THE POPULATION, DISTRIBUTION AND DENSITY OF MOOSE IN THE LIARD VALLEY 1978

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ABSTRACT

In February and March 1978, the N.W.T. Wildlife Service conducted three aerial transect surveys along the Liard Valley highway route to gather baseline data on local moose (Alces alces) populations. Habitat was mapped according to four levels of utilization based on the relative abundance of moose tracks observed. In the early February survey, the largest estimate obtained was 440 moose (0.06 moose/km^2) for the 7390 km^2 study area. Densities ranged from 0.24 moose/km^2 to 0.01 moose/km^2. A questionnaire survey and data from native hunting licence returns were used to determine the socio-economic importance of moose to local people in the Liard Valley. Moose were valued as high as $2000 per animal for food, clothing, and handicraft material. The highway will likely have little direct effect on the local moose population through loss of winter range and impediment of movement. Its greatest effect will be the access it will provide for hunters. Such access would cause a much greater harvest which could lead to a marked decline in the moose population in the Liard Valley.

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INTRODUCTION

In 1969, Federal Government approval was given for the construction of a Liard Valley highway to link the Mackenzie highway, 45 km south of Fort Simpson, Northwest Territories with the Alaska highway at Fort Nelson, British Columbia and provide all-weather access to the isolated communities of Fort Liard and Nahanni Butte.

Highway construction began in 1970. Forty kilometres of highway right-of-way and 14 km of road were completed by 1971 when Federal funding was terminated. Construction resumed when further Federal funding was allocated in 1978.

In 1977, Chief Harry Deneron of the Fort Liard Indian band requested that wildlife resources in the area be examined and steps be taken to protect these resources from possible detrimental impacts arising from the construction and operation of the highway. The Department of Indian Affairs and Northern Development (DIAND) requested that the N.W.T. Wildlife Service (NWTWS) identify the wildlife resources which could be adversely affected by highway development. The Wildlife Service concluded that sociologically and economically, moose were the most important wildlife resource to the local residents, and were the most likely species to be directly affected by the development and maintenance of the highway.

The objectives of our study were to gather baseline data on moose numbers, densities, winter distribution, and habitat use in the areas adjacent to the proposed highway route. Federal funding for the project was approved in late January 1978 with the understanding that a further objective would be to obtain information on the importance of moose to native inhabitants of the area.

METHODS

Aerial Surveys

Aerial surveys were carried out to obtain information on moose numbers, densities, distribution and habitat use. A corridor, approximately 20 km on either side of the proposed highway, running along its 250 km length from the Mackenzie highway to the British Columbia border and covering 7390 km^2 was surveyed on three occasions during February and March. Linear transects at 4 km intervals were flown during the first two surveys and at 8 km intervals on the final survey.

Surveys were conducted using a Cessna 185 aircraft flying at 185 km/hr. The windows and struts were marked to delineate a ground transect width of 200 m on either side of the aircraft at an altitude of 120 m. Numbers of moose observed, in transect, out of transect, off the transect routes (i.e. moose observed while not flying transects), and group size were recorded on tape or directly on maps.

Because moose were often difficult to see under certain conditions we also mapped relative track density and subjectively categorized distribution.

Habitat descriptions with the subjective assessments of the relative abundance of moose tracks for each area of differing vegetation encountered along the transect routes were recorded. Forest inventory maps of the Liard Valley (Hirvonen 1968) and aerial photographs of the Liard highway route were used to define boundaries of vegetation types. Vegetation units exhibiting similar track densities were combined and a map was prepared dividing the study area into four levels (strata) of habitat use: high, moderate, low and very low (Table 2).

Socio-Economic Survey

The Fort Simpson Hunters' and Trappers' Association (HTA) was contracted to undertake a detailed questionnaire survey of hunters in the area to determine the importance of moose to the residents of the Liard Valley. Only 59 hunters (General Hunting Licence holders[1]) in the communities of Fort Simpson, Nahanni Butte and Fort Liard were available at the time.

Survey data included the number, age, sex and location of moose killed, as well as season, hunter's activity and mode of transportation. Questions on the use, estimated value, and distribution of meat and hides within the community were asked. The hunters' opinions of the potential effect of the proposed highway on the local moose populations were also sought. The results of the survey were then compared with hunter kill information from General Hunting Licence returns (NWTWS files, Yellowknife).

