Factors Influencing Cattle, Elk, and Mule Deer Distribution in Managed Forests

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SUMMARY

Intensive research involving elk, mule deer, and cattle has been conducted on the Starkey Experimental Forest and Range since 1989. The unique aspect of this research included the enclosure of 25,000 acres in 1989 to maintain a managed herd of mule deer and elk and the use of an automated telemetry system to track animal movements. Initial research focused on the influence of intensive timber management on mule deer and elk; the influence of roads and traffic on mule deer and elk; forage allocation/animal-unit-equivalencies of cattle, mule deer and elk; and the influence of age of breeding bull elk on elk production. Extensive timber harvest within Starkey had no effect on the productivity of elk but did increase their vulnerability to harvest. Roads, traffic, and cattle influence the distribution of elk, which in turn influences the distribution of mule deer. Herbivores are very adaptive in their selection of habitats and the foods they consume in those habitats. Development of management tools for allocating forage is ongoing. Human off-road recreation (e.g., All-terrain vehicle use) has an impact on elk movement rates and often initiates a flight response. Elk, in the presence of off-road recreation, alter their behavior, spending more time in hiding cover and less time foraging. They also move away from recreation routes.

INTRODUCTION

Since its creation in 1940 the Starkey Experimental Forest and Range has a long history of research involving elk, mule deer and cattle. One of the first studies on the grazing relationships of cattle, mule deer, and elk was conducted over an 11-year period (1954-1965) and stands out as one of the most important works of its kind (Skovlin et al. 1976).

In the 1980s perceived conflicts over relationships among livestock grazing, elk numbers, timber harvest, and road development led to the development of the Starkey Project. The Pacific Northwest Research Station, U.S. Forest Service, and Oregon Department of Fish and Wildlife jointly developed the research direction and provided funding. Eastern Oregon Agricultural Research Center, Union Station provided cattle and logistic support and was an active research partner. National Forest Systems provided initial funding for fence construction and the telemetry system. Through the years over 40 other partners, including Federal and state agencies, universities, tribal nations, and private organizations have participated in the project. In 1989, the project became operational with the enclosure of 25,000 acres of the Starkey Experimental Forest and Range with a high-tensile game-proof fence and establishment of an automated telemetry system. Four large studies were initially undertaken that addressed major public land and livestock/big game conflicts through the following objectives: 1) determine the influence of intensive timber harvest on mule deer, elk, and cattle; 2) determine the influence of roads and traffic on distribution of elk and mule deer; 3) evaluate the concept of animal-unit-equivalencies and develop tools for forage allocation; and 4) determine the influence of age of breeding bulls on reproductive success in elk. These studies and several "spin-off" studies encompassed the first 10 years of the Starkey Project. In 2000 planning for new projects was initiated, whose objectives include: 1) the influence of fuels reduction and prescribed fire on distribution of elk, mule deer, and cattle; 2) the influence of three levels of ungulate herbivory on secondary succession of plant communities following fuels reduction and prescribed fire; 3) the influence of off-road recreation on elk and mule deer; and 4) the influence of ATV use during hunting seasons on the movement patterns of mule deer and elk. Within the Starkey Project the Meadow Creek Study Area is maintained to evaluate the impact of various livestock grazing regimes on riparian vegetation and stream bank integrity. In this paper the results of various studies dealing with factors that influence the distribution of elk, mule deer, and cattle will be discussed.

METHODS

Research protocols were developed for each study initiated as part of the Starkey Project. Many of the studies incorporated data generated from animals tracked with the automated telemetry system and the development of Geographic Information System (GIS) data layers.

In 1989 data collection began on the movement of elk, mule deer, and cattle with the completion of all game-proof fencing and the installation of an automated telemetry system. A LORAN-C-based telemetry system was in place from 1989 through 2005. In 2006 a Global Positioning System (GPS) was fully functional and replaced the outdated LORAN system. Annually up to 40 elk, mule deer, and cattle are fitted with radio transmitters to monitor their movements.

Geographic Information Systems are widely used to develop databases for analyzing wildlife and cattle habitat relations. Construction of the Starkey habitat database began in 1989 and continues today. The database contains maps for all major resource themes, such as vegetation, topography, water, fences, soils, and roads. More than 100 variables related to distribution of mule deer, elk, and cattle have been included. Application of appropriate statistical analyses to the animal distribution data and the various physical resources in the database result in prediction of which resources and physical attributes play key roles in the distribution of animals. Further analyses provide predictive tools that managers can use to evaluate habitat effectiveness.

