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Initial Response of Moose, *Alces alces*, to a Wildfire in Interior Alaska

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The initial response of seven radio-collared Moose (*Alces alces*) to wildfire was investigated to determine if Moose were displaced from the burned portion of their home ranges. Home ranges of these Moose overlapped a 500-km² fire that burned from 3 May-20 June 1980 in interior Alaska. By comparing relocations and home ranges of animals from May-August of the two years preceding the fire to data in the year of the fire, we concluded radio-collared Moose were not displaced. Moose selected primarily unburned sites within the perimeter of the fire.

Key Words: Moose, *Alces alces*, wildfire, Alaska

The immediate effect of wildfire on wildlife is often perceived as animals fleeing from flames. Although some examples support this concept (Komarek 1969), little is known about the response of Moose to wildfire (Kelleyhouse 1979). Hakala et al. (1971) observed no Moose fleeing from approaching flames of a 348-km² fire on the Kenai National Moose Range, Alaska. Komarek (1969) indicated that large mammals usually escaped without panic along the sides and flanks upon determining the fire's direction. Conversely, Udvardy (1969, cited in Bendell 1974) reported a chaotic incident of Moose and other animals escaping wildfire by swimming across large rivers. In Manitoba, a large, fast-moving fire (809-km² in 8 hours) killed and scorched some Moose and other wildlife unable to escape (V. Crichton, personal communication).

Our objective was to determine if radio-collared Moose were displaced from the burned portion of their traditional home ranges during and/or shortly after a large wildfire in interior Alaska. This information will help Moose managers predict effects of wildfire on Moose, on postfire Moose population density, and on potential population growth. If most Moose are displaced from their home ranges either permanently or for many years, Moose population regrowth would be slow or highly dependent upon immigration. Where Moose density is low adjacent to the burn, immigration may not significantly contribute to population growth. Conversely, if Moose that traditionally used the burned area remained in their established ranges, then they could contribute substantially to population growth in the burn, and there would be less need for concern by wildlife managers, fire suppression personnel, and the general public about the welfare of Moose during and after wildfires.

Study Area

The interior Alaska study area, located on the Tanana Flats lowlands (Figure 1), supports a mosaic of

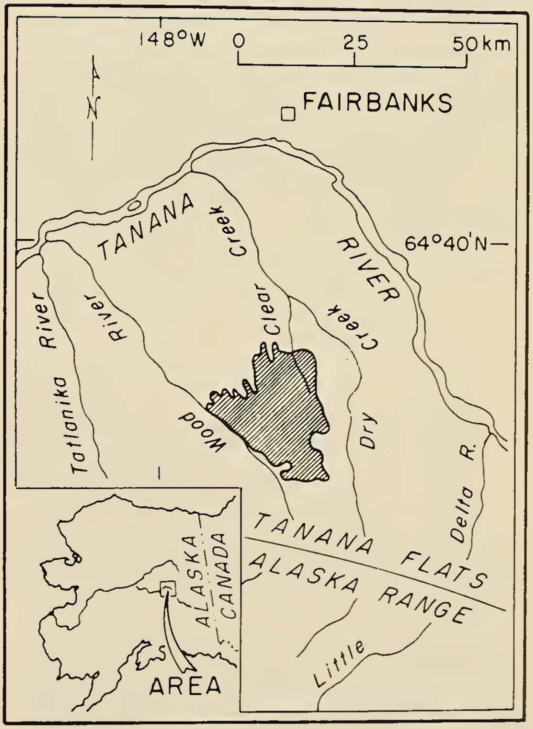

Figure 1. Location of the 500-km² wildfire (shaded area) that burned on the Tanana Flats, Alaska from 3 May-20 June 1980.

habitat types including herbaceous bogs, shrub-dominated seres following numerous wildfires, deciduous forest, and Black Spruce (*Picea mariana*) and White Spruce (*P. glauca*) forests (LeResche et al. 1974).

