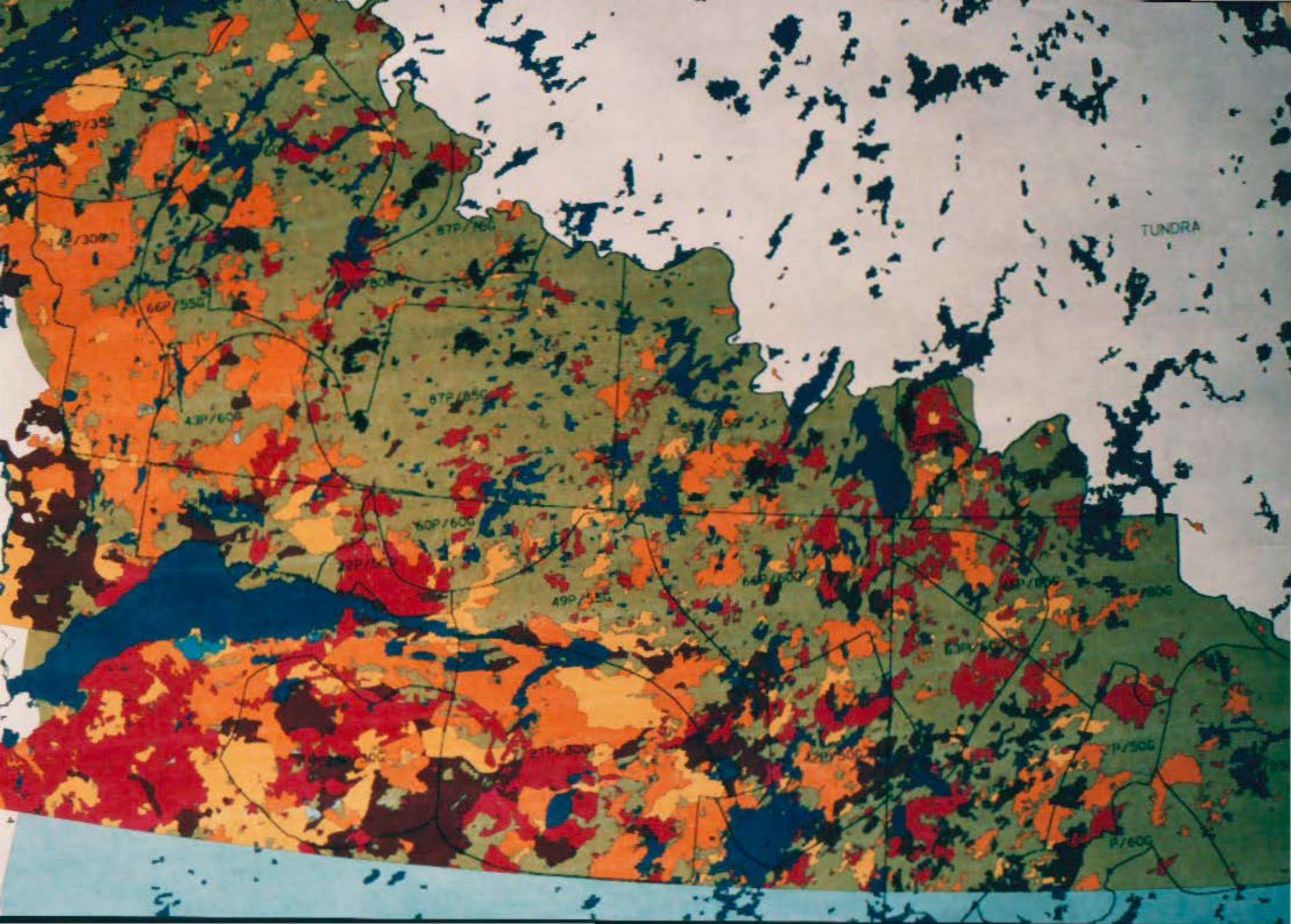
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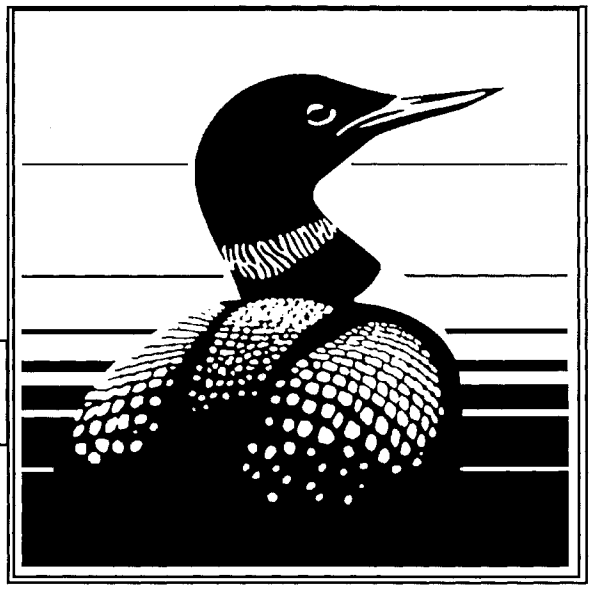
Fire-caribou relationships: (VI) Fire history of winter range of the Beverly herd

Don C. Thomas and H.J. Armbruster

Prairie and Northern Region 1998
Canadian Wildlife Service
Environmental Conservation Branch



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CANADIAN WILDLIFE SERVICE

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FIRE - CARIBOU RELATIONSHIPS: (VI) FIRE HISTORY OF WINTER RANGE OF THE BEVERLY HERD

DON. C. THOMAS
H.J. ARMBRUSTER

Technical Report Series No. 314
Prairie & Northern Region 1998
Canadian Wildlife Service

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4. Thomas, D.C. and H.P.L. Kiliaan. 1998c. Fire-caribou relationships: (IV) Recovery of habitat after fire on winter range of the Beverly herd. Tech. Rep. Series No. 312. Can. Wildl. Serv., Prairie & Northern Reg., Edmonton, Alberta. 115pp.

5. Thomas, D.C. 1998a. Fire-caribou relationships: (V) Winter diet of the Beverly herd in northern Canada, 1980-87. Tech. Rep. Series No. 313. Can. Wildl. Serv., Prairie & Northern Reg., Edmonton, Alberta. 41pp.

6. Thomas, D.C. and H.J. Armbruster. 1998. Fire-caribou relationships: (VI) Fire history of winter range of the Beverly herd. Tech. Rep. Series No. 314. Can. Wildl. Serv., Prairie & Northern Reg., Edmonton, Alberta. 94pp.

7. Thomas, D.C. 1998b. Fire-caribou relationships: (VII) Fire management on winter range of the Beverly herd: final conclusions and recommendations. Tech. Rep. Series No. 315. Can. Wildl. Serv., Prairie & Northern Reg., Edmonton, Alberta. 100pp.

8. Thomas, D.C. 1998c. Fire-caribou relationships: (VIII) Background information. Tech. Rep. Series No. 316. Can. Wildl. Serv., Prairie & Northern Reg., Edmonton, Alberta. 104pp.

SUMMARY

Burns were mapped on forested winter range of the Beverly herd of caribou. The general study area was north of 58°N in Saskatchewan, Alberta, and Manitoba to forest limits and between 102°W and 114°W. Burn ages were obtained from numerous sources including all jurisdictions responsible for fire management. Age reliability for burns over 20 years old was excellent in NWT but only fair in the provinces where decade classes are more appropriate than specific years of fires before 1970. Ages were obtained on the ground at more than 484 sites, most of them in Northwest Territories.

Proportions of potential caribou range older than 50 years was calculated for forest areas within each of 31 map sheets, scale 1:250 000. Areas of large lakes, tundra, and outside "normal" range were excluded from potential caribou range. Small lakes, that generally comprise 14-21% of landscape in the Precambrian Shield portion of winter range, were included as potential caribou range because some of them are enclosed in burns.

In western sections of winter range, average interval between burns increased from 69 years around Thekulthili Lake, to 95 years around Nonacho Lake, and 137 years near the forest limit in the Porter Lake region. The longest average interval, 144 years, was in eastern sections of winter range around Selwyn Lake. Length of fire cycles appeared to be linked to several factors including climate (for example, distance from the forest limit); surface materials (bedrock to thick till types); topography (lowland wet areas *vs.* uplands); and forest type, which is an expression of the other factors plus fire.

RÉSUMÉ

Nous avons cartographié les régions détruites par le feu dans l'aire d'hivernage du troupeau de caribous de Beverly. L'aire étudiée comprend les territoires situés au nord du 58e degré de latitude nord (Saskatchewan et parties voisines de l'Alberta et du Manitoba) et compris entre les 102e le 114e degrés de longitude ouest. L'âge des brûlis a été obtenu de nombreuses sources, y compris des autorités responsables de la prévention des incendies. Il a été déterminé au sol pour environ 484 sites, dont la majorité sont situés dans les Territoires du Nord-Ouest (TNO). La fiabilité de la détermination de l'âge pour les régions brûlées il y a plus de 20 ans était excellente pour les TNO, mais à peine acceptable pour les provinces, où une précision de l'ordre de la décennie a été retenue.

La proportion de l'aire d'hivernage potentielle qui a brûlé il y a plus de 50 ans a été calculée pour les régions forestières de chacune des 31 feuilles de carte. Les régions de toundra ou de grands lacs ont été exclues, de même que celles situées à l'extérieur de l'aire d'hivernage normale. Les régions de petits lacs, qui occupent généralement 14 à 21% du territoire dans la portion faisant partie du bouclier précambrien, ont été inclues dans l'aire d'hivernage potentielle, parce que certaines d'entre elles étaient situées dans les territoires incendiés.

Dans les sections occidentales de l'aire d'hivernage, l'intervalle moyen entre les incendies variait de 69 ans dans la région du lac Thekulthili à 95 ans dans la région du lac Nonacho et à 137 ans dans la région voisine de la limite des forêts, près du lac Porter. L'intervalle moyen le plus long, 144 ans, a été mesuré dans les sections orientales de l'aire d'hivernage, autour du lac Selwyn. La durée du cycle des incendies semble être liée à plusieurs facteurs, notamment au climat (distance de la limite des forêts), aux matériaux de surface présents (roche en place ou till profond), à la topographie (plaine humide ou région montagneuse) et au type de forêt, qui résulte de la combinaison des autres facteurs et du feu.

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ACKNOWLEDGEMENTS

The Canadian Wildlife Service and Indian and Northern Affairs Canada provided long-term support for this project. Fire maps dating back to 1969 were provided for Northwest Territories (NWT) by fire offices in Fort Smith and Yellowknife. NWT Department of Renewable Resources, provided similar maps after 1987 when fire management was transferred from the Federal Government to NWT. The Saskatchewan Department of Parks and Renewable Resources provided maps of Northern Saskatchewan. The remote sensing units in Northern Forest Centre, Edmonton, and in Yellowknife kindly allowed use of their satellite imagery and Pro Com 2 equipment to map burns. The Alberta Centre for Remote Sensing permitted use of microfische of images and loaned images. A significant step in mapping and analysis of fire history was incorporation of existing maps in a Geographic Information System. That project was initiated by the Department of Renewable Resources in Yellowknife, conducted by the Remote Sensing Unit there, and supported by the Beverly and Kaminuriak Caribou Management Board. That project was the impetus to bring fire mapping in Saskatchewan north of 58°N up-to-date and to draft a fire map for much of the winter range of the Beverly herd of caribou. The following individuals contributed significantly to this project: Bob Bailey and Rick Lanoville in the NWT fire office; Bill Maudsley in the District Fire Office, Fort Smith; Helmut Epp in NWT Centre for Remote Sensing; Paul Panegyuk, who calculated areas of burns and large lakes; Walt Moore in the Northern Forest Centre, Edmonton. We thank Kevin Eberhardt and Paul Panegyuk for mapping assistance.

INTRODUCTION

From 1980 through 1988, the Canadian Wildlife Service (CWS) conducted studies on the Beverly herd of barren-ground caribou (*Rangifer tarandus groenlandicus*) and their ranges in Northwest Territories (NWT). The main purpose was to evaluate if, when, and where fire should be managed for caribou on forested winter range. Other results were reported in five completion reports (see "Reports In This Series") and in a number of publications. A major objective was to examine relationships among age of burns, abundance of caribou forage, and use of winter range by caribou.

A major requirement was to map fire history of winter range as much as possible with available resources. Fire history is an essential first step to research winter ecology of caribou and for development of fire management plans and effective fire management. Although our primary study area was in NWT, we extended fire history to north of 58°N in Saskatchewan and adjacent Alberta and Manitoba (**Fig. 1**). This expansion was necessary to accommodate data requirements of the Beverly and Qamanirjuaq Caribou Management Board.

The purpose of this report is to describe how and where burn ages were obtained; to present data on forest ages; to present regional differences in proportions of range burned since about 1939; to present data on burn intervals; and to discuss factors that influence fire regimes.

Color burn maps showing burn history to 1989 and additional information are in a long technical review and a short management report (Beverly and Qamanirjuaq Caribou Management Board 1994a, 1994b).

Figure 1

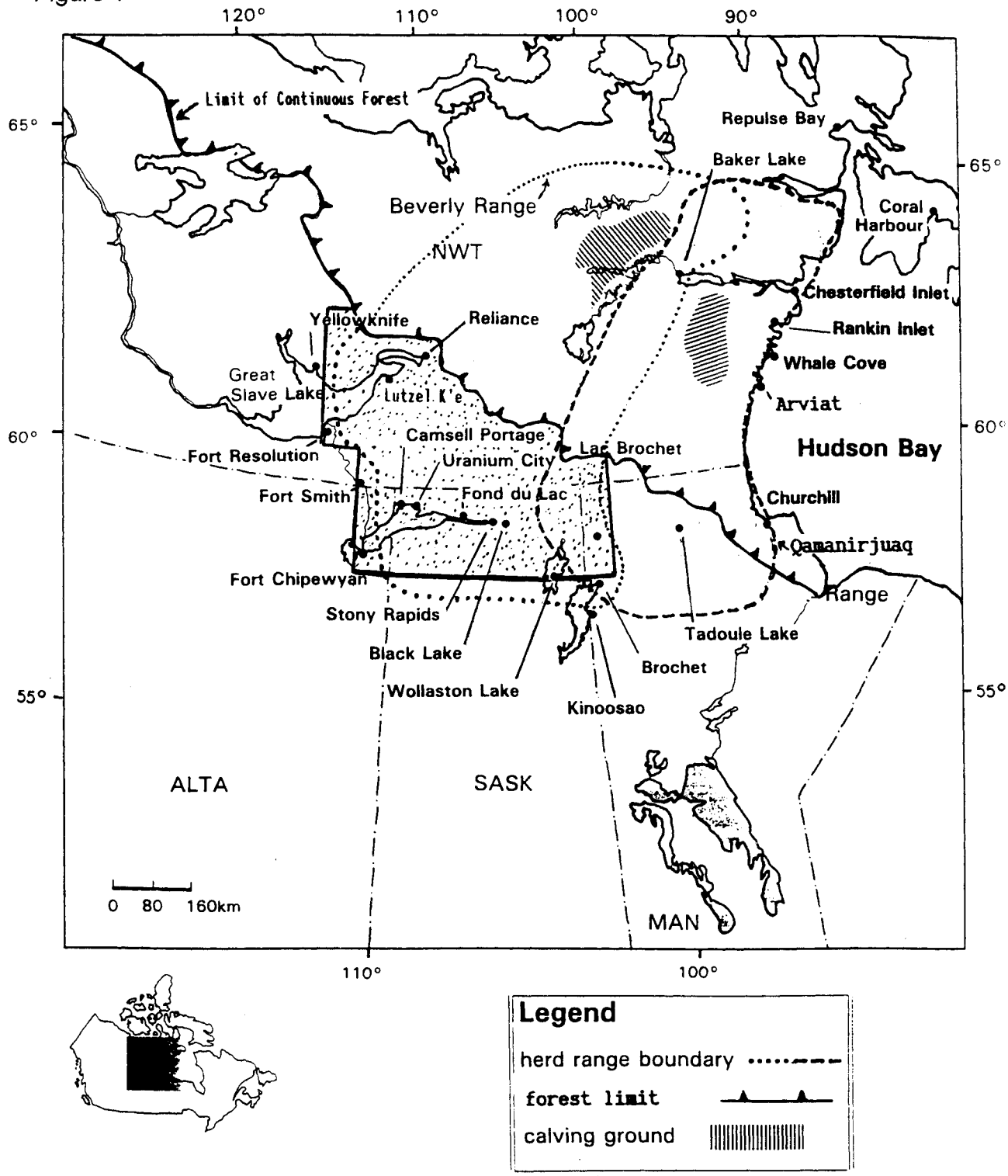

Figure 1. The study area, forested winter range of the Beverly herd of caribou, and ranges of the Beverly and Qamanirjuaq herds.

METHODS

Data on fire history was accumulated from many sources: (1) fire history maps (scale 1:250 000) of NWT dating to 1969 obtained by visual mapping of burn peripheries using aircraft (Indian & Northern Affairs Canada and NWT Department of Renewable Resources, pers. comm.); (2) fire history maps (scale 1:250 000 and 1:1 000 000) for years 1973 to 1981 inclusive obtained for Northern Saskatchewan (Sask. Dep. Parks & Renewable Resources, pers. comm.); (3) fire history data obtained in 1958 by E. Kuyt for a study area in northern Saskatchewan (Kelsall 1960); (4) burns noted by Scotter (1964) while conducting range studies in 1960; (5) fire history data mapped by Banfield (1954) in 1948-1950; (6) burned areas mapped by Thomas (unpubl. data) during studies in 1957, 1958, and 1967; (7) burns mapped on aerial surveys (**Fig. 2**) conducted from 1980 through 1988 (minimum of one transect every 5°N latitude), and on reconnaissance and supply flights during the same period; (8) burn lines visible on 1:60 000 scale aerial photography of the study area obtained for mapping purposes in 1954-1956; (9) burns mapped from 1973-79 satellite imagery for six 1:250 000 maps in northwestern Manitoba (Dixon 1981); (10) burns apparent in maps (scale 1:250 000) produced from digital satellite data along a power transmission line between Beaverlodge and Wollaston Lake in northern Saskatchewan (Sask. Power Corp. 1987); (11) burns visible on over 190 ERTS (Earth Resources Technology Satellite) and LANDSAT (Land Satellite) images (**App. 1**); and (12) forest ages obtained at 199 habitat sites in the NWT (n = 192), Saskatchewan (n = 5), and Alberta (n = 2) (**App. 2**) and at another 172 sites examined from 1980 through 1989 and scattered throughout the forested winter range (**App. 3**).

Figure 2

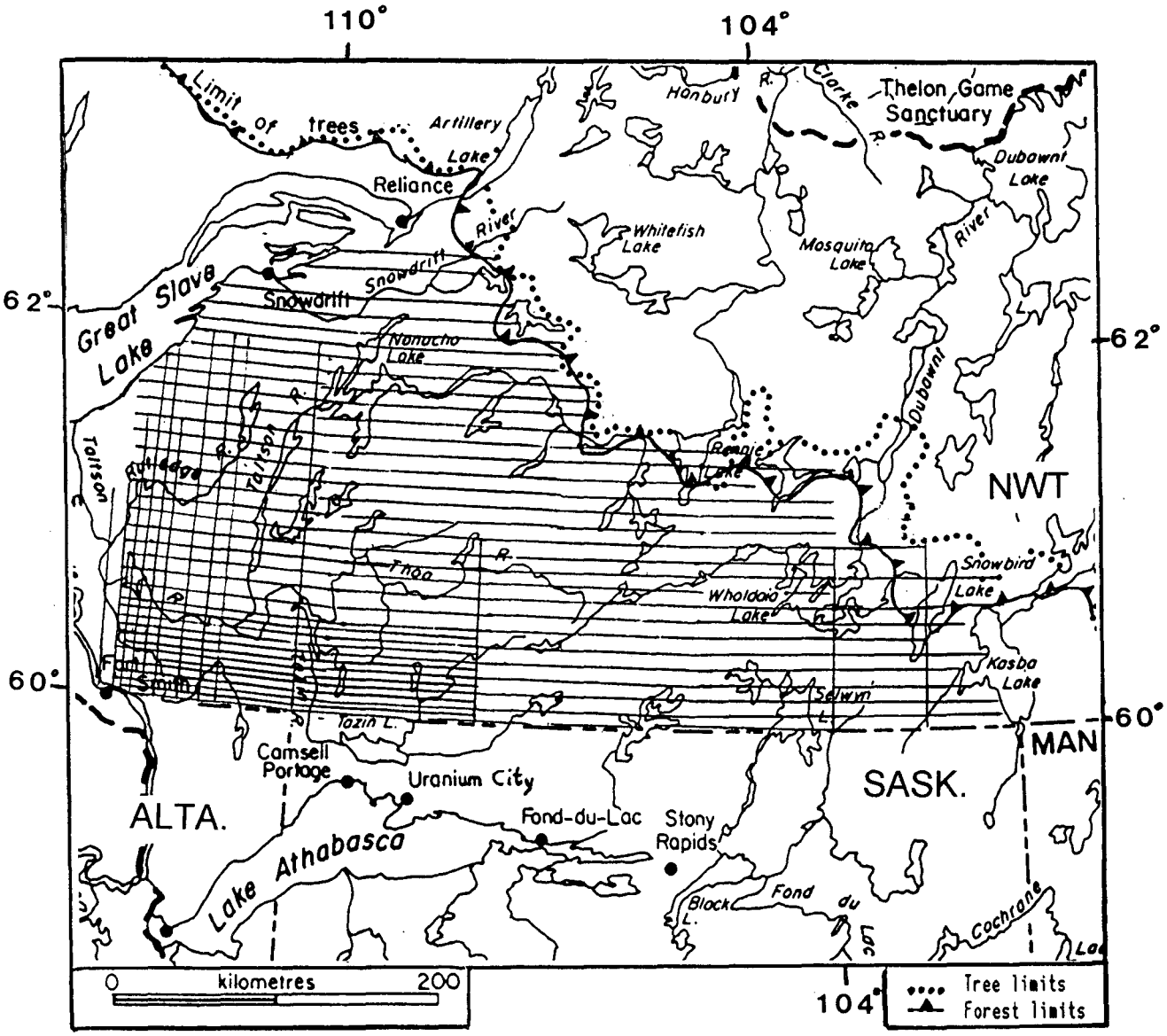

Figure 2. Transects flown to estimate proportions of burns, cover types, and water by constant-interval, spot sampling of forested winter range of the Beverly herd of caribou.

