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Winter Diets and Habitat Use Of An Alaska Bison Herd After Wildfire.

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Abstract: Post-wildfire Winter distribution and diet of an interior Alaska bison herd were studied between 1979 and 1982. The herd responded to a fire related increase in wet-meadow habitat from 190 km^2 to 438 km^2 by expanding their winter range into the burn. Micro-histological analysis of 41 fecal samples collected during 1980 and 1981 indicated that 94% of the late winter diet was comprised of herbaceous graminoids. Sedges were the major dietary item (49%-1980, 83%-1981), followed by fescue (44%-1980, 13%-1981). Carrying capacity, based on annual above ground biomass production estimates for similar northern habitats, suggests that present winter range availability is not a limiting factor. However, as wet-meadow serel stages are generally short lived in interior Alaska, available winter range will likely decline unless additional burning occurs.

The North American bison (*Bison bison Athoabascae*) was common in the Alaska fauna until 200 to 300 years ago (Skinner and Kaisen 1974, McDonald 1978). Reasons for extirpation are not known, however, changing climate and habitat are suspected to have played a major role. The species was reintroduced to Alaska with a transplant of 17 plains bison (*Bison bison bison*) from the National Bison Range, Montana to Delta Junction in 1928. By the early 1950's, this herd had grown sufficiently to allow sport hunting as well as provide animals for additional trans-plants. In 1965, 18 bison were transplanted to Farewell Lake Alaska. In 1968, this herd was augmented with a second transplant of 20 bison to form a nucleus herd of 45. By 1971, the population had grown to 70 animals and, as available range appeared to be severely limited, a permit hunt was held in 1972. The Alaska Department of Fish and Game determined that the carrying capacity of the range was around 100 animals (Burris and McKnight 1973:18) and, through controlled hunts, has managed for that number until present.

Winter is the most difficult season for bison (Fuller 1962:12). Harsh weather conditions place strong energy demands on the bison and, determine winter distribution. During winter months in lower and mid-latitudes of North America, bison depend primarily on grasses (Meagher 1973, Peden 1976), while sedges are the major dietary item in northern latitudes (Reynolds et al 1978). The winter diet of northern bison reflects their preference for sedge dominated habitat (Soper 1941, Reynolds et. al. 1978, Cairns & Telfer 1980). Distribution and life pan of sedge-grasslands, which provide large quantities of vegetation that can be obtained with a minimum of foraging effort (Van Camp 1975), are often dependant upon natural phenomena such as stream

meandering, flooding, or wildfire. These events initiate secondary succession which, in northern latitudes, generally includes a grass-sedge serel stage (Viereck 1973)

In 1977, a wildfire (Bear Creek fire) burned approximately 1,400 km^2 in the Farewell, Alaska area including a portion of bison winter range. This paper reports the results of a study to ascertain winter distribution and diet of the bison after fire.

Study Area

The 450 km^2 study area is located 275 km northwest of Anchorage, Alaska (Fig. 1). It includes 390 km^2 along the South Fork of the Kuskokwim River that was moderate to severely burned by the 1977 wildfire plus 60 km^2 of unburned habitat. Located at the western foot of the Alaska Range, the area lies within the Tanana-Kuskokwim lowland of the Alaska Intermontane Plateau Physiographic Region (Wahrhafting 1965). Topography is nearly level glacial outwash plains dissected by three undulating glacial moraines running north and south through the area. Elevations range from 480 m on the moraines to 180 m along the South Fork of the Kuskokwim River. The climate is typical of Interior Alaska with long, cold winters (mean temperature = -18°C) and short, cool summers (mean temperature = 13°C). Annual precipitation averages 42.4 cm, half of which is snow. Strong winds, ranging from 24 to 65 km/hr. play an important role in snow accumulation and forage availability.

Viereck and Little (1972:11-23) described the vegetation of the Tanana-Kuskokwim lowlands as a mosaic pattern. Major components of this mosaic are open black spruce forests comprised primarily of black spruce (*Picea mariana*), willows (*Salix spp*.), ericaceous shrubs (*Vaccinium spp.*) and sedges (*Carex spp.* and *Eriophorum spp.*), and low brush-muskeg comprised of near continuous stands of willows, shrub birch (*Betula spp.*), bog cranberry (*Oxycoccus microcarpus*) and sedges. Additional important components include deciduous brush lined stream meanders and an occasional closed spruce-hardwood stand. Major species along stream meanders are alder (*Alnus spp.*) and willows, while white spruce (*Picea glauca*), paper birch (*Betula papyrifera*), willows, and thick moss mats characterize the spruce-hardwood stands.