A 500-km² wildfire burned on the Tanana Flats from 3 May-20 June 1980. The fire burned an area of predominantly mature Black Spruce and Aspen (*Populus tremuloides*) forest, which supported a Moose density of approximately 0.1 moose/km².

In that portion of the burn traditionally used by radio-collared Moose, about 75% of the area was moderately to severely burned, about 10% lightly burned, and about 15% unburned. Basal sprouting of willows (*Salix* spp.) occurred during summer 1980. An average of 58% (SE 8, *N* 7, range 20-76) of the 1980 home ranges occupied from 29 April-August were inside the fire perimeter.

Methods

We tested the following hypotheses: (H_0) wildfire does not displace Moose from burned portions of home ranges, (H_a) wildfire displaces Moose from burned portions of their traditional home ranges. A wildfire in May and June 1980 burned portions of home ranges of five radio-collared cow Moose and two radio-collared bulls. To determine if the fire displaced Moose, locations and home ranges of radio-collared Moose during 29 April-August 1980 were compared to similar data from the same Moose during 29 April-August of 1978 and 1979. The 1978 and 1979 Moose movements identify traditional home ranges and serve as controls for detecting effects of wildfire on home ranges. The number of relocations from 29 April-August for individual Moose ranged from 8-11 in 1978, 4-7 in 1979, and 4-6 in 1980 prior to and during the fire and 2-5 after the fire. Only four of the seven Moose were radio-collared in 1978. Home ranges were drawn using the minimum home range method (Mohr 1947). Subjective visual comparisons between the 1978-79 and 1980 home ranges of each Moose helped to determine if displacement occurred. We realize the limitations of home range polygons drawn from a small sample of locations.

In testing the hypotheses, H_0 will be rejected if: (1) a X^2 test shows significantly fewer ($P < 0.05$) relocations of Moose are found in the burn perimeter during 1980 than are expected, based on 1978 and 1979 relocations, and (2) a significantly ($P < 0.05$) greater percentage of 1980 home range polygon area is outside the burn perimeter when compared to percentages for 1978 and 1979; the test is Wilcoxon's signed ranks procedure (Hollander and Wolfe 1973). If we fail to reject H_0, we will inspect the data to determine if we want to make a heuristic argument for acceptance of H_0. If we reject H_0, inspection of data will be used to heuristically argue to accept H_a.

In 1980, Moose were recorded as being inside or outside the fire perimeter. If inside, the site selected by the Moose was recorded as burned or unburned. All relocations were made from fixed-wing aircraft and plotted on 1:63 360 maps.

To determine the percentage of radio-locations from 1978 and 1979 that were in the 1980 burn, each location was compared to a map showing the chronological advance of the fire perimeter. The Moose was determined to be in the area burned during 1978 or 1979 if the location was within the burn perimeter for that day in 1980. Therefore, when the burned area was small, a 1979 point could have been recorded out of the burn, yet later when the burned area had enlarged the same location could have been in the burn. The advance of the fire was monitored by the Bureau of Land Management and the Alaska Department of Natural Resources, Division of Forestry during fire suppression activities. Chronological advance of the fire's perimeter was drawn on 1:63 360 maps. The intensity of the burn, based on criteria of Viereck and Schandelmeier (1980), was assessed during aerial and ground level surveys.

Results

We accepted H_0 because we did not statistically reject H_0 and inspection of data provided no evidence that fire displaced Moose from the general area used 1-2 years prior to the fire. The number of relocation points inside the fire perimeter in 1980 did not decline ($P > 0.05$) compared with 1978 and 1979 (Table 1). The mean percentage of May-August home range area outside the burn perimeter was not greater in 1980 (42%, SE 7.7, *N* 7) than in 1978 and 1979 (57%, SE 8.6, *N* 11). In addition, May-August home ranges in 1980 overlapped 1978 and 1979 ranges by an aver-

TABLE 1. Percentage of relocations for seven radio-collared moose within an area burned by wildfire on the Tanana Flats, Alaska.