Burn ages have three levels of certainty: (1) known age as witnessed by fire managers or others or from satellite scenes in consecutive years; (2) ages estimated from fire scars; and (3) ages estimated from adding an appropriate number of years to oldest trees in a stand. Recorded burn years generally were reliable in NWT but discrepancies were noted in data for Saskatchewan and Manitoba. Scar data are reliable but inexperienced readers may underestimate ages by 1-3 years if growth is delayed in the trunk near a scar. The third method hinges on finding oldest trees and is not applicable if the stand is so old that the oldest trees have died. It is more reliable if pine are present than in stands of spruce. Experience is required to recognize trees that survived previous fires.

Forest ages were based on known ages when present and secondly on fire scars where they could be found. Otherwise, ages were estimated by adding 5 and 10 years to the maximum number of winter annulations at 25-30 cm above ground level in pine (*Pinus banksiana*) and black and white spruce (*Picea mariana* and *P. glauca*), respectively. These intervals were selected after preliminary assessment of numbers of annuli in disks from trees in stands of known age.

Some forest ages in Saskatchewan and Manitoba were estimated by comparing them to burns of known age. In a few cases, stand ages were estimated visually from aircraft on transects (Fig. 2) or reconnaissance surveys.

Burns were mapped at a scale of 1:250 000 by projecting satellite images (scale 1:1 000 000) with Pro Com 2 equipment. Subsequently, an overhead projector was found to be superior. There was less distortion and the entire scene could be viewed

and mapped at one time. Initial registration of a scene on a map took 5-10 minutes. Some burn mapping was also done at scale 1:500 000.

Burns in NWT mapped in 1981 by Moore (no date), in 1982 and 1983 by Mychesiw (1983) (four 1:250 000 scale maps), and in 1989-90 by the Forestry Branch of NWT Renewable Resources were traced and compared with our maps. Final burn boundaries were drawn on 1:250 000 scale maps and then transferred to 1:500 000 and 1:1 000 000 maps by photographic transfer. The initial study area, encompassed by 11 maps at scale 1:250 000, was expanded to 31 maps (**Fig. 3**) for which data are included in this report.

Fire intervals were classified as (1) first series or most recent (last fire to second last); (2) second series or penultimate (second last fire to third last); and (3) third series (third last fire to fourth last). Age certainty classes were lumped to include (1) known age or fire scar, and (2), any interval that included maximum number of annulations plus an adjustment.

Data analysis consisted primarily of examining year, age, and fire interval distributions and statistics in four primary study areas and other areas with fewer samples (**Fig. 4**), ecoregions (**Fig. 5**), west and east of 107°30'W (**Fig. 6**), and in 1:250 000 map sheets (Fig. 3).

Figure 3

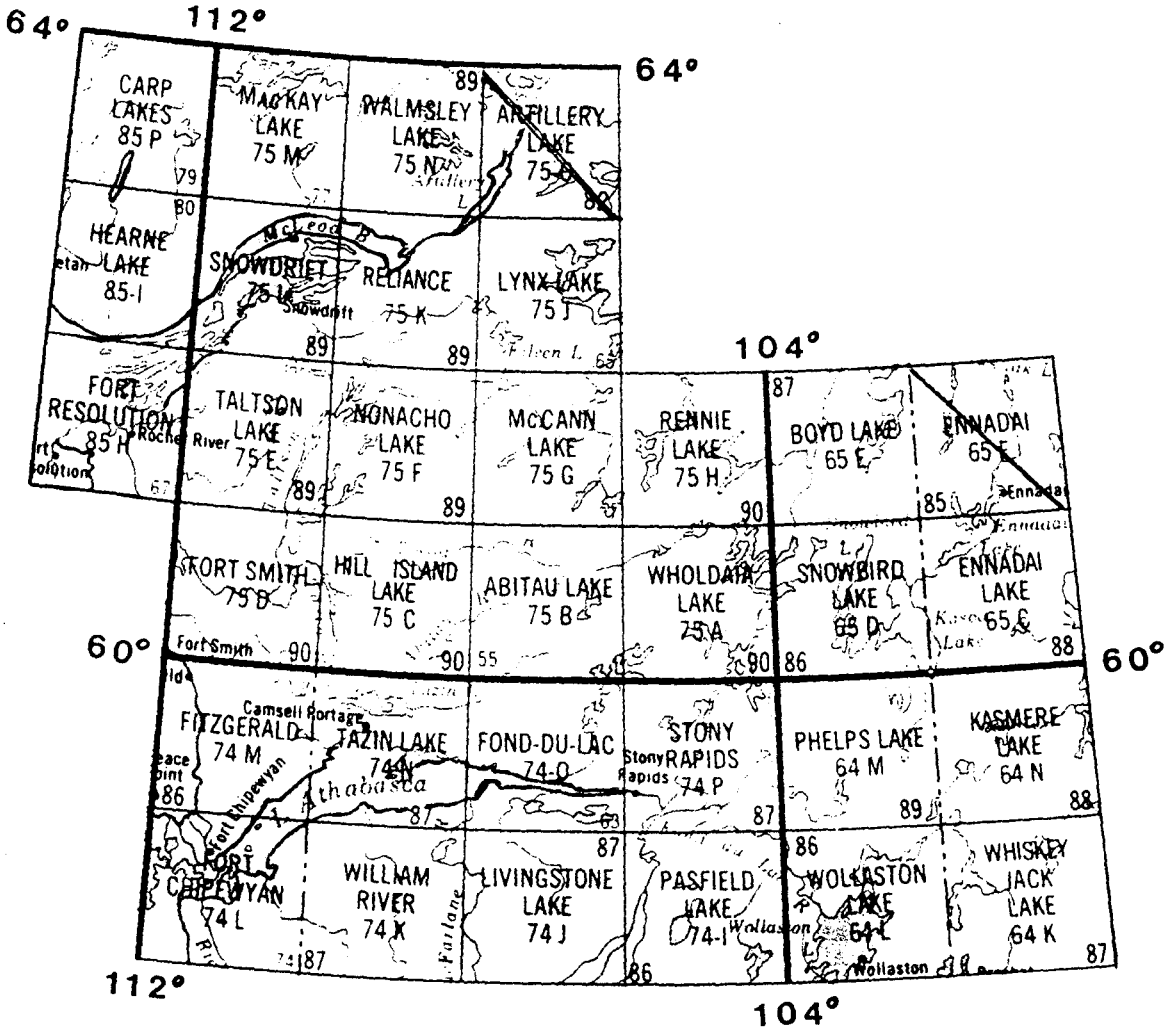

Figure 3. Legend of 1:250 000 scale maps where burns were mapped within forested winter range of the Beverly herd of caribou.

Figure 4

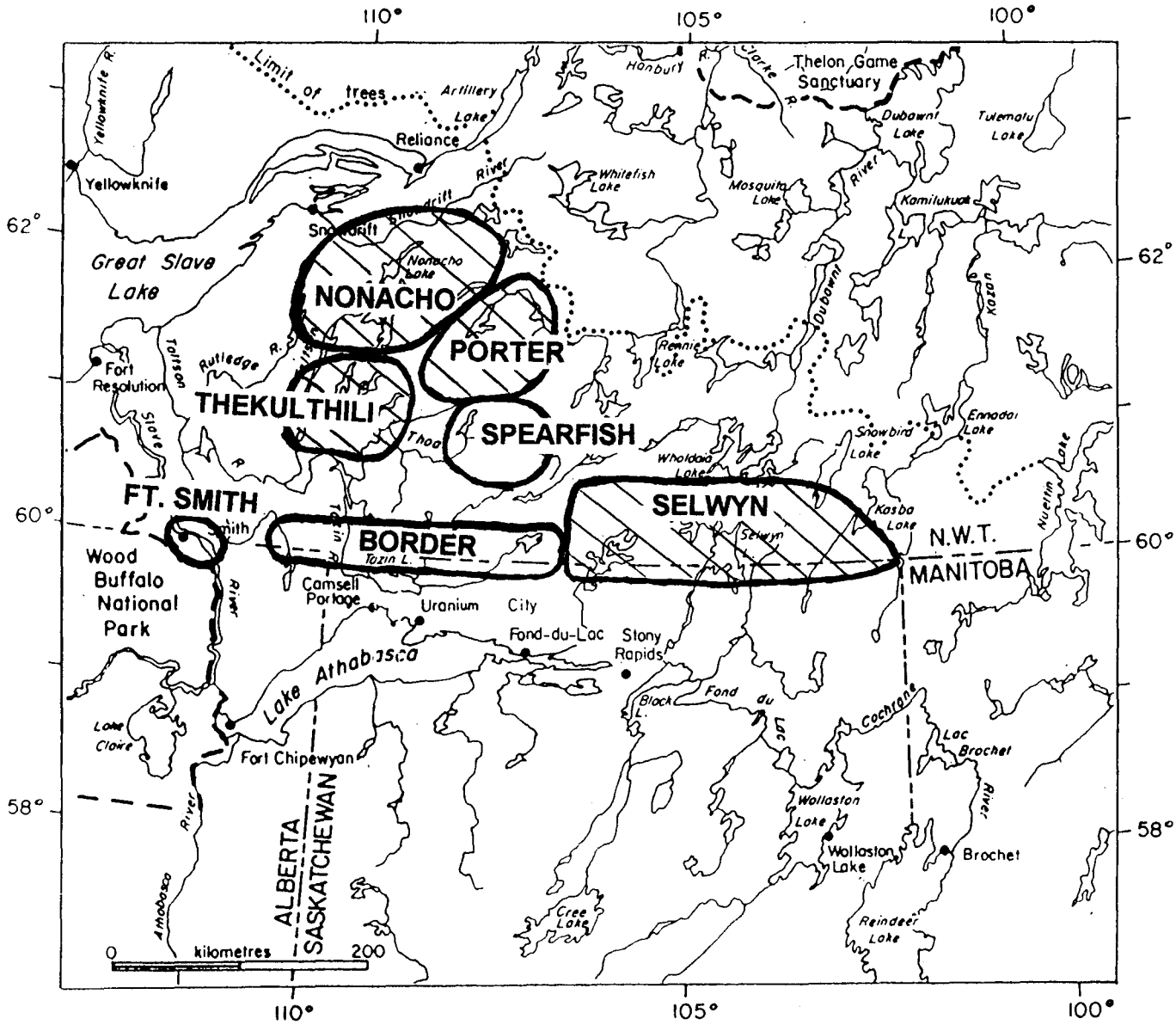

Figure 4. Location of four primary study areas where sampling was intensive (hatch) and other areas where groups of samples were obtained from 1980 through 1987 on winter range of the Beverly herd of caribou.

Figure 5.

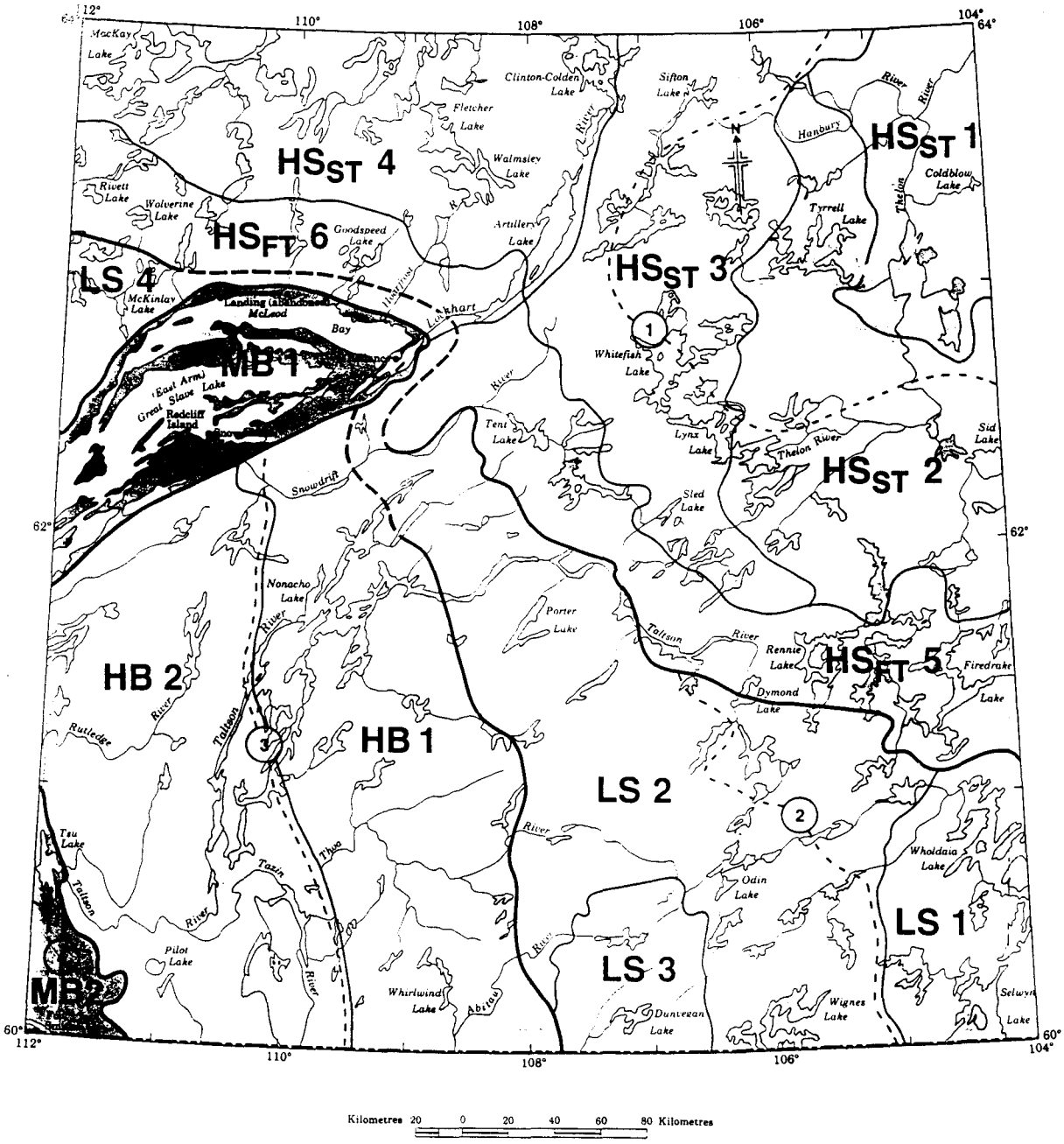

Figure 5. Ecoregions (MB = Mid Boreal, HB = High Boreal, LS = Low Subarctic, HS = High Subarctic) on winter range of the Beverly herd of caribou (Bradley et al. 1982).

Figure 6

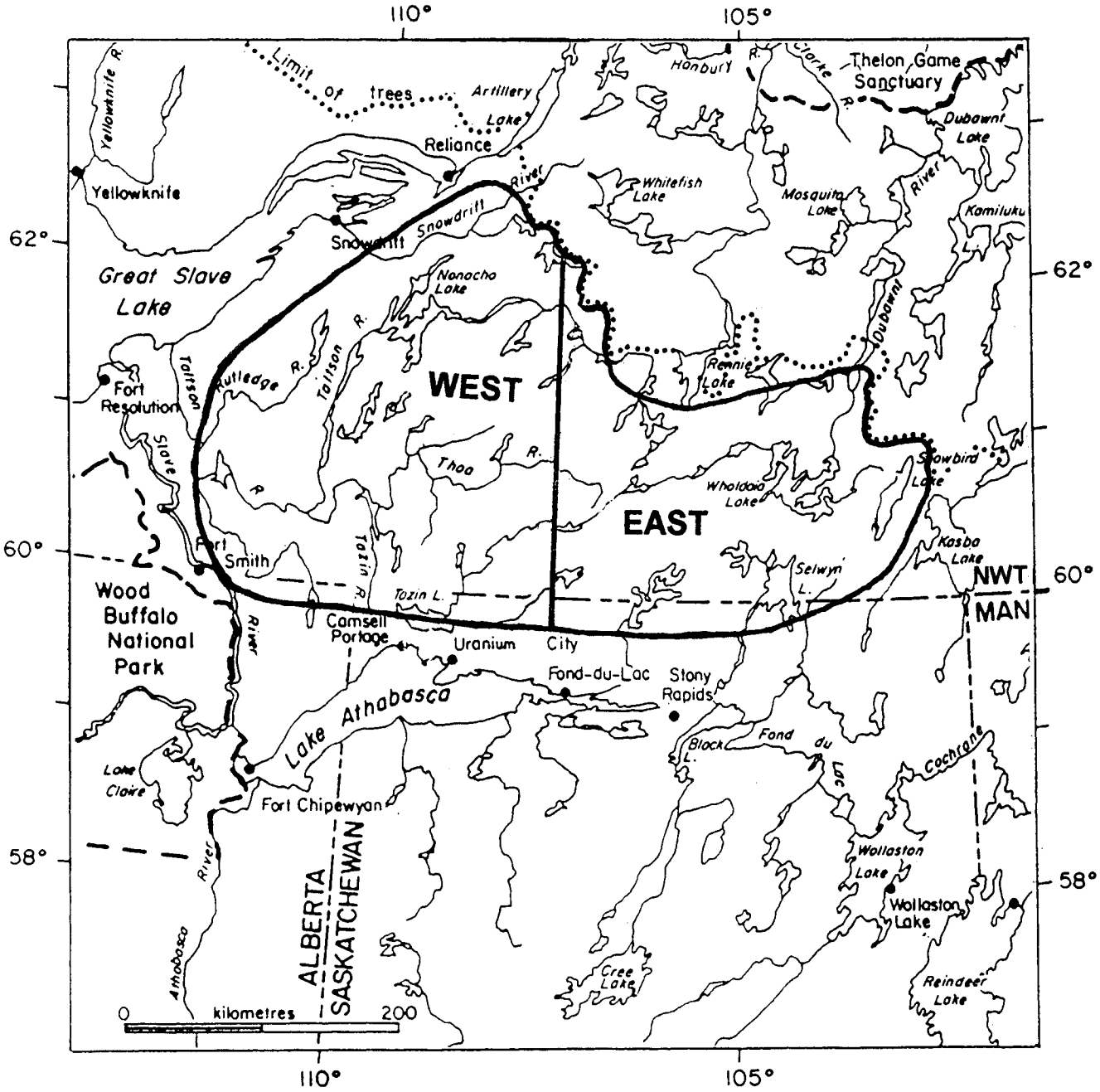

Figure 6. West and east sampled portions of winter range of the Beverly herd of caribou and forest limit defined from winter LANDSAT scenes.

RESULTS

Tree annulations at 25-30 cm above ground relative to stand age

Plots of number of annulations in tree discs cut at 25-30 cm above ground level with known age of burn (**Fig. 7**) indicated that adding 5 years to numbers of summer annulations in pine and 10 years to those in spruce provided approximate stand ages where fire scars were not available.

At habitat sites, the most frequent difference for pine was 4 years (range 4-23) and 4-7 annulations accounted for 69% (25/36) of cases. For black spruce, the most frequent differences were 5 and 7 years (frequency 9/50 for each). Whereas 5-8 annulations accounted for 56% of cases, addition of 10 years was appropriate for most stands where the oldest trees may not be selected for age sampling.

Decade origin of sampled forests

Although sampling was not random, the distribution of decade of stand origin at sites in four primary study areas may indicate *relative* variation in burn frequency with time (**Fig. 8**). Likewise, the distribution of decades of fire origin in other areas reveals younger stands in the southwest (Ft. Smith and Border) and older ones to the east and north (**Fig. 9**). This trend is supported by frequency distributions for fires in ecoregions (**Fig. 10**), west and east of 107°30'W (**Fig. 11**), and by 1:250 000 map sheet (**Fig. 12 & 13**) where sample sizes were larger than 10.

Median fire year of 484 burns was partitioned by study area, other areas, ecoregions, west and east of 107°30'W, and by map sheet (**Table 1**).

Figure 7

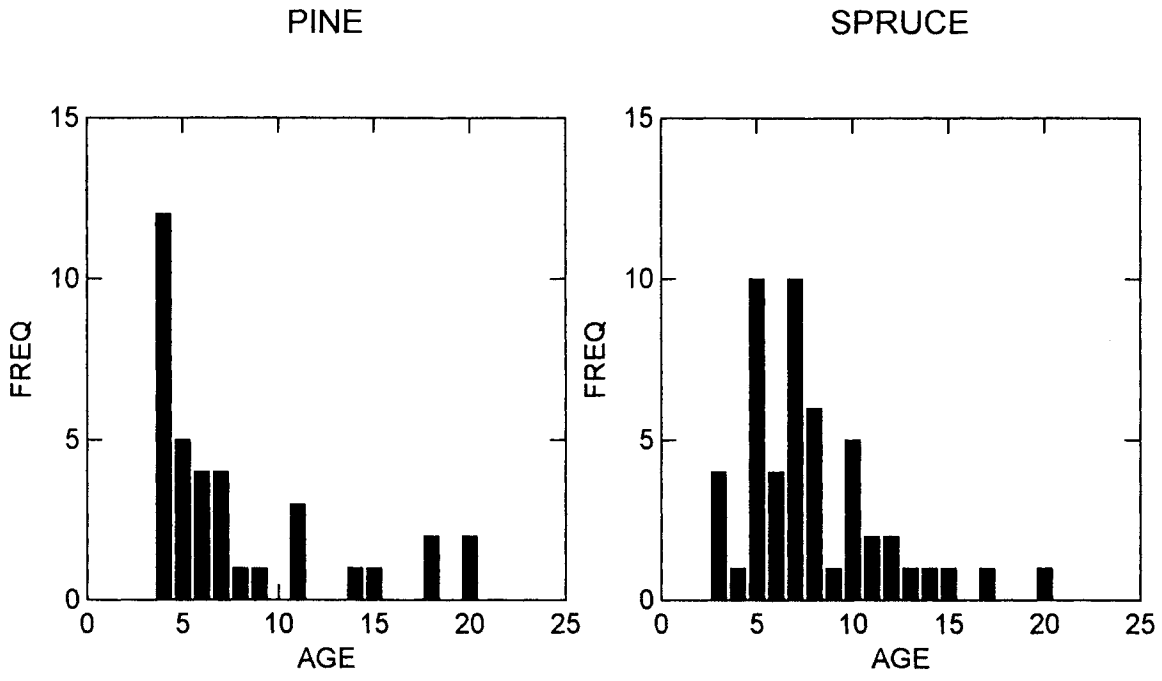

Figure 7. Frequency (FREQ) distribution of age differences (AGE) between known ages and numbers of winter annulations 25-30 cm above ground in visually oldest pine and black spruce in transitional forest of southern Northwest Territories.