RESULTS AND DISCUSSION

Intensive Timber Harvest Study

Extensive logging of National Forests in the 1960s, through the 1980s elevated concerns of biologists that elk populations might be negatively impacted by the degree of timber harvest taking place. Concerns were raised over losses to thermal and security cover for elk. To address this issue on Starkey, 3,590 acres were fenced exclusively for timber harvest effects research. Fencing the study area prevented animals from leaving during the logging operation and afterward when cover was reduced. Elk were contained by the fence in an extensively logged environment. Timber harvest encompassed 1,207 acres 34 percent, of the study area, but comprised 50% of the forested lands. Most of the harvest was shelterwood and seed tree regeneration cuts that removed most of the overstory. There were 63 individual harvest units ranging in size form 3 to 55 acres. Existing management guidelines for elk cover were ignored, denying elk large blocks of security or thermal cover. Cattle grazing took place during the entire study and cattle were monitored for effects of timber harvest on their distribution. During timber harvest, elk distributed themselves more widely across the study area. When harvest was completed elk generally returned to their preharvest distribution; they were more widely distributed than before harvest, but not as much as during harvest. Cattle showed little change in distribution over the entire range of the study, before, during, or after harvest. A key part of this study was our ability to weigh both cattle and elk using the study area and compare them to cattle and elk in the Main Study Area where timber harvest did not occur. Even though elk made substantial changes in their distribution during timber harvest operations, no change in animal performance (weight change) was observed. Annual weight gains for female elk and calf elk in the timber management area were no different than those in the Main Study Area. In general beef cow and calf weight gains were higher in the timber management area than in the Main Study Area.

The elk herd in the timber management area was hunted before, during, and after timber harvest. Before timber harvest hunter success averaged 2 percent, requiring an average of approximately 19 days to achieve this level of success. During harvest, hunter success increased to 35 percent, with hunters spending an average of 9 days to achieve that success. After timber harvest hunter success remained high (32 percent and 14 days) similar to that occurring with timber harvest. Timber harvest increased vulnerability of elk to harvest because of the decrease in escape/hiding cover. In areas where landscape scale timber harvest or wild fire substantially reduces escape/hiding cover, restrictions on hunter numbers, hunting season length, decreased road access, or combinations of these changes should be considered to ameliorate elk escapement and prevent over-harvest.

Roads and Traffic

The extensive logging on National Forests mentioned above also resulted in a vast network of roads. In some cases 6 miles of roads existed per 1 mi^2 of forest. Generally, these roads remained open to the public. Considerable research has evaluated the impacts of roads and logging on elk distribution across affected landscapes. Starkey research indicated roads with vehicular traffic restricted the habitat used by elk in spring and summer. Open roads effectively fragment elk habitat; few patches of forest cover exist that are large enough to provide secure habitat for elk. The degree of forest density and topography can mediate some of the effects of road density. Research at Starkey indicated that traffic rates as low as 1 vehicle passing per 12 hours influenced distribution of elk. This research, as well as other studies at Starkey, also revealed that elk impacted the distribution of mule deer. Mule deer avoid habitats occupied by elk. Therefore, as elk moved away from roads mule deer selected habitats closer to roads. When managers develop habitat models to evaluate landscapes for potential elk use, roads open to traffic and traffic rate should be included as variables. Moreover, distance band approaches provide better quantification of elk-roads effects than do traditional road-density analyses.

Forage Allocation/Animal-unit-equivalencies

One of the major problems that has plagued range and wildlife managers is that of allocating forage among the various large herbivores utilizing a common landscape. Early managers used a simple animal-unit-equivalency conversion based solely on forage intake per animal per day: one cow = five deer = two elk = five sheep. The assumption was made that all animals consumed a common forage base in the same place and at the same time. The fallacy of this approach is obvious; different ungulate species do not occupy the same place at the same time, or eat the same forage plants. However, once this is recognized and the decision made to develop a realistic approach to forage allocation, the hard part begins. Factors other than the availability of nutritious food may drive where an animal forages. In a pristine landscape, the first survival priority elk may have is a highly nutritious diet. Nevertheless, as previously mentioned, elk move away from roads with traffic. In this case the need for a secure, risk-free environment may override the need for the highest quality diet. Starkey research also indicates that elk will alter their distribution on a landscape when cattle are introduced. Therefore roads and traffic and/or the presence of cattle may cause elk to seek secure but nutritionally inferior habitats. Declining forage availability is the usual driver that causes animals to seek new foraging habitats. When security becomes the first driver in habitat selection, animals may choose to exist in nutritionally inferior habitats, resulting in less than optimum body condition. Degradation of the secure habitat due to overgrazing also becomes a possibility, but is not very predictable. In late summer when forage quality decreases, elk are less likely to move away from cattle and they may share the same habitats to secure scarce nutrients. Cattle and roads can displace elk, and mule deer are displaced by the presence of elk. Therefore, when considering the allocation of forage across a landscape, these confounding influences on animal habitat choices must be addressed.