	1978-79 (pre-burn)		1980		
Month	*N*	%	*N*	%	Status of fire
May	37	11	11	9	Burning
June	17	12	20	50	Burning
July	6	17	8	75	Postburn
August	8	63	9	78	Postburn
Total or mean of means	68	26	48	53	

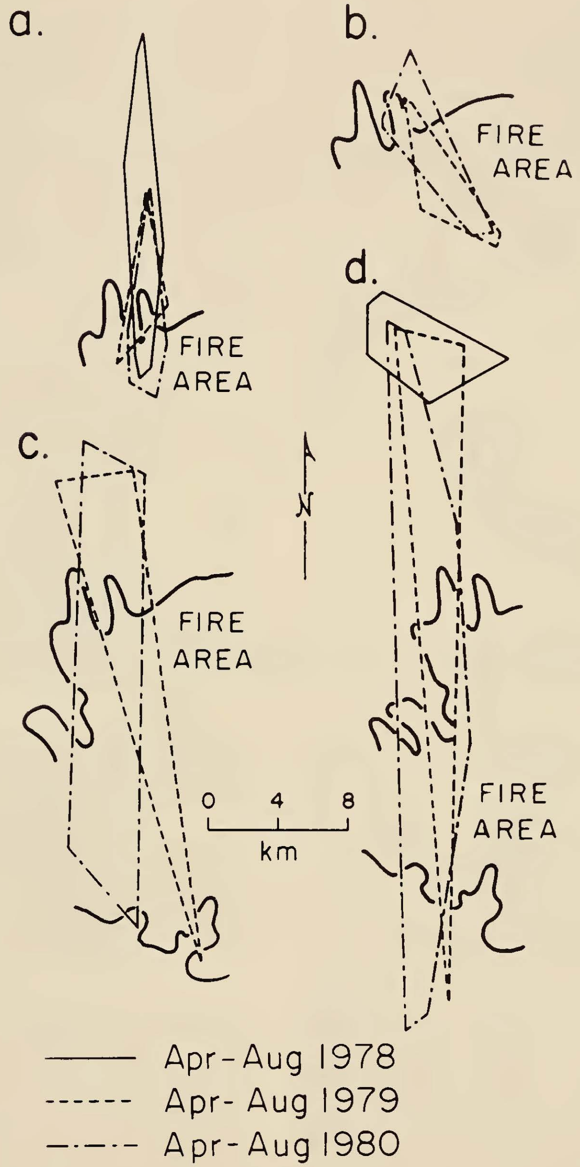

FIGURE 2. Home ranges of four radio-collared Moose for 29 April-August 1978, 1979, and 1980 in relation to a wildfire that burned from 3 May-20 June 1980 on the Tanana Flats, Alaska.

age of 46% (SE 7, *N* 11). Visual inspection of these prefire and 1980 May-August home ranges shows nonoverlapping portions of ranges were spatially close and the long axes were generally parallel (Figures 2, 3). These data indicate the fire had little effect on the shape and location of home ranges.

Moose showed no reluctance to use that portion of their range within the fire perimeter while the fire was burning and producing dense smoke (Figure 4). Fifty percent of all June 1980 relocation points were inside the fire perimeter (Table 1) and, on two occasions, Moose were seen standing within 2 and 15 m of small