Figure 8.

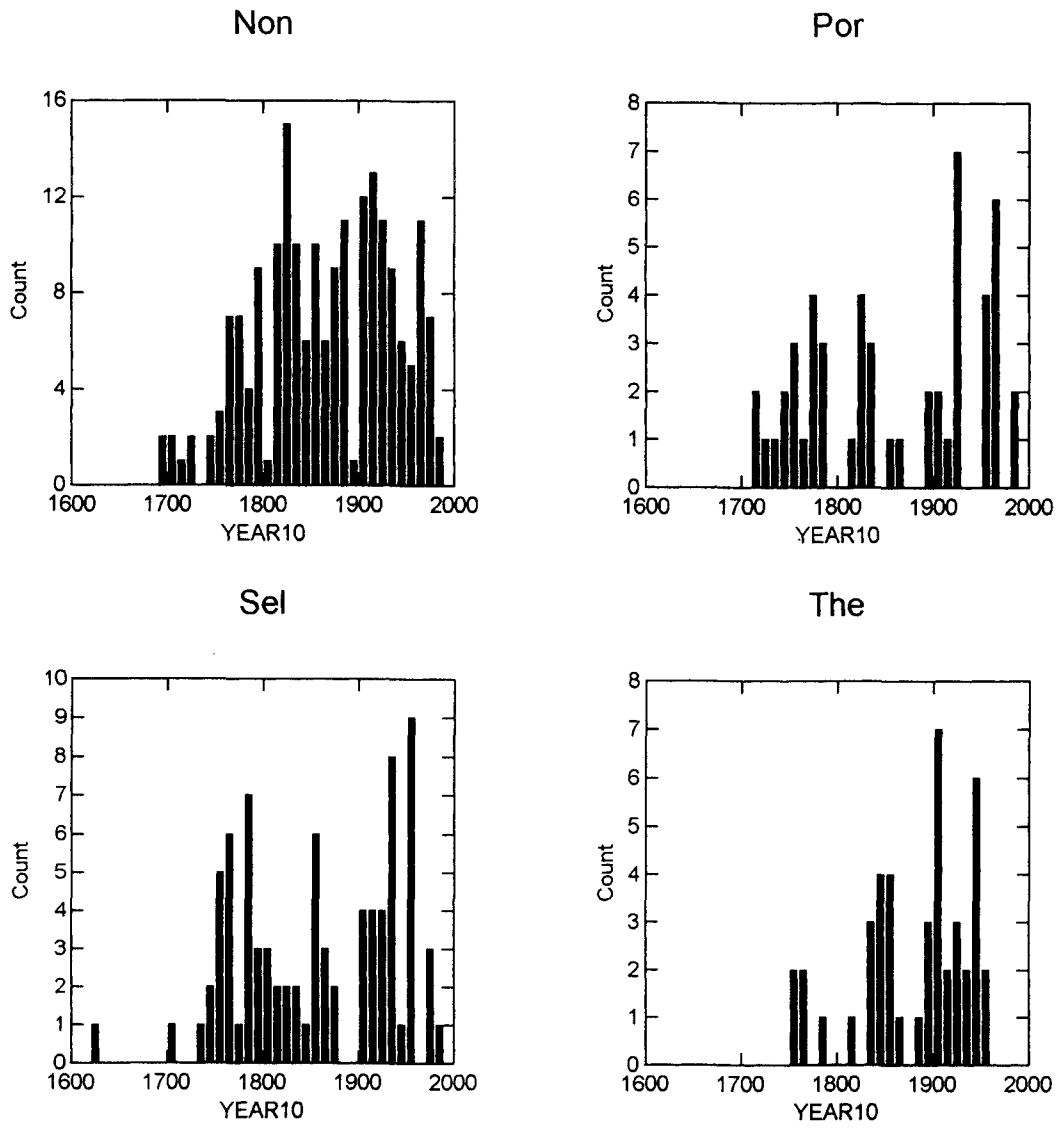

Figure 8. Frequency (COUNT) distribution of forest origin by decade (YEAR10) at sites in four primary study areas (Selwyn = Sel, Thekulthili = The, Nonacho = Non, and Porter = Por [Fig. 4]) on winter range of the Beverly herd of caribou.

Figure 9.

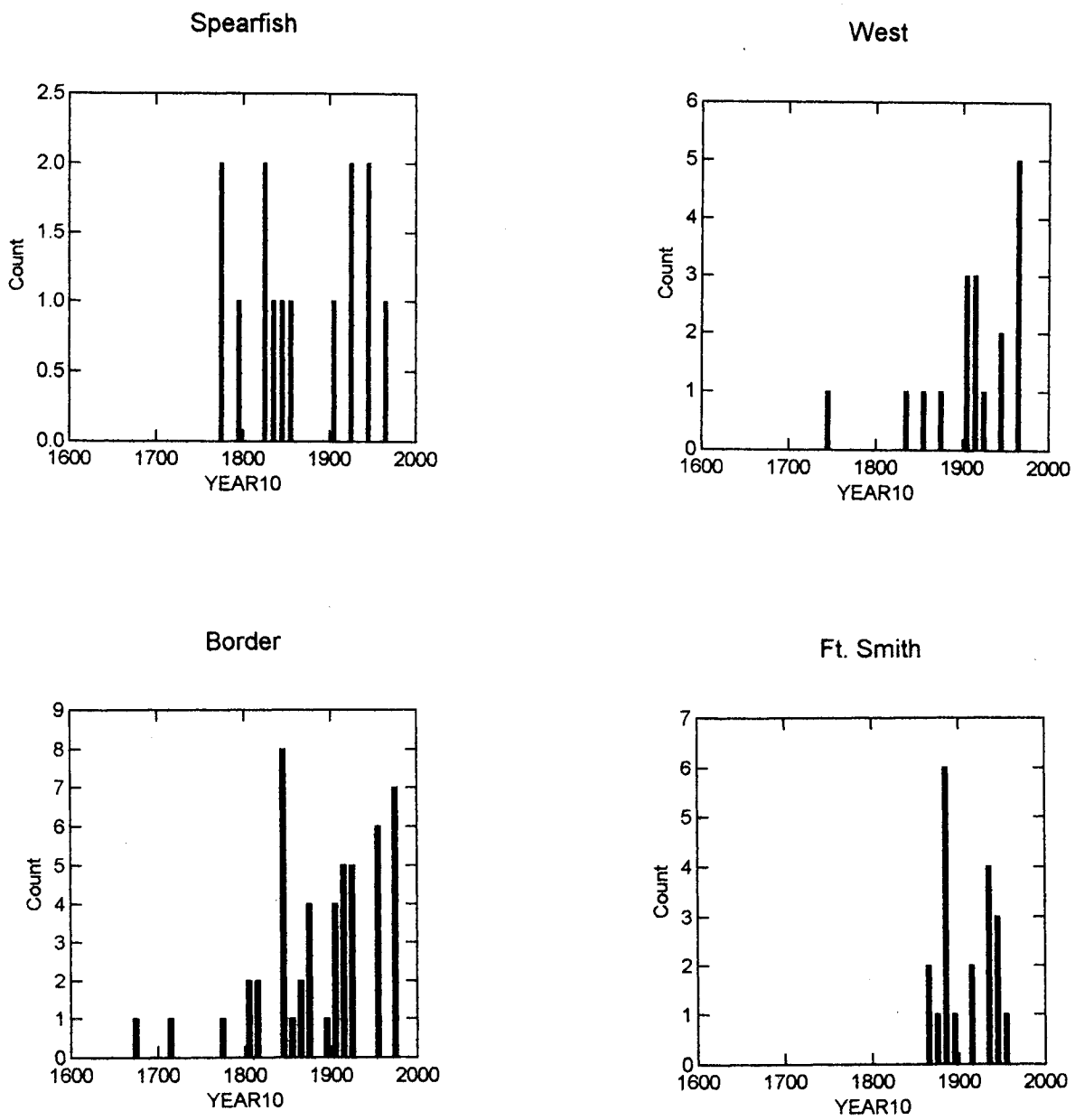

Figure 9. Frequency (COUNT) distribution of fire origin by decade (YEAR10) in four areas outside primary study areas (Fig. 4) on winter range of the Beverly herd of caribou.

Figure 10

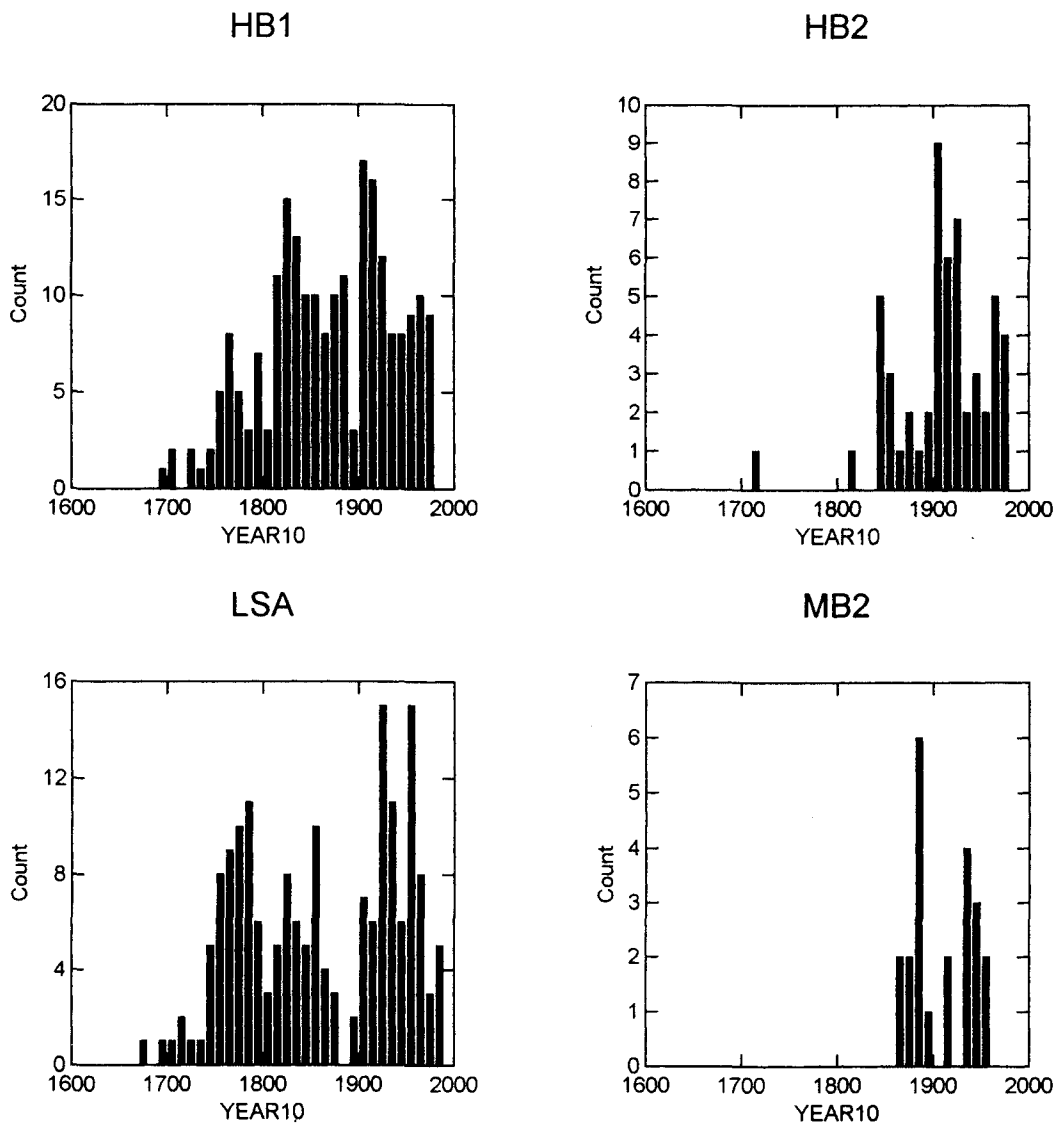

Figure 10. Frequency (COUNT) distribution of fire origin by decade (YEAR10) in ecoregions High Boreal 1 & 2, Low Subarctic, and Mid Boreal (Fig. 5) on winter range of the Beverly herd of caribou.

Figure 11

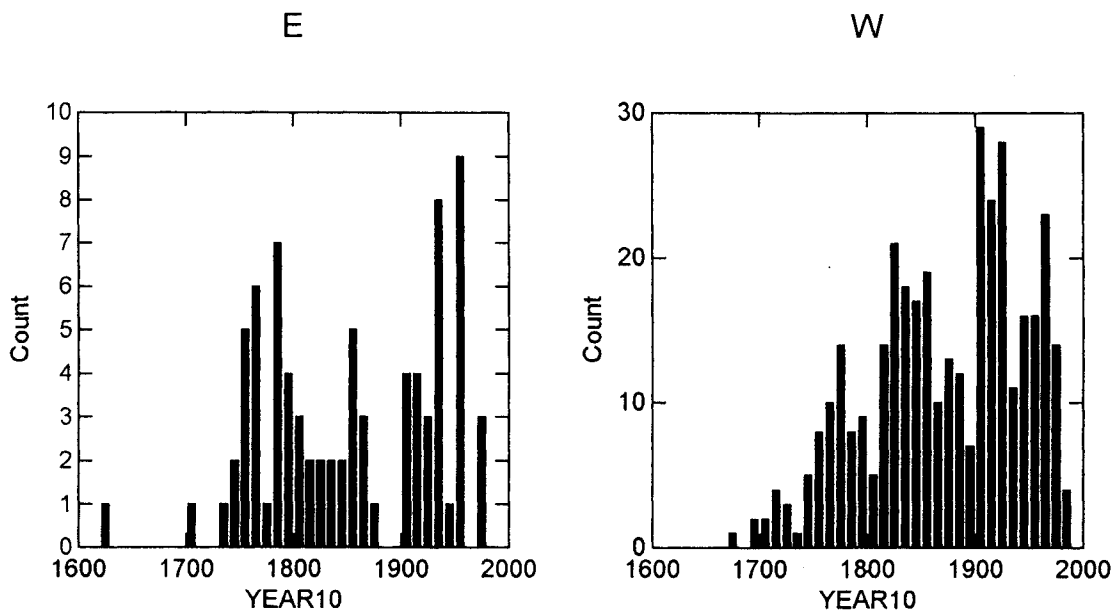

Figure 11. Frequency (COUNT) distributions of fire origin, by decade (YEAR10), west and east of 107°30'W (Fig. 6) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 12.

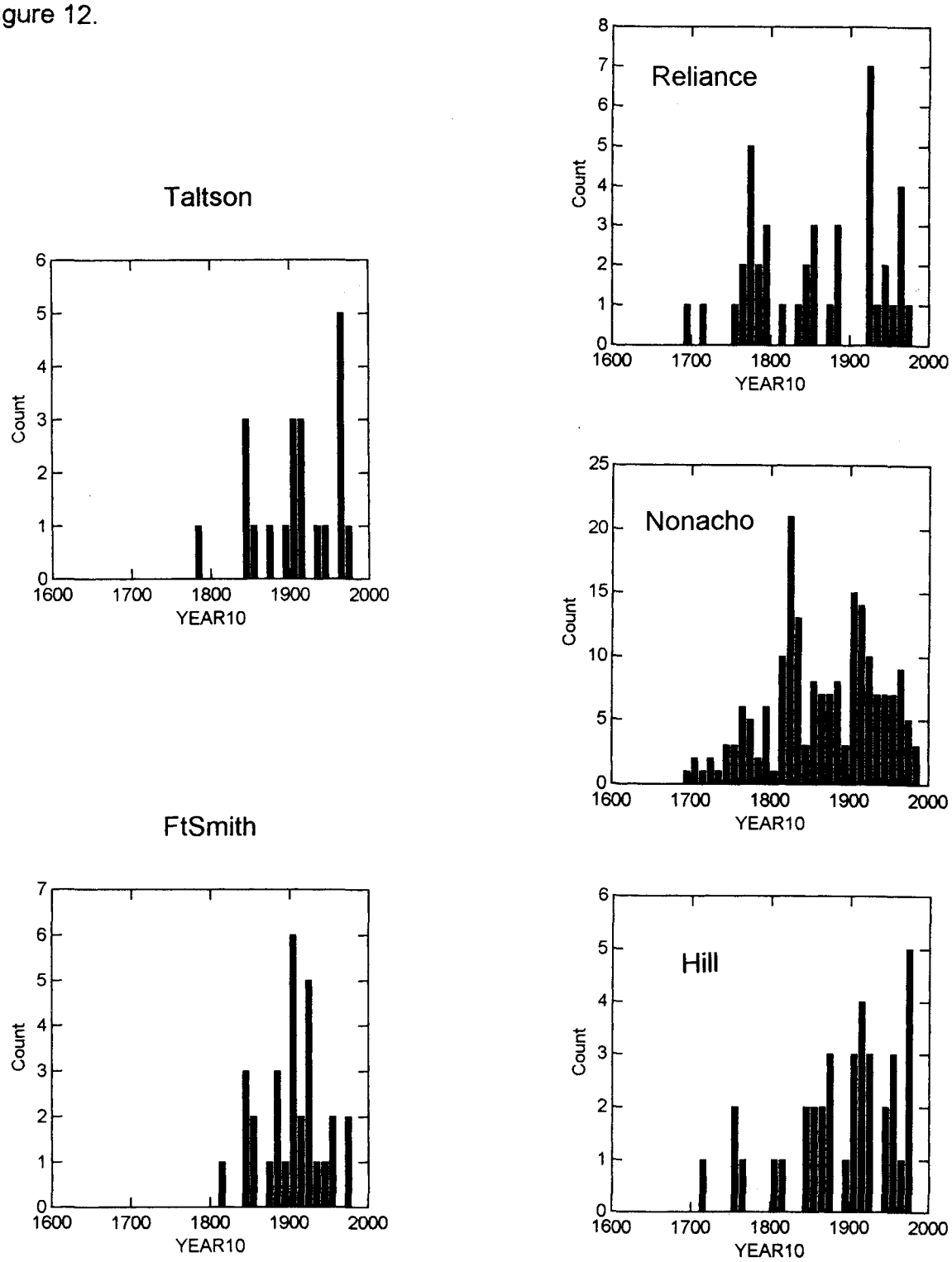

Figure 12. Frequency (COUNT) distribution of fire origin, by decade (YEAR10), in 1:250 000 map areas west of 106° W (Fig. 3) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 13.

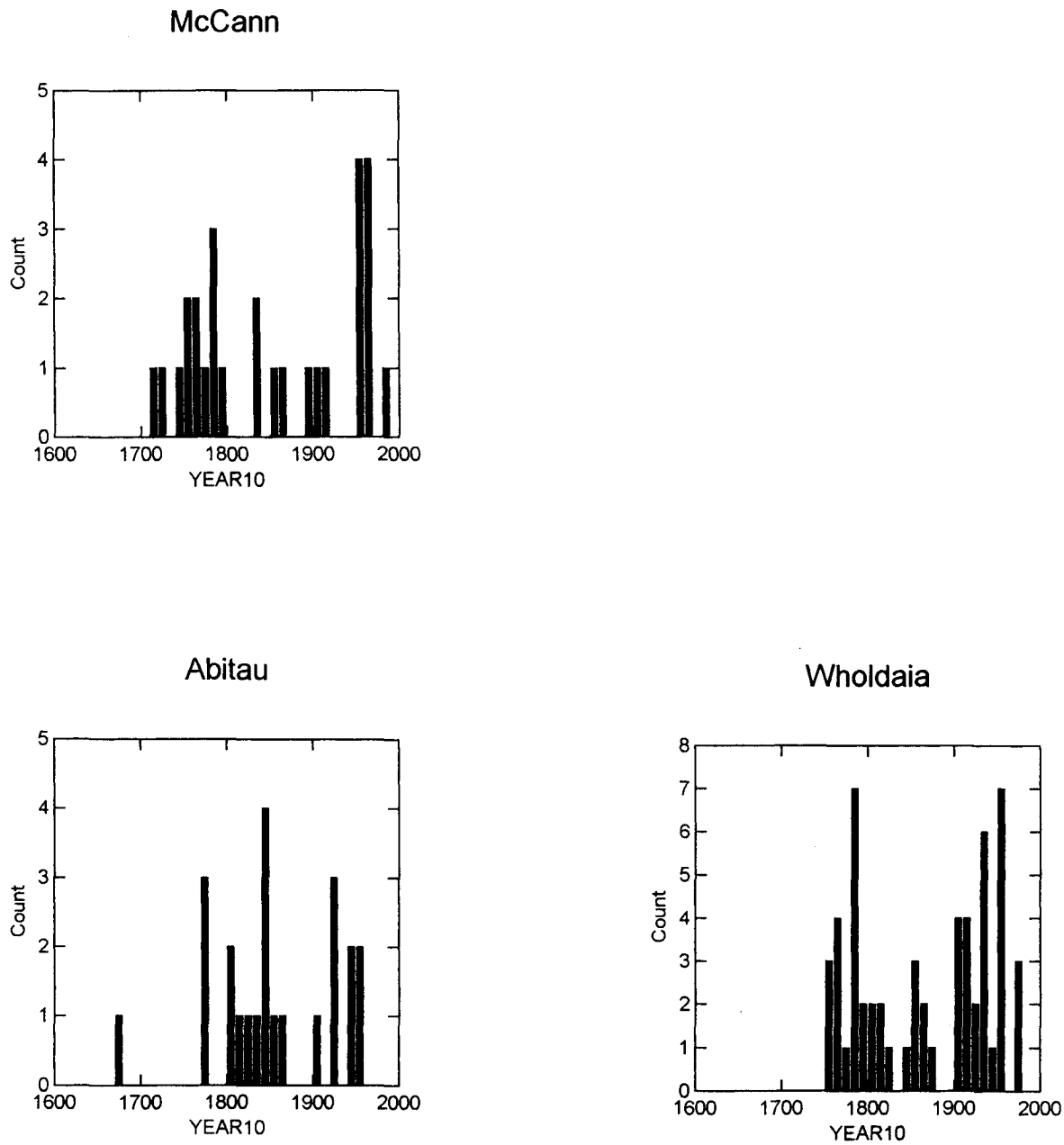

Figure 13. Frequency (COUNT) distributions of fire origin, by decade (YEAR10), on 1:250 000 map sheets east of 106° W (Fig. 3) on winter range of the Beverly herd of caribou in Northwest Territories.