The basis for forage allocation is the identification of foods eaten by the herbivores present as well as the availability (lb/acre) of those food items. However, animals are highly adaptable in their foraging choices and show great variation in diet dependent on year, season, and forage availability. Where different species of herbivores share a common landscape, each species probably uses a foraging habitat that has been previously grazed by another species. In Starkey research, dietary overlap was lowest between cattle and mule deer in previously ungrazed paddocks. In paddocks previously grazed by cattle, dietary overlap between the two species increased. However, the nutritional quality of mule deer diets remained the same suggesting that competition did not occur. The greatest potential for dietary competition was between mule deer and elk. Diets of the two species did not change when they each grazed paddocks previously grazed by cattle or elk. Previously mentioned research revealed that mule deer use declines when elk are present, indicating interference competition may be occurring. Dietary overlap was high between cattle and elk especially in paddocks previously grazed by cattle or elk. The potential critical period for competition is late summer when the availability of high-quality forage is limited and elk and cattle tend to use the same habitats in search of that high quality forage.

The complexities of foraging behavior and animal distribution described above illustrate the challenge in developing a forage allocation model useful to managers. At this time no such model exists. Scientists working on Starkey data have developed a landscape-scale foraging simulation model. The goal is to use this model to evaluate different grazing management strategies on summer range landscapes and test various hypotheses about the effects of alternative stocking rates for ungulates. However, at this time further refinement of the model is required.

Human Disturbance

Because roads and traffic have an influence on the distribution of elk, scientists explored the potential influence of human off-road recreation on distribution of deer and elk. A 3-year study was conducted to evaluate the potential influence of mountain biking, horse riding, ATV riding, and hiking on elk and mule deer distribution. We used the telemetry system to monitor movements in response to each activity. All forms of recreation tested affected distributions of mule deer and particularly elk. Mule deer do not appear to respond strongly to any of the four activities; they may prefer to hide rather than run from disturbance, and our telemetry data would not show this response. Elk responded to all four activities by reducing feeding times, increasing movement rates, and initiating flight responses. Elk responses to ATVs and mountain bike riding were stronger than to horse riding and hiking. Foraging time was lower and flight responses higher during ATV and mountain bike riding. Elk avoided recreation routes during all recreation activities and spent more time in cover, with avoidance strongest during ATV activity.

Cattle Grazing

Telemetry data on cattle were analyzed for distribution relative to water and vegetation resources during either early (mid-June to mid-July) or late (early-September to mid-October) summer. Feeding sites for cattle were different between seasons relative to distance to water, structure of vegetation, and canopy cover. In early summer cattle avoided steep slopes, tended to disperse randomly relative to water, and preferred more southerly aspects. As forage resources were consumed in early summer and vegetation dried, however, cattle shifted distributions down from ridgetops, and moved closer to water, sites with higher forage production, and more northerly aspects. In late summer, patterns were reversed. In the first half of late-season grazing, cattle selected areas closer to water, higher forage production areas, and northerly aspects, but as resources were removed, cattle used areas far from water, more concave sites, and areas with deeper soils. Timing of grazing will have substantial effects on forage utilization and distributions relative to use of riparian areas.

In other research, scientists found that cow age and therefore experience directly influences distribution patterns and forage resource use. Cattle were monitored during peak foraging time, 1 hour before sunrise to 4 hours after sunrise and 4 hours prior to sundown to 1 hour after sundown, from July 15 to August 30. All age classes of cattle preferred areas of gentler slopes, westerly aspects, farther from water, and with greater forage production than the pasture average. Young cows (less than 5 years old) selected lower elevations and steeper slopes than the oldest cows (over 5 years old). Cattle 2–3 years old utilized areas lower in elevation and closer to cover and water, whereas cattle over 8 years old used areas of higher elevation farther from cattle fences, cover, and water. Age structure of a cow herd, then, may have an influence on how a pasture is utilized.

