MOOSE MOVEMENTS AND HABITAT USE ALONG THE SUSITNA RIVER NEAR DEVIL'S CANYON

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Abstract: From October 1976 through January 1979 a moose movements and population study was conducted along the Susitna River in southcentral Alaska to aid in assessing the potential impacts of hydroelectric power development on moose (*Alces alces gigas*). Twenty-two radio collars and 21 visual collars were placed on adult cow moose during the study. Radio-collared moose were located on 467 occasions while visual-collared moose were observed 43 times. Annual home ranges of moose are calculated and compared between drainages and to those from other studies in North America. Movement patterns, fidelity to summer and winter ranges and habitat utilization are discussed. Areas of high moose concentration are identified. Proposed hydro-electric developments are described and their potential impacts on moose are considered.

The merits of utilizing the Susitna River to provide Anchorage and Fairbanks, Alaska with hydro-electric power have been the subject of a number of feasability studies since 1948. Proposals have ranged from a two to twelve dam system. Most recently, the Devil's Canyon-Watana Creek two dam system was selected by the U.S. Army Corps of Engineers as the most viable of several alternatives.

The Susitna River drainage, located south of the Alaska Mountain Range in south-central Alaska, has long been recognized as an extremely rugged wilderness area of high esthetic appeal and as an important habitat area to a variety of wildlife species (Ak. Dept. Fish & Game, unpubl. data). Large numbers of moose (*Alces alces*) and caribou (*Rangifer tarandus*) have historically inhabited the Susitna River Basin. The recent upsurge of interest in providing hydro-electric power by damming the Susitna River has focused attention on the potential impact of this action on wildlife. Although many species of animals could potentially be influenced, studies to date have focused on ungulate populations, primarily moose. The purpose of this report is to present our findings on moose movements and habitat use in and adjacent to the proposed impoundment areas and to discuss the potential impacts of the hydro-electric projects.

DESCRIPTION OF PROPOSED HYDROELECTRIC PROJECTS

The Devil's Canyon-Watana Creek two dam system would theoretically provide 6.1 billion kilowatt hours of electrical power annually from a

dependable capacity of 1,568 megawatts (Ak. Dist. Army Corps Engineers 1975). The Devil's Canyon dam would be a concrete structure 193 m high, while the Watana dam would be a rock fill impoundment rising 247 m above the river bottom. A 103 km road from Chulitna to the Watana site, including a 198 m bridge across the Susitna would be constructed for transporting materials and personnel to the dam sites. 586 km of transmission line corridors, 57-64 m wide, would be cut across the mountains between Anchorage and Fairbanks. Warehouses, vehicle storage buildings and permanent living quarters would be erected at the dam sites. The total projected cost of completing this project is 2.6 billion dollars (Ak. Dist. Army Corps Eng. 1977). The estimated annual cost of operation for 100 years following completion is 104 million dollars. Construction and maintenance of this system would constitute the largest hydro-power project in North America (Gravel 1977).

Construction of both proposed dams would inundate 20,700 hectares of the river valley, 132 km upstream to a point between the Tyone and Oshetna Rivers (U.S. Fish and Wildl. Serv. 1975). Water levels of the Devil's Canyon reservoir are expected to remain almost constant, but may fluctuate up to 55 m (op. cit.). The Watana reservoir is projected to have seasonal fluctuations up to 78 m. Downstream flow is expected to be maintained at a relatively constant rate between 230 and 280 cubic meters per second (cms) eliminating the flooding action that presently occurs each spring when downstream flows may be as high as 2,550 cms (Ak. Dist. Army Corps Eng. 1975).

STUDY AREA

Moose were studied in that portion of the Susitna River Basin lying between latitudes 60°30'-63°15' north and longitudes 146°30'-149° west (Fig. 1). The landscape is primarily mountainous and ranges in elevation from 300 to 1900 m. Semi-arid conditions dominate this area of the basin. Temperatures are generally cool in the summer and overcast days are common. Snowfall is usually moderate and ground accumulation seldom exceeds one meter (U.S. Soil Cons. Ser. 1976-78). Prevailing winds are from the east and north. Strong winds along the river are common during any season.

