that can discriminate between site-specific patterns of habitat selection and correlates of survivorship, and more general regional patterns. Wildlife and land managers have long complained that site-specific conditions limit the usefulness of the current regionally applied model for deer habitat suitability (Suring et al. 1993). That model plays an important role in evaluating the effects of land development plan alternatives on deer population. Conflicting results from habitat use studies have also perplexed and confused managers with respect to the importance and suitability of different habitats for deer. Relating habitat use to survivorship under different conditions of topography, snowfall, and predator diversity would help clarify the roles of those factors on habitat selection and mortality of deer. Moreover, previous studies employed methods of analysis that are problematic and in need of updating. We combined data from an unpublished radio telemetry study of deer on Prince of Wales Island with data from previously published telemetry studies on Heceta (Farmer 2002) and Mitkof (Doerr et al. 2005) islands to investigate patterns of habitat use and habitat correlates of mortality for Sitka black-tailed deer in Southeast Alaska. We originally intended to include data from Admiralty Island (Schoen and Kirchhoff 1990); however, those data were not available and we had to settle for comparing our results with those published from that study. We believed a re-analysis of telemetry data from previous studies in combination with our recent data from Prince of Wales Island would help clear up some of the ambiguity of results reported by previous studies and lead to stronger inference concerning regional patterns of habitat use by deer. By combining data sets from multiple studies from different areas of southeast, we were able to dramatically increase sample size and filter out some local effects by including study location as an independent and interactive covariate. We used methods of analysis that eliminated many of the problems and limitations of previous work and allowed examination of a broader spectrum of variables that included landscape-level features. Unlike most of the other studies, we avoided confounding factors related to sex and age by focusing on yearling and adult females only. We compared covariates of habitat selection with habitat correlates of mortality enabling us to evaluate suitability of habitats and landscape features with respect to one component of fitness.

## II. REVIEW OF PRIOR RESEARCH ON THE PROBLEM OR NEED

Sitka black-tailed deer (*Odocoileus hemionus sitkensis*), a relatively small subspecies of mule deer (*O. hemionus*), is the most important ungulate with respect to sport and subsistence hunting in Southeast Alaska. It is the most abundant ungulate in the region and it plays a major ecological role as a forest herbivore and as prey for Alexander Archipelago wolves (*Canis lupus ligoni*), black bears (*Ursus americanus*), and brown bears (*U. arctos*) (Klein 1965, Olson 1979, Wallmo 1981, Hanley 1984, Person et al. 1996, Kohira and Rexstad 1997, Person 2001). Portions of Southeast Alaska were logged extensively during the past 50 years and >400,000 ha of forest have been harvested on private, state, and federal lands, mostly by clearcut logging. Timber harvesting and the inexorable patterns of forest succession following harvest likely will have important consequences for deer, their predators, and the communities of subsistence hunters that depend on them (Alaback 1982, Schoen et al. 1988, Hanley 1993, Person 2001, Farmer et al. 2006, Brinkman et al 2007, Brinkman et al. 2009). Consequently, understanding relations between deer and their environment, and the effects of logging on important habitats has been the primary focus of research for many years. Numerous studies examined the ecology, habitat use, and energetics of Sitka black-tailed deer (Klein and Olson 1960, Klein 1965, Olson 1979, Wallmo and Schoen 1980, Hanley 1984, Schoen and Kirchhoff 1985, Schoen and Kirchhoff 1990, Yeo and Peek 1992, Parker et al. 1999, Farmer 2002, Doerr et al. 2005). On relatively unlogged Admiralty Island, Schoen and Kirchhoff (1985) and Schoen and Kirchhoff (1990) documented strong selection by radiocollared Sitka black-tailed deer for productive old-growth forest, particularly during winter. Those results bolstered previous work by Wallmo and Schoen (1980) that compared relative abundance of fecal pellet groups to investigate habitat use by deer. Hanley and Rose (1987) and Kirchhoff and Schoen (1987) demonstrated that the forest canopy intercepts snow, reducing accumulations on the forest floor and decreasing the cost of locomotion for deer compared to habitats with sparse canopies. The uneven-age structure of old-growth forest creates gaps in the canopy allowing sunlight to penetrate to the forest floor enhancing growth of understory vegetation (Alaback 1982). The combination of snow interception and availability of forage provide a compelling explanation for selection by deer of old-growth forest during winter. Indeed, Parker et al (1999) concluded that habitat use by Sitka black-tailed deer primarily was a process in which deer optimized energy inputs from foraging with the energy costs of acquiring food. Consequently, for >25 years the regnant paradigm has been that old-growth coniferous forest is critical to the well being of deer during winters with snow.