Table 1. Mean and median burn year and age and calculated fire cycle of 484 sampled forests, partitioned by study area, other areas, ecoregion, west and east of 107°30'W, and by map sheet where sample size was >10.

Location	Sample size	Burn year Mean	Burn year Median	Burn age Mean	Burn age Median	Fire cycle (yrs)[1]
Study areas[2]						
Thekulthili	44	1880	1900	104	88	0.96
Nonacho	194	1865	1860	118	113	0.85
Porter	51	1858	1845	125	127	0.80
Selwyn	82	1855	1857	130	126	0.77
Other areas[2]						
Fort Smith	20	1908	1905	77	80	1.30
Border	50	1890	1903	90	77	1.11
Spearfish	14	1867	1850	115	134	0.87
Ecoregions[3]						
Low Subarctic	178	1859	1856	125	127	0.80
High Boreal 1	219	1869	1874	114	108	0.88
High Boreal 2	55	1908	1913	75	75	1.33
West & east of 107°30'[4]						
West	368	1871	1880	112	103	0.89
East	80	1851	1852	134	127	0.75
Map sheets[5]						
Fort Smith	30	1904	1907	80	78	1.25
Taltson L.	21	1908	1913	76	75	1.32
Hill Island L	37	1891	1908	90	71	1.11
Nonacho L.	190	1867	1871	117	112	0.85
Reliance	42	1858	1857	126	129	0.79
Abitau L.	24	1855	1845	127	130	0.79
McCann L.	28	1854	1840	129	140	0.78
Wholdaia L.	56	1866	1870	120	118	0.83

[1] Assuming mean age approximately equals the fire cycle.
[2] See Fig. 4.
[3] See Fig. 5.
[4] See Fig. 6.
[5] See Fig. 3.

Distribution of forest ages

Information on fire regimes can be gleaned from the distribution of forest ages by decade classes in primary study areas (**Fig. 14**), by ecoregion (**Fig. 15**), by regions east and west of 107°30'W (**Fig. 16**), and by 1:250 000 map sheets west and east of 106°W (**Fig. 17 & 18**). These distributions generally indicate younger age structures in the west and younger age structures at greater distances from forest limits. Relative influence of longitude, distance from forest limit, and physiography is uncertain.

Fire intervals

Distributions of burn intervals in primary study areas indicate some relatively short intervals in the Thekulthili study area but progressively fewer of them in the sequence Nonacho, Porter, and Selwyn (**Fig. 19**). Distribution of burn intervals in two other areas (Fig. 19), data for ecoregions (**Fig. 20**), and at sites west and east of 107°30'W indicates skewed normal distributions with skewing toward shorter intervals in the west and the opposite in the east (**Fig. 21**).

Graphical displays of interval means, standard deviations, and ranges at primary study areas and other areas (**Fig. 22**), ecoregions (**Fig. 23**), west and east of 107°30'W (**Fig. 24**), at Fort Smith and a border area (Fig. 24), and within 1:250 000 map areas (**Fig. 25**) revealed relatively shorter intervals in the west and at greater distances from forest limits.

Figure 14

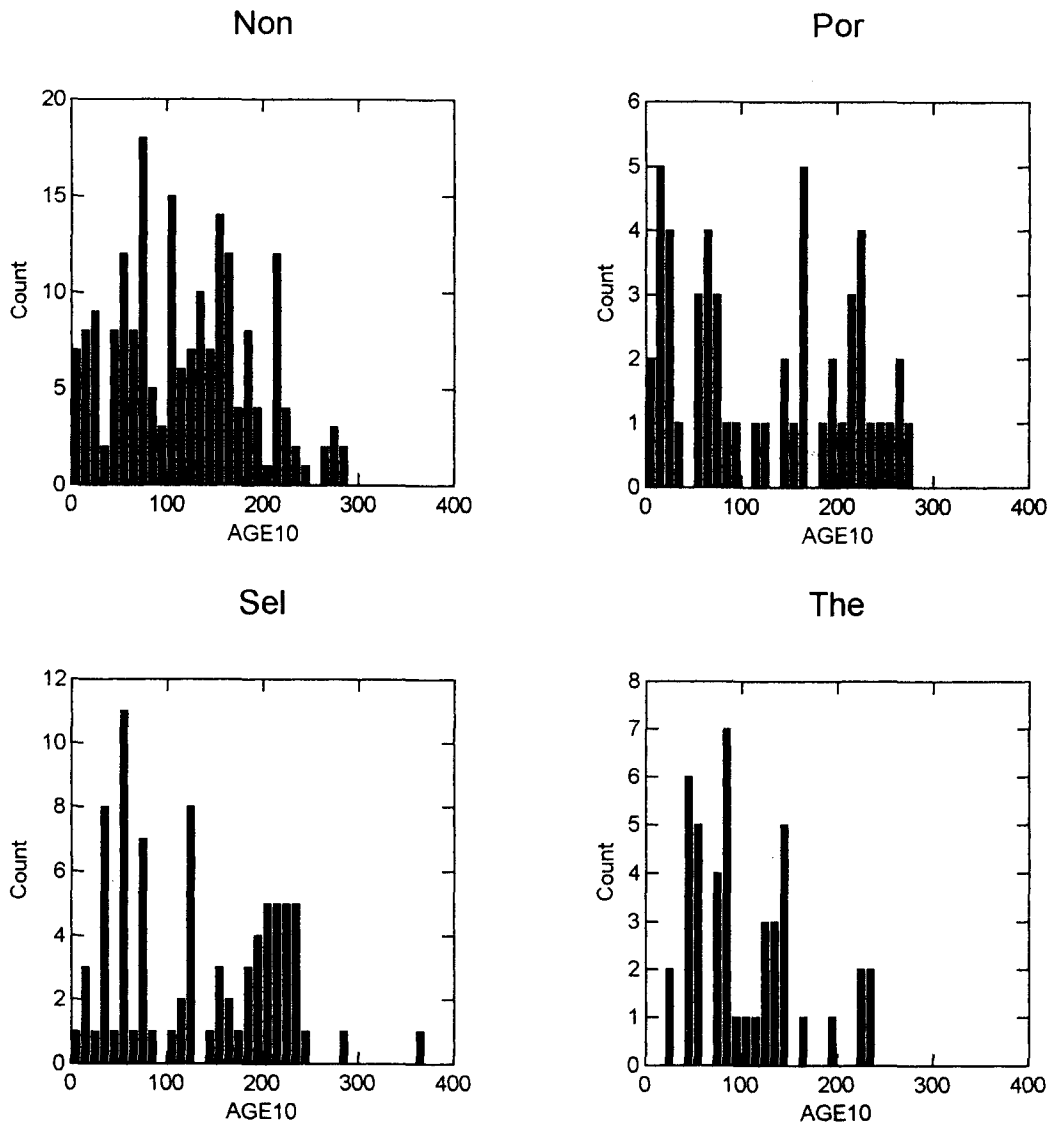

Figure 14. Frequency (COUNT) distribution of forest ages by decade (AGE10) at sites in four primary study areas designated Selwyn (Sel), Thekulthili (The), Nonacho (Non), and Porter (Por) (Fig. 4) on winter range of the Beverly herd of caribou.

Figure 15.

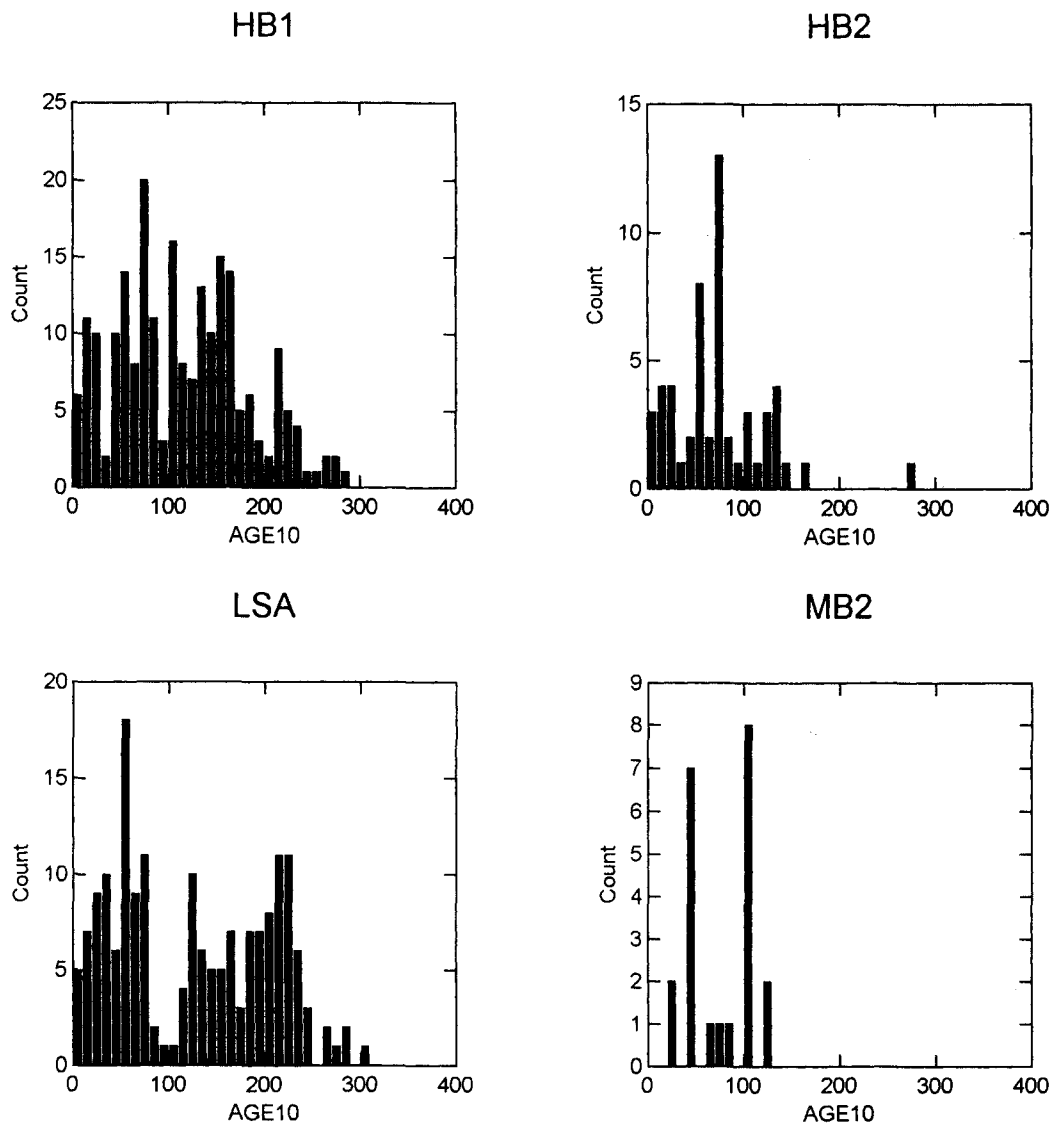

Figure 15. Frequency (COUNT) distribution of forest ages by decade (AGE10) in ecoregions High Boreal 1 (HB1), High Boreal 2 (HB2), Low Subarctic (LSA), and Mid Boreal 2 (MB 2) (Fig. 5) on winter range of the Beverly herd of caribou.

Figure 16

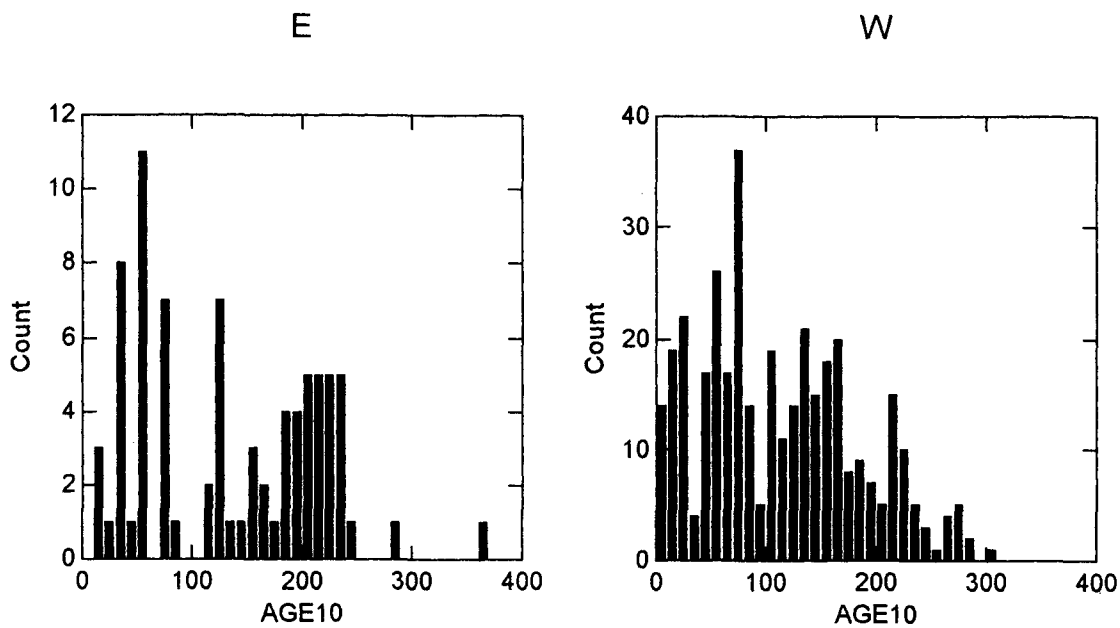

Figure 16. Frequency (COUNT) distribution of forest ages by decade (AGE10) at sites west and east of 107°30'W (Fig. 6) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 17

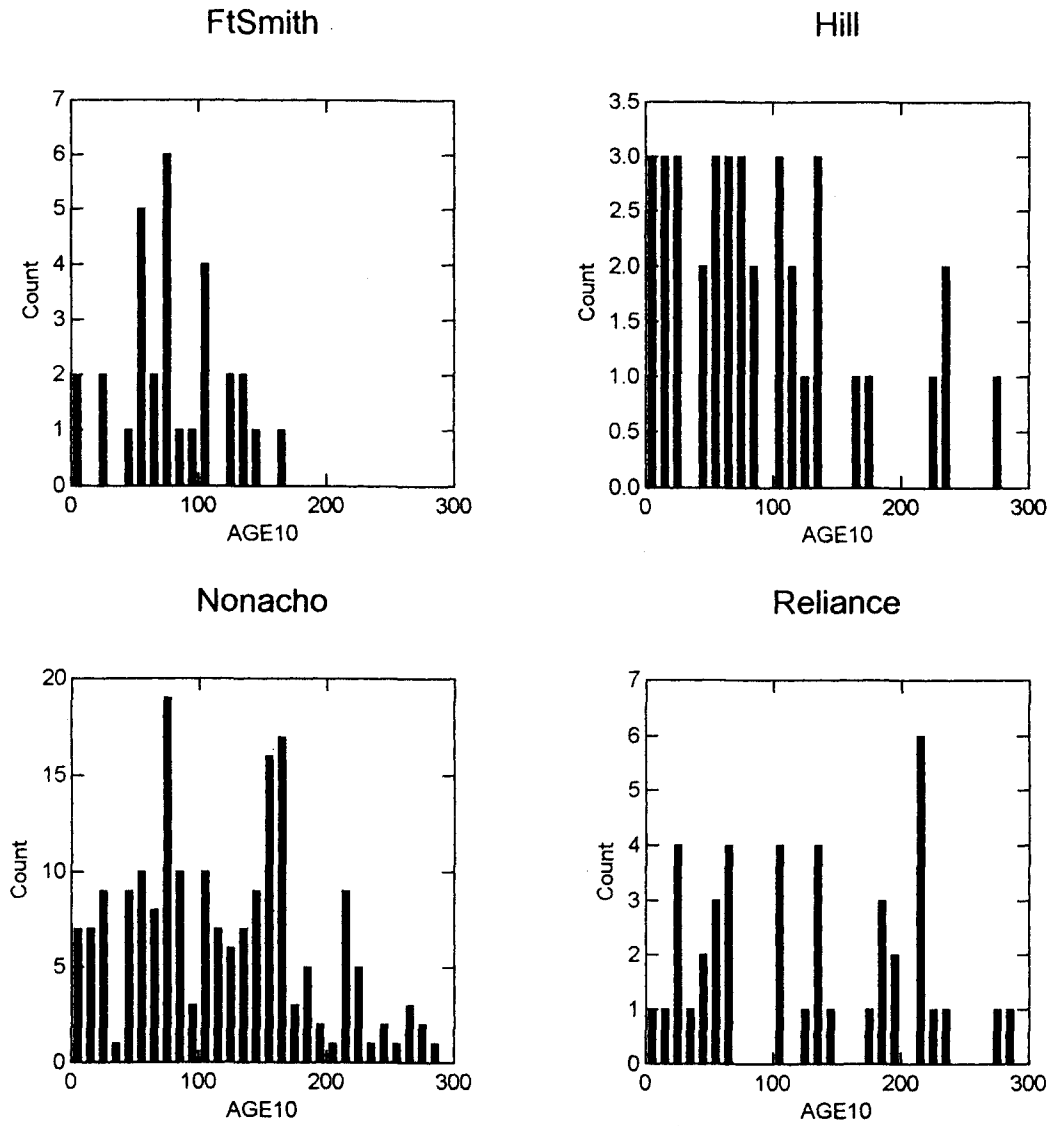

Figure 17. Frequency (COUNT) distribution of forest ages by decade (AGE10) at sites within 1:250 000 map areas west of 106°W (Fig. 6) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 18

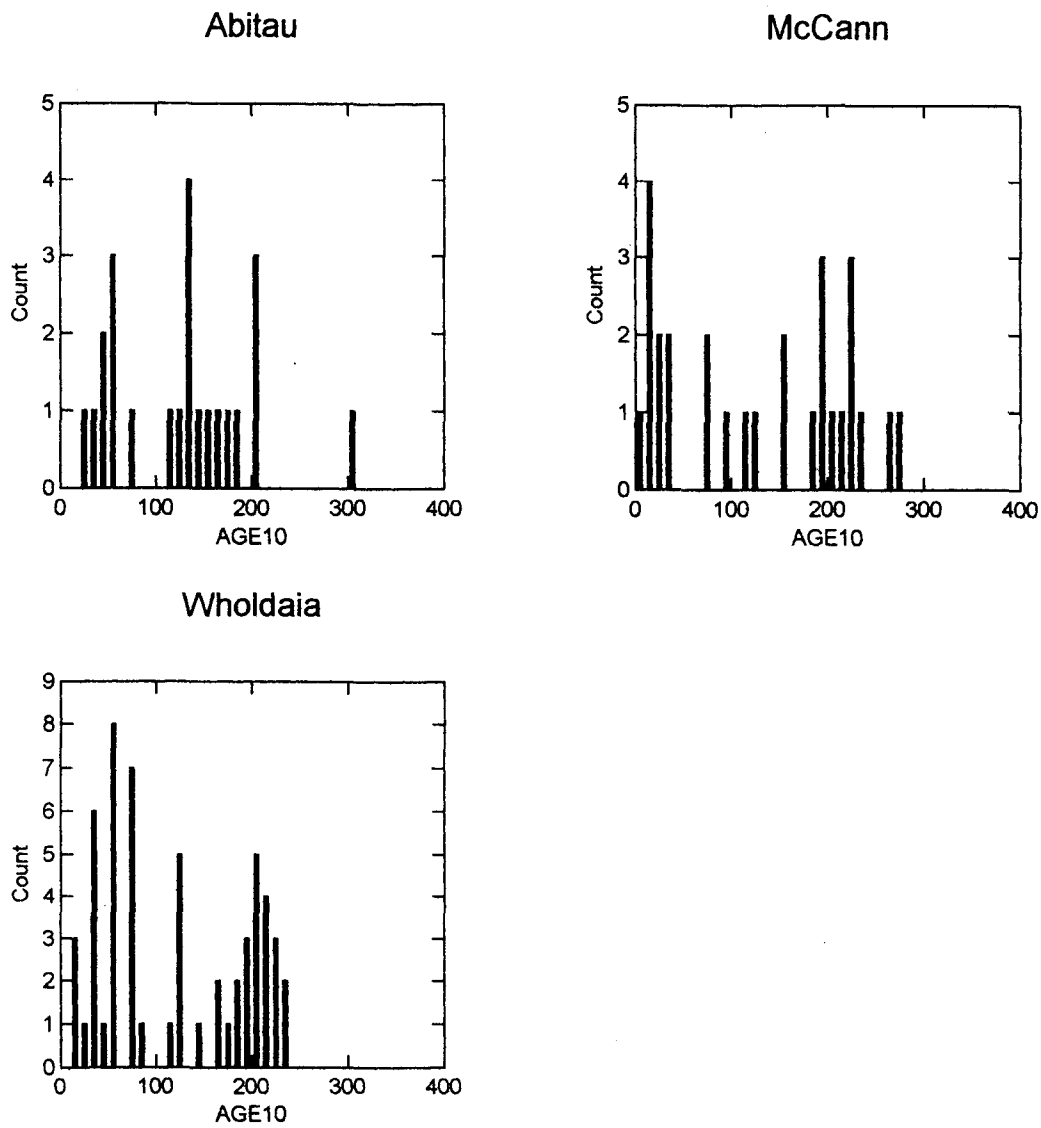

Figure 18. Frequency (COUNT) distribution of forest ages by decade (AGE10) at sites within 1:250 000 map areas east of 106°W (Fig. 6) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 19