RESULTS

Aerial Surveys

The estimated moose population (Table 1) in the study area ranged from a high of 400 ± 93 (0.06 moose/km^2) for the February 7-10 survey (Fig. 1) to 370 ± 92 (0.05 moose/km^2) for the February 24-27 survey (Fig. 2) and a low of 300 ± 122 (0.04 moose/km^2) for the March 30-31 survey (Fig. 3). Moose densities ranged from a high of 0.27 moose/km^2 in the high-use stratum during

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[1] In the Northwest Territories, all Indians, most Metis and a few other long time residents hold, or are eligible to hold, a General Hunting Licence. Holders of this licence have virtually no hunting restrictions placed upon them in the form of seasons or bag limits on any game animals with the exception of endangered species and migratory birds.

Table 1. Sampling effort, numbers of moose observed on transect, densities, and population estimates of moose in the Liard Valley study area during February and March, 1978.

Survey dates	Area sampled (km^2)	Percent of total study area	No. of moose observed on transect	Density (moose/km^2)	Est. pop. for total study area ± SE *
February 7-10	610	8.3	37	0.06	400 ± 93
February 24-27	630	8.5	34	0.05	370 ± 92
March 30-31	310	4.2	12	0.04	300 ± 122

* SE calculated using methods outlined by Cochran (1977).