Along the banks of the Susitna and its tributaries from the Maclaren River to Devil Creek the dominant vegetative cover type is black spruce (*Picea mariana*) interspersed with muskeg bogs on the basin floor. Occasional stands of cottonwood (*Populus trichocarpa*) are found on islands in the river. Understory vegetation in spruce forests includes highbush cranberry (*Viburnum edule*), devil's club (*Echinopanax horridum*), blueberry (*Vaccinium* spp.), lowbush cranberry (*Vaccinium vitis*) and several representatives of the rose and grass families. Hardwoods such as aspen (*Populus tremuloides*) and birch (*Betula papyrifera*) are often found interspersed among the spruce, predominantly on south-facing slopes. White spruce (*Picea glauca*) replaces the smaller stunted black spruce on better drained soils. The forest understory above 800 m contains blueberry, lowbush cranberry, Labrador Tea (*Ledum* spp.), fireweed (*Epilobium* spp.), crowberry (*Empetrum nigrum*) and several mosses and lichens.

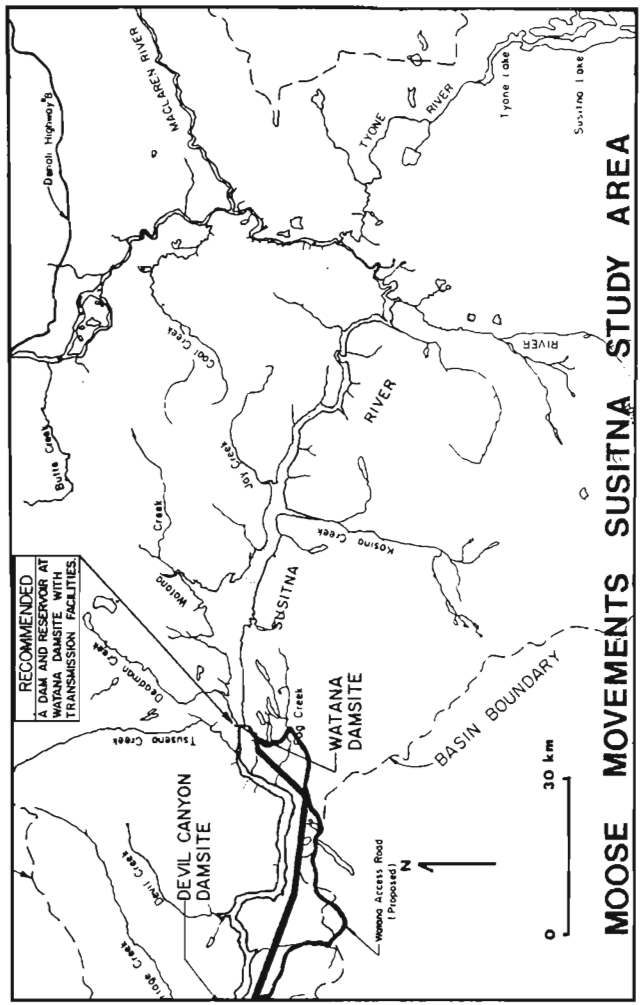

Figure 1. Devil's Canyon proposed hydroelectric project moose movement study area.

Alder (*Alnus* spp.) is the predominant woody plant between timberline and alpine tundra particularly along the headwaters of streams. Willow (*Salix* spp.) exists throughout the study area but occurs most frequently at timberline and riparian sites. Alpine tundra extends above the alder zone to about 1200 m.

