POPULATION STATUS, HABITAT AND MOVEMENT OF ELK IN THE GUADALUPE MOUNTAINS NATIONAL PARK, TEXAS[a]

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Abstract: Introduced Rocky Mountain elk (*Cervus canadensis nelsoni*) were studied in the Guadalupe Mountain National Park in the summer of 1976. This population was stable at about 100 animals, with sex and age ratios closest to those of the Tule elk. Animals utilized all 4 major habitats in the higher elevations of the Park. Movement between 3 elk aggregations were related to the availability of surface water and the carrying capacity of the area. Sixty-two % of the mortalities were closely associated with temporary pools which may substantiate the importance of water in limiting elk numbers.

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Merriam's elk (*C. canadensis merriami*) was indigenous to the Guadalupe Mountains and similar areas in New Mexico and Arizona before 1900 (Murie 1951). At the turn of the century these animals were reported extinct in Texas (Bailey 1905). In 1928 a private landowner introduced 44 Rocky Mountain elk to the Guadalupe Mountains (Davis and Robertson 1944). Their numbers increased to approximately 60 individuals by 1931 (Wright and Thompson 1934) and Davis (1940) estimated a population of 400 in 1939. The availability of water at the McKittrick Canyon release site (Davis 1940) had a significant influence on the early success of this reintroduction. Elk that later emigrated from McKittrick Canyon met their water requirements at stock tanks that dotted the region in what is now the National Park, but maintenance of these domestic water points was terminated upon the Parks' inception. It appears that the present population, reduced significantly from previous years, may reflect the scarcity of water that now exists on the elk range.

This is a report on the preliminary survey of elk in the Guadalupe Mountains National Park made in the summer of 1976. The project was supported by the National Park Service and conducted in cooperation with this agency and the Department of Range and Wildlife Management, Texas Tech University. This is the first detailed study undertaken on these reintroduced ungulates in the Guadalupe Mountains. Our thanks are extended to those Park Service personnel and private individuals who helped the project in many ways.

MATERIAL AND METHODS

The Guadalupe Mountains National Park is comprised of approximately 31,364 ha of desert and mountainous terrain in west Texas along the New Mexico border. El Paso, Texas, lies 160 km to the west and Carlsbad, New Mexico, is 82 km to the northeast. Elevation ranges from 1,100 m on the desert floor to 2,667 m at Guadalupe Peak. The area was described by Genoways et al (1977) as "an island in the Chihuahuan desert inhabited by plants and animals most of which have affinities with the fauna and flora of the Rocky Mountains."

The elk range in the National Park consists of approximately 10,875 ha encircled by well defined natural boundaries. The ridge running southwest from the mouth of McKittrick Canyon to Hunter Peak and then northwest to Blue Ridge, together with the escarpment from this point north to Cutoff Mountain, form 3 sides of the main elk range. The Park boundary along the Texas/New Mexico state line provides the northern limit of the study area. A small herd of about 15 elk occurs off the south escarpment in the vicinity of Pine Springs Campground and the Frijole Information Station east to the mouth of McKittrick Canyon. No elk were reported on the western escarpment south of PX Flat and below Bush Mountain.

Five basic habitat types can be defined on the elk range:

(1) DECIDUOUS-CONIFEROUS FOREST TYPE: Confined to the drainage bottoms that interlace the region, this habitat contains deciduous and coniferous

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overstory species. The canyon bottom around Dog Canyon Spring is typical for this vegetation type, where big tooth maple (*Acer grandidentatum*), chinquapin oak (*Quercus muhlenbergii*), and Douglas-fir (*Pseudotsuga menziesii*) predominate.

(2) PINON-JUNIPER TYPE: This habitat is found in the West Dog Canyon area and is also represented at higher elevations. Species that distinguish this type include pinon (*Pinus edulis*), several species of juniper (*Juniperus* spp.), New Mexico agave (*Agave neomexicana*), New Mexico muhly (*Muhlenbergia pauciflora*), and pine muhly (*M. dubia*).

(3) MOUNTAIN SHRUB TYPE: This habitat is well distributed throughout the Park and is characteristically found on south slopes. *Agave*, sotol (*Dasylirion leiophyllum*), mountain mahogany (*Cerocarpus montanus*), desert ceanothus (*Ceanothus greggi*), New Mexico muhly, gambel oak (*Q. gambelli*), and waveyleaf oak (*Q. undulata*) are indicative species.