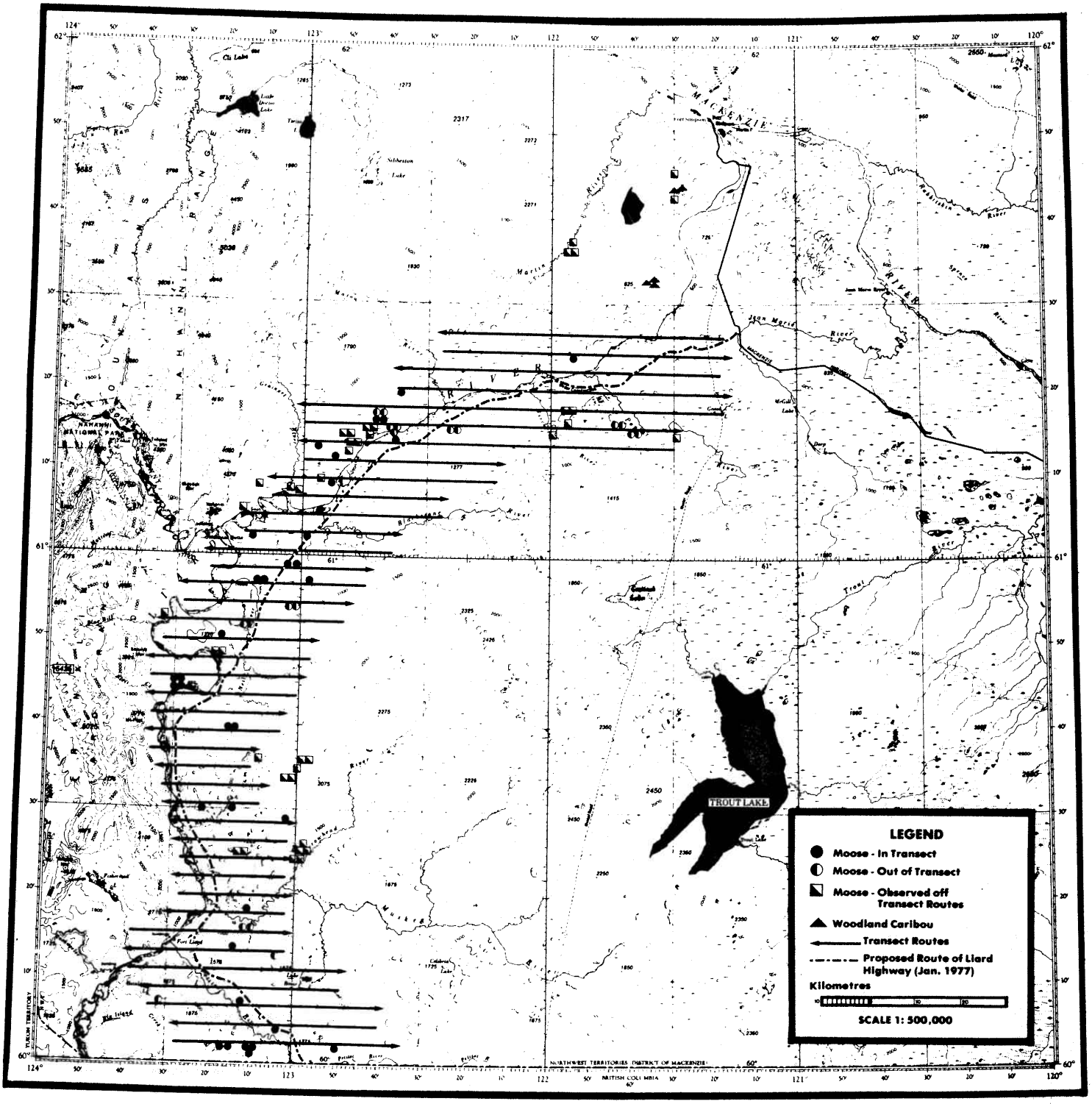

Figure 1. Aerial transect routes with moose and woodland caribou observations for the February 7-10 survey in the Liard Valley.

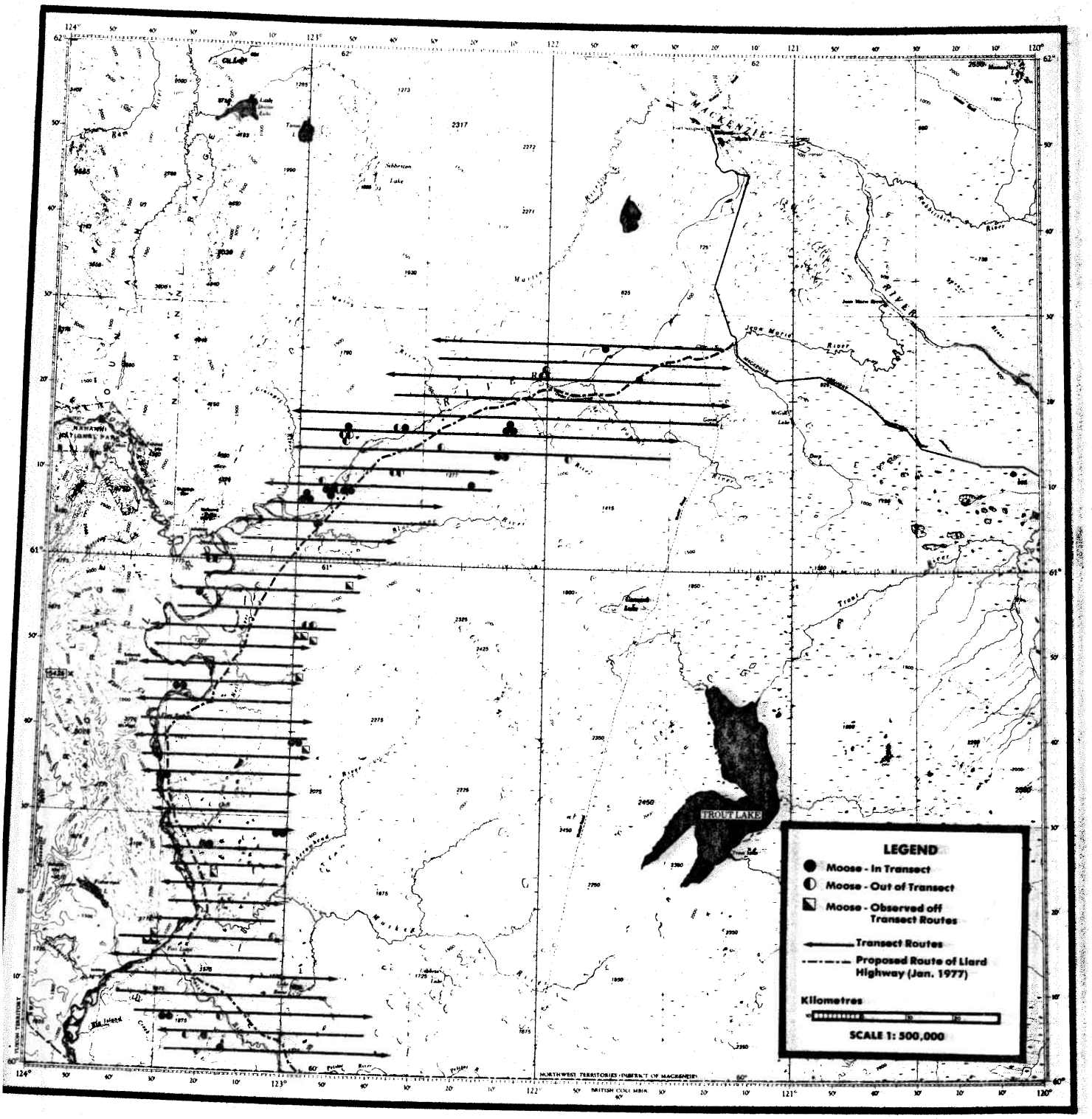

Figure 2. Aerial transect routes and moose observations for the February 24-27 survey in the Liard Valley.