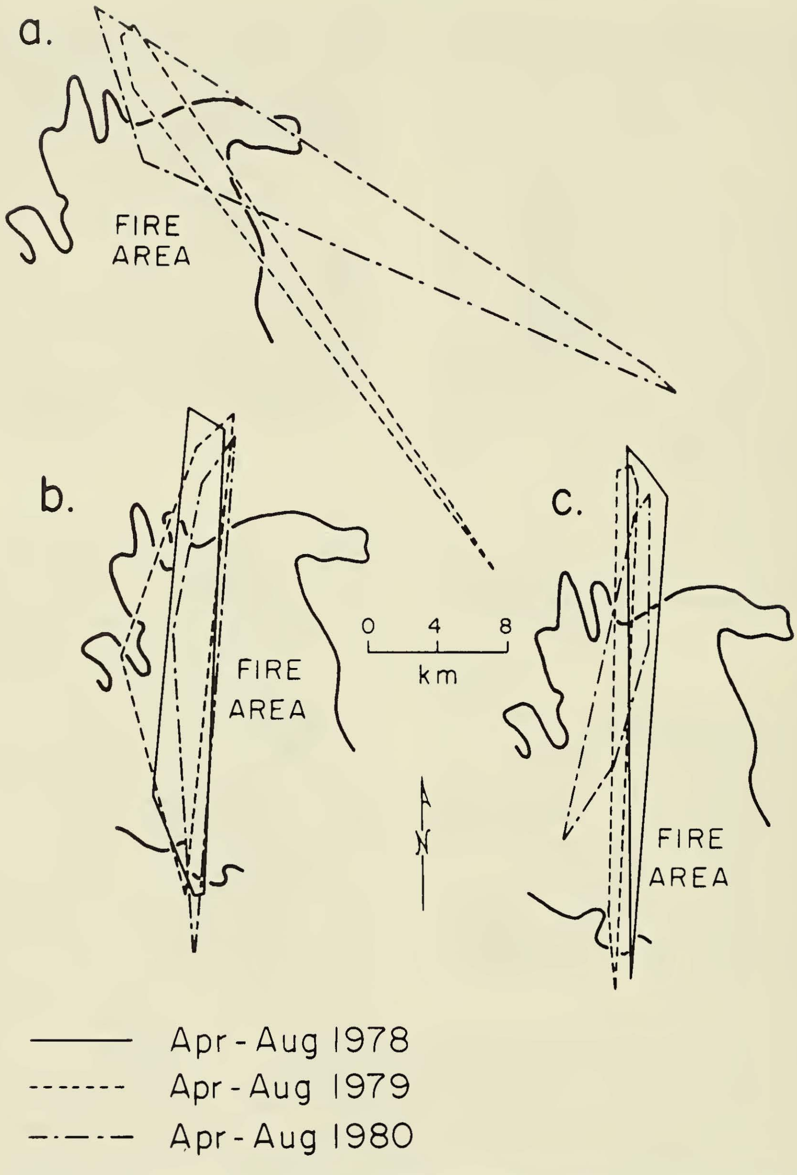

FIGURE 3. Home ranges of three radio-collared Moose for 29 April-August 1978, 1979, and 1980 in relation to a wildfire that burned from 3 May-20 June 1980 on the Tanana Flats, Alaska.

flames. These two Moose appeared unconcerned about the flames.

When Moose were within the perimeter of the burn, they showed strong selection for unburned vegetation (X^2, $P < 0.01$). Although only approximately 15% of the vegetation remained unburned, radio-collared Moose were located in unburned sites 67% ($N = 30$) of the time.

Discussion

Moose were not displaced from their traditional May-August home ranges when a portion of their range was altered by fire. Unburned vegetation apparently met their immediate food and cover requirements and may have been the main factor initially enabling them to remain within their ranges. Unburned vegetation outside the fire perimeter and as