(4) CONIFEROUS FOREST TYPE: The Bush Mountain area exemplifies this habitat. The dominant overstory consists of southwestern white pine (*P. strobiformis*) and Douglas fir. Ponderosa pine (*P. ponderosa*) also occurs here. Understory species include honeysuckle (*Lonicera* spp.), Utah serviceberry (*Amelanchier utahenses*), and Fendler bush (*Fendlera rupecola*).

(5) OAK SAVANNAH TYPE: This habitat type, found in the Juniper Spring area off the south escarpment, is represented by several species of oak (*Quercus* spp.). As mentioned earlier, little time was spent with the few elk that utilize this area, therefore, this habitat type will be excluded from figures involving elk habitat utilization.

Permanent water (Fig. 1) was available on top of the mountains only at the Upper Dog Canyon Springs. Several small pools of permanent water were found along the north and south forks of McKittrick Canyon, but due to the nature of the terrain, these were unavailable to elk on the high range. A significant permanent water source utilized by the high range elk lies some 800 m beyond the northern boundary in West Dog Canyon. Although this tank is on private property, the landowners do not harass the watering elk. Springs were scattered along the lower slopes of the eastern escarpment and were the foci for the herd of 15 elk which remained around the Park headquarters. Temporary water is available throughout the Park for a few days after heavy rains, but is present for longer periods only in Cox Tank and The Bowl area (Fig. 1).

The elk range was under continuous assessment June 1 through August 31, during the dry summer months, except for short trips by the researcher to Carlsbad for supplies and consultations with Park personnel. A base camp was established on the north side of the Park near Dog Canyon Ranger Station and the survey team worked from there until arrangements were made for water supplies at strategic localities. For the remainder of the summer the researchers lived in a tent at several localities in the study area. A pack horse was used to move camp and bring in supplies when necessary.

To facilitate data collection, the study area, including the south escarpment, was divided into 12 study units (Fig. 1). These units varied in size from approximately 518 ha to 2,850 ha. Nine units were in the main study area and 3 more were located below the south escarpment. The boundares of these units were along topographical barriers important in elk movement. The fieldworkers camped 5 to 6 days in each study unit and inventoried activities of bands of elk in that unit. An overlay grid system was constructed for use in locating elk observations and mortalities (Fig. 1). Each grid was 64.75 ha in area. The study unit and grid number were documented for each observation and mortality recorded.

All observations were made on foot using 8 X 40 binoculars. Established hiking trails, game trails, and ridge tops provided access. When elk were found several data were tabulated. In addition to study unit and grid reference, time, sex and age structure, habitat type, and activity were recorded on observation sheets. Activity was classed as feeding, resting, drinking, and moving. No attempt was made to continuously monitor daily activity of a single herd over long periods during this survey.

Three clearly recognizable individuals were found, each with a specific distinguishing mark. The distinction between new sightings and resightings was sometimes difficult among herds of cows, calves, and yearlings. Where no known individual was present, these groups were separable by herd size and structure data. Bachelor herds were more readily distinguishable because of individual antler characteristics.

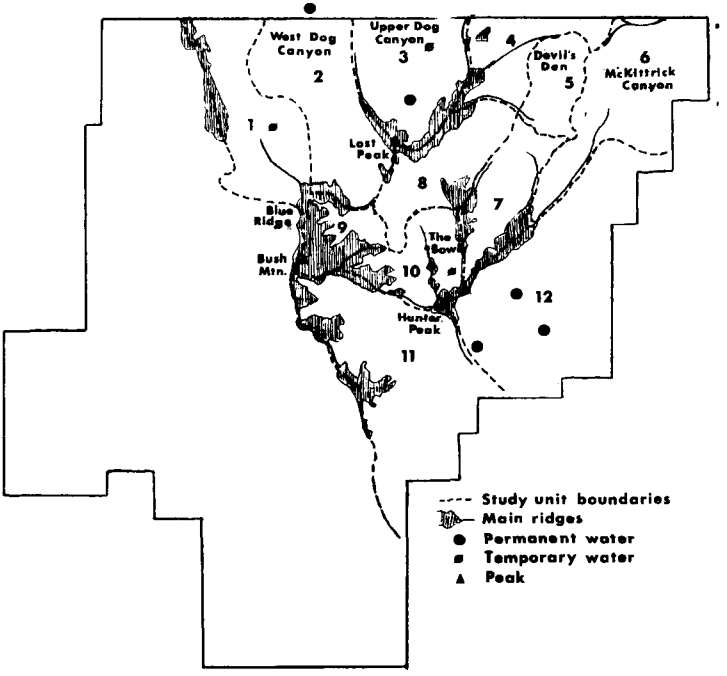

Fig. 1. The Guadalupe Mountains National Park, Texas showing boundaries of the Study Units based on major topographical features, the grid system used to locate elk, and the distribution of temporary and permanent water points.