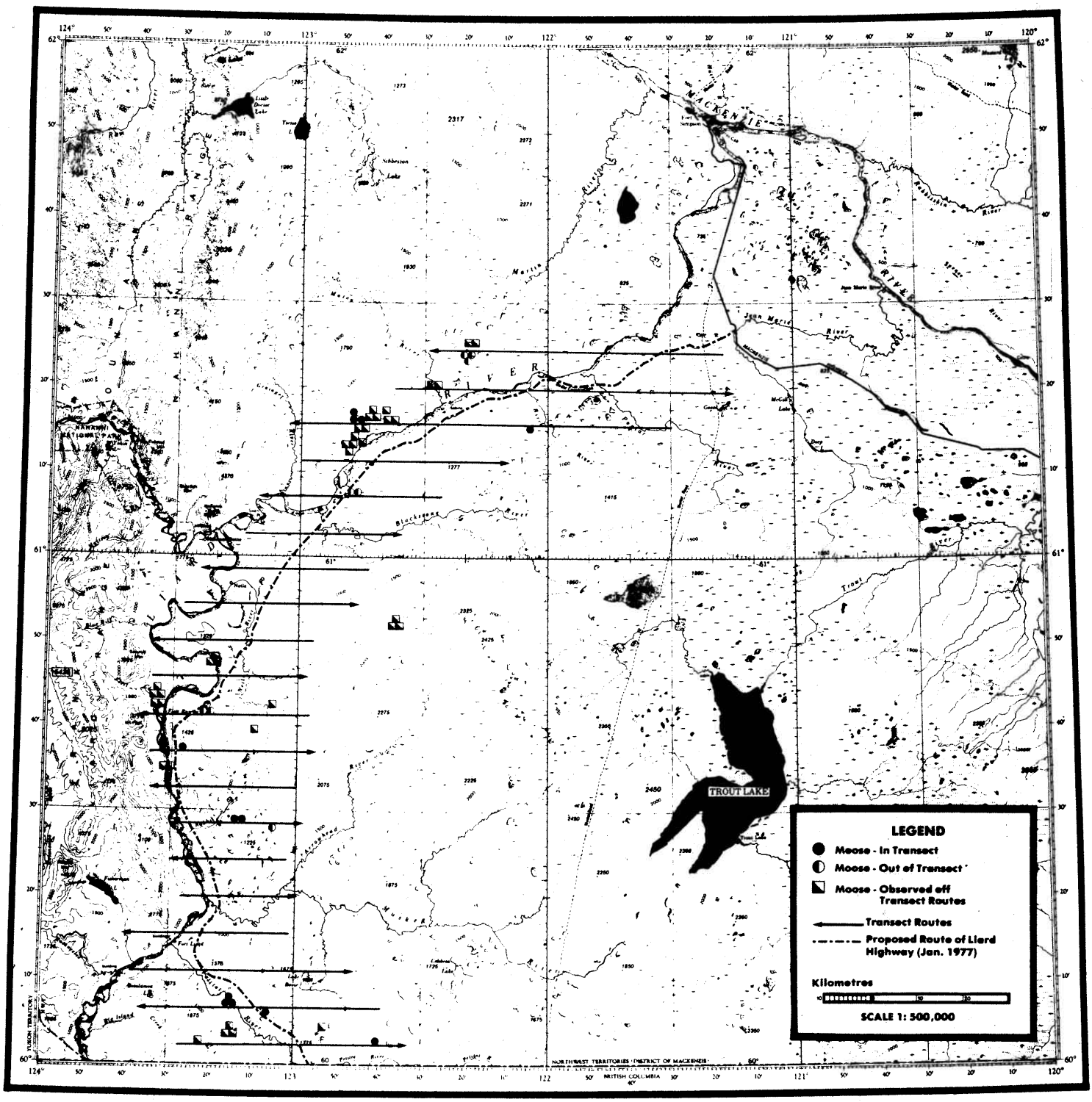

Figure 3. Aerial transect routes and moose observations for the March 30-31 survey in the Liard Valley.