Alaska Department of Fish and Game surveys indicate that prior to the 1977 fire, bison were found primarily along or immediately adjacent to the flood plain of the Kuskokwim River. Animals inhabited exposed river bars and abandoned channels where grasses and sedges were abundant. During the winter, bison were occasionally observed in graminoid dominated communities around lakes on the moraine immediately adjacent to the Kuskokwim River.

Methods

Field investigations were conducted between 1979 and 1982. The study area was surveyed during February and early March of each year by flying parallel transects 0.8 km apart at approximately 150 m altitude. Bison locations and numbers were recorded on 1:63,000 USGS topographic maps. During the winters of 1980 and 1981, the areas where bison were observed were visited by either foot or helicopter within 48 hours of the survey to collect fresh fecal samples. These samples were preserved for later microhistological analyses at the Composition Analysis Laboratory, Colorado State University. Sample preparation and analysis followed techniques discussed by Hansen and Flinders (1969) and Flinders and Hansen (1972) . Fecal composition data were pooled by year for analysis.

Habitat data were gleaned from a vegetation study conducted in conjunction with the bison study. Briefly, these data were collected from permanent ¼ hectare plots during the summers of 1978-1980. Sixteen 0.5m x 2m subplots were systematically located within each plot and the amount of shrub, forb, lichen, and moss cover estimated using cover classes described by Daubenmire (1959). In addition, frequency of occurrence of plant species was estimated by mile long toe-point transects adjacent to each plot. Transects were comprised of 200 equally spaced recording points. Cover and frequency data were used in conjunction with interpretation of aerial photography to describe pre- and post-fire plant communities.

Results

Pre-wildfire photography indicates that three major plant communities occurred on the study area before 1977. A closed spruce-hardwood forest comprised of white spruce, dwarf birch (*Betula nana*) and willows (*Salix spp.*) occurred on well drained sites throughout the area. Poorly drained sites supported an open spruce forest-muskeg dominated by black spruce, willows, labrador tea *(Ledium sp.*), ericaceous shrubs and sedges. Much of the moraines were vegetated with a shrubland community comprised primarily of dwarf birch, willow, and occasional islands of white spruce and balsam poplar (*Populus balsomifera*).

Grass and sedge dominated communities covered 38% or approximately 190 km^2 of the study area before the 1977 fire. More than 47% (90 km^2) of these communities resulted from old burns and were at least 6 km from traditional bison winter habitat. The remaining 53% (100 km^2) of the grasslands were dispersed throughout the study area, occurring primarily around small lakes and dry lake beds.

In 1981, four years after the fire, approximately 97% or 438 km^2 of the study area supported graminoid dominated communities while the remaining 3% was shrubland. Sixty-three percent of the area (276 km^2) supported communities in which grasses (*Calamagrostis canadensis, Elymus innovatus, festuca sp. , Poa sp.,* and *Galium sp.*) were a major component and 36% (162 km^2) supported communities in which *Carex spp.* and *Eriophorum spp.* were major components.

A total of 281 bison were observed on the study area during the study, 33 in 1979, 75 in 1980, 75 in 1981, and 98 in 1982. With the exception of 1979, these observations likely represented a major portion of the Farewell herd. Alaska Department of Fish and Game population estimates

were 100 in 1979, 90 in 1980, 90 in 1981 and 100 in 1982. Group size ranged from individual animals to groups of 45 with a mean herd size of 13.3 animals over the 4 winters.

Winter distribution expanded during the study (Fig. 2). In 1979, bison were observed bedding and feeding on the grass and sedge covered dry lakes and shores of small lakes on the moraine adjacent to the South Fork of the Kuskokwim River. These locations were within or near pre-fire winter range. In 1980, bison again used this area, but animals were also observed on the next maraine to the west. In 1981 and 1982, bison appeared to have expanded their range further into the burn with the majority of sign and bison observations occurring to the north and west of the previous years' locations.