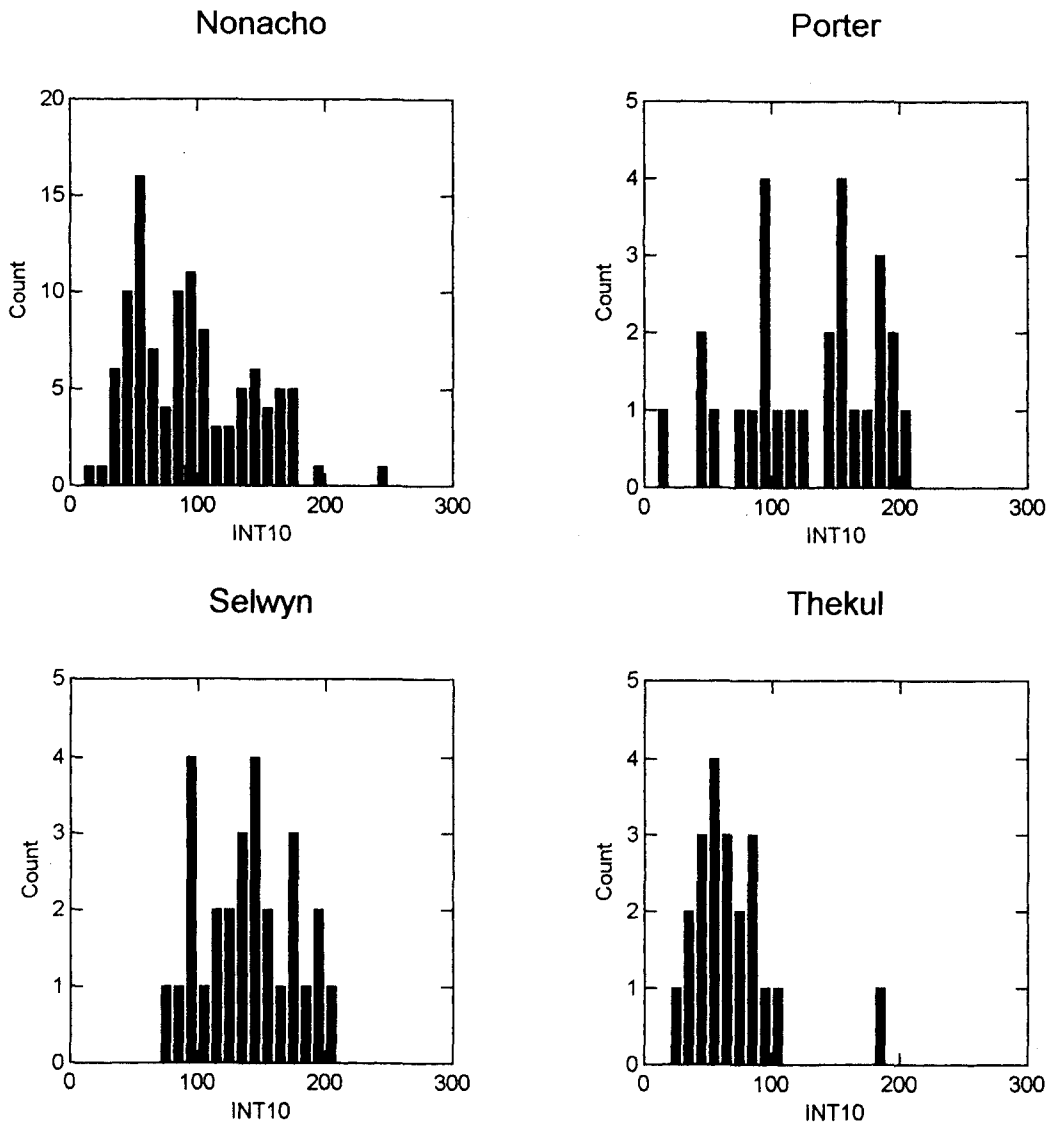

Figure 19. Frequency (COUNT) distribution of decade intervals (INT10) between burns in four primary study areas (Thekul = Thekulthili) (Fig. 4) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 20

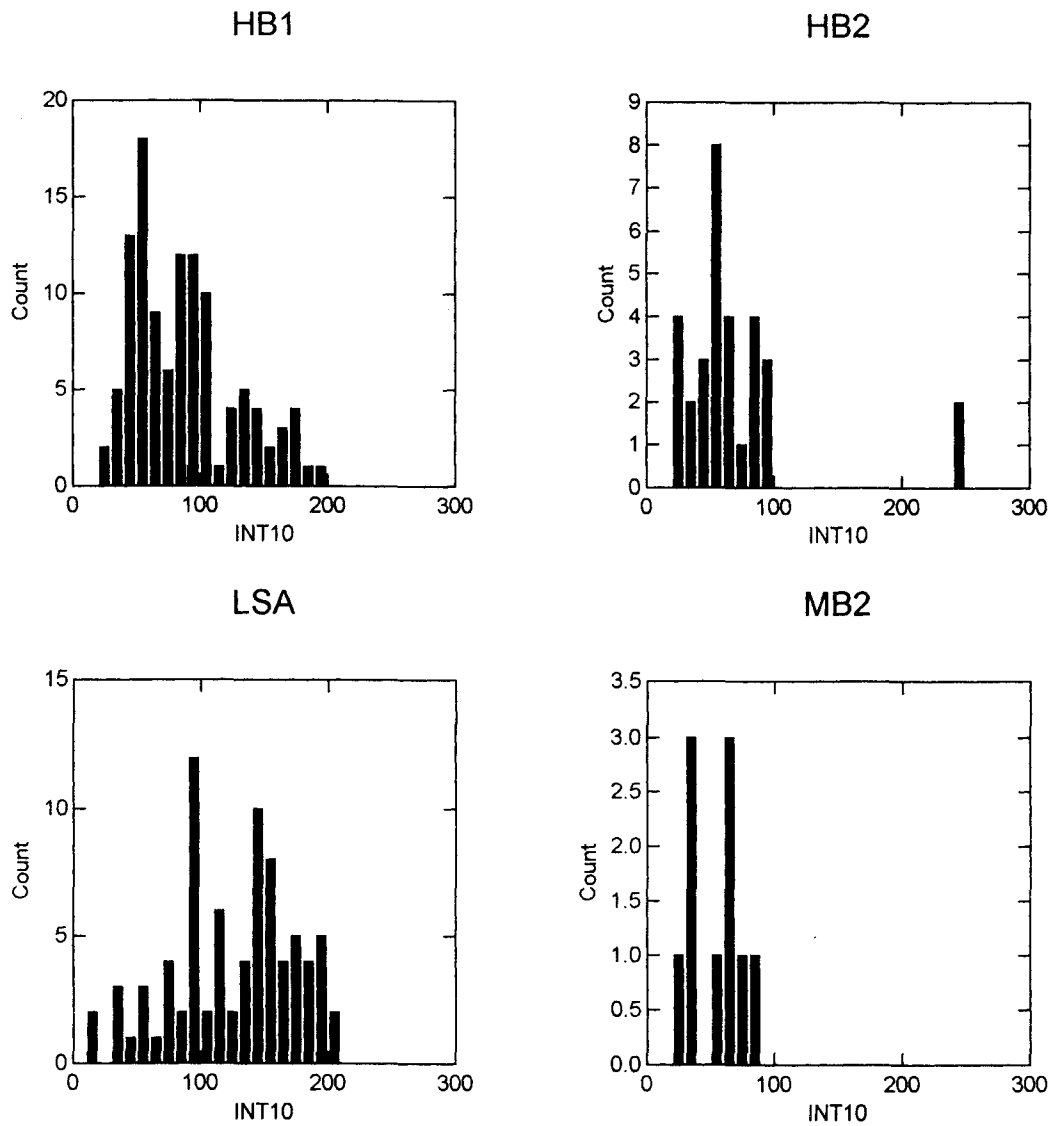

Figure 20. Frequency (COUNT) distribution of decade intervals (INT10) between burns in four ecoregions (Mid Boreal 2, High Boreal 1, High Boreal 2, and Low Subarctic) (Fig. 5) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 21

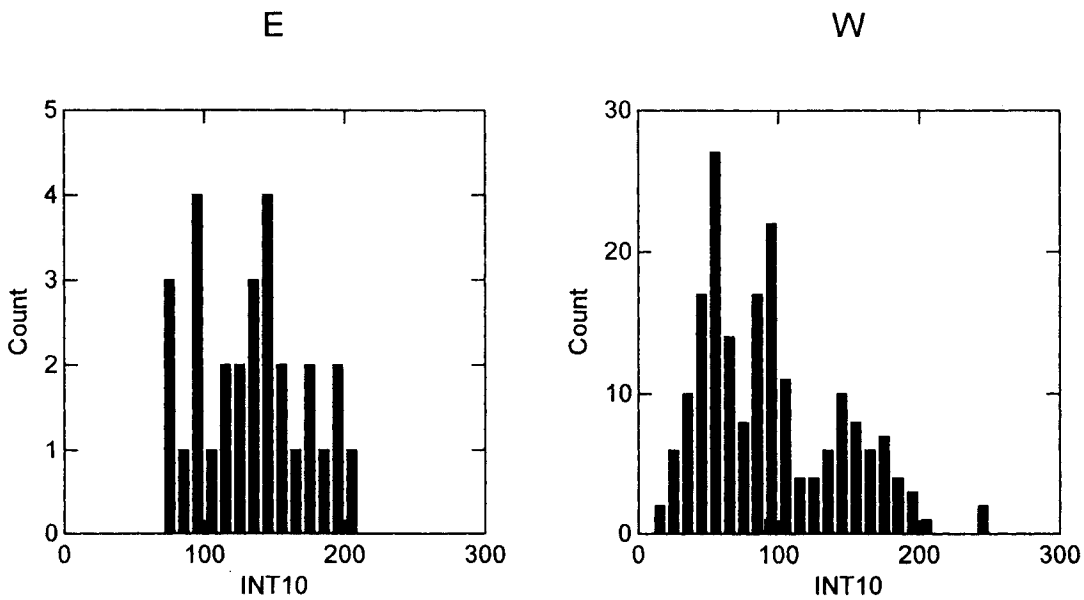

Figure 21. Frequency (COUNT) distribution of decade intervals (INT10) between burns west and east of 107°30'W (Fig. 6) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 22.

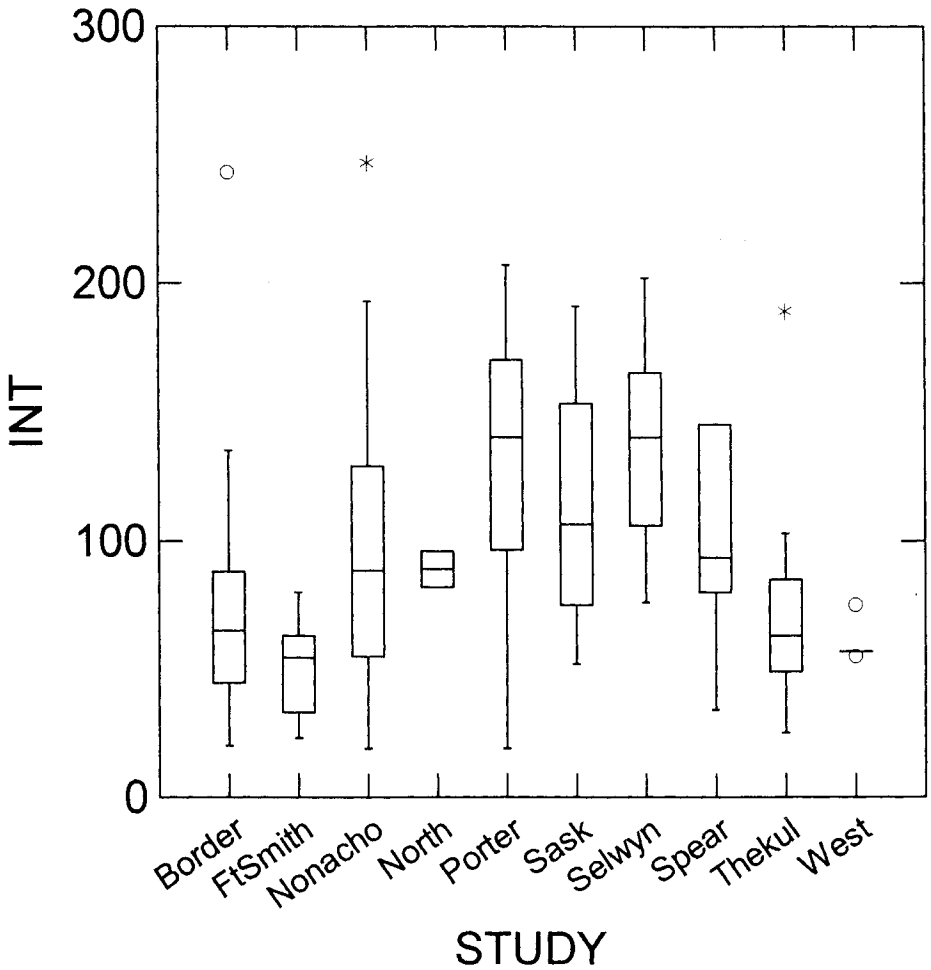

Figure 22. Burn interval (INT) means, standard deviations, and ranges in primary study areas and other areas (Fig. 4) on winter range of the Beverly herd of caribou in Northwest Territories. In this graph and others, symbols "o" and "*" represent outliers.

Figure 23

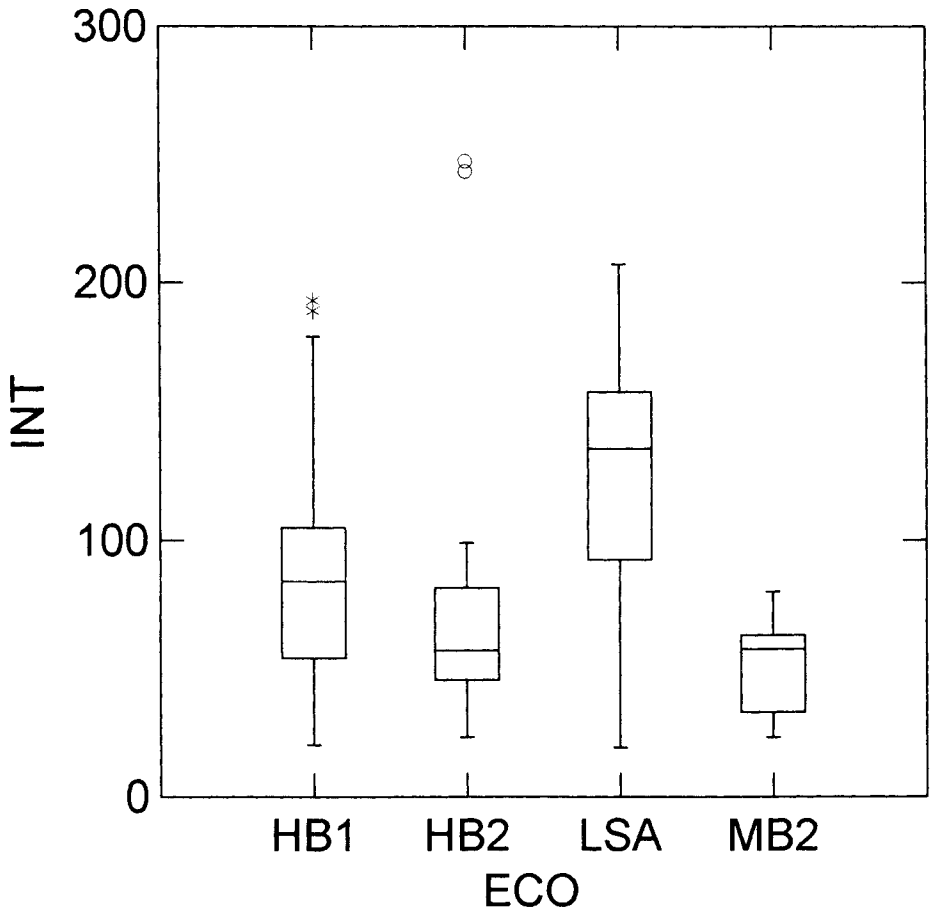

Figure 23. Burn interval (INT) means, standard deviations, and ranges in ecoregions (ECO = Mid Boreal 2, High Boreal 1, High Boreal 2, and Low Subarctic) (Fig. 5) on winter range of the Beverly herd of caribou in Northwest Territories.

Figure 24

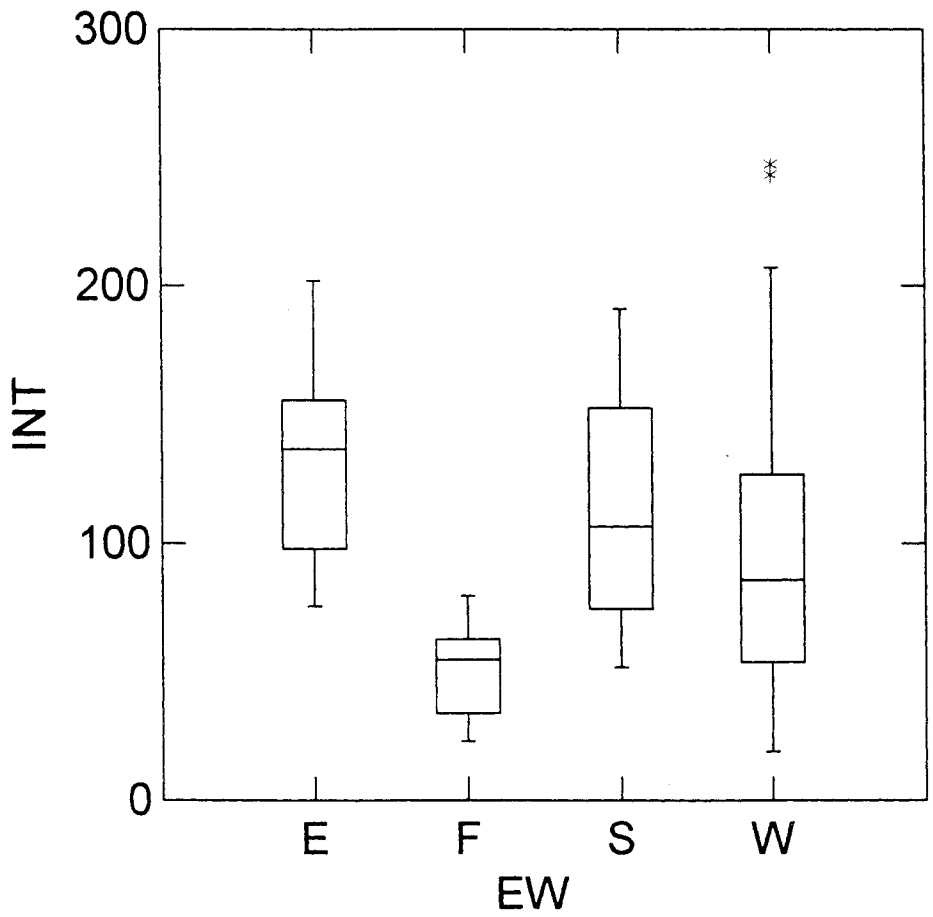

Figure 24. Burn interval (INT) means, standard deviations, and ranges west and east of 107°30'W (Fig. 6), near Ft. Smith (F), and in Saskatchewan (S) on winter range of the Beverly herd of caribou.

Figure 25

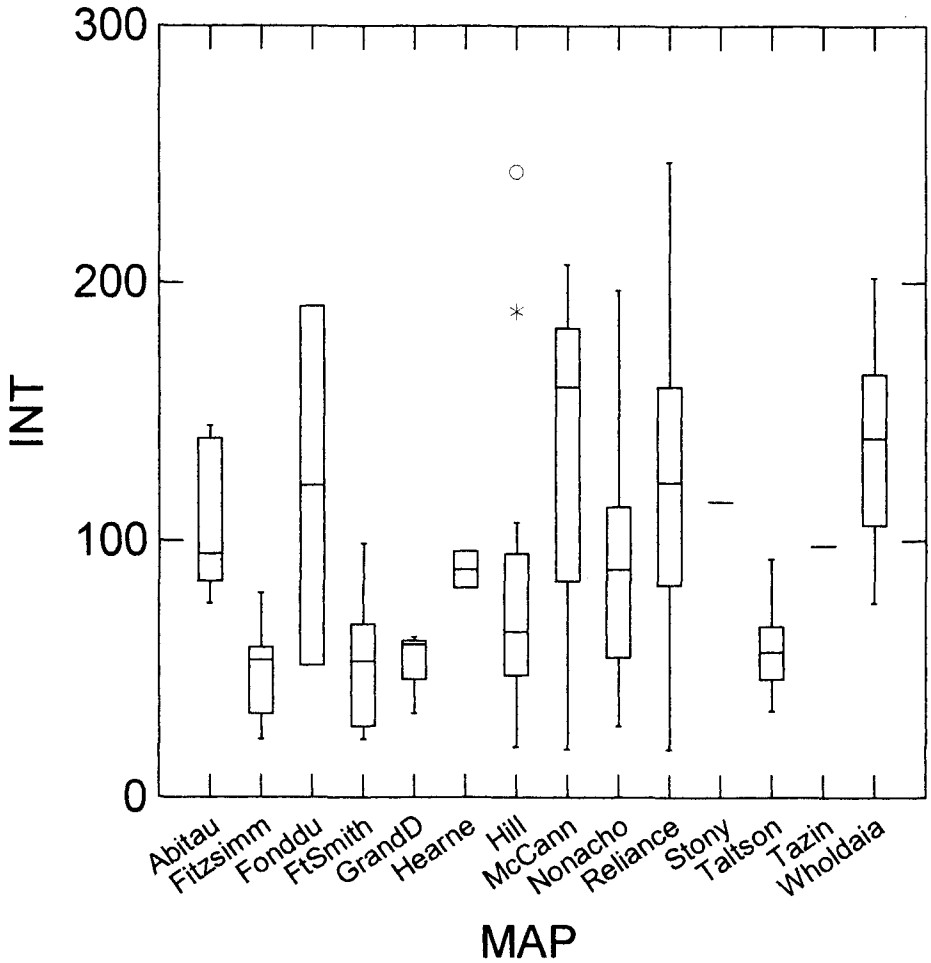

Figure 25. Burn interval (INT) means, standard deviations, and ranges in 1:250 000 map areas (Fig. 3) on winter range of the Beverly herd of caribou.

Table 2. Average interval between burns, average proportion burned annually, and mean distance to forest limits in areas sampled from 1983 through 1986 on winter range of the Beverly herd of caribou.

Region	Burn interval (years) Mean	SD	N	Ave. annual proportion burned (%)	Distance to forest limit (km)
Study areas					
Thekulthili region	69	36	19	1.45	170
Nonacho region	95	39	54	1.05	90
Porter region	137	42	20	0.73	55
Selwyn region	144	34	26	0.69	125
Ecoregions					
Low Subarctic	131	85	39	0.76	79
High Boreal 1	111	70	156	0.90	117
High Boreal 2	102	39	13	0.98	208
Mid Boreal 2	52	19	10	1.92	324
West and East of 107°30'W					
W of 107°30'W	93	117	188	1.08	117
E of 107°30'W	133	37	29	0.75	91

Note: The average annual proportion burned (%) is 1/the mean burn interval.

Average intervals between burns at habitat sites varied from 69 years to 144 years in the four primary study areas (**Table 2, App. 4**). Data were also obtained from other locations scattered throughout the range (**App. 5**). These date were grouped with site data (Table 2) according to map sheet areas in physiographic regions (**Table 3**). Data for fire intervals in other areas (**Table 4**) may indicate trends but sample sizes were small.