MANAGEMENT IMPLICATIONS

Managing forest landscapes for multiple use is a daunting challenge. Research at Starkey is informing managers through the development of predictive tools that illustrate how herbivores utilize landscapes and what biotic and abiotic factors interact to influence that utilization. The result should be forested landscapes that provide sustainable ecosystem services. Discovering the factors that influence (especially negatively) the distribution of mule deer and elk leads to the development of guidelines for critical habitat. Maintaining sufficiently sized habitat blocks for mule deer and elk through design of recreation areas and road systems should help maintain viable mule deer and elk populations and lessen the chance of habitat degradation. Knowledge of cattle grazing behavior and distribution contributes to the development of grazing systems that are not in conflict with mule deer and elk and do not degrade riparian systems and fish habitat.

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SUGGESTED READING

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For publications and more information visit the Starkey web site:
http://www.fs.fed.us/pnw/Starkey

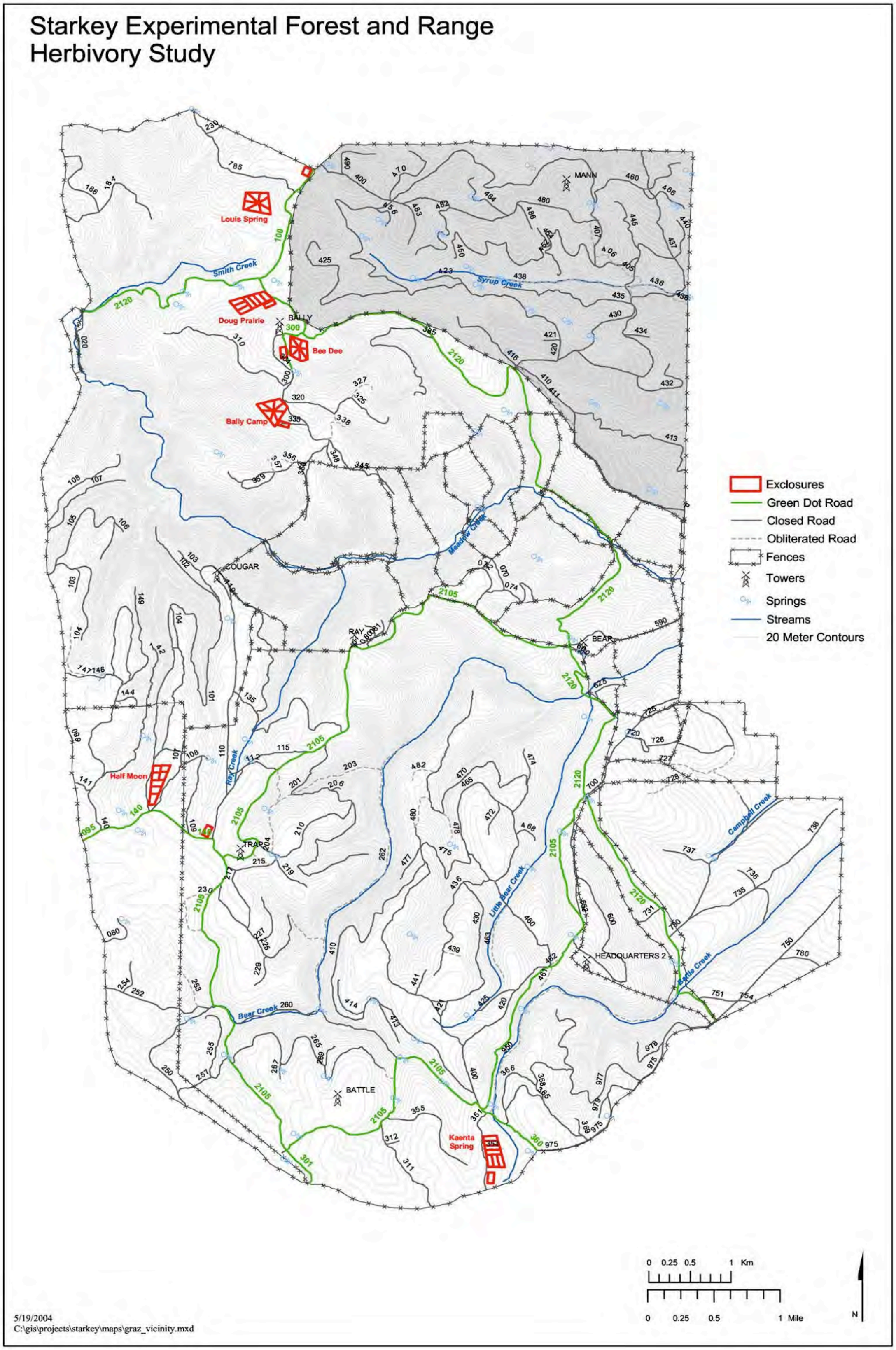

Figure 1. The Starkey Experimental Forest and Range, Blue Mountains of northeastern Oregon.