Presumably, loss of that habitat from clearcut logging would reduce resilience of deer to severe winters and result in population declines.

Nonetheless, studies of radiocollared deer on Prince of Wales (Yeo and Peek 1992) and Mitkof Islands (Doerr et al. 2005) suggested the association between deer and productive old-growth forest was more ambiguous even during winter. Doerr et al. (2005) concluded that southerly exposures near shore were the most important factors associated with habitat use by deer during winters and that forest stand type was less influential. Indeed, they observed deer selecting even-aged or multi-cohort forest stands on southerly aspects that were the product of large-scale blow down during severe windstorms. Those stands have dense forest canopies but depauperate understory vegetation (Kramer et al 2001). They suggested those locations were exposed to warm winter storms from the southeast that ameliorated winter conditions by melting snow pack. They also concluded that selection for productive old-growth forest within their study area was weak or negative because most was located on wind-protected northern aspects that accumulated deep snow.

Of concern equal to loss of winter habitat, is the reduction in forage biomass that occurs 25–40 years after clearcut logging. During early seral stages, clearcuts may provide abundant forage during snow-free months (Alaback 1982, Farmer and Kirchhoff 2007). However, even-aged conifer regeneration eventually forms a dense canopy that shades out understory plants. After 2–3 decades (depending on site quality), clearcuts transform into stem-exclusion seral forest, which is characterized by a closed canopy and sparse understory vegetation. Stem-exclusion forest may provide cover from snow but it offers little forage during all seasons. All telemetry studies in Southeast Alaska that included deer within logged watersheds reported that they selected clearcuts <20 years old during snow free months (Yeo and Peek 1992, Farmer 2002, Doerr et al 2005) and most concluded deer avoided stem-exclusion seral forest. Doerr et al. 2005 reported no differences in use of clearcuts 25-40 years old compared to younger cuts, however, they acknowledged that most older cuts in their study area were pre-commercially thinned.

Although generally well done, all published telemetry studies of deer in Southeast Alaska involved relatively small samples sizes. Moreover, inference from them is limited because of site-specific conditions and circumstances. For example, winter severity is consistently greater in the northern portion of the region where the Admiralty Island study occurred but snow accumulation often is intermittent in southern areas such as Heceta and Prince of Wales Islands. Certainly, winter weather and availability of forage are important influences on habitat selection but other independent and interactive factors may be equally important. The density of deer and their proximity to carrying capacity (*K)* likely influences habitat selection. In dense populations, some deer may select less-preferred habitats because of competition from other deer (Hobbs and Hanley 1990). Further, habitat selection by ungulates is influenced by the risk of predation (Creel et al. 2005). Mitkof, Heceta, and Prince of Wales Islands support populations of wolves and black bears, whereas, brown bears are the only predator of deer on Admiralty Island. Deer may optimize tradeoffs between forage availability and risk of predation. Indeed, predators may restrict deer and other ungulates from exploiting high value habitats (Creel et al. 2005). All of the telemetry studies focused on deer habitat selection at stand-level scales. Only limited attention was given to landscape-level attributes that may affect habitat selection. Kie et al. (2002) observed that most variation in home range size of mule and black-tailed deer in California was explained by landscape-level factors such as density of habitat edges, contrasts between adjacent habitats, and distribution of habitats across the landscape. They concluded that deer select habitats at multiple scales and that studies focusing on stand-level selection will miss landscape-level habitat features that are equally or perhaps more important as predictors of habitat selection. Further, habitat selection studies may reveal patterns of habitat use but habitat suitability or quality cannot readily be inferred. Habitat correlates of survivorship likely are better indicators of habitat suitability than use. Only one study, Farmer et al. (2006), examined linkages between habitat use and components of fitness such as mortality. They concluded that although deer may select young clearcuts during snow free months, they were at greater risk of death from wolf predation and hunting. They also reported that landscape features such as density of edge and patch size were important predictors of risk of death, particularly when considered at large scales. Indeed, the best models predicting risk of death of adult and yearling females in their study included habitat and landscape variables tabulated within a radius of 500m around radio locations. Finally, all of the telemetry studies used outdated and problematic methods of analyses. Schoen and Kirchhoff (1990), Yeo and Peek (1992), and Doerr et al. (2005) pooled all deer together risking problems with psuedo-replication (Hurlbert 1984). They also combined sexes despite the fact that for most sexually dimorphic ungulates the sexes have different life history strategies and sexually segregate spatially. Moreover, they used Ivlev's electivity index as a measure of selection, which has serious limitations with respect to testing for differences in selection between subsampled groupings of animals (Strauss 1979). Farmer (2002) used Neu et. al. (1974), which may produce inconsistent results depending on the number of habitat categories used.