Partition by individual map sheet (**Table 5**) also may reveal trends but sample

Table 3. Mean interval between burns and average proportion burned annually in physiographic regions of Northwest Territories (Fig. 4) based on data for map sheets in those regions.

Region	Burn interval (years) Mean	SD	N	Ave. ann. proportion burned (%)
Exposed bedrock zone	**56**	**20.5**	**26**	**1.78**
Fort Smith	55	22.5	14	1.83
Taltson Lake	58	17.6	12	1.71
Thin Till and Exposed bedrock	**95**	**47.7**	**144**	**1.05**
Hill Island L.	78	50.8	21	1.28
Nonacho L.	92	42.8	97	1.08
Reliance/Snowdrift	117	54.2	26	0.85
Moderate and Thick Till	**133**	**42.1**	**46**	**0.78**
Abitau L.	109	28.9	7	0.91
McCann L.	134	58.6	11	0.75
Wholdaia L.	138	34.5	28	0.72

Table 4. Mean interval between burns, average proportion burned annually, and mean distance to forest limits in areas of winter range of the Beverly herd of caribou in Northwest Territories (Fig. 4).

Region[1]	Burn interval (years) Mean	SD	N	Ave. annual proportion burned (%)	Distance to forest limit (km)
Fort Smith[2]	50	17	10	2.00	336
Thekulthili[3]	68	34	21	1.47	182
Border[4]	72	46	23	1.39	227
Nonacho[5]	94	46	106	1.06	93
Spearfish[6]	99	38	6	1.01	128
Porter[7]	127	51	27	0.79	59
Selwyn[8]	138	35	28	0.72	90

[1] See Fig. 4 (Note this is not a 1:250 000 map area).
[2] In and around the town of Fort Smith and south 20 km.
[3] Between about 59°40'N and 60°30'N and between 109°10'W and 110° 50'W.
[4] Between about 60°50'N and 61°20'N and between 106°30'W and 110°40'W.
[5] Between about 60°30'N and 61°10'N and between 108°00'W and 110°40'W.
[6] Between about 61°20'N and 62°30'N and between 107°00'W and 108°30'W.
[7] Between about 61°20'N and 62°30'N and between 107°00'W and 108°40'W.
[8] Between about 59°45'N and 60°45'N and between 102°00'W and 106°30'W.

Table 5. Mean interval between burns, average proportion burned annually, and mean distance to forest limits in map areas of winter range of caribou in Northwest Territories.

Map sheet	Burn interval (years) Mean	SD	N	Ave. ann. proportion burned (%)	Distance to forest limit (km)
Fitzsimmons	49	19	7	2.04	336
Fort Smith	55	23	14	1.82	236
Taltson L.	58	18	12	1.72	178
Hill Island L.	78	51	21	1.28	207
Nonacho L.	92	43	97	1.09	95
Abitau L.	109	29	7	0.92	129
Reliance	117	54	26	0.85	66
McCann L.	134	59	11	0.75	50
Wholdaia L.	138	35	28	0.72	90
All	96	49	232	1.04	125

sizes are too small for some map areas to produce reliable results.

Fire intervals relative to distance to forest limit

Plots of mean fire interval with distance to forest limit for the primary study areas and Ft. Smith, Border, Spearfish, and West (Taltson and Hearne map areas) (**Fig. 26**), and for 1:250 000 map areas where *n* >10 (**Fig. 27**), produced negative exponential-like relationships. Plots of fire intervals and distance to forest limit for all data produced a similar distribution of points (**Fig. 28**).

Fire history maps

Fire history color coded to decade (1980s, 1970s) and longer (1950s & 60s, 1930s & 40s) age classes was compiled on 1:250 000 base maps and summarized on 1:1 000 000 scale maps. Sets of maps at both scales were provided to each jurisdiction and to each community encompassing their sphere of influence. Copies of the 1:1 000 000 maps were provided to each jurisdiction and to each community by the Beverly and Qamanirjuaq Caribou Management Board. Burns were summarized by decade class and longer in reports of the Beverly and Qamanirjuaq Caribou Management Board (1994a & b). Maps in those publications also showed composite priority zones for caribou hunting provided by the communities (Dantouzie 1991, 1992) and fire cycle zones of three lengths. The base maps at scale 1:250 000 were digitized by the Centre for Remote Sensing in Yellowknife.

Figure 26

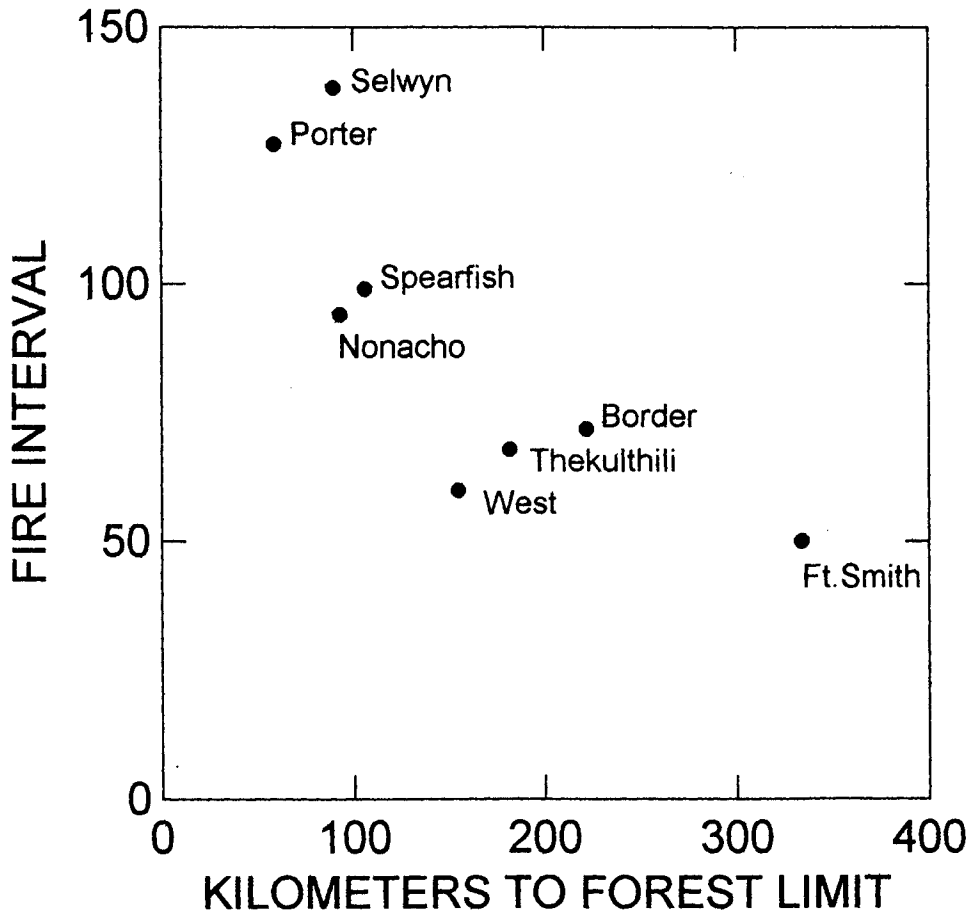

Figure 26. Relationship between mean distance from forest limit and mean interval between fires in primary study areas and at four other areas (Ft. Smith, Border, Spearfish, and "West") on winter range of the Beverly herd of caribou.

Figure 27

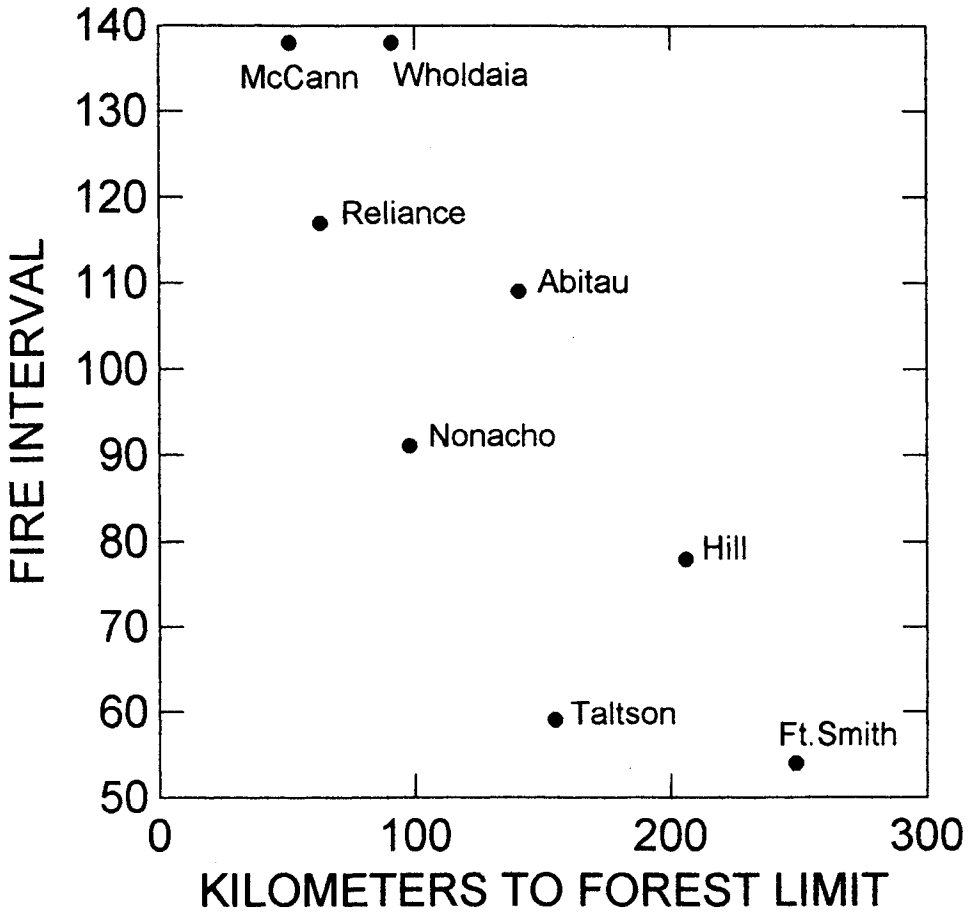

Figure 27. Relationship between mean distance from forest limits and mean interval between fires in 1:250 000 map areas (Fig. 3) on winter range of the Beverly herd of caribou.

Figure 28.

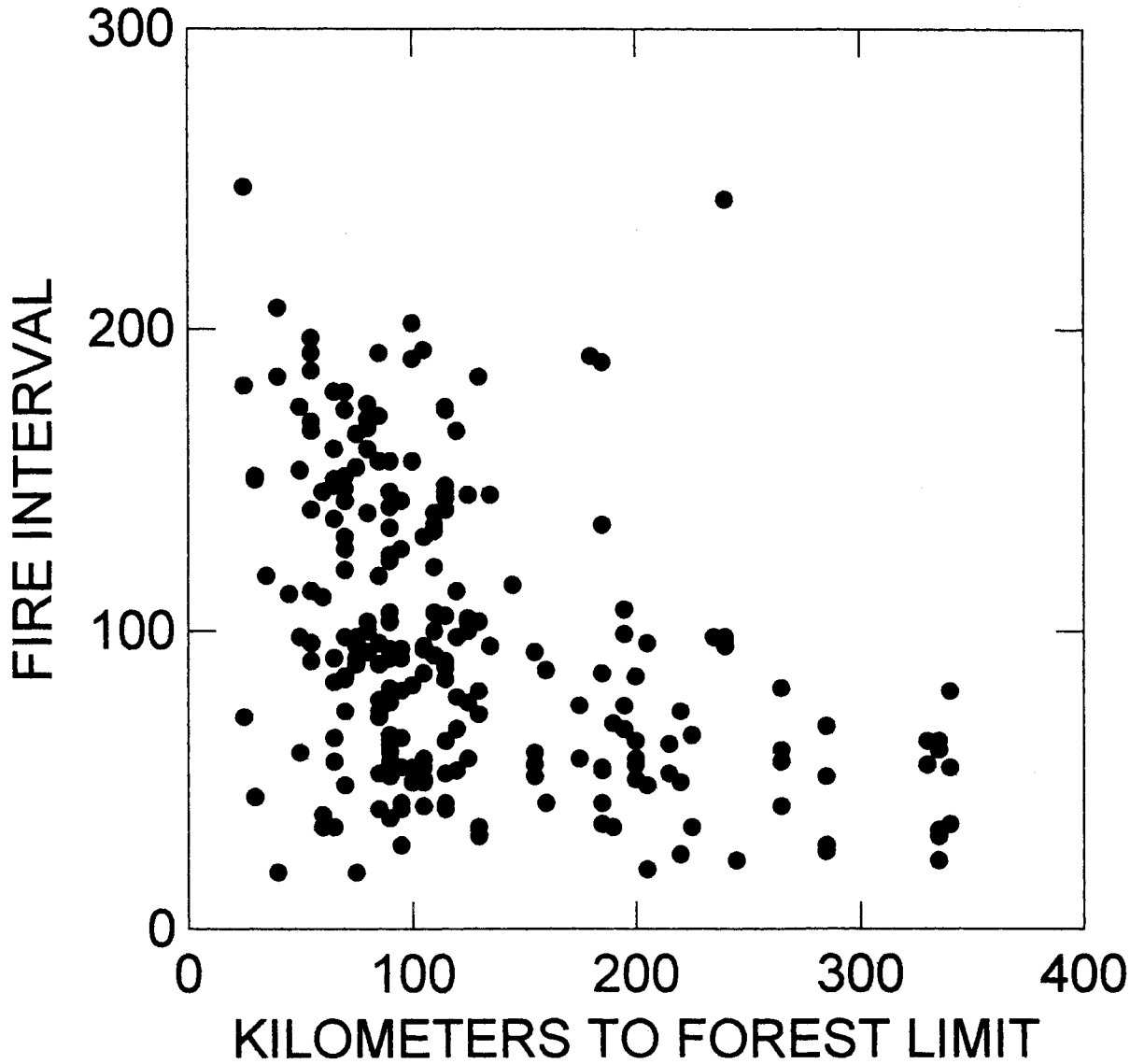

Figure 28. Relationship between distance from forest limits and interval between fires at all sites on winter range of the Beverly herd of caribou.

Burn mapping

Good imagery for differentiating burns of various ages up to about 50 years was summer multispectral (mss) imagery from ERTS 1 and 2 and LANDSAT 1-3, bands 4, 5, and 7. Bands 4, 5, and 7 perhaps were slightly superior to bands 5, 6, and 7 but either combination was satisfactory. Similar results are expected from mss bands 2, 3, and 4 of LANDSAT 5.

The LANDSAT 5 thematic mapper (TM) imagery with enhancement was the best product for mapping burns from imagery obtained in summer. The best enhancement seemed to vary among images. For example, with histogram enhancement a 40 year-old burn was clearly visible on one image but virtually undetectable on an overlapping image. Histogram enhancement was particularly effective with some images but not with others. Type of enhancement is usually left to image technicians at the production facility in Prince Albert (now Richmond, B.C.). Imagery produced from TM bands 4, 5, and 6 was inferior and permitted mapping of only relatively recent burns, ca. 10-20 years.

Single band scenes obtained in summer from LANDSAT 1-3 typically enabled mapping only of recent (1-10 yr) burns. Order of usefulness was bands 7 (near-infrared), 6, and 5, although there were marginal differences between the last two visible-spectrum bands. In some cases, fires that burned only 3-5 years earlier were difficult to detect on single-band images. Such images are not recommended unless the objective is only an annual update of burned areas.

In contrast, single-band images of winter (November-March) scenes were exceedingly useful in mapping burns of all ages. Such images were relatively cheap

and burn boundaries are distinct. The imagery was used to estimate ages of burns by comparing their tone to that of adjacent burns of known age. Relative proportions of forest cover and snow appeared as shades of grey ranging from slight tone at 20-30 years post fire to dark tones for old forests. Recent burns appeared as essentially white areas and their age is not discernible. If mapping is done annually, any new white areas obviously are new burns. Even without burns of known age, it is possible to map old burns and place moderate-toned areas into age classes of say 25-50 years, 51-100 years, and >100 years. Actual ages should then be obtained by ground surveys.

Assignment of ages by monochrome tone is justified only where there are forests of known ages in the vicinity of forests of unknown age. Spruce, mixed spruce and pine, and pine forests have different tones at equal ages. Furthermore, stand density affects tone in an image. Lowland areas with a sparse cover of spruce have a lighter tone than adjacent upland areas. Monochromatic scenes provide an index of forest ages over broad areas where there is little information on stand ages. Most forests that are old enough to produce caribou forage can be identified by their darker tone. Those areas can be mapped and their proportions calculated in a selected area such as a 1:250 000 map area. The focus is therefore shifted from recent fire history to ages old enough to produce productive caribou winter range.

Age 50 years post fire is a reasonable dividing line between non-productive and productive caribou winter range. Dark tones appear on the shadow side of hills because of a low sun angle in winter. These tones should not be confused with old forests if attention is paid to contour lines and watersheds.

Burn history statistics

Areas known or estimated to have burned from about 1940 through 1989 in caribou range in NWT, Manitoba, Saskatchewan, and Alberta (**Tables 6 & 7**) were based on calculated amount of forested caribou range in each map area. Total area considered to be caribou range and total area less large (>10 km^2) lakes (**App. 6 & 7**) were calculated for each 1:250 000 scale map sheet. Calculated average annual proportions burned (large lakes excluded) and the reciprocal, the fire cycle (**Fig. 29**), were based on digitizing peripheries of burns whose ages were known or whose estimated ages were younger than 50 years. Those data yield *gross fire cycles.* Assuming 15% unburned inclusions, the effective or *net fire cycle* was calculated (Tables 6 & 7). The GIS in Yellowknife may be able to make these calculations and temporal changes in fire cycles once detailed lake data are available or a model is added to account for the water component.

A subtraction of areas of small lakes (App. 6 & 7 and Thomas et al. 1998, Table 29) provides an approximation of land (non-water) surface available to caribou. Data in **Appendix 8** is for average annual proportions burned 1940 - 1983 based on constant-interval spot samples on systematic aerial transects. It was stratified for land area excluding all water and including small lakes. Fire cycles (gross and net) based on fire history, 1940 - 1989 (Table 6), and on spot sampling of burns 1940 - 1983 (App. 8) are compared in **Table 8**.

Table 6. Areas and proportions of winter range (within "tree line") of the Beverly herd of caribou in the Northwest Territories that was burned from about 1940 through 1989, and calculated fire cycles by 1:250 000 map areas. These data are based on burn mapping and are more reliable than data in Table 5.

	Area(km^2) or proportion(%)								
1:250 000	Total	Caribou range[2]		Burned 1940-1989			Fire cycle[6]	Adjust. cycle[7]	Km to
Map sheet	area[1]	Total	(%)[3]	area[4]	(%)[5]	Ave.%/yr	(yrs)	(yrs)	for.limit[8]
Fort Smith	12310	9238	75.0	7301	79.0	1.58	63	74	257
Hill Isl. L.	12157	12062	99.2	8282	68.7	1.37	73	86	184
Abitau L.	12203	12203	100.0	1273	10.4	0.21	476	560	112
Wholdaia L.	12127	10729	88.5	2207	20.6	0.41	244	287	89
Snowbird L.	12175	11026	90.6	3712	33.7	0.67	149	176	22
Ennadai L.	12166	7074	58.2	2611	36.9	0.74	135	159	6
Boyd L.	11911	2989	25.1	44	1.5	0.03	3333	3922	0
Rennie L.	11772	5703	48.5	202	3.5	0.07	1429	1681	0
McCann L.	11789	9644	81.8	1933	20.0	0.40	250	294	28
Nonacho L.	11791	11017	93.4	3498	31.8	0.64	156	184	106
Taltson L.	11823	11115	94.0	7200	64.8	1.30	77	90	168
Ft. Resolut.	11772	3730	31.7	1417	38.0	0.76	132	155	196
Hearne L.	11422	5669	49.6	672	11.9	0.24	417	490	95
Snowdrift	11410	7115	62.4	1472	20.7	0.41	244	287	67
Reliance	11378	8991	79.0	1551	17.3	0.35	286	336	17
Lynx L.	11390	643	5.7	64	10.0	0.20	500	588	0
Walmsley L.	11048	1059	9.6	137	12.9	0.26	385	452	0
MacKay L.	11042	1808	16.4	464	25.7	0.51	196	231	0
Carp L.	11053	2745	24.8	587	21.4	0.43	233	274	11

[1] Length of mapped area x width of mapped area at mid-point.
[2] Forested caribou range = total area less large lakes (>10 km^2), tundra, and non-caribou range (outside range boundary).
[3] *100 x forested caribou range/total area.*
[4] Calculated from the sum of burn areas obtained by digitizing all burns.
[5] Percent of potential caribou range.
[6] This is the *gross fire cycle* based on burn periphery mapping.
[7] This is the *net fire cycle* assuming 15% unburned inclusions.
[8] The "*tree line*" or "*limit of trees*" on topographic maps varies from the *"forest limit"* mapped from monochromic images of late winter.

Table 7. Areas and proportions of winter range of the Beverly herd of caribou in Saskatchewan, Alberta, and Manitoba that was burned from about 1940 through 1989, and calculated fire cycles by 1:250 000 map areas.

1:250 000 map sheet	Area(km²) or proportion(%) Total area[1]	Caribou range[2] Total	Caribou range[2] (%)[3]	Burned 1940-1989 area[4]	Burned 1940-1989 (%)[5]	Burned 1940-1989 Ave.%/yr	Fire cycle (yrs)[6]	Adjust. cycle (yrs)[7]	Km to for.limit
Saskatchewan									
Tazin L.	12489	6971	55.8	3902	56.0	1.12	89	105	257
Fond-du-Lac	12472	10847	87.0	6633	61.2	1.22	82	96	207
Stony Rapids	12549	11136	88.7	5433	48.8	0.98	102	120	190
Phelps Lake	12371	11134	90.0	4546	40.8	0.82	122	143	145
Wollaston L.	12922	10414	80.6	6299	60.5	1.21	83	97	252
Pasfield L.	12919	12157	94.1	9471	77.9	1.56	64	75	285
Livingstone L.	12925	12631	97.7	9081	71.9	1.44	69	82	324
William R.	12934	12669	98.0	10428	82.3	1.65	61	71	363
Alberta									
Fitzgerald	12457	5200	41.7	3466	66.7	1.33	75	88	347
Ft. Chip.[8]	12987	5274	40.6	5046	95.7	1.91	52	62	425
Manitoba									
Kasmere L.	12544	12114	96.6	5306	43.8	0.88	114	134	129
Whiskey J. L.	12919	12436	96.3	6881	55.3	1.11	90	106	196

[1] Length of mapped area x width of mapped area (at mid-points of map).
[2] Forested winter range = total area less large lakes (>10 km²), tundra, and non-caribou range (outside "*usual-range*" boundary).
[3] 100 x forested caribou range/total area.
[4] Burn areas obtained by digitizing burn peripheries.
[5] Percentage potential caribou range.
[6] This is the *gross fire cycle* based on burn periphery mapping.
[7] This is the *net fire cycle* assuming 15% unburned inclusions.
[8] Includes upland area south of Athabasca Delta and Lake.

