1979

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NORTH AMERICAN ELK: ECOLOGY, BEHAVIOR AND MANAGEMENT. Edited by M.S. Boyce and L.D. Hayden-Wing. Univ. Wyoming 1979, 294 p.

ELK PELLET GROUP DISTRIBUTIONS AND RATES OF DEPOSITION IN ASPEN AND LODGEPOLE PINE HABITATS

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Abstract: Free-ranging tame elk (*Cervus canadensis nelsoni*) were observed for several 24-hour periods in aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta*) types to determine if relative distributions of pellet groups parallel habitat-segment use. Results showed significant ($p<0.01$) differences between pellet-group distributions and actual distributions of elk activity. Also, the number of pellet groups deposited per elk per day during the summer were double those reported for elk on winter range. Estimates of elk population density on summer ranges using pellet-group counts must take into consideration biases created by differential deposition of fecal groups.

Pellet-group counts have been widely used to estimate numbers of big game and/or relative intensity of use since the early 1940's. Since Riney's (1957) work, the pellet-group count method has increasingly been used as an index to relative use between habitat types and subtypes. This is especially evident as demonstrated by the fact that one-third of the studies reported in the Elk-Logging-Roads Symposium (Peek and Hieb 1976) used the technique to assess elk use and preference for various habitats, subtypes, and habitat modifications.

Riney (1957) suggested that feces counts can provide a description of preferred habitat, and seasonal use of several mammals including red deer (*Cervus elaphus*). Julander et al. (1963) stated that the pellet-group method can estimate relative intensity of use, trend in use from year to year, and total population of a given area. While this technique can reliably estimate population numbers of general areas, its use as an index to habitat segment preferences is questionable (Neff 1968). Anderson (1969) cautioned against inferring "use" (total time herbivores spend in a specific habitat) through the pellet-group method, because the method assumes that the rate of fecal deposition is a linear function of time and that average deposition rates within individual adjacent habitats are similar. The validity of these assumptions has been investigated in only a few cases (Leckenby 1968, Welles and Welles 1961, White 1960).

While numerous defecation rates have been published for deer (Neff 1968), few are available for elk (Morris reported by Julander et al. 1963, Neff et al. 1965), and these have only been for elk occupying winter range or a combination of winter and spring range. We are not aware of any defecation-rate estimates for elk consuming large quantities of green feed.

The material reported here originated during the course of a larger study on big game habitat values on lodgepole pine summer range in 1976. The senior author, while observing free-ranging tame elk, was impressed by the fact that they defecated at noticeably higher rates when moving from one area to another and that pellet group distribution did not appear to reflect actual use patterns. Thus, our objective was to determine if relative distributions of pellet groups are directly proportional to elk use of various habitat segments within major vegetation types. Use is defined here as relative time spent on various habitat segments.

STUDY AREAS

The study was conducted on the Chicken Creek drainages of the Davis County Experimental Watershed in north-central Utah, and the Little Brush Creek drainage of the Ashley National Forest in north-eastern Utah. The Chicken Creek watersheds include two of the upper-most tributaries of Farmington Creek and are dominated by aspen. The aspen type covers more than 60 percent of the area; other habitat segments represented are: grass-forb, mountain brush, sagebrush-grass, and conifer. In addition, the west branch of the watershed includes five 1 to 4 ha areas which were clearcut between 1974 and 1976. Forage resource on the grass-forb and aspen segments are abundant and diverse. The watersheds generally have northwest aspect, moderate side slopes (12 to 45%) and are separated by a low ridge. Gently sloping meadows occupy the bottoms of each drainage. Detailed description of the Chicken Creek watersheds is given by Johnston and Doty (1972).

The Little Brush Creek area is a gently-rolling, forested plateau at the east end of the Uinta Mountain range. Ninety percent has an overstory dominated by lodgepole pine with a small percentage of Engelmann spruce (*Picea engelmanni*) and alpine fir (*Abies lasiocarpa*). Much of the forest is composed of dense (11,000 to 22,000 trees per ha) even-aged stands that are practically devoid of understory. About 10 percent of the area is meadow. Dry meadows are the most common nonforested segment in the area. They produce a diverse array of forbs, grasses, and sedges. Wet meadows are less widely distributed and are restricted to areas immediately adjacent to stream courses; they seldom exceed 15 m in width. Wet meadows have many of the same species as dry meadows, but are about twice as productive. Created upland meadows (actually, clearcuts) are less productive than natural openings, but exceed forested segments in this regard and support a greater diversity of forage species. More detailed description of the Little Brush Creek area is given by Collins (1977).