Elk movements throughout the Park were determined from observations and elk sign. Reobservations provided reference points from which movements could be plotted.

Mortality data were collected wherever a carcass was found. Most mortalities were located in drainage bottoms so time was spent searching canyon floors for mortalities. All elk mandibles were collected and aged by tooth wear (Quimby and Gaab 1957) to determine survival and mortality statistics.

RESULTS AND DISCUSSION

Habitat Utilizations

No attempt was made in this survey to determine the relative proportions of each habitat available to elk in the study area. With the exception of the Deciduous/Coniferous Forest type, however, the habitat types were extensive throughout the study area and habitat selection probably had little limitation resulting from availability. The Oak Savannah type habitat was restricted to the lower slopes of the eastern escarpment. The small herd of lower ranging elk moved through this habitat type in much the same manner as the upper range elk utilized the Deciduous/Coniferous forest type.

Fig. 2. shows the distribution of upper range elk observations in each habitat as a percentage of all observations. Most observations occurred in Mountain Shrub; the relative openness of this vegetation type clearly influences visibility of elk and consequently may affect the percent rating obtained in the survey. Nonetheless, Mountain Shrub appears to be an important constituent of overall elk requirements. Visibility is comparatively uniform among the remaining 3 habitat types and their percent ratings probably yield a relative index of elk habitat preference.

The 4 recorded activities of elk were classified by habitat (Fig. 3). The majority of observations were of elk feeding in Deciduous/Coniferous Forest. As this habitat type is relatively restricted, the data indicated that this vegetation type may be significant to elk as a food source. However, feeding activity was observed in all habitats. Mountain

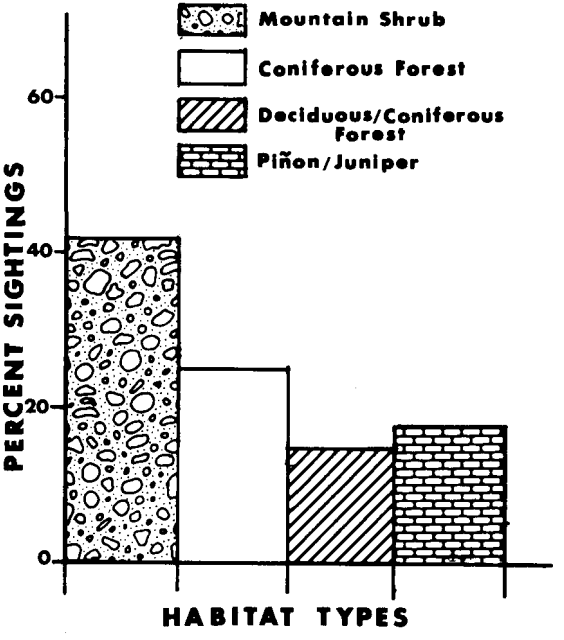

Fig. 2. 1976 distribution of all elk sightings related to four major habitat types in the Guadalupe Mountains National Park, Texas.