METHODS

A total of 43 moose were captured during October 1976, March 1977, and August 1978 along the Susitna River from its confluence with the Maclaren River downstream to Devil Creek. They were darted with 23 to 29 mg of succinylcholine chloride from a Bell 206B Jet Ranger helicopter employing standard techniques in use throughout Alaska (Franzmann et al. 1974). All captured moose were marked with plastic flagging affixed with metal ear tags. Twenty-two moose were fitted with radio collars manufactured by AVM Instrument Company (Champaign, Illinois). Numbered canvas collars were placed on 21 moose. Small (presumably yearling) moose were generally avoided during the collaring operation.

A first incisor was taken from the lower jaw of each moose for age determination (Sergeant and Pimlott 1959). Blood and hair samples were also taken to aid in assessing physiological condition using methods described by Franzmann et al. (1975). Total body length and girth measurements were taken when time permitted and general physical condition was assessed according to criteria developed by Franzmann and Arneson (1973). Cows captured in March were rectally palpated to determine

pregnancy (Greer and Hawkins 1967). Results of pregnancy tests and physical condition assessments were reported in Ballard and Taylor (1978).

Radio tracking flights were made at least once a month in either a Piper PA-18 Supercub or a Stol Cessna 180 equipped with two directional Yagi antennas connnected to a portable receiver manufactured by AVM Instrument Company. Tracking methods were similar to those described by Mech (1974). During and for six weeks following parturition, flights were increased to approximately every 3 to 5 days to assess productivity and survival of calves. Radio locations, vegetation type and miscellaneous notes were recorded for each observation. Locations were mapped on U.S. Geological Survey topographical maps (scale 1:250,000). Range sizes were computed by including the total area within the outermost observation points for a given moose. Dominant vegetation at each moose observation was classified in one of nine groups: open spruce (trees with average space of 6 or more meters apart), medium spruce (trees with average space 3-5 meters apart), dense spruce (trees less than 3 meters apart), spruce/hardwood (spruce mixed with aspen, birch or cottonwood), alder, alpine tundra, upland willow, riparian willow and marsh.

RESULTS

Four hundred sixty-seven observations of radio-collared moose were recorded during this study. Visual collars were observed on 43 occasions. Movement behavior ranged from sedentary to migrations in excess of 150 km.

Some individual radio-collared animals ranged as far as 70 km north, 150 km east and 100 km south of the capture locations. Little migratory behavior was noted in the western portion of the study area. Extensive seasonal migrations were most evident in those moose radio-collared east of Jay Creek (Figure 2). Long migrations from summer range along the Maclaren River and Clearwater Creek to wintering areas near the mouth of the Oshetna River and along the Tyone River were repeated annually. Some interchange from Butte Creek to Watana Creek and from Jay Creek to Coal Creek was also evident. Migrations from lower Butte Creek to the mouth of the Tyone River occurred during two of the three winters of this study when snow depths were greatest (U.S. Soil Cons. Service 1976-1978).

Radio-collared moose crossed the Susitna River a minimum of 27 times, 20 (74%) of which were in the vicinity of the proposed impoundment areas. Eleven (50%) crossed the river at least once. No moose were actually observed crossing the river during radio monitoring flights, but it could be inferred from the data that most crossings took place downstream from the mouth of Fog Creek and upstream from the mouth of Jay Creek. Most river crossings were associated with seasonal migratory movements. Once moose reached their destinations they tended to remain there throughout the season and did not wander back and forth across the river. During the winter, however, numerous tracks along and across the river were recorded, indicating that moose wintering along the riverbanks moved freely back and forth as long as the river remained frozen.