## III. APPROACHES USED AND FINDINGS RELATED TO THE OBJECTIVES AND TO PROBLEM OR NEED

OBJECTIVE 1: Include telemetry data from Admiralty (Schoen and Kirchhoff 1985), Mitkof (Doerr et al. *in review*), Heceta (Farmer et al. 2006.) and Prince of Wales Islands (ADFG unpublished data) in a comprehensive meta-analysis of habitat selection that will result in a regionally applicable resource selection function.

We combined data from 3 telemetry studies of adult and yearling female deer in Southeast Alaska and investigated habitat selection. We evaluated the effects of habitat, landscape, and topographic variables on habitat use by deer using conditional logistic regression of used versus matched random locations (Hosmer and Lemeshow 2000, SPSS 2004). We analyzed data for each covariate group separately so that we could compare the relative influences of habitat composition, landscape features, and topography on use. The analyses were repeated for 50-m and 500-m scales of buffers. We analyzed data for all seasons combined, during winters with snow (December–April 1998-1999 and December–April 2001–2002), and during parturition and weaning (May 15 – August 1). Variables were screened for strong correlations ($-0.7 \geq r \geq 0.7$) with other variables within covariate groups prior to model selection. If strong correlations occurred, we dropped those covariates with the weakest relations to the outcome variables from the models. We stratified our analyses by individual deer to eliminate effects of lack of independence owing to repeated measures. We used AIC criteria (Burnham and Anderson 1998) to select the best multivariate models and calculated AIC weights (*w*) to compare models within each covariate group and buffer scale. We only considered models to be valid if $\Delta \leq 4$ (Burnham and Anderson 1998). We calculated the relative effect size for each covariate included in composite models by evaluating the odds ratio for an increase in the covariate equal to 10% of its range of values.

Combining data sets enabled us to examine patterns of habitat selection and that were common for deer throughout a large portion of Southeast Alaska. Generally, deer selected habitats with open forest canopies such as young clearcuts and open-canopy old growth during most of the year. However, topographic and measures of distance were much better predictors of use than vegetation classes at the 50-m buffer scale. At the 500-m scale, composition of vegetation classes within buffers was the best predictor of use. Nonetheless, that implied that the matrix of vegetative classes at a large scale influenced use of a location more than the vegetative classes within the immediate vicinity of deer. Clearly, deer were integrating information at large scales. Clearcuts in early seral stages (<30 years post logging) were the habitats most strongly selected by deer, and studies of plant biomass within forested and logged habitats consistently rank young (<10 years post harvest) and shrub-sapling stage (11–30 years post harvest) clearcuts the highest with respect to forage biomass (Alaback 1982, Farmer and Kirchhoff 2007). Deer avoided forage-poor habitats such as stem-exclusion seral forest. They avoided that habitat during winters with snow and during parturition and weaning. Consistent with our results, Brinkman (2009) noted that abundance of deer was low in that habitat during winter and early spring. Although, grasslands contained high quality forage plants during spring and early summer (Hanley and McKendrick 1983), deer did not select it during parturition and weaning and avoided it during winters with snow. Grasslands were rare habitats within the study areas included in our analyses and usually were associated with estuaries and beaver flows. Often those areas were adjacent to wolf dens and rendezvous sites (Person and Russell 2009), which may influence their use by deer during summer. Black and brown bears also forage in estuaries during spring to feed on emerging plants and again in late summer to access salmon.

Curiously, deer were attracted to roads. Indeed, average distance to roads was the most influential covariate in our models for the 50-m buffer scale, particularly during parturition and weaning. Road edges can support early successional vegetation, however, plant growth is highly variable depending on the location and age of the road. Roads create edge and increase fragmentation of the forest canopy, characteristics selected by deer, but their effects on vegetation along roads is highly variable. Moreover, use of roads substantially increased risks of death from wolf predation and hunting; therefore, deer located within the vicinity of roads may not be selecting habitats that optimize fitness. Nonetheless, deer avoided roads within 50-m buffers during winters with snow, a time when risk of predation by wolves may be highest, but within 500-m buffers they still preferred to be in areas traversed by roads. The effects of roads on habitat selection and fitness of Sitka black-tailed deer warrants further investigation using GPS telemetry that permits greater spatial and temporal resolution than VHF transmitters. Moreover, we recommend that studies address tradeoffs between forage availability and risk of death from hunting and predation.