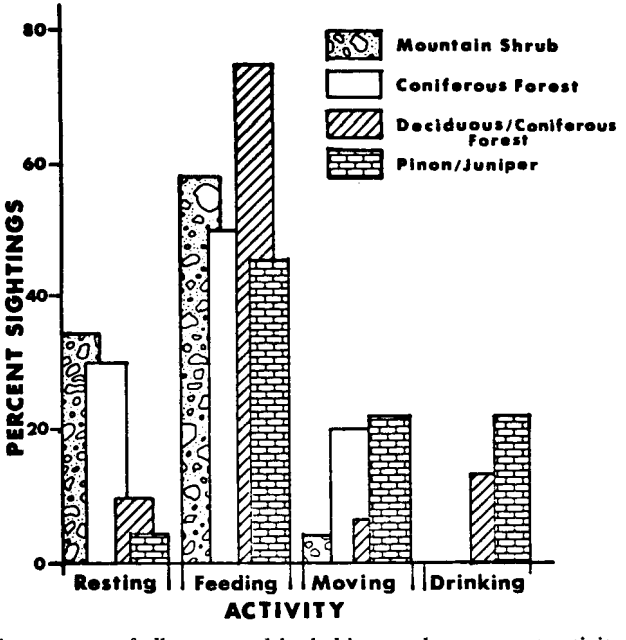

Fig. 3. 1976 activity patterns of elk separated by habitat to show percent activity recorded in each habitat type in Guadalupe Mountains National Park, Texas.

Shrub and Coniferous Forest were both preferred areas as resting sites. Movement in the Mountain Shrub and the Deciduous/Coniferous Forest was low, but somewhat higher in the Pinon/Juniper and the Coniferous Forest. These results clearly showed a reciprocal relationship to feeding use.

The complete absence of drinking activity in Coniferous Forest and in Mountain Shrub represents a function of surface water distribution. The free water available to the upper range elk occurred in Pinon/Juniper and Deciduous/Coniferous Forest. Following the first rains in July, water accumulated in small, isolated pools in drainage bottoms; some of these pools dried up rapidly, while others held water for several days. These pools were especially numerous in the Pinon/Juniper of West Dog Canyon.

When elk activity data are compared by time of day (Fig. 4), a daily pattern emerges. Elk appear to feed predominantly in the morning and feeding declines during the day, although there is a slight increase in activity in the late afternoon. Movement shows a

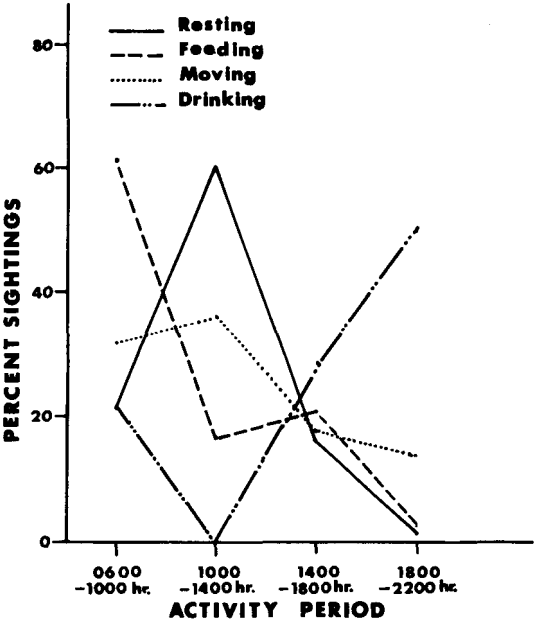

Fig. 4. Percentage of elk activity related to time of day at which they occurred in Guadalupe Mountains National Park, Texas, during the summer of 1976.

peak over the noon period and decreases to a low in the late afternoon. Resting has a definitive peak at noon. Some drinking occurs in the morning, none in the noon period, but increases again to a high peak in the late afternoon. No data were obtained on animal activity after dark.

There is little information in the literature on daily activity patterns of elk. McCullough (1969) was able to show a statistically significant decline in Tule elk activity during the midday period and recorded a low incidence of feeding or drinking at this time. This is consistent with the Guadalupe findings.

Population Dynamics

Sixty-one separate observations totaling 246 individuals were obtained on elk in the summer survey. Contacts varied from single individuals to a maximum herd size of 16 animals. Group structures changed, but fell into 4 main categories: mixed herds comprising both adult male and female elements, brood herds comprising adult females with young animals, bachelor herds, and single individuals.

The sex and age structure of herds, their physical characteristics, and observed localities were all used to separate new observations from reobservations. After careful evalua-

tion, the final estimate was 104 ± 4 individual elk in the study area. This is not an exact figure, but represents a reliable estimate of the elk population.

The ratio of 1 male:2.1 females found in this study is not surprising, for as Murie (1951) points out, a preponderance of females is normal for a polygamous species such as elk. Murie (1951) recorded an overall adult sex ratio of almost 1:4. Craighead et al. (1973) reported an average sex ratio of 1:5.2, and commented that this herd had a low productivity, while McCullough (1969) documented a 1:1.8 ratio for Tule elk in California.