METHODS

During 24-hour periods of continuous observation, total defecations of free-ranging tame elk were recorded with reference to the habitat segments where the feces were deposited and the animal activity at the time of deposition. This was done on a biweekly basis in the Little Brush Creek area in the summer 1976, and in the Chicken Creek area in summer 1977.

Once during each 2-week period, elk (seven in the lodgepole pine type, five in the aspen type) were released simultaneously from a common location and allowed to roam freely for a 24-hour period. In addition to recording defecations, percent total activity time was determined with scan sampling, a behavioral sampling technique described by Altmann (1974). At the end of each 10-minute interval the activity of each elk and its location with reference to habitat segments was noted. Grazing, ruminating, lying, sleeping, travelling, standing, playing, and drinking were the states or activities noted. The activity time total on each habitat segment was then taken as percentage of the total specific activity time on all habitat segments combined.

The distribution of pellet groups was then compared with the true time distribution of elk, and a goodness-of-fit test was used to determine if the two were significantly different. Pellet-group distributions were treated as observed frequencies, and true time distributions as expected frequencies.

Defecation rates were computed for elk in both the aspen and lodgepole pine types on the basis of the 24-hour observation data. In addition, the observer's ability to record total defecations was checked by comparing the rate he observed with that computed from a count made in an enclosure where seven elk had been contained for 15 days. During nonsampling periods, the elk were maintained in enclosures which encompassed vegetation and habitat segments typical of the study areas.

RESULTS AND DISCUSSION

The hypothesis that relative distributions of pellet groups and actual elk use are not significantly different was rejected ($G = 171.3 > \chi^2_{0.01[5]} = 15.086$) in the lodgepole pine type and ($G = 20.77 > \chi^2_{0.01[5]} = 15.086$) in the aspen type. Clearly, the distribution of pellet groups did not give accurate represen-

Table 1. **Distribution of pellet groups, grazing, and all activities combined for elk in the aspen and lodgepole pine types.**

Habitat Segment	Pellet groups	Grazing	All activities
	Aspen Type		
	% of total		
Aspen	36.5	18.3	23.5
Clearcut	10.4	8.4	5.3
Conifer	0.9	0.0	1.0
Logging road	0.0	2.6	2.0
Meadow	47.8	61.8	63.5
Mountain brush	4.3	8.9	4.5
	Lodgepole Pine Type		
Clearcut	18.5	14.6	8.4
Dry meadow	20.1	33.6	20.6
Mature forest	22.1	3.3	12.4
Revegetated roads	7.0	3.0	2.0
Stagnated forest	9.0	2.0	9.8
Wet meadow	23.4	43.6	46.8

tation of relative habitat segment use. Likewise, distribution of pellet groups was significantly different from the distribution of grazing activity ($G = 255.7 > \chi^2_{0.01[5]} = 15.086$ for elk in the lodgepole pine type; $G = 38.21 > \chi^2_{0.01[4]} = 15.086$ for the aspen type). Table 1 gives the actual distributions of pellet groups, grazing, and all activities combined for elk in both the aspen and lodgepole pine types.

Defecations were observed to occur only during grazing or travelling activities. It was eventually realized that the elk defecated most when they were most active (i. e. walking from one area to another). Roughly 40 percent of all defecations occurred as the animals were travelling, yet travelling represented only 3.5 to 5.6 percent of the elk day. Figures 1 and 2 depict the percent of all pellet groups which were deposited when the animal was simply travelling through an area and those deposited during the actual grazing activity. It also seemed logical that elk would defecate more per unit of time in habitat segments where more walking would be required in the grazing activity. This was verified in a comparison between the clearcut and stagnated forest habitat segments in the lodgepole pine site. These two segments were chosen for the comparison because they were adjacent and the elk tended to wander back and forth between them every 5 to 10 minutes during August when the occurrence of mushrooms made the stagnated segment as attractive as the clearcut for grazing. Under these conditions, the elk were observed to defecate 4.1 times more per unit of time in the stagnated forest than in the clearcut. A rank correlation (Kendell's τ) computed between summer means of pellet groups per grazing hour and meters moved