The habitats used by bison during all four winters were similar in that they were predominately bluejoint grass (*Calamagrostis canadensis*) and sedges. The major difference was in the type of pre-fire plant community that occurred on the areas. Wintering areas on the moraines had supported graminoid and low shrub dominated communities while the areas used in 1981 and 1982 had primarily supported open black spruce muskeg.

A total of 41 fecal samples were collected during the study, 30 in 1980 and 11 in 1981. These samples indicate that the winter diet of bison on the burn was comprised primarily of grasses and sedges (Table 1). While sedges and fescue (*Festuca sp.*) compiled 92.9% and 95.7% of the 1980 and 1981 diets, respectively, diet composition differed significantly (X^2=96.3, P#0.05) between winters. This difference reflected a shift from near equal amounts of sedges (48.9%) and fescue (44.0%) in the 1980 sample to predominately sedges (82.7%) in 1981. Sedges and Fescue were also the only species that occurred consistently in all samples both years, although small amounts of willow and lyme grass (*Elymus innovatus*) occurred in many of the 1981 samples. Some herbaceous graminoids that were relatively abundant on the wintering areas such as bluejoint grass, lyme grass and (*Eriophorum spp.*) were not used to any extent.

Table 1. Items composing more than 1 percent of the diet and/or occurring in 10 percent or more of the fecal samples during Feb. 1980 and 1981.

	1980		1981	
Species	Rel. Freq.	% occurrence	Rel. Freq.	% occurrence
Agrostis sp.	0.2	13.3	0.2	36.4
Calamagrostis canadensis	0.0	10.0	0.1	9.1
Carex sp.	48.9	100.0	82.7	100.0
Elymus innovatus	0.2	33.3	1.1	81.8
Eriophorum sp.	1.1	53.3	0.6	36.4
Festuca sp.	44.0	96.7	13.0	100.0
Luzula sp.	3.7	2.0	1.0	54.5
Salix sp.	1.1	66.6	1.1	90.9

Discussion

The winter distribution of the Farewell bison herd is apparently expanding. This expansion is attributed to fire related habitat changes. Similar to habitat use reported for bison in Elk Island and Wood Buffalo National Parks of Canada (Soper 1941, Van Camp 1975, Reynolds et. al 1978, Cairns and Telfer 1980), a major portion of the Farewell herd winters on areas with extensive sedge cover. The extent of this habitat type has more than doubled since the 1977 wildfire, primarily due to the conversion of 260 km^2 of predominately black spruce-muskeg to sedge-grasslands. In addition, the new sedge-grasslands are contiguous with summer and historic winter bison range which facilitates rapid range expansion.

Fire related snow pack changes may have also stimulated bison winter range expansion. The disjunct and widely scattered sedge-grasslands were separated by extensive open spruce forest-muskeg bogs and shrublands before the fire. Spruce forest-muskeg and shrublands, which generally have a snow pack significantly greater than the grasslands (Van Camp 1975, authors' observations), may have discouraged bison movements. While quantitative data were not collected, observations indicate that the grasslands resulting from the 1977 fire have had less snow pack than adjacent unburned spruce-muskeg and shrublands. During the winters of 1980 and 1981 large areas were swept free of snow by the prevailing winds off of the Alaska Range.

Similar to what has been reported for bison in Yellowstone National Park (Meagher 1973:90) and northern latitudes (Holsworth, W. M., Unpubl. Can. Wildl. Ser. Rpt. 1960, Fuller 1962:14, Reynolds et. al 1978) sedges were the main source of winter forage. Diet composition did differ between 1980 and 1981, however, this is attributed to the differences in wintering areas between the two years. *Festuca* was more common on the sandy, well drained soils of the moraines used in 1980 than wet, boggy areas used in 1981. Regardless of the differences, bison winter distribution and predominance of sedges and grasses in the bison's diet indicate the importance of the burn to the Farewell herd.