Contrary to Doerr et al. (2005), deer selected productive old-growth forest during winters with snow but the strength of selection was relatively weak compared to other factors such as elevation, slope, and avoidance of habitats that lacked forest cover. Indeed, when we included southing as an interactive term modifying coarse-canopy old growth, the coefficient for the main effect of old growth was negative but the coefficient for the interactive term was positive. That indicated that deer avoided productive old growth forest on northerly aspects but selected it when located on southerly exposures. For example, a patch of coarse-canopy old growth on a slope facing due south has double the probability of being used than a patch facing due north. Selection for coarse-canopy old growth becomes positive between 124°–214°. Deer also selected for open-canopy old growth during winters with snow, which was unexpected. However, addition of southing as an interactive term along with open-canopy old growth fit the data better than the inclusion of the habitat alone, indicating that southerly aspect was an important modifying factor determining use. Elevation, slope, and aspect were the most influential determinates of habitat use by deer in our study during winters with snow. For telemetry data obtained during winters with snow at both the 50-m and 500-m buffer scales, logistic regression models containing covariates representing topography and distance measures consistently out performed the other covariate groups.

Schoen and Kirchhoff (1990) reported strong selection by deer on Admiralty Island for productive old-growth forest during a winter with snow. Admiralty Island is located within the northern portion of the Alexander Archipelgo and has substantial snowfall most years with snowpack persisting well into April. Winter conditions typically are more severe than experienced by deer in the study areas we included in our analyses. Most deer in their study were migratory, wintering in forest habitat at mid elevations and moving to lush alpine meadows during summer after snow melt (Schoen and Kirchhoff 1985). Hence, snow conditions strongly influenced habitat selection by deer. In addition, very little of their study area was logged and patches of productive old-growth forest dominated the landscape. In contrast, productive old growth was extensively fragmented by logging within the areas included in our analyses and the landscape was a more diverse matrix of managed and unmanaged patches of vegetative classes. None of the deer included in our analyses were migratory. A few deer moved to higher elevations intermittently, but none exhibited migratory behavior similar to deer monitored on Admiralty Island. Moreover, Brinkman (2009) monitored changes in deer populations in 3 watersheds on Prince of Wales Island during 2006–2008 using population estimates based on identification of individual deer from DNA extracted from fecal pellets. He monitored deer abundance during 3 consecutive winters that were much more severe than any encountered during the telemetry studies on Mitkof, Heceta, and Prince of Wales Islands. Abundance declined most in the watershed containing the smallest proportion of productive old-growth forest (Brinkman 2009, Person et al. 2009). Therefore, we acknowledge that our results do not challenge conclusions reached by Schoen and Kirchhoff (1990) or the importance of old-growth forest during severe winter events, but suggest the role of old-growth forest is more complicated than previously thought. Productive old-growth forest is a diverse habitat encompassing a fine scale matrix of small patches of closed-canopy forest, coarse-canopy forest, open-canopy forest, and young seral forest (from windthrow). In addition, site-specific characteristics such as winter severity, exposure to storms, diversity and number of predators, and landscape characteristics all complicate assessments of the value of that habitat for deer.

Topography and distance measures generally were the best predictors of habitat use. Aspect, elevation, and slope consistently entered models of habitat use. Doerr et al.

(2005) noted the influence of elevation and aspect but did not consider slope. Similar to our conclusions, they reported deer chose southerly aspects at low elevation during winters with snow. Schoen and Kirchhoff (1990) considered aspect, elevation and slope, reporting that deer selected lower elevations and southerly exposures during winter, but they also suggested aspect was less important than elevation and canopy cover. Our results indicate that southerly aspect is at least as important as canopy cover, and an essential mediating factor determining selection of coarse-canopy old growth during winters with snow. We also determined that deer selected for steeper slopes during winter rather than gentler slopes as reported by Schoen and Kirchhoff (1990).