February 7-10 (Fig. 4) to a low of no moose observed in the low-use stratum during March 30-31 (Table 2). On March 30, a count in a 100 km^2 block between the Matou River and Swan Point provided a density of 0.42 moose/km^2. This area displayed the highest utilization by moose during all three surveys.

In February and March, moose were concentrated in a relatively small portion of the Liard Valley (Fig. 4). Habitat receiving high-use comprised 12% of the study area.

Socio-Economic Survey

The HTA interviews indicated that over the past 5 years native hunters had harvested a minimum of 252 moose from the Fort Liard area (population 308), 81 from the Fort Simpson area (population 1,078) and 52 from the Nahanni Butte area (population 86) (Tables 3 to 5). Hunting was opportunistic with little or no selection for the age or sex of the animals killed. Most hunting was done in the fall, with summer being the next most important season. Hunters usually travelled by boat or snow machine.

The interviews indicated a high utilization of moose for food and clothing, with many families in the community sharing the meat. The estimated value of moose in 1978 varied from $2,000 per animal in Nahanni Butte, to $1,000 per animal in Fort Simpson. Indirect benefits were not included in the estimates.

Table 2. Comparison of the results of the February and March 1978 aerial moose surveys in the Liard Valley study area for each habitat utilization stratum.

Habitat utilization Stratum[a]		High use	Moderate use	Low use	Very low use	Total
Stratum	Total area (km^2)	870[b]	1510	2040	2970	7390
	% of study area	11.8	20.4	27.6	40.2	100
No. of moose observed on transect in each stratum		20[c]	7	8	2	37
		9	12	10	3	34
		9	2	1	0	12
Density (moose/km^2)		0.27	0.05	0.05	0.01	
		0.12	0.09	0.06	0.01	
		0.21	0.03	0.01	0	
Estimated total no. of moose in each stratum		235	78	103	24	440
		103	133	122	35	393
		188	43	29	0	260

[a] As defined in the text.

[b] Area of each stratum was assumed to be the same during all three survey periods.

[c] Within each column, the first figure was obtained from the results of the February 7-10 aerial survey, the second figure from the February 24-27 survey, and the third figure from the March 30-31 survey.

Figure 4. Relative habitat utilization by moose in the Liard Valley study area, February and March 1978.

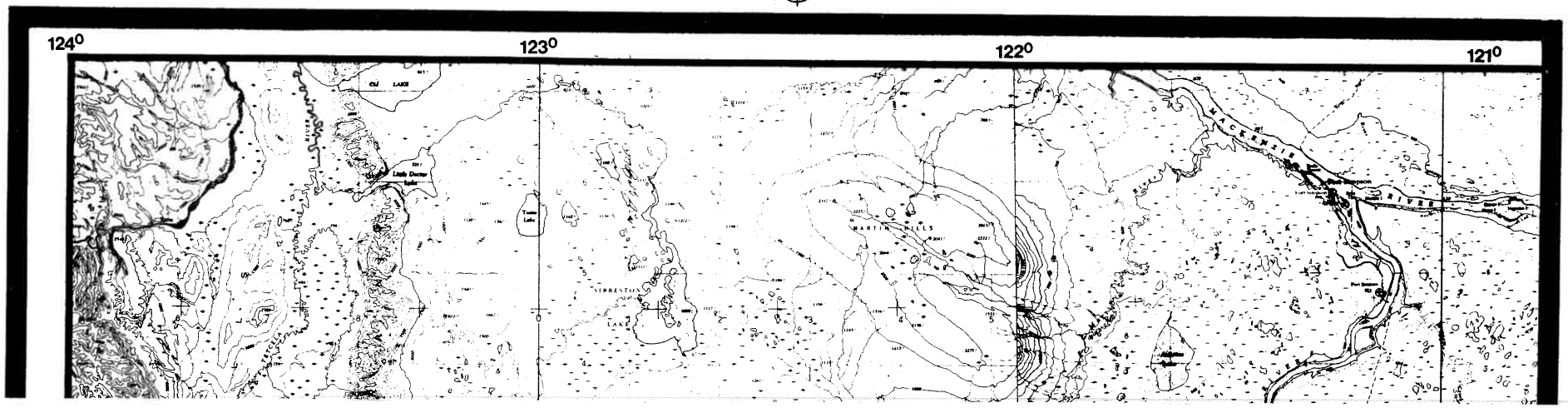
124°
123°
122°
121°
LAKE
Lady Evelyn Falls
MARTIN FALLS
SIBBESTON
LAKE
MACKENZIE
RIVER
Fort Simpson

Table 3. Moose harvest data from Fort Simpson Hunters' and Trappers' Association survey and General Hunting Licence returns for Fort Simpson from 1973 - 1978.