The elk herd of the East Pecos region of New Mexico apparently has a low male: female ratio, as does the population in the Gila Wilderness Area (Wain Evans, New Mexico Game & Fish *pers. comm.*). Glass et al (1974) in a browse analysis in the Guadalupes recorded an almost equal sex ratio for elk. It would thus seem evident that the sex ratio found in this study is below that recorded elsewhere for Rocky Mountain elk over its normal range, but may be consistent for the species in semi-arid conditions.

A low incidence of juveniles was found during this survey; calves made up only 6.7 percent of the total count. Over the 3 month survey period a calf-cow ratio of 12:100 was obtained. Elsewhere, Kimball and Wolfe (1974) reported a 57:100 ratio in summer. Fall ratios of 55:100 and 52:100 were recorded by Follis and Spillet (1974) and Jansen (1962) found a ratio of 52 calves:100 females. The 5 year average ratio of 29:100 documented by Picton (1960) was considered "below standard" by Knight (1970).

The 8.6 percent subadults sighted in 1976 indicate that calf recruitment for 1975 was also small. These two consecutive years of low recruitment cannot be considered a trend, but they do indicate a somewhat static population at the present time. Glass et al. (1974) observed only 8.7 percent of Guadalupe elk were calves, and no subadults were recorded during their fieldwork. These data further substantiate our conclusions as to the population status of the elk herd. Low calf crop percentages have also been reported for New Mexico's Pecos elk herd (Lange et al. 1975), which inhabit an area similar to the Guadalupe Mountains.

Some outside factor or factors unrelated to individual reproductive condition and performance may be operative in suppressing increase among the Guadalupe and Pecos herds. Bull elk offset a disproportionate sex ratio with their characteristic behavior of herding cows into harems during the rut. The question as to whether scattered herds, rough terrain, or some other factor inhibits increase, or that there is poor conception and/or survival in the Guadalupe elk remains unanswered. Evans (*pers. comm.*) found a high pregnancy rate in cows collected from the East Pecos elk herd, despite the herd's apparent low productivity. This may be the case in the Guadalupe herd, in which event a closer look at calf survival will give a better understanding of both herd dynamics and the carrying capacity of the area.

Mortality

Localities of 31 elk carcasses found during normal survey were plotted and mortality data were recorded. A calf and adult cow were drowned, a calf was killed by a mountain lion (*Felis concolor*), and a cow and neonate calf may have died during or shortly after parturition as their carcases were found within 3m of each other. The positive cause of death for other mortalities remains unknown, but it is significant that 19 (62 percent) of the carcasses were found in close association to depressions that held water after rain. It was not possible to establish time of death in most cases so annual mortality in the population cannot be estimated from these data.

The role of mountain lion as a predator on elk in the study area is unknown, and no evidence was found of lion killing adult elk. In the event that the conception rate is as high in this population as in the East Pecos elk herd (Evans *pers. comm.*), lion may affect calf survival and herd productivity. Whatever the cause of death, calf carcasses disintegrate and decay more rapidly than adults, leaving less evidence for obtaining data on elk mortality. It is thus possible that calf mortality in the Guadalupe herd is higher than recorded here.

The 19 carcasses found near dried up pools, large enough to retain water for a week or longer, may offer strong evidence as to the dependency of the Guadalupe elk on surface water. The age structure of these carcasses were 1 calf, 2 yearlings and 15 animals of 7 years or older. The absence of animals between 2 and 7 years indicates a possible explanation for these mortalities. Animals using the permanent water sources on the upper range must travel several kilometers over steep, rocky terrain to and from feeding grounds. In the event a sick or old animal remains close to 1 of these temporary pools until it dries up, it may become too weak to move.

McCullough (1969) reported 4 to 5 percent of Tule elk yearlings and adults were lost each year to mortality factors other than hunting. If a similar circumstance is true for the Guadalupe herd, these data may indicate that the 9.2 percent recruitment in 1975 and the 6.7 percent in 1976 could merely be compensating for mortality losses in the older cohorts; this would result in the negligible population increase indicated from this survey.

Population Movements

The elk in the Guadalupes do not confine themselves to well defined trails but do have major movement routes which generally follow topographical features. This is evidenced by the abundance of tracks and droppings up some valleys and over low saddles along the ridges. Elk were observed using the contoured backpacking trails made for tourists, but appeared equally at home moving across steep, rocky slopes.