We created a series of variables that reduced some of the characteristics of different vegetation classes into simplified structural categories and categorized landscape features. In general, models containing only those covariates did not fit the data as well as models containing variables representing topography and distance measures, and habitat composition. Nonetheless, canopy cover and forest canopy contrast were important influences on habitat selection. Dense forest canopies reduced snow depths and thus were important for deer during winters with snow. Open habitats with abundant herbaceous and shrub vegetation were important summer ranges. During winters with snow, deer tended to avoid locations in which changes in forest canopy closure were abrupt such as along the edge of clearcuts or muskegs. During snow-free months deer may be attracted to edges between forests and openings (including those created by roads) because of the availability of forage and proximity of escape cover.

OBJECTIVE 2: Combine deer survivorship from Admiralty (Schoen and Kirchhoff 1985), Mitkof (Doerr et al. 2005), Heceta (Farmer et al. 2006) and Prince of Wales Islands (Yeo and Peek 1992, ADFG unpublished data) in a comprehensive meta-analysis of deer survivorship.

We combined survival and mortality data from 3 telemetry studies of adult and yearling female deer in Southeast Alaska and investigated habitat correlates of risks of death. We evaluated the relations between habitat use and mortality of deer using Cox proportional hazards regression (Hosmer and Lemeshow 2000, Riggs and Pollock 1992, SPSS 2004). Habitat variables tabulated within buffers around radiolocations were averaged over all locations for each deer. Thus, we created an "average" buffer for each animal that represented the history of habitat use by that animal. In the parlance of clinical medical research, that was analogous to obtaining patient or treatment histories for subjects in survival studies of humans.

Twenty deer (41.7%) died during the study on Prince of Wales Island. Eighteen (36.7%) died during the Heceta Island study and 14 (38.9 %) died during the study on Mitkof Island. Survivorship at 12, 24, and 36 months was 0.88 (SD = 0.05), 0.77 (SD = 0.06), and 0.60 (SD = 0.07) for deer on Prince of Wales Island, respectively. For deer monitored on Heceta Island those values were 0.80 (SD = 0.6), 0.55 (SD = 0.09), and 0.51 (SD = 0.09), respectively. For deer on Mitkof Island, survivorship at 12, 24, and 36 months was 0.89 (SD = 0.05), 0.71 (SD = 0.08), and 0.36 (SD = 0.16), respectively. Average survival times subsequent to capture were 169 weeks (SD = 12) for deer monitored on Prince of Wales Islands, 114 weeks (SD = 8) for deer on Heceta Island, and 121 weeks (SD = 8) for deer on Mitkof Island. Although deer on Prince of Wales Island generally had higher rates of survival, the survival and hazard functions did not differ between studies (logrank test $\chi^2 = 1.931$, $df = 2$, $P = 0.381$). Predation was the primary source of mortality for deer in all studies. We identified wolves and black bears as predators of deer on Prince of Wales Island. Only predation by wolves occurred on Heceta and Mitkof Islands. Hunting (legal and illegal) and malnutrition were important sources of mortality of deer on Prince of Wales and Heceta Islands but not on Mitkof Island. Accidents such as vehicle collisions or falls accounted all remaining deaths.

We were able to include data from all 3 studies in our proportional hazards regression analyses for habitat correlates of wolf predation. Models for habitat composition, and topography and distance measures, were all similar with respect to predicting risks of death at the 50-m scale. Models incorporating landscape features did much worse. Use of old-growth forest did not confer any significant overall advantage for survival with respect to reducing risks of death from malnutrition, predation, or hunting. The proportion of coarse-canopy old growth within 500-m buffers around used locations increased risk of predation from wolves but the effect was small. Use of open-canopy old growth strongly reduced risk of death from wolf predation and hunting, a result reported by Farmer et al. (2006), but strongly increased risk of death from predation by black bears. Wolves are coursing hunters and the thick, brushy understory typical of open-canopy old growth stands likely makes pursuit and capture of deer difficult. Conversely, bears may hunt more furtively, relying on ambush rather than pursuit. Thus, thick vegetation may provide them with an advantage. Closed-canopy old growth stands were generally associated with riparian zones. They typically had sparse understory vegetation somewhat similar to stem-exclusion seral forest. Use of both of those forage-poor habitats strongly increased risk of death from malnutrition. We also determined that deer selected for steeper slopes during winter rather than gentler slopes as reported by Schoen and Kirchhoff (1990). Wolf predation during winter may be the driving force behind that difference. Wolves do not inhabit Admiralty Island but were numerous throughout all of the study areas included in our study. Slope was a key factor reducing risk of death from wolf predation. Indeed, a 9° increase in slope reduced risk of predation >50%. Density of edge had a moderately strong effect increasing risk of death from wolf predation at large and small buffer scales. During snow-free months deer may be attracted to edges between forests and openings (including those created by roads) because of the availability of forage and proximity of escape cover. However, those locations can be risky if wolves are able to chase deer out into the open where they are very vulnerable.