Year	73-74	74-75	75-76	76-77	77-78
General Hunting Licence returns					
No. of G.H.L. returns	17	100	88	117	133
Reported moose kill	4	40	63	63	91
Success rate (moose/hunter)	0.2	0.4	0.7	0.5	0.7
Estimated total harvest[a]	36	72	126	90	126
Value of harvest[b]	$36,000	$72,000	$126,000	$90,000	$126,000
Fort Simpson H.T.A. survey					
No. of hunters interviewed	26	26	26	26	26
Reported moose kill	19	7	4	4	47
Success rate (moose/hunter)	0.7	0.3	0.2	0.2	1.8
Estimated total harvest[a]	126	54	36	36	324
Value of harvest[b]	$126,000	$54,000	$36,000	$36,000	$324,000

[a] An average of 180 General Hunting Licences issued annually from 1973-78 was used as the total number of potential native hunters. The estimated total harvest was calculated by multiplying the average number of hunters by the annual success rate.

[b] A value of $1,000 per moose was the perceived value of this resource to the residents of Fort Simpson as indicated by the Fort Simpson H.T.A.'s socio-economic survey.

Table 4. Moose harvest data from the Fort Simpson Hunters' and Trappers' Association survey and General Hunting Licence returns for Nahanni Butte from 1973 - 1978.

Year	73-74	74-75	75-76	76-77	77-78
General Hunting Licence returns					
No. of G.H.L. returns	5	8	0	2	3
Reported moose kill	10	11	0	4	0
Success rate (moose/hunter)	2.0	1.4	0	2.0	0
Estimated total harvest[a]	40	28	0	40	0
Value of harvest[b]	$80,000	$56,000	0	$80,000	0
Fort Simpson H.T.A. survey					
No. of hunters interviewed	8	8	8	8	8
Reported moose kill	11	11	11	10	9
Success rate (moose/hunter)	1.4	1.4	1.4	1.3	1.1
Estimated total harvest[a]	28	28	28	26	22
Value of harvest[b]	$56,000	$56,000	$56,000	$52,000	$44,000

[a] An average of 20 General Hunting Licences issued annually from 1973-78 was used as the total number of potential native hunters. The estimated total harvest was calculated by multiplying the average number of hunters by the annual success rate.

[b] A value of $2,000 per moose was the perceived value of this resource to the residents of Nahanni Butte as indicated by the Fort Simpson H.T.A.'s socio-economic survey.

Table 5. Moose harvest data from the Fort Simpson Hunters' and Trappers' Association survey and General Hunting Licence returns for Fort Liard from 1973 - 1978.

Year	73-74	74-75	75-76	76-77	77-78
General Hunting Licence Returns					
No. of G.H.L. returns	18	16	16	16	0
Reported moose kill	38	23	33	25	0
Success rate (moose/hunter)	2.1	1.4	2.1	1.7	0
Estimated total harvest[a]	84	58	84	68	0
Value of harvest[b]	$126,000	$87,000	$126,000	$102,000	0
Fort Simpson H.T.A. survey					
No. of hunters interviewed	26	26	26	26	26
Reported moose kill	30	30	38	61	93
Success rate (moose/hunter)	1.2	1.2	1.5	2.3	3.6
Estimated total harvest[a]	48	48	60	92	144
Value of harvest[b]	$72,000	$72,000	$90,000	$138,000	$216,000

[a] An average of 40 General Hunting Licences issued annually from 1973 - 78 was used as the total number of potential native hunters. The estimated total harvest was calculated by multiplying the average number of hunters by the annual success rate.

[b] A value of $1,500 per moose was the perceived value of this resource to the residents of Fort Liard as indicated by the Fort Simpson H.T.A.'s socio-economic survey.