Total ranges occupied by radio-collared moose varied from 43 km^2 to 1104 km^2 in size (Table 1). Most were substantially larger than those

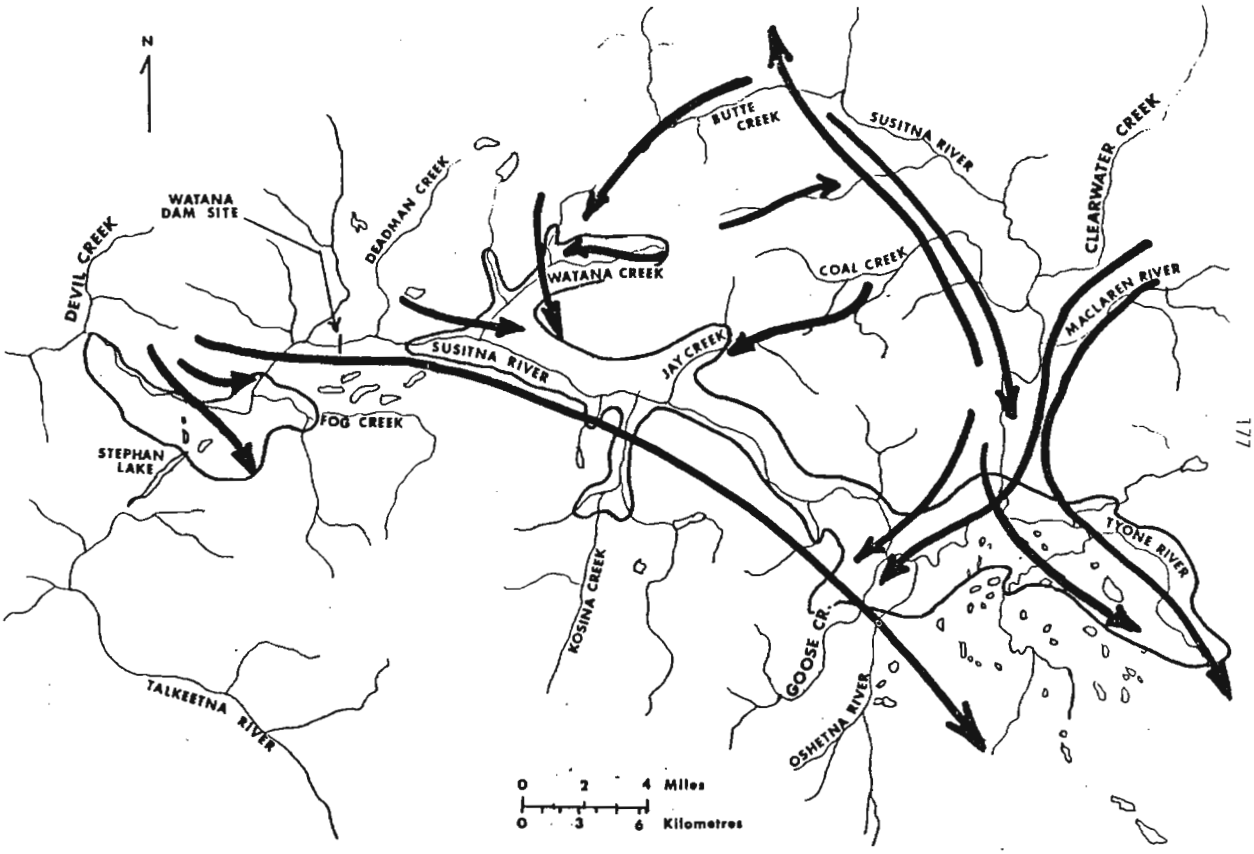

Figure 2. Major fall moose migration routes and wintering areas along the Susitna River.

Table 1. Number of observations, range sizes, distance between summer and winter ranges and minimum number of river crossings of radio-c ollared moose along the Susitna River.

Moose Number	Number of Observations	Summer (1978) Range Size (km^2)	Total Range Size (km^2)	Distance Between Summer and Winter Ranges (km)	Minimum No. River Crossings
1	24	13	43	None	0
2	25	26	113	11	5
3	22	14	88	None	1
4	2	--	--	--	-
5	1	--	--	--	-
6	6	--	47	--	0
7	7	--	63	--	0
8	28	16	277	None	2
9	23	--	69	None	0
10	15	--	90	None	1***
11	22	--	92	None	0
12	26	10	74	None	2
13	25	40	66	None	0
14	4	--	--	--	0
15	5	119	172*	--	0
16	42	29	188	None	0
17	27	29	76**	None	1
18	23	319	602	24	4
19	40	29	727	40	4
20	42	55	698	52	2
21	28	16	1104	90	2
22	30	63	1030	45	3
TOTAL		$\bar{x}$=55.7	$\bar{x}$=295.7		27