OBJECTIVE 3: Present scientific information at public and professional meetings, and assisting public and professional organizations created to advise policy makers.

We presented portions of our analyses at the 2006 Wildlife Society annual conference in Anchorage, Alaska, and at the 2007 Alaska Chapter of the Wildlife Society annual meeting in Fairbanks. We also presented information at several professional meetings focusing on habitat management of deer in Southeast Alaska involving state and federal personnel. Much of the information presented in this report was also included in the habitat guidelines for mule and black-tailed deer (Nelson et al. 2008) published by the Mule Deer Working Group of the Western Association of Fish and Wildlife Agencies. We compiled our research into a manuscript that will be submitted to the Journal of Wildlife Management for publication as a wildlife monograph. The manuscript is currently under review by collaborators, after which a revised version will be sent for informal review in October 2009, and the final version submitted to Wildlife Monographs in November 2009.

## IV. MANAGEMENT IMPLICATIONS

1. Productive old-growth forest on south facing slopes is an important habitat selected by deer during winters with snow; however, other habitats such as open-canopy old growth are used as well. Land managers should consider all forest habitat with canopy cover >60% on slopes between 120–240° aspect and below 300m as potential winter habitat for deer.

2. Stem-exclusion seral forest is avoided by deer during all seasons. Those stands will require extensive modification through thinning or selective harvesting to restore some conditions that support deer.

3. Deer select forest edges and for higher forest canopy contrast during snow-free months. Therefore, silvicultural methods aimed at improving deer habitat within second-growth patches or stands of stem-exclusion forest should create a matrix of treatments that increase edge and avoid large blocks in which a single treatment has been applied. For example, rather than pre-commercially thinning an entire cutting unit with one prescription, treatments should use a mix of spacing prescriptions within the unit including leaving unthinned patches. Moreover, managers should only expect that forage along edges of patches will likely be used by deer. Cleared strips or corridors through slash likely would allow deer to access forage throughout the treatment unit.

4. Slopes reduce risk of predation by wolves, but density of edge between vegetation classes increases that risk. Consequently, managers should try to restrict timber harvesting or silvicultural treatments that increase edge to hillsides with slopes >9° where wolves exist.

5. Characteristics of habitat, topography, and landscapes tabulated within 500m of radio locations were significant predictors of habitat use and risks of death, often more influential than characteristics within 50m of radiolocations. We suggest that land managers consider applying and evaluating habitat manipulations to enhance range conditions for deer at a 1 $km^2$ scale. The matrix of treatments, their number and distribution, and evaluations of their implementation and effects should be planned at that scale.

## V. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN FOR LAST SEGMENT PERIOD ONLY

JOB/ACTIVITY 1: Collect and collate data from contributors.

Job was completed by June 30, 2008.

JOB/ACTIVITY 2: Conduct and complete data analyses

Analyses of telemetry and survival data from 134 adult and female deer were completed. See details in OBJECTIVES 1 and 2 above.

## VI. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THE LAST SEGMENT PERIOD, IF NOT REPORTED PREVIOUSLY

During the project segment, Dr. Person contributed to the authorship of publication on habitat guidelines for mule and black-tailed deer. The publication was sponsored by the Western Association of Fish and Game Agencies and was produced by members of the Mule Deer Working Group of which Dr. Person was Alaska's representative during preparation of the manuscript (see publications below).

## VII. PUBLICATIONS

Farmer, C.J., D.K. Person, and R.T. Bowyer. 2006. Risk factors and mortality of black-tailed deer in a managed forest landscape. Journal of Wildlife Management 70:1403–1415.

Nelson, J.D., D. Cottam, E.W. Holman, D.J. Lancaster, S. McCorquodale, and D.K. Person. 2008. Habitat guidelines for black-tailed deer: coastal rainforest ecoregion. Mule Deer Working Group, Western Association of Fish and Wildlife Agencies.

The major publication resulting from this project will be submitted to Wildlife Monographs in autumn 2009 (see OBJECTIVE 3) above.

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