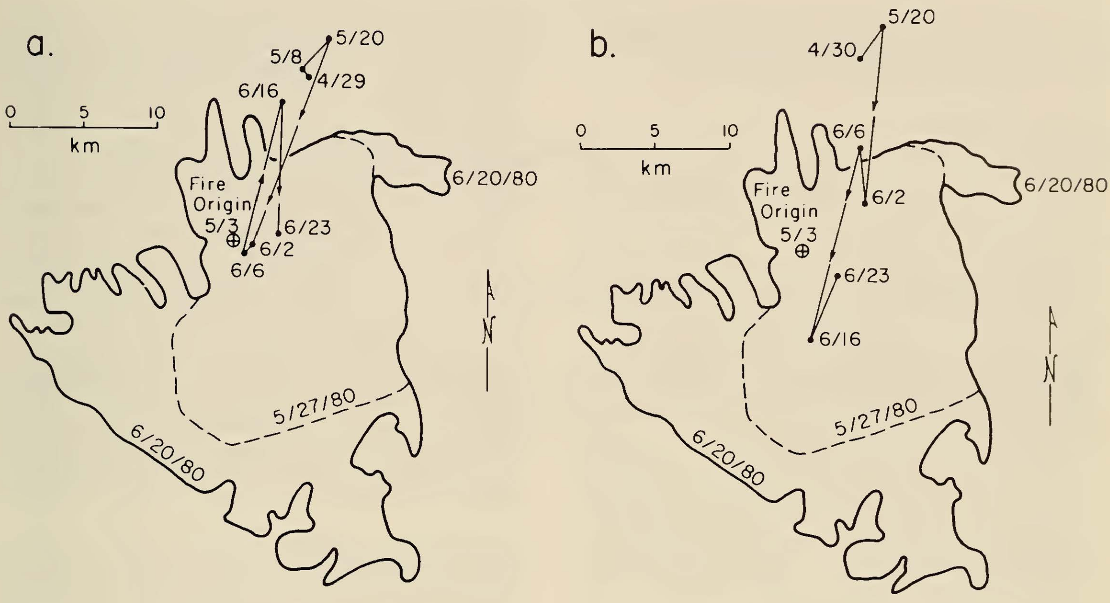

FIGURE 4. Movements of two radio-collared Moose from 29 April-23 June 1980 in relation to a wildfire that burned from 3 May-20 June 1980 on the Tanana Flats, Alaska. Intermediate (dashed line) and final fire perimeter (solid line) are shown.

"islands" inside the fire perimeter was used (Figure 4). Additionally, Moose had resprouting browse available in the burned area during summer 1980; therefore, their food base quickly increased.

Data in Table 1 appear to indicate that Moose were attracted to the burn area during June and July 1980, but we hesitate to draw this conclusion. Movements of each Moose viewed independently showed no clear shift of home range into the burn during 1980 as compared with other years.

Large wildfires in interior Alaska commonly burn mature or climax forests, which generally have low Moose densities (0.1-0.2 Moose/km^2; Gasaway and DuBois, unpublished data); therefore, few Moose will be associated directly with wildfires. Moose that are in contact with wildfires similar to the one we observed may not be adversely affected and probably will remain in their home range. In contrast, extremely hot, large, and fast-moving wildfires that leave few unburned inclusions may occasionally kill or temporarily force Moose to abandon their home ranges. These factors should be considered when planning prescribed burns or managing wildfire to benefit low density moose populations. When moose density is high adjacent to burns, type of burn is of lesser long-term importance because of the potentially high rates of immigration, as observed in Minnesota (Peek 1974). Additionally, burning in spring or early summer allows some forage regrowth in the same year, thus providing a widespread food source. Burning in late summer or fall in northern latitudes will delay vegetative regrowth until the following spring, which could be a factor in forcing Moose to abandon portions of their home range.

The consequences of home range abandonment and the resultant slowed population growth are significant to people dependent on Moose for food and recreation in interior Alaska and northern Canada. Moose density is currently low over much of the area, and this can have a bearing on the long-term response of Moose to burned areas. When Moose density is low and well below carrying capacity, there is neither a reservoir of Moose nor the competitive incentive for Moose to immigrate into burns. Therefore, growth of low density Moose populations may be primarily dependent on production by Moose that traditionally occupied the area (Gasaway et al. 1980). Under favorable conditions, Moose populations can double in 3-4 years (finite rate of growth = 1.2-1.25) (Gasaway et al. 1983; Keith 1983), hence the starting Moose density is an important determinant of future Moose densities and availability of Moose for use by humans.

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