DISCUSSION

Aerial Surveys

Population Estimates

The overall moose density in the Liard Valley is similar to that previously recorded in the Mackenzie Valley by Slaney (1974) (0.05 moose/km^2) and Rippin (1971), (0.07 moose/km^2) for the Mackenzie Bison Sanctuary. Although these areas likely contain the major portion of the more productive moose habitat in the N.W.T. densities here are low when compared to areas of similar habitat outside the N.W.T. Surveys in the Tanana Flats in Alaska (1956) showed overall densities of 0.12 moose/km^2 at a time when the population was known to be still growing (Bishop and Rausch 1974). In eastern Canada "... 1 moose per 5 square miles (0.08 moose/km^2) might be regarded as a "normal" average density over a great portion of the overall range. One moose per square mile (0.4 moose/km^2) is probably a relatively high density under most conditions, while 2 or more moose ($\geq$ 0.8 moose/km^2) represents an approach to maximum carrying capacity for most large regions." (Peterson 1955). In northeastern Minnesota during 1967-1970, the average density ranged from 0.43 moose/km^2 to 0.78 moose/km^2 (Peek et al. 1976). Compared to these figures, moose density in the Liard Valley is low.

Although aerial surveys are the only practical means of estimating numbers of large animals in a large area, they are subject to inherent errors (Caughley 1977). Accuracy in transect surveys relies on all animals within the sampled area being counted. Observability of animals can be affected by such things as observer experience, number of observers, habitat type, behaviour of animals (i.e. are the animals standing up, moving, bedded down, etc.), snow and weather conditions. In our late February and late March

surveys we encountered lack of good snow cover on the ground and on the standing vegetation, lengthening periods of daylight which increased the frequency of animals being bedded down most of the day, and increasing prevalence of bright sunlight which produced dark shadows on the ground. All these conditions make moose more difficult to see and as a result, the numbers of moose observed on transects declined from the early February survey. Our results therefore should only be considered as minimum population estimates. During the earlier survey (February 7-10), conditions were generally more favourable and it is likely that fewer moose on transect were missed. The population estimate for this survey (400 ± 93) should be considered the closest estimate of the moose population in the study area.

Winter Distribution

Moose have been reported to concentrate on the mid-channel islands in the Liard River (Synergy 1975). This is also characteristic of moose winter behaviour on the lower Mackenzie River where concentrations as high as 1.4 moose/km^2 have been recorded on some of the islands. Our surveys showed that this did not occur in the Liard Valley during February and March 1978. Although the islands between the mouth of the Matou River and Fort Liard appear to be similar in biophysical characteristics to those having large concentrations of wintering moose on the lower Mackenzie River, few moose were observed. These islands may be used more during years of above average snowfall when wind may keep them more snow free. B. Gauthier (DIAND, Fort Simpson) and C. Hope, a Fort Liard hunter and close associate of the chief (pers. comm.), indicated that pregnant cows often move to the islands to calve during spring break-up to avoid predation.

Habitat Use

Observations of moose numbers and levels of utilization of areas appeared to be directly related to the abundance and availability of winter food supplies. Browse surveys conducted by Walton-Rankin (1977) throughout the Mackenzie Valley indicated that successional species such as the willow (Salix spp.) balsam poplar (Populus balsamifera) and red osier dogwood (Cornus stolonifera) comprise 90.6% of the food eaten, with willow providing over half (52.1%) of the total winter diet. Aspen (Populus tremuloides) is also highly preferred when available. Areas of abundant willow and other deciduous growth typical of disturbed sites such as areas burned within the last 10 years, wetland complexes, and floodlands which could provide a plentiful source of winter feed almost always fell within the high and moderate use strata. The one major exception to this was the area near the junction of the Liard and Mackenzie highways. The habitat appeared to have a good source of winter feed; however, there was little sign of moose occupying this area. A nearby native hunting and trapping camp may have created a local scarcity.

In the Mackenzie Valley, moose in winter favour areas of deciduous sub-climax vegetation (Walton-Rankin 1977, Watson et al. 1973). The lack of many major fires in the Liard Valley over the last 20 to 30 years (B. Gauthier, pers. comm.), resulting in the gradual replacement of young deciduous vegetation with either more mature or coniferous types, has led to a gradual reduction in the quantity of favoured moose winter habitat over the past 2 decades. This was substantiated by the survey results in which the highest density of moose for the entire study area was observed in the area between the Matou River and Swan Point - the only area in the Liard Valley in which a major fire had occurred in the last 10 years (B. Gauthier pers. comm.).