* Small sample size of observations
** Atypical emigration of approximately 170 km during fall not included in computation
*** Moose observed on island

found by Didrickson and Taylor (unpublished data) in the Peters Hills, approximately 80 km southwest of the Susitna study area. Substantially smaller ranges were occupied in the rugged terrain between Devil's Canyon and Jay Creek than to the east where the terrain becomes more open and level. All sedentary radio-collared moose inhabited the area west of Jay Creek.

Summer range sizes varied from 10 km^2 to 319 km^2 in 1978. These ranges were substantially larger than those found by LeResche (1974) who concluded that home range seldom exceeds 5-10 km^2 during a given season. Fidelity to summer range was greater than to winter range. Of 14 radio-collared moose alive through 1978, 10 utilized the same ranges during summer 1978 as they inhabited in summer 1977. Six of the 14 utilized the same winter range in both years. Although the number of winter observations in any given year was insufficient to accurately determine winter range sizes, moose appeared to be much less mobile during the winter months. They were generally found in spruce dominated habitats and at lower elevations than in the summer. Two radio-collared moose in the Watana Creek drainage, however, habitually wintered above timberline along the south-facing windblown slopes in willow/alder habitat.

Habitat types utilized by collared moose were noted during radio tracking flights and observations were categorized into 9 groups (Table 2). Most (70%) collared moose observations were made in spruce dominated habitats, usually in spruce of low to moderate density, interspersed with willows or scrub birch. Fifteen of 20 calves born to radio-collared cows were first observed in spruce dominated habitats; three were found

in the willow/alder community and two were first noted in marsh areas. Willow/alder habitats at and above timberline were utilized mostly during the rut. Moose remained in these locations until late in the fall when snow depths approached one meter, at which time they migrated to their wintering areas.

The seasonal distribution and relative abundance of moose in the study area was determined during radio monitoring flights by recording unmarked moose observed in association with radio-collared moose, groups of moose seen incidentally and areas showing signs of extensive utilization by moose. Highest densities were noted throughout the year between Watana and Jay Creeks at elevations from 650 m to 850 m (Figure 2). A major portion of this habitat lies within the area that would be flooded by the proposed Watana reservoir. Winter concentrations of moose were observed along the lower Tyone River west to the mouth of Goose Creek and along the hillsides from Fog Creek to Stephan Lake. Concentrations were observed on the south side of the Maclaren River during spring and summer and along the Susitna River from the mouth of Coal Creek to the mouth of the Oshetna River during the breeding season. Few moose were noted during any season on the north side of the river between Devil Creek and Deadman Creek.

DISCUSSION AND CONCLUSIONS

Hydroelectric development along the Susitna River would impact both resident and transient moose populations. Analysis of the telemetry

Table 2. Habitat utilization by radio-collared moose along the Susitna River in the Devils' Canyon study area.

Moose Number	Total Habitat Observations	Open Spruce	Medium Spruce	Dense Spruce	Spruce/ Hardwood	Alpine Tundra	Alder	Upland Willow	Riparian Willow	Marsh
1	22	3	9	1	6			2		1
2	23	7	10	1	2		1	2		
3	19	6	10	1				1	1	
4	2		1	1						
5	1			1						
6	7	3	2				1		1	
7	7	4	1					2		
8	21	3	2	1			6	6	2	1
9	11	1	1				5	2	2	
10	14	6	2	2			2	2		
11	17	8	7	1	1					
12	23	6	7	4			1	5		
13	25	6	12	1	2		1	2	1	
14	4		3					1		
15	5	1	1	1	1				1	
16	27	7	5	9			1	5		
17	21	12	2	2		2		2	1	
18	22	5	5	3		2		6	1	
19	28	6	11	9	1			1		
20	30	6	8	7		2		2	4	1
21	23	6	9	6				1	1	
22	24	5	6				4	4	4	
	376	101	114	51	13	7	22	46	19	3
Percent of Total		27	30	14	3	2	6	12	5	1