Fuller (1962) reported that because of its abundance in relationship to summer range, winter range availability may not be the limiting factor for bison in Wood Buffalo National Park. This is also likely the case at Farewell. Wet sedge meadows are important winter bison habitat (Soper 1941, Van Camp 1975). Assuming this to be the situation at Farewell, 162 km^2 of the study area is potential winter habitat. Based on annual above ground estimates for unburned bison habitat in other parts of Alaska, (McKendrick 1982), a minimum of 560 kg/ha of annual above ground biomass production is likely at Farewell. This translates into 8,183,765 kg. (162 km^2 or 14,609 hectares x 560 kg/ha) of annual production on the wet meadows of the study area. Since bison usually graze only the top third of wet meadow vegetation (Reynolds et. al 1978) approximately 2,727,922 kg. of forage would actually be available. Dividing available production (2,727,922 kg.) by the annual requirement of 4,899 kg. dry matter per animal (Palmer 1944) indicates approximately 557 animal units or 1.2 bison per km^2 could be supported by the wet sedge meadows. Actual carrying capacity may be greater (fire often increased primary production) or less, considering areas inaccessible due to snow cover. However, the present winter carrying capacity of the study area likely surpasses the requirements of the existing bison population.

The future carrying capacity of the winter bison range will decline unless it is maintained by

appropriate range management techniques. Wild-fire conversion of black spruce-muskeg to wet sedge-grasslands is common in interior Alaska. However, this seral stage generally does not persist for much more than a decade unless burning was severe or reburning occurs (Viereck and Schandelmeier 1980:47-54).

The results of this study indicate that the Bear Creek fire increased the Farewell bison herd's wintering range substantially by converting black spruce-bog to graminoid dominated wet meadows. The present abundance of winter range suggests that it is not the limiting factor for bison. Results also identify the potential of fire as a tool for the management of northern bison populations.

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Literature Cited

Burris, 0. E. and D. E. McKnight. 1973. Game transplants in Alaska. AK. Dept. Fish and Game, Game Tech. Bull. No. 4 . 57pp .

Carins, A. L. and E. S. Telfer. 1980. Habitat used by 4 sympatric ungulates in boreal mixed wood J. Wildl. Manage.44:849-857.

Daubenmire R. F. 1959. Plants and Environment. John Wiley, New York. 422pp.

Flinders, J. T. and R. M. Hansen. 1972. Diets and habitats of jackrabbits in north eastern Colorado. Range Sci. Dept. Sci. Ser. 12. Colorado State Univ., Ft. Collins . 29pp.

Fuller, W. 1962. The biology and management of the bison of Wood buffalo National Park. Can. Wildl. Ser. Wildl. Manage. Bull. Series 1, No. 16.

Hansen, R. M, and J. T. Flinders. 1969. Food habits of North American hares. Range. Sci. Dept. Sci. Ser. 1. Colorado State Univ., Fort Collins. 18pp.

Holsworth, W. M., Unpublished. Canadian Wildlife Service Report 1960

McDonald, J. 1978. The north American bison: a revised classification and interpretation of their evolution. Unpub. PhD. Dissertation. Univ. Calif. (Los Angeles). 752pp.

McKendrick, J. D. 1982. Alaska's bison: a game biologist's range-management problem. Agroborealis 14:73-79.

Meagher, M. 1973. The bison of Yellowstone National Park. N.P.S. Scientific Monogr. Series No 1. 161pp.

Palmer, L. J. 1944. Food requirements of some Alaskan game mammals. J. Mamm. 25:49-54.

Peden, D. 1976. Botanical composition of bison diets on shortgrass plains. Amer. Midl. Natl, 96:225-229.

Reynolds, H., R. Hansen, and D. Peden. 1978. Diets of the Slave River lowland bison herd, Northwest Territories, Can. J. Wildl. Manage. 41:581-590.

Skinner, M. and 0. Kaisen. 1974. The fossil bison of Alaska and preliminary revision of the genus. Bull. Amer. Mus. Natl. Hist. 89:127-256.

Soper, J. 1941. History, range, and homelife of the northern bison. Eco. Monogr. 11:347-412.

Van Camp, J. 1975. Snow conditions and the winter feeding behavior of *Bison bison* in Elk Island National Park. Can. Wildl. Ser. Rpt. CWS-53-75, 91pp.

Viereck, L. A. and Little (1972:11-23)

Viereck, L. A. 1973. Wildfire in the taiga of Alaska Quatern. Res. 3:465-495.

Viereck, L. A. and L. A. Schandelmeier. 1980. Effects of fire in Alaska and adjacent Canada - A literature review. USDI, BL,-Alaska Tech. Rpt. 6. 124pp.