Figure 29

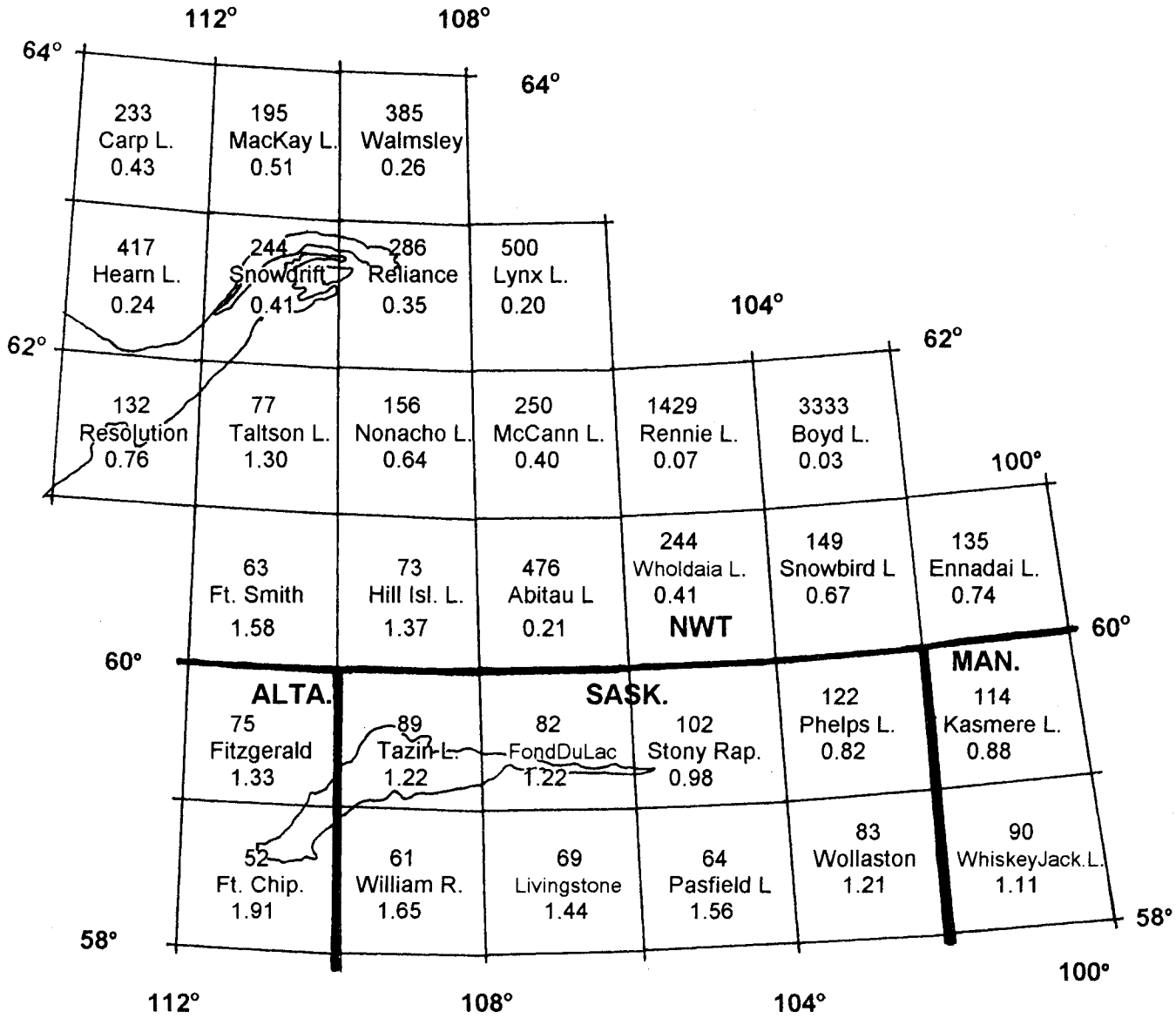

Figure 29. Average mean interval between burns in years (fire cycle) (above map name) and calculated mean average annual rate of burning (below name) in 1:250 000 map areas in forested winter range of the Beverly herd of caribou.

Table 8. Average annual proportion burned (AAPB as %) and fire cycle lengths in 1:250 000 map areas based on frequency of occurrence of burns, 1944 -1983, and burn history, 1940-1989.

1:250 000	Frequency of occurrence[1]		Burn history, 1940-1989[2]		
map area	AAPB	Fire cycle (yr)[3]	AAPB	Fire cycle (yr)[4]	Adj. cycle[5]
Fort Smith	1.04	96	1.58	63	74
Hill Island L.	0.84	119	1.37	73	86
Taltson L.	0.93	108	1.30	77	90
Snowbird L.	0.30	333	0.67	149	176
Nonacho L.	0.43	233	0.64	156	184
Wholdaia L.	0.39	256	0.41	244	287
McCann L.	0.28	357	0.40	250	294
Snowdrift/Reliance	0.42	238	0.38	266	313
Abitau L.	0.14	714	0.21	476	560
Rennie L.	0.01[6]	1429	0.07	1429	1681

[1] Constant-interval, spot sampling on systematic aerial surveys.
[2] Digitized areas of all burns, 1940-1989, relative to total caribou range excluding lakes >10 km^2 (Table 6).
[3] *Fire cycle* = 1/average annual proportion burned.
[4] *Gross fire cycle* based on burn-periphery mapping.
[5] *Net fire cycle* assumes average of 15% unburned inclusions in burns.
[6] Rounded from 0.007%.

The proportion of small lakes inside burns would be less than outside because most burns have small lakes at locations along their periphery. Most feeding is in upland areas that usually comprise 50 - 80% of non-water landscape. For example, uplands comprised 47% of the total landscape and 52% of the non-water landscape in the Whiskey Jack Lake map area in northwestern Manitoba (Miller 1976).

Fire cycle relative to distance from forest limit

Gross fire cycle length was regressed against distance from forest limits to the centre of each map sheet in NWT (**Fig. 30**), the provinces (**Fig. 31**) , and for combined data (**Fig. 32**). In NWT, the relationship generally was linear with the exception of Abitau and Hearne lakes (Fig. 30). Data were highly variable within 120 km of forest limits. Data for the provinces, where distances from forest limits are all greater than 120 km, were strongly linear (Fig. 31). Combined data yielded a negative exponential curve (Fig. 31).

DISCUSSION

Tree annulations at 25-30 cm above the ground relative to stand age

The addition of 5 years to the number of annulations in pine cut at 25-30 cm above ground level is appropriate if disks are cut from only 2 or 3 trees of each species at a site. Most pine start to grow in the summer following fire. Many are 1-3 cm tall at the end of the second summer. In the fourth summer, some pine in a hectare area are 25-40 cm tall.

Spruce regenerate at any time after fire. At 4 years after fire, few trees in a

Figure 30

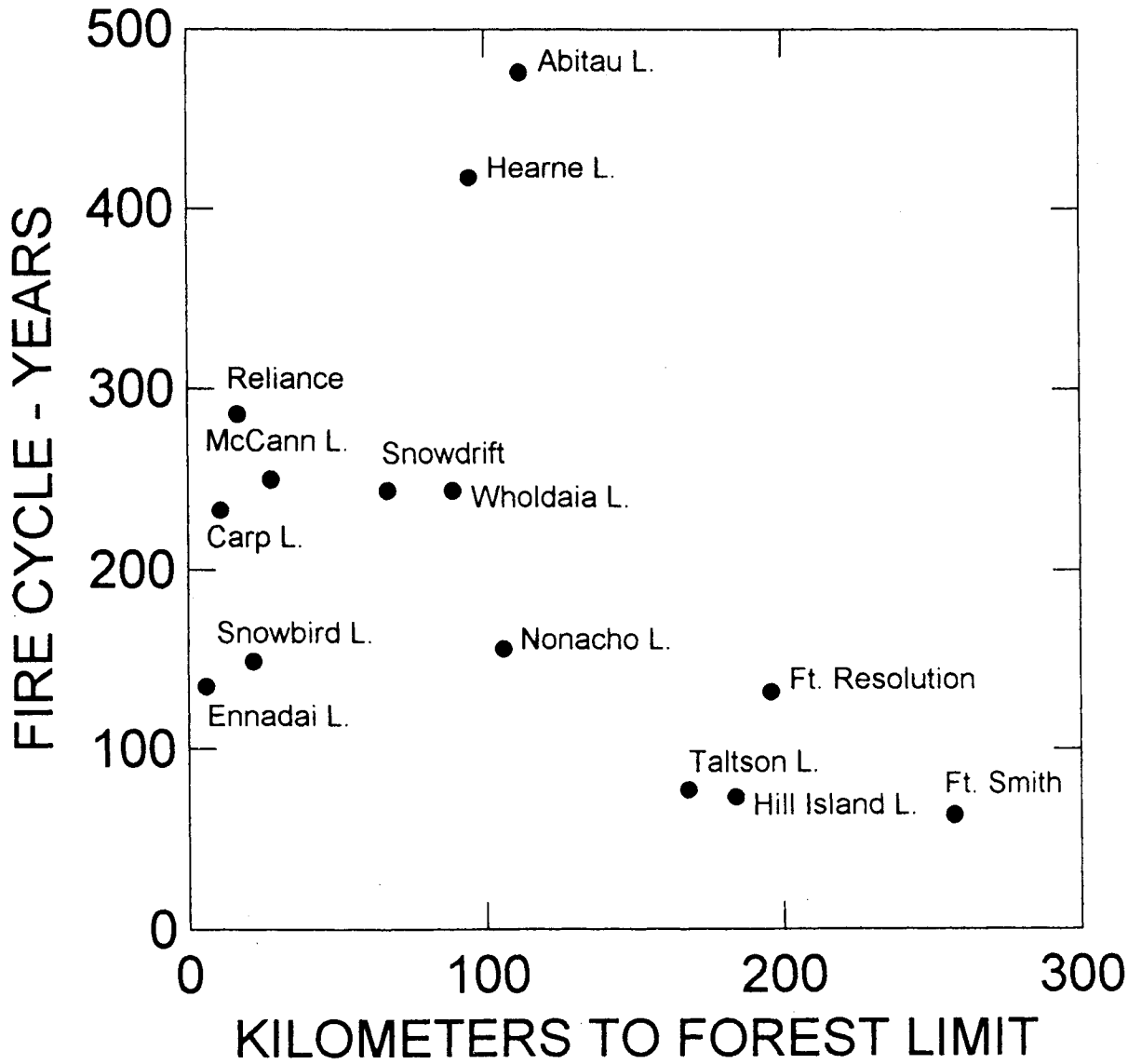

Figure 30. Relationship between gross fire cycle length and distance to forest limits for 1:250 000 map areas in Northwest Territories based on burn history 1940-1989.

Figure 31

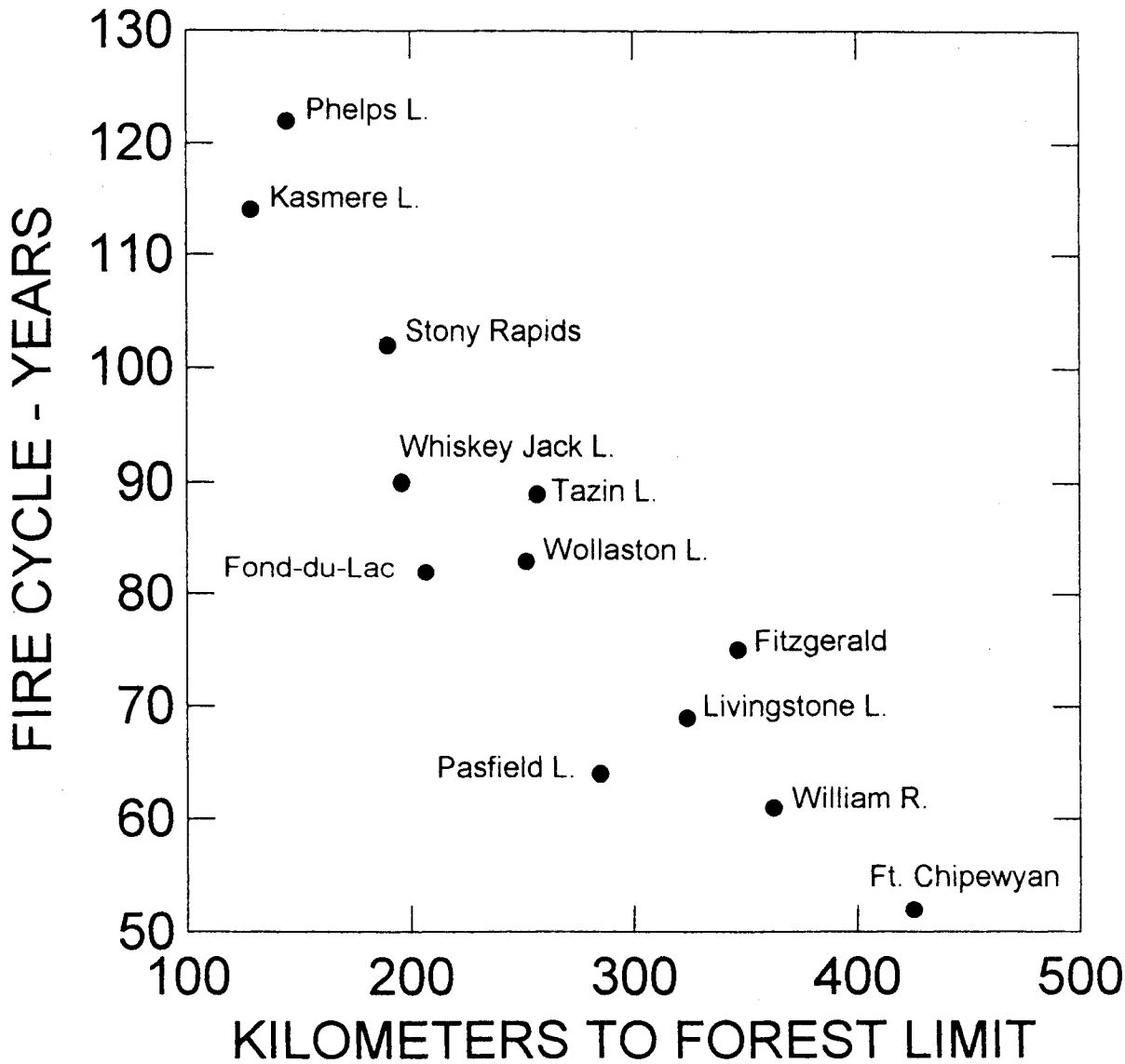

Figure 31. Relationship between gross fire cycle length and distance to forest limits >120 km for 1:250 000 map areas in Manitoba, Saskatchewan, and Alberta based on burn history 1940-1989.

Figure 32

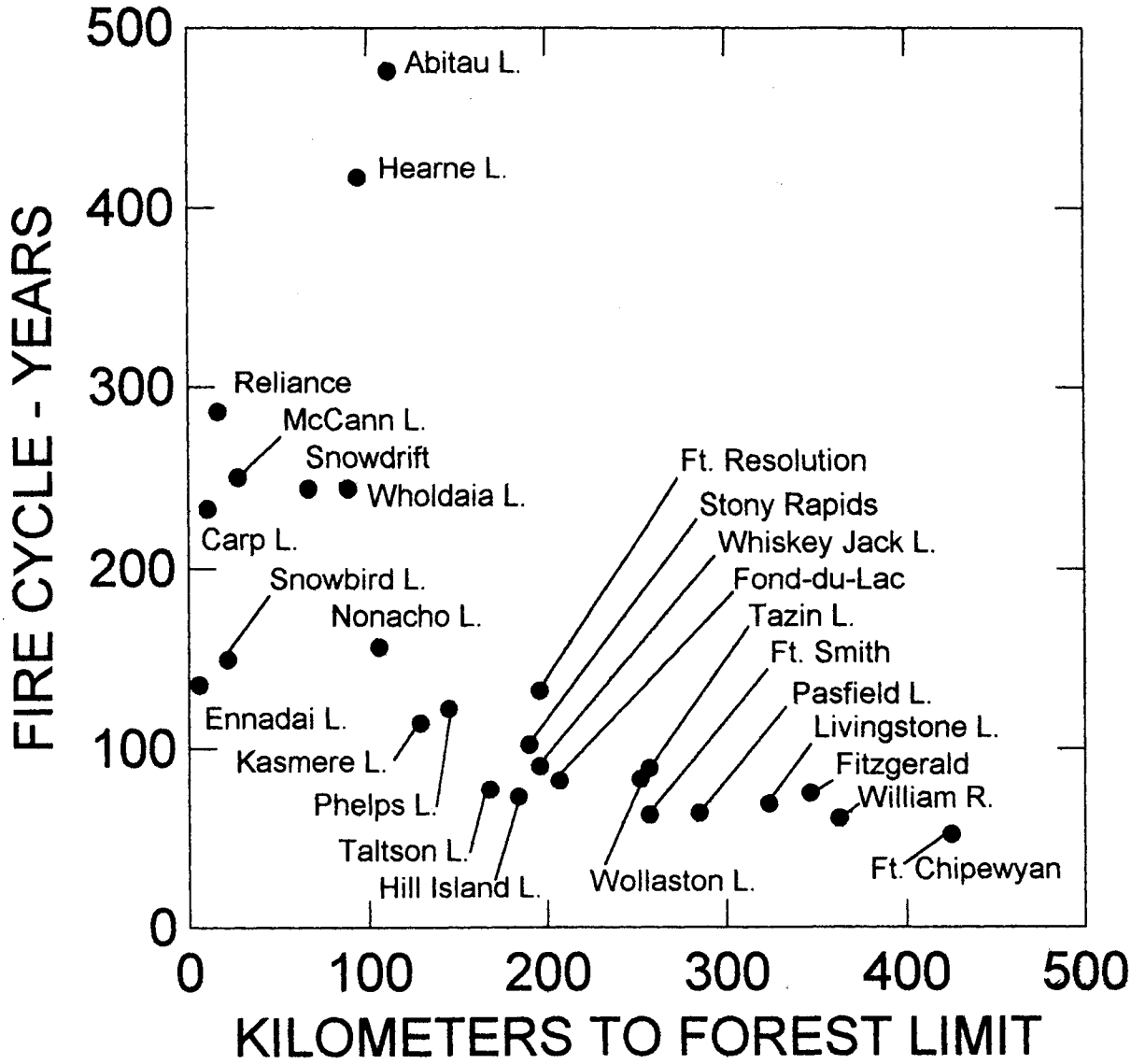

Figure 32. Relationship between gross fire cycle length and distance to forest limits for 1:250 000 map areas in Northwest Territories, Manitoba, Saskatchewan, and Alberta based on burn history 1940-1989.

hectare are 25-40 cm tall and they tend to have clumped distributions. It would be appropriate to add 5 years to numbers of annulations at 25-30 cm in young stands if a large area was searched for the tallest and oldest trees. In old stands, it is appropriate to add 10 years because early-regeneration trees are unlikely to be cut.

Burn intervals and fire cycles

Data on burn intervals (Tables 4 & 5) yields shorter fire cycles than by the areal rate of burning in the past 50 years (Tables 6 & 7). For example, in the Nonacho Lake map area, mean fire interval was 92 years versus 156 based on burn history. Similarly, in the Wholdaia Lake map area, corresponding values were 138 and 244 years. Frequency of occurrence data, based on constant-interval spot samples on aerial transects, produces the longest fire cycles (Table 8). Why do these differences occur and what data are most reliable?

Differences in fire cycles with technique are caused by use of different time periods and sampling biases. First, the fire cycle appears to have shortened since 1939. High proportions burned since about 1969 and particularly in 1979, 1980, 1981, and 1989 are atypical in relation to longer periods. Secondly, fire interval data at sites was not random. Burns of an array of ages were selected to record successional trends and to compare vegetation characteristics in burns with adjacent old forest. A bias to shorter intervals occurs when young forests are selected, particularly where fire intervals are long and in periods such as 1970 through 1989 when an unusually high proportion of the landscape burned.

Frequency of occurrence data yields longer fire cycles than burn history data

because unburned inclusions are sampled whereas burn history is based on burn periphery mapping. Secondly, burn history data included 1989 burns, which were extensive in eastern parts of winter range. It is not known if sample size were adequate in spot sampling or if burn ages were estimated accurately from aircraft. The best data for 1940-1989 are burn history where net fire cycles were calculated from gross fire cycles (Tables 6 & 7). Mychasiw (1983) found that water and unburned inclusions averaged 25% of 19 burns in Fort Smith, Hill Island Lake, Taltson Lake, and Nonacho Lake map sheets. Small lakes averaged 16% of landscape in those areas (App. 6). Since lake area is less inside burns than outside, we conclude that area of unburned inclusions accounted for about 15% of those burns.

Long-term (100-200 year) burn cycles likely were longer than net fire cycles in Tables 6 and 7. Current trends to fire cycles (1970 - 1989) may approximate gross fire cycles.

Fire return intervals of three lengths (<81, 81-140, and >140 years) were estimated in a review (Beverly and Qamanirjuaq Caribou Management Board 1994a) before this analysis. That map accurately reflects gross fire cycle lengths in Figure 29.

Fire history

Extreme care is necessary to distinguish between trees arising from the last fire and from fires before that. Surviving pine trees often are fire scarred but spruce seldom scars. Fire that reaches spruce trunks usually kills it unless there are few low branches to burn as in some old trees. With experience, approximate age of trees can be estimated from several characteristics. These include general form; size;

branch lengths, mortality, pruning; and coloration. For example, spruce older than 100 years have a bulb of small branches at the top and lower branches begin to die. Pine become "scraggly" with age, lower branches self prune, and trees increase in diameter but not in height after 40-60 years.

The approximate age of a forest can be estimated from a distance by several characteristics. Old forests have an irregular skyline whereas young forests, particularly pine forests have a smooth skyline. Green tones of both pine and spruce forests darken with age. Color differences are most obvious under low cloud cover. The darker tone is a result of foliage differences, death and pruning of lower branches, and more black arboreal lichen that progressively becomes more exposed with time particularly in spruce forests.