* Spruce categories include both white spruce and black spruce.
** Hardwood category includes birch, aspen and cottonwood.

data revealed that moose from several surrounding areas of the Susitna River basin migrate across or utilize this portion of the river during some period of the year. Estimates of the total upper Susitna River basin population, based on a total of 2,037 moose counted during fall 1977 sex and age composition surveys in a portion of the basin, range between 4,000 and 5,000 moose (ADF&G, unpublished data).

Although water levels in the Devil's Canyon reservoir are expected to remain relatively constant, the Watana reservoir may fluctuate as much as 78 m. The resulting ice shelving may provide an effective barrier 87 km long to those moose that migrate across this portion of the river to their seasonal ranges. This disruption of movements to traditional breeding and calving grounds may adversely affect productivity. Increased mortality of neonates during post calving movements may also occur.

Data available indicate moose depend heavily upon the river banks and adjacent areas for winter habitat both above and below the Watana and Devil's Canyon dam sites. The lower spruce covered reaches of Watana Creek are probably critical for moose in this area during severe winters. The reservoir created by construction of the Watana dam would inundate a major portion of this winter habitat which in turn would substantially reduce the carrying capacity of those drainages lying between Jay Creek and Devil Creek.

A reduction in moose carrying capacity would impact recreational sport hunting in this portion of the Susitna River drainage. Harvests have averaged 146 moose taken annually since 1974 within the immediate drainages along the upstream portion of the Susitna River (ADF&G, unpublished data). Approximately 475 to 500 sportsmen participate in moose hunts in this area each fall (op. cit.). It is premature at this time to attempt to quantify the possible impact of the hydroproject on moose but if project impacts reduced local moose populations by 50 percent, the corresponding loss of harvest would be 7,500 moose during the life of the dam, presently estimated at 100 years by the Corps of Engineers. We would expect ungulate populations to be more severely impacted than the endemic predator species by dam construction as predators are less directly dependent on their habitat for sustenance. The resulting imbalance in predator-prey densities may further depress moose population and keep them at low densities for several years. How significantly dam construction might reduce or increase the level of hunter activity for both predators and ungulates is difficult to say at this time. Certainly, the construction of an access road to the Watana site through a presently roadless area would, if it remained open to the public, stimulate an increase in hunting pressure as would the creation of the proposed airstrip at the Watana site.

Although this moose population study focused on habitat upstream of the proposed hydropower development, the downstream effects of dam construction should be considered. The lack of adequate wintering areas is a major limiting factor to moose populations inhabiting the lower Susitna River valley (Chatelain 1951). Periodic flooding of major river

systems causing rechannelization and subsequent colonization of the dry stream beds by riparian willows and cottonwoods provides a major portion of the presently available winter range in the valley. 1000 moose were observed in the western Talkeetna mountains between the Talkeetna River and Willow Creek during fall composition counts in November 1978 (ADF&G, unpublished data). Most of these moose winter along the lower Susitna River as do many from the Matanuska Valley and the Mt. Susitna area (Didrickson pers. comm.). Much of the flooding action of the Susitna River occurs during the spring when the volume of water flow may be as high as 2,550 cubic meters per second. Maintaining a steady flow year round of 230 to 280 cubic meters per second as proposed by the Corps of Engineers would effectively prevent this flooding activity. Without these periodic reversions to successional growth stages, it is likely these riparian areas would become mature stands of hardwoods in 25 to 30 years and would provide little forage to overwintering moose. Hence, these dams will not only adversely impact moose populations upstream, but will have far reaching effects on moose throughout the entire Susitna drainage.

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