Socio-Economic Survey

Discrepancies in the numbers of moose killed shown in reports of the Hunters' and Trappers' Association's socio-economic survey, with numbers on the NWTWS General Hunting Licence reports (Tables 3 - 5) show clearly the difficulty in compiling accurate statistics for management.

Because a hunter may forget how many animals he killed over a period of time, it was decided that only the last year's data obtained from the questionnaire survey was meaningful. It is also difficult to ensure that all hunters were interviewed or would make out a G.H.L. kill return. In the case of the questionnaire surveys carried out by the Fort Simpson H.T.A., hunters sampled were not randomly selected. The 59 people interviewed included only those hunters thought to have killed moose in the past 5 years and who were available in town. There was no way to estimate the number of moose harvested by hunters not interviewed.

The interview survey showed that in Fort Liard, moose hunting was increasing. This was thought to be due primarily to increased cost of living (A. Hope, pers. comm.). The survey in Fort Simpson showed that people who had not hunted much in the past few years, anticipated using the new highway to get to better moose hunting areas in the Fort Liard - Nahanni Butte area.

The Hunters' and Trappers' survey indicated that the estimated value of moose varied from community to community. The value appears to be based only on the direct value of the moose to the residents in the form of pounds of meat, replacement value of an equal amount of beef and the value of handicrafts derived from manufacture of articles. It is evident that this resource is of significant economic and cultural value to the residents of the Liard Valley.

People from the three communities in the Liard Valley expressed concern for the potential impact of increased hunting along the highway. There was a general concensus that some form of controls should be implemented to limit moose hunting.

Effect of the Highway on Moose

The Liard highway has been routed through several of the more heavily utilized wintering areas particularly along the Netla River, Rabbit Creek and Petitot River drainage systems (Fig. 4). However, it is felt that the present routing of the Liard highway should have little or no direct effect on the local moose population through the loss of important winter range resulting from highway construction. The densities of moose even in the most heavily used areas are too low, the animals too widely dispersed, and the extent of range that would be destroyed too small to have anything but a localized and minimal effect on the moose population in the Liard Valley. If anything, the clearing and maintenance of the right-of-way may create more winter range for moose than it will destroy.

The presence of the highway may also stimulate the development of a forest industry in the area. A program of clear-cutting forest management could enhance habitat quality for moose in the Liard Valley.

Highway accidents involving moose have constituted a serious management problem in some parts of eastern Canada (Grenier 1973). However collisions between moose and motor vehicles along the Liard highway should be infrequent because of low densities of animals in the area and low volumes of traffic anticipated.

The single greatest impact of the highway on the moose population in the Liard Valley will be increased hunting pressure arising from improved access.

Most hunting now takes place along the Liard River during summer and fall. The harvest is, therefore, localized in the immediate vicinity of the river. As animals are harvested along the river, areas away from the river may now serve as replacement reservoirs supplying more animals as voids are created. However the Liard highway will provide all-weather access to many of these reservoirs by opening routes to the numerous seismic lines and rivers which, particularly in winter, provide easy travelling for snowmobiles. Uncontrolled hunting could lead to a severe reduction in numbers of moose in these areas, which would result in a drastic decline in the entire Liard Valley moose population.

The main hunters in the area now are the natives of the Liard Valley whose hunting is virtually unrestricted. The highway will open the area to outside hunters. It can be seen from comparing harvest data from the communities in the Liard Valley (Tables 3 - 5) with the population estimates obtained during the surveys (Tables 1 and 2) that the local moose populations may already be exploited at near maximum levels. Any action which increases hunting in the area will likely have a detrimental effect on the moose population.

RECOMMENDATIONS AND CONCLUSIONS

(1) We feel that our estimate of moose populations in the study area is low. Future surveys should be carried out earlier in the winter when conditions are more conducive to observing moose.

(2) Further studies should be done on movements of moose, range distribution and range quality.

(3) Accurate hunter kill statistics should be compiled to monitor the effects of hunting on the moose population.

(4) Moose are an important resource to residents of the Liard Valley. There is danger of over-harvest as a result of the Liard Valley highway. It is imperative that further research be carried out and that a moose management plan, relying on adequate legislation and native cooperation, be developed to ensure the continued maintenance of this resource at a level sufficient to supply the needs of the local residents.

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