Wahrhafting, C. 1965. The Physiographic Divisions of Alaska. U.S. Geological Survey Prof. Pap. 482pp.

Figure 1. Location of the Farewell bison study area. Shaded area was burned by the 1977 wildfire.

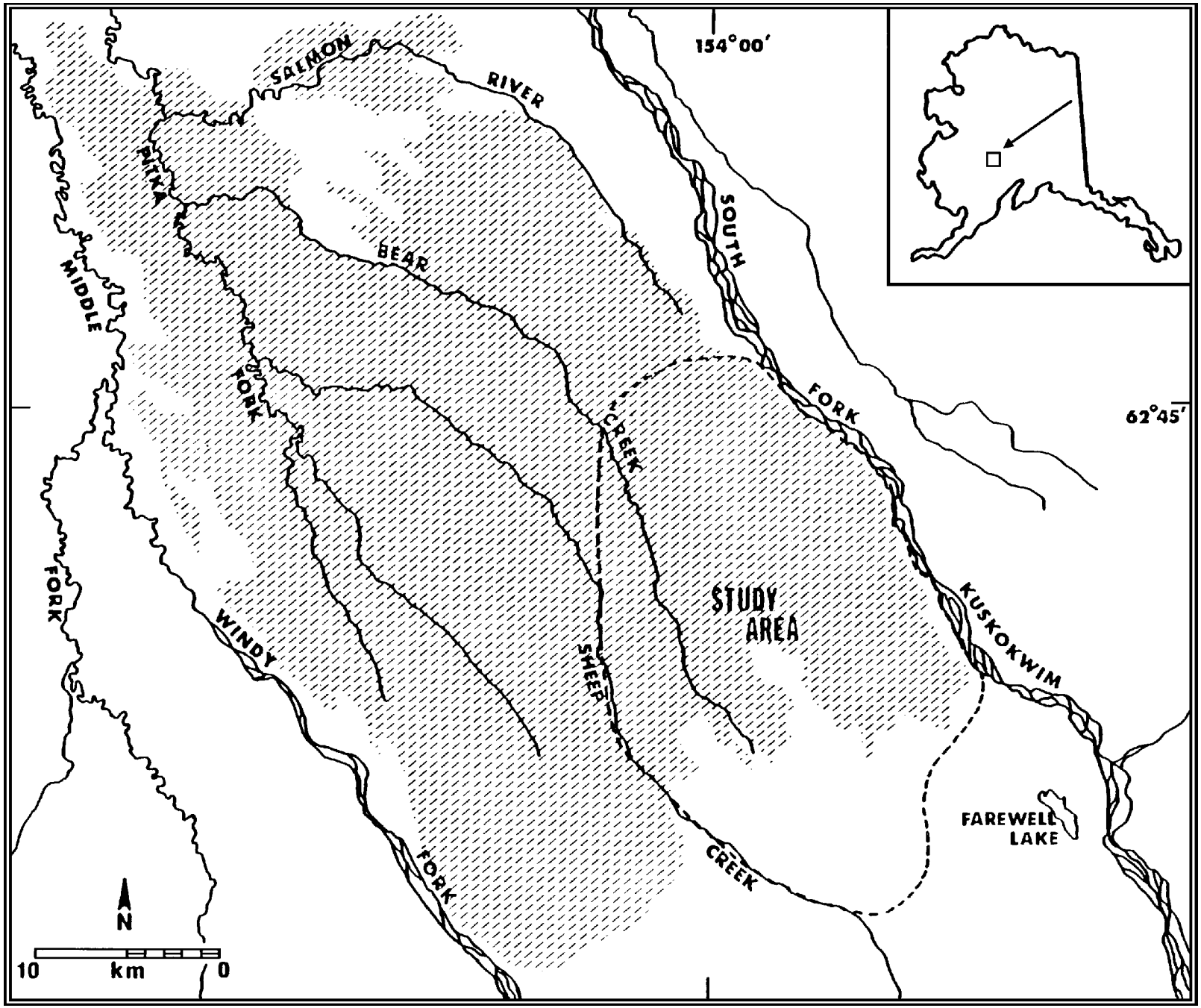

Figure 2. Distribution of bison observations during the winters of 1979-82 at Farewell, Alaska.