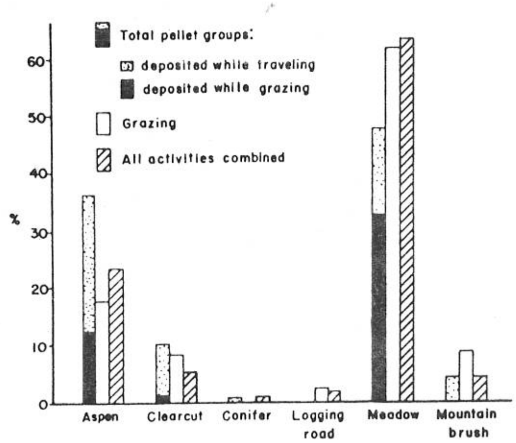

Fig. 1. Pellet-group distribution related to means of grazing and all activities combined for elk in the aspen type.

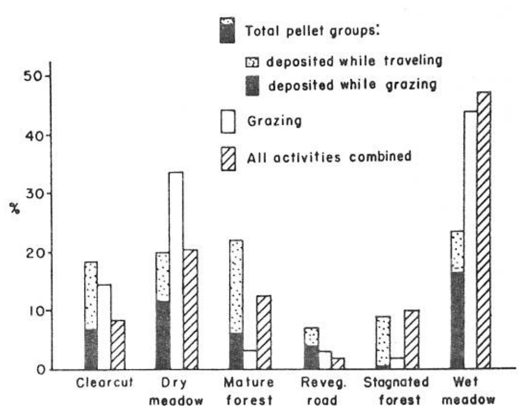

Fig. 2. Pellet-group distribution related to means of grazing and all activities combined for elk in the lodgepole pine type.

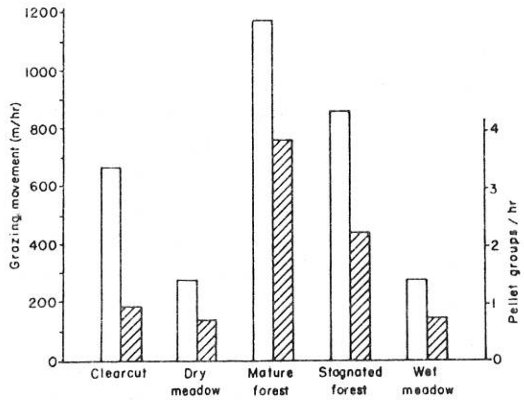

Fig. 3. Pellet groups/grazing hour relative to meters moved/grazing hour of elk grazing the lodgepole pine type in northeastern Utah.

per grazing hour (Fig. 3) showed a significant positive correlation ($p < 0.01$). Pellet group-distance moved comparisons are not yet available for the aspen study area.

Other work (Collins 1977), coincident with the Little Brush Creek study, showed that elk are less likely to move about in search of preferred forage when they are in more productive and species-diverse habitat segments. Such segments were also found to be the most preferred for grazing by elk. Hence, the value of habitat segments important for feeding will tend to be underestimated by the pellet group technique, because those segments are associated with relatively less physical activity and less fecal output.

A mean defecation rate for elk in the lodgepole pine type, determined after the first scan sampling period, was 24 defecations per elk per day, much higher than expected. This was verified by counting pellet groups inside an enclosure where the elk were maintained during nonsampling periods. The total number of pellet groups deposited in the enclosure by seven elk in 351 hours, resulted in a calculated rate of slightly more than 23 pellet groups per elk per day. Thus, we are confident that most defecations occurring in the scan sampling periods were witnessed by the observer. The mean summer defecation rate observed for elk in the aspen type was approximately 30 pellet groups per elk per day.

These values are at least double the approximately 12 groups per day reported in the literature from winter range. Such high rates are probably the result of the quality and quantity of forage our study animals were consuming. Relatively good conditions on summer vs. winter range can result in higher feed intake (Rogers et al. 1958), possibly producing higher defecation rates. Likewise, high moisture content in forage has been found to coincide with higher defecation rates (Longhurst 1954). Fulgham (1978[1]) has observed fecal volume to double in deer as they switch from a predominantly browse diet to a herbaceous diet in spring. Hence, defecation rates which are determined for animals consuming dryer, more fibrous or limited forages are probably not applicable to animals on summer range.

[1] Personal interview with Kenneth O. Fulgham, Department of Animal and Range Sciences, New Mexico State University, Las Cruces.

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