The elk movement routes in the study area are shown in Fig. 5. The saddle to the

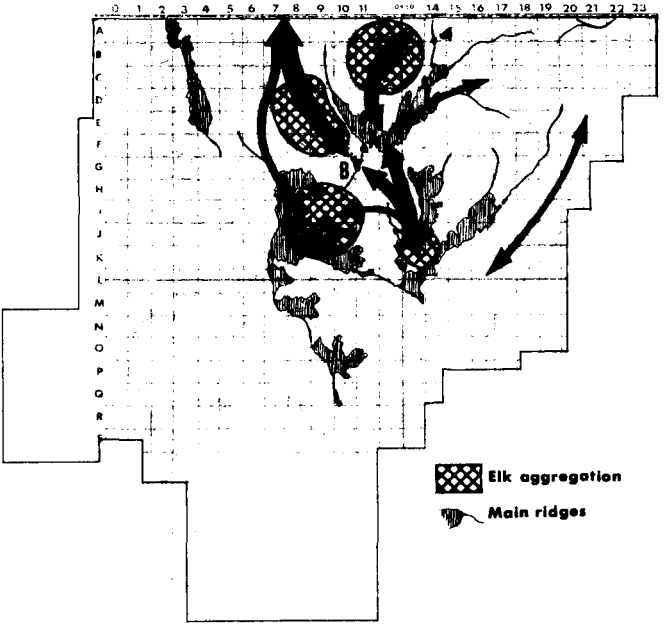

Fig. 5. 1976 elk aggregations and major movement routes in the Guadalupe Mountains National Park, Texas.

east of Lost Peak (A), and the low ridge immediately to the south (B), were found to be the major crossover points between study units 3 and 2, respectively, and the remainder of the study area. Lesser routes were found going south from West Dog Canyon up Blue Ridge toward the Bush Mountain area, joining the Bush Mountain drainage and The Bowl area, and going northeast along the ridge from Lost Peak toward Devil's Den. Elk living below the eastern escarpment moved freely along its face between Pine Springs and McKittrick Canyon, but did not appear to have any significant interchange with the rest of the elk population.

When elk observations were combined with track and pellet evaluations, it became apparent that there are 3 major areas of elk concentration in the National Park (Fig. 5). They are centered in Upper Dog Canyon, in West Dog Canyon, and in the Blue Ridge drainage east of Bush Mountain. A small aggregation of elk may frequent The Bowl area, northwest of Pine Top Mountain, but although there was considerable sign of elk usage, very few animals were sighted in the dense vegetation of this area.

The concentrations in study units 2 and 3 are undoubtedly focused on the availability of water; the spring and the horse-pasture tank in Upper Dog Canyon (unit 2), and

Plowman and Cox tanks in West Dog Canyon (unit 3) are all important water sources for the elk. The concentration at The Bowl (if this does, indeed, occur) may be dependent on the seasonally available water in the tank there, or may be traditionally occupied range dating back to the time when water was pumped into The Bowl tank prior to the establishment of the National Park.

The elk aggregation in study unit 9 east of Bush Mountain is less easily understood. There are no known sources of even temporary water in this unit and elk move down into West Dog or Upper Dog Canyons to water. Either route involves crossing rough terrain as well as elevation changes of well over 460 m.

Two feasible explanations for the Bush Mountain concentration can be postulated although there is no substantive evidence for either possibility. The aggregation may be the result of some unique feature of the area—vegetation, topography, soil minerals, weather conditions, etc.,—which makes it highly desirable to elk. If this is true, the benefit gained from frequenting the area would have to outweigh the disadvantages of being so far from surface water. The other circumstance may relate to population density. It is possible that the carrying capacity for both upper Dog and West Dog Canyons has been reached, and neither area can adequately support any more resident animals. Those elk concentrating in the Bush Mountain area may be doing so because this drainage represents the nearest hospitable area to existing water sources. This latter postulation would also serve to explain the high number of observations of single animals in other parts of the study area. If this suggestion is valid, the limiting factors governing the carrying capacity of an area with regard to elk need further, detailed evaluation. Two factors appear of primary importance toward understanding these limitations; the availability and location of surface water, and the competition between elk for available resources.

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