Burn mapping

Burn maps for winter range of the Beverly herd were digitized in the Remote Sensing Centre in Yellowknife with support of the Beverly and Qamanirjuaq Caribou Management Board. With incorporation of maps in a Geographical Information System (GIS), areas burned in the past 50 years can be calculated quickly and updated. That period is about average recovery time for lichens preferred by caribou.

The Board published burn maps by decade and longer for winter range north of 58°N (Beverly and Qamanirjuaq Caribou Management Board 1994b). Small-scale copies of original burn maps are reproduced in Appendix 8 because data on exact year of burns may be lost in time if mapping in a GIS program is by decade class. Care must be taken to retain a duplicate sets of original maps at scale 1:250 000.

Original maps sent to Yellowknife cannot be found. The burn history for map sheets in Saskatchewan done in the 1950s are missing from a consultant's report.

High costs of multispectral imagery dictates that winter LANDSAT scenes should be used to map burns if burns are not systematically mapped by fire managers visually, photographically, or by geographic positioning systems. The NOOAH satellite composite imagery is another possibility but resolution is poor.

Burn statistics on productive range for caribou

The high average annual burn rate, 1940-1989, for the provinces and southwestern portions of caribou winter range in NWT should not be considered a long-term average. It was caused by an extremely high rate of burning from 1970 through 1989. There likely is a cyclic nature to burning with high rates of burning as forests attain 60-100 years of age in the south and west and >100 years elsewhere. The last extensive burning in the west was around 1911. By the 1970s, those forests were at a stage of high probability of burning. A review of burn statistics reveals high variability among regions and high proportions of areas burned in a few individual years in 50 or 100 years (Beverly and Qamanirjuaq Caribou Management Board 1994b).

Factors that affect the burn cycle

The occurrence of fire is dependent on weather, terrain features, and past distribution and timing of burns. Limits of forest and trees are expressions of climate. Relationships between length of fire cycle, estimated from average annual proportion

burned 1940-1989, and distance to forest limits indicated high variability at distances less than 120 km from forest limits and a linear relationship at greater distances (Fig. 30-32). This relationship may not hold in other regions because areas distant from forest limits were on the Athabasca Sandstone Formation where fire cycles are short.

Overall, a negative exponential curve fits the data (Fig. 32) with high variability within 120 km of forest limits and lower variability at greater distances. Perusal of 1:1 000 000 burn maps reveals a central "green zone" in NWT extending from the Abitau Lake map area to the northeast to include eastern portions of the McCann Lake map area, northwestern portions of the Wholdaia Lake map area, and the Rennie Lake map area. Why this area has such a long fire cycle is unknown. The forest limit and limit of trees dips southward in that region implicating climatic factors. The area is northeast of Lake Athabasca, which may have a cooling effect in summer via southerly winds. However, the area north of Lake Athabasca in Saskatchewan has relatively short, gross fire cycles (Tazin Lake - 89 years, Fond-du-Lac - 82 years) based on 1940-1989 data.

The physiography of the green zone is an important factor. This area of deep till is characterized by large drumlinoid ridges with wetlands between them (Bradley et al. 1982). When fire starts in the spruce forest, it is likely to be confined to the ridge unless winds carry burning cones to the next ridge or fire traverses intervening wetland that are relatively dry.

The other anomaly, Hearne Lake map area (Fig. 32), is northeast of Great Slave Lake. Large expanses of forests there appear to be 50-100 years old (since fire) implicating burn history as an important variable. That is, the 50 years of fire history

used in the analysis is too short, with biased results. Further, few ground checks were obtained there and burn history may be unreliable.

Data for fire intervals and distance of sites from forest limits in study areas also produced a negative exponential distribution (Fig. 25), whereas data for 1:250 000 map areas was linear (Fig. 26). However, a scatter plot graph of all 484 sites revealed a negative exponential form (Fig. 28).

In summary, the timing and distribution of burns in taiga winter range of the Beverly herd of caribou is a result of a complex of factors (variables) including climate (temperature, precipitation, wind, humidity, frequency of lightening, etc.), and terrain features (till, soil, wetlands, lakes, rivers, etc). Previous burn history is a factor where the burn cycle is calculated on data for short periods - up to 50 years or more. Climate, primarily summer length and temperature, determines forest limits and therefore distance from forest limit is correlated with fire regime. Superimposed on this pattern are difference in precipitation from west to east and location of air masses, Arctic and Pacific, which influence occurrence of lightening (Rowe et al. 1975, Johnson and Rowe 1975).

CONCLUSIONS

1. Fire return intervals vary in length from about 50 years to 300-500 years or longer across winter range of the Beverly herd and therefore they must be calculated for local areas or within 1:250 000 map sheets or within ecodistricts.

2. Fire interval is related to distance from forest limits by a negative-exponential type of distribution with a curvilinear and highly variable component within 120 km of forest limits and a more linear relationship at greater distances.

3. Fire return intervals primarily are "driven" by climate/weather and terrain features such as presence and thickness of till and proportion and distribution of wetlands and secondarily by previous burn history.

4. Deeper snow in the eastern half of the winter range of the Beverly herd may account for some of the variation in fire return intervals.

5. Tree composition and other vegetation is a reflection of the regional fire regime, which in turn is an expression of a complex of geoclimatic variables (climate, soil, and terrain characteristics).

6. The pattern (distribution in time and space, size, shape) of burns on winter range of caribou herds can easily be analyzed once burn history is incorporated into a GIS system.

7. Fire and caribou managers and caribou resource users must incorporate regional differences in fire cycles in their management goals and objectives and in explanations of past burn patterns and caribou distributions.

LITERATURE CITED

Banfield, A.W.F. 1954. Preliminary investigation of the barren-ground caribou, Part 1. Former and present distribution, migrations, and status. Can. Wildl. Serv., Wildl. Manage. Bull. Ser. 1, No. 10A. 79pp.

Beverly and Qamanirjuaq Caribou Management Board. 1994a. A review of fire management on forested range of the Beverly and Qamanirjuaq herds of caribou herds. Technical Report 1. The Secretariat, 3565 Revelstoke Drive, Ottawa K1V 7B8. 64pp.

Beverly and Qamanirjuaq Caribou Management Board. 1993b. Fire management recommendations for forested range of the Beverly and Qamanirjuaq herds of caribou. Management Report 1. The Secretariat, 3565 Revelstoke Drive, Ottawa K1V 7B8. 11pp + map.

Bradley, S.W., J.S. Rowe, and G. Tarnocai. 1982. An ecological land survey of the Lockhart River map area, Northwest Territories. Ecol. Land Classif. Ser., No. 16., Lands Directorate, Environment Canada, Ottawa. 152pp.

Dantouze, J. 1991. Community survey report: Fire-caribou relationship - environment community survey on the winter range of the Beverly and Kaminuriak herd. Contract from Beverly and Kaminuriak Caribou Management Board to Prince Albert Tribal Council, Prince Albert, Sask. Text + Maps (Sask. and Man. communities).

Dantouze, J. 1992. Community survey report: Fire-caribou relationship - environment community survey on the winter range of the Beverly and Kaminuriak herd. Contract from Beverly and Kaminuriak Caribou Management Board to Prince Albert Tribal Council, Prince Albert, Sask. Text + Maps (NWT communities).

Dixon, R.J. 1981. Vegetation mapping the barrenground (sic) caribou winter range in northern Manitoba using LANDSAT. Rep. TR 81-1, Dep. Natural Resources, Winnipeg. 49pp. + maps.

Johnson, E.A. and J.S. Rowe. 1975. Fire in the subarctic wintering ground of the Beverley (sic) caribou herd. The Am. Midl. Nat. 94:1-14.

Kelsall, J.P. 1960. Co-operative studies of barren-ground caribou, 1957-58. Can. Wildl. Ser., Wildl. Manage. Bull., Ser. 1, No. 15. 145pp.

Kelsall, J.P. 1968. The migratory barren-ground caribou in Canada. Can. Wildl. Serv. Monogr. 3. Queen's Printer, Ottawa. 339pp.

Miller, D.R. 1976. Biology of the Kaminuriak population of barren-ground caribou. Part 3: Taiga winter range relationships and diet. Can. Wildl. Serv. Rep. Ser. 36. 41pp.

Moore, W.C. n.d. Mapping of burned forest land in the Northwest Territories. Unpubl. Rep. Northern Forestry Centre, Can. For. Serv., Edmonton. 17pp.

Mychasiw, L. 1983. Comparison of forest fire mapping results from aerial reconnaissance and from LANDSAT imagery. Unpubl. N.W.T. Wildl. Serv. Rep. 24pp.

Rowe, J.S., D. Spittlehouse, E. Johnson, and M. Jasieniuk. 1975. Fire studies in the Upper Mackenzie Valley and adjacent Precambrian Uplands. ALUR Rep. 1974-75-61, Dep. Ind. & Nor. Affairs, Ottawa. 128pp.

Saskatchewan Power Corporation 1987. Uranium City-Rabbit Lake 115 kv transmission line. Vol. 111: Wildlife Resources, App. B: Wildlife resources impact assessment, mammals. 91pp. (Sask. Power Corp. 2025 Victoria Ave., Regina, Sask. S4P 0S1).

Scotter, G.W. 1964. Effects of forest fires on the winter range of barren-ground caribou in northern Saskatchewan. Can. Wildl. Serv. Wildl. Manage. Bull. Ser. 1, No. 18. 111pp.

Thomas, D.C., H.P.L. Kiliaan, and T.W.P. Trottier. 1998. Fire-caribou relationships: (III) Movement patterns of the Beverly herd in relation to burns and snow. Tech. Rep. Series No. 311. Can. Wildl. Serv., Prairie & Northern Reg., Edmonton, Alberta. 176pp.

Appendix 1. ERTS[1] and LANDSAT[2] images used to map fire history of winter range of the Beverly herd of caribou.

Satellite Track	Satellite Row	Date (YrMoDa)	Band	Product	Location Lake/River	Location Lat.N,	Location Long.W
ERTS 1 and 2							
40	17	73 09 06	6	B/W print	Hicks	61 20	100 25
40	17	73 09 06	7	B/W print			
40	17	73 09 06	567	Color trans.			
40	18	73 09 06	6	B/W print	Tier	59 50	101 25
40	18	73 09 06	567	Color trans			
40	19	72 08 22	6	B/W print	Kingsley	58 30	102 25
40	19	73 09 06	567	Color trans.			
40	19	73 09 07	7	B/W print			
41	17	73 06 09	6	B/W print	Ennadai	61 20	101 30
41	17	73 06 09	7	B/W print			
41	19	73 09 07	7	B/W print	Hatchet	58 30	103 40
42	17	73 10 01	6	B/W print	Arno	61 20	103 00
42	17	76 03 14	5	B/W print			
42	18	73 07 21	567	Color trans.	Selwyn	59 50	104 05
42	18	73 10 01	7	B/W print			
42	18	74 10 27	5	B/W trans.			
42	18	76 03 14	5	B/W print			
42	19	73 06 28	6	B/W print	Pasfield	58 30	105 05
42	19	76 03 14	5	B/W print			
43	17	73 07 17	567	Color trans.	Firedrake	61 20	104 20
43	18	77 03 19	5	B/W print	Dodge	59 50	105 35
43	19	73 07 17	567	Color trans.	Pine	58 30	106 30
43	19	73 08 22	6	B/W print			
43	19	73 08 22	567	Color trans.			
43	19	73 09 09	567	Color trans.			
43	19	75 03 21	5	B/W print			
43	19	77 03 19	5	B/W print			
43	20	73 09 09	567	Color trans.	SW Cree L	57 05	105 00
44	16	73 05 25	7	Color trans.	Thelon R.	62 30	104 50
44	16	73 06 30	7	B/W print			
44	16	73 08 23	567	Color trans.			
44	17	73 08 23	567	Color trans.	Coventry	61 20	105 55
44	17	73 11 03	6	B/W print			
44	17	73 11 03	567	Color trans.			
44	17	76 02 27	5	B/W print			
44	18	73 05 25	7	B/W print	Picea	59 50	106 55
44	18	73 05 25	567	Color trans.			
44	18	73 06 30	6	B/W print			
44	18	73 08 25	567	Color trans.			
44	18	73 08 23	567	Color trans.			
44	18	73 08 23	6	B/W print			

(continued next page) ...

Appendix 1 (ctd).

Satellite Track	Row	Date (YrMoDa)	Band	Product	Location Lake/River	Lat.N	Long.W
ERTS 1 and 2							
44	18	73 08 23	7	B/W print	Picea	59 50	106 55
44	18	73 09 28	7	B/W print			
44	18	73 09 28	567	Color trans.			
44	18	73 10 16	6	B/W print			
44	18	73 10 16	7	B/W print			
44	18	73 10 16	567	Color trans.			
44	18	76 02 27	5	B/W print			
44	19	76 02 27	5	B/W print	Snow	58 30	108 00
45	18	73 06 13	6	B/W print	Ena	59 50	108 20
45	18	73 06 13	7	B/W print			
45	18	76 04 04	5	B/W print			
46	16	73 05 25	567	Color trans.	Tent	62 30	107 45
46	16	73 05 25	6	B/W print			
46	16	73 08 23	7	B/W print			
46	16	77 02 03	5	B/W print			
46	17	73 11 05	567	Color trans.	Halliday	61 20	108 45
46	17	73 11 05	6	B/W print			
46	17	73 11 05	6	B/W print			
46	17	76 04 05	5	B/W print			
46	17	77 03 04	5	B/W print			
46	17	81 05 30	7	B/W trans.			
46	17	81 05 30	4	B/W print			
46	17	81 05 30	457	Color trans.			
46	18	73 04 21	6	B/W print	Tazin	59 50	109 50
46	18	73 11 05	6	B/W print			
46	18	73 11 05	7	B/W print			
46	18	77 03 04	5	B/W print			
46	18	81 05 31	7	B/W trans.			
46	18	81 05 31	4	B/W print			
46	18	81 05 31	457	Color trans.			
46	19	73 11 05	7	B/W print	Ft. Chip.	58 30	110 50
47	15	73 08 08	567	Color trans.	Clinton C.	63 55	107 45
47	15	73 09 13	567	Color trans.			
47	16	73 06 15	7	B/W print	Reliance	62 30	109 00
47	16	73 09 13	567	Color trans.			
47	16	77 03 05	5	B/W print			
47	17	73 08 08	567	Color trans.	MacInnis	61 20	110 05
47	17	73 09 13	6	B/W print			
47	17	73 09 13	7	B/W print.			
47	17	73 10 10	6	B/W print			
47	17	77 03 05	5	B/W print			
47	17	77 03 19	5	B/W print			

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Appendix 1 (ctd.).

Satellite Track	Row	Date (YrMoDa)	Band	Product	Location Lake/River	Lat.N	Long.W
ERTS 1 and 2							
47	17	81 05 31	7	B/W trans.	Manchester	61 20	107 20
47	17	81 05 31	4	B/W print			
47	17	81 05 31	457	Color trans.			
47	18	73 05 31	567	Color trans.	Leland	59 50	111 10
47	18	73 07 21	567	Color trans.			
47	18	73 07 21	6	B/W print			
47	18	73 07 21	7	B/W print			
47	18	73 10 10	7	B/W print			
47	18	77 03 05	5	B/W print			
47	18	81 05 31	7	B/W trans.			
47	18	81 05 31	457	Color trans.			
48	15	73 09 14	567	Color trans.	Buck	63 55	109 20
48	15	73 10 02	567	Color trans.			
48	16	73 06 15	7	B/W print	Snowdrift	62 30	110 25
48	16	73 08 27	567	Color trans.			
48	16	73 09 14	7	B/W print			
48	16	73 10 20	567	Color trans.			
48	17	73 07 03	6	B/W print	O'Connor	61 20	111 30
48	17	73 07 03	7	B/W print			
48	17	73 08 27	567	Color trans.			
48	17	73 09 14	567	Color trans.			
48	17	73 10 02	567	Color trans.			
48	17	73 10 20	7	B/W print			
48	18	79 08 05	457	Color trans.	Ft. Smith	59 50	112 30
49	15	73 07 23	567	Color trans.	MacKay	63 55	110 40
49	16	73 09 15	7	B/W print	Thaltheli	62 30	111 50
49	16	73 10 02	5	B/W print			
49	16	73 11 08	6	B/W print			
49	16	73 11 08	567	Color trans.			
52	15	73 08 31	567	Color trans.	Snare R	63 55	117 00
52	15	73 09 18	567	Color trans.			
52	16	73 08 31	567	Color trans.			
53	15	73 09 19	567	Color trans.			
54	15	73 09 02	567	Color trans.			
54	15	73 09 20	567	Color trans.			
54	16	73 09 20	567	Color trans.	Horn R	62 30	121 00
43	17	77 03 19	5	B/W print	Firedrake	61 20	104 30

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Appendix 1 (ctd).

Satellite Track	Row	Date (YrMoDa)	Band	Product	Location Lake/River	Lat.N	Long.W
LANDSAT 3 - 5							
36	19	86 02 09	2	B/W trans.	Maria	58 45	101 40
36	19	87 06 20	2	B/W trans.			
36	19	87 06 20	4	B/W trans.			
36	19	86 09 21	3	B/W trans.			
36	20	87 06 20	2	B/W trans.	Reindeer	57 20	101 40
36	20	87 06 20	4	B/W trans.			
37	18	87 08 30	2	B/W trans.	Kasba	60 03	101 40
37	18	89 10 06	234	Color trans.			
37	19	87 08 30	2	B/W trans.	Cochrane	58 45	102 30
37	19	87 08 30	4	B/W trans.			
37	19	89 10 06	347TM	Color trans.			
38	18	86 01 22	2	B/W trans.	Bradford	60 03	103 20
38	18	86 08 02	3	B/W trans.			
38	19	86 01 22	2	B/W trans.	Waterfowl	58 45	104 10
38	19	86 08 02	3	B/W trans.			
38	19	87 05 01	2	B/W trans.			
38	20	87 05 01	2	B/W trans.	Geikie	57 20	104 50
38	20	87 05 01	4	B/W trans.			
39	17	87 06 09	2	B/W trans.	Dolby	61 30	103 50
39	17	87 06 09	4	B/W trans.			
39	17	89 09 02	347TM	Color trans.			
39	19	89 09 02	347TM	Color trans.	Wapata	58 45	105 40
40	17	85 02 02	2	B/W trans.	Rennie	61 30	105 25
40	17	86 05 28	3	B/W trans.			
40	18	85 02 02	2	B/W trans.	Scott	60 03	106 15
40	18	86 05 28	3	B/W trans.			
40	18	87 08 03	2	B/W trans.			
40	19	85 02 02	2	B/W trans.	Livingstone	58 45	107 10
40	19	86 05 28	3	B/W trans.			
41	17	87 07 25	2	B/W trans.	McArthur	61 30	106 50
41	17	87 07 25	4	B/W trans.			
41	17	87 07 25	345TM	Color trans.			
41	17	89 08 15	347TM	Color trans.			
41	18	87 07 25	2	B/W trans.	Brazen	60 03	107 50
41	18	87 07 25	4	B/W trans.			
41	18	87 09 11	2	B/W trans.			
41	18	89 08 31	4	B/W trans.			
41	19	87 07 25	2	B/W trans.	William	58 45	108 45
41	19	87 07 25	4	B/W trans.			
41	19	89 08 15	347TM	Color trans.			

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Appendix 1 (ctd).

Satellite Track	Row	Date (YrMoDa)	Band	Product	Location Lake/River	Lat.N	Long.W
LANDSAT 3 - 5							
42	17	76 03 14	5	B/W trans.	Porter	61 30	108 25
42	17	85 06 24	3	B/W trans.			
42	17	86 03 07	2	B/W trans.			
42	17	87 08 01	345TM	Color trans.			
42	18	74 10 27	5	B/W trans.	Van Dyck	60 03	109 30
42	18	85 06 24	3	B/W trans.			
42	18	86 03 07	2	B/W trans.			
42	18	88 09 04	345TM	Color trans.			
42	19	84 05 04	3	B/W trans.	Athabasca	58 45	110 20
42	19	88 09 04	347TM	Color trans.			
43	16	87 06 21	345TM	Color trans.	Reliance	62 50	109 10
43	16	89 08 29	347TM	Color trans.			
43	17	85 07 01	345TM	Color trans.	Tronka Chua	61 30	110 00
43	18	74 01 31	5	B/W trans.	Leland	60 03	110 55
43	18	74 05 01	5	B/W trans.			
43	18	87 07 23	345TM	Color trans.			
43	18	89 08 13	347TM	Color trans.			
44	16	86 09 13	3	B/W trans.	McLeod Bay	62 50	110 30
44	17	84 11 26	2	B/W trans.	Thorburn	61 30	111 25
44	17	86 09 13	3	B/W trans.			
44	17	87 05 27	2	B/W trans.			
44	17	87 05 27	4	B/W trans.			
44	18	87 05 27	2	B/W trans.	Ft. Smith	60 03	112 20
44	18	87 05 27	4	B/W trans.			
44	16	87 09 07	2	B/W trans.			
45	16	87 09 07	4	B/W trans.	Payne	52 59	112 99
45	17	87 06 19	2	B/W trans.	Rocher	61 30	112 55
45	17	87 06 19	4	B/W trans.			
46	17	87 05 25	3	B/W trans.			
47	16	89 09 26	347TM	Color trans.	Awry	62 50	113 05

[1] ERTS = Earth Resource Technology Satellite.
[2] LANDSAT = Land Satellites.

Appendix 2. Dates, locations, ages, and burn intervals at 199 sites sampled for vegetation in summers 1983 through 1986 on winter range of the Beverly herd of caribou.

Site no.	Date DaMoYr	General location	Latit-ude	Long-itude	Age by	Age (yr)	Burn Year	Burn int.(yr)	1:250 000 map	Burn type[1]
001	070783	Nonacho	6149	10915	Scar[2]	133	1850	62	Nonacho	1
002	080783	Nonacho	6148	10915	Scar	74	1909	56	Nonacho	1
003	100783	Nonacho	6150	10909	Tree[3]	214	1769		Nonacho	1
004	110783	Nonacho	6148	10915	Scar	130	1853		Nonacho	1
005	120783	Nonacho	6152	10910	Tree	219	1764		Nonacho	1
006	120783	Nonacho	6152	10914	Scar	81	1902	73	Nonacho	1
007	130783	Nonacho	6152	10914	Scar	81	1902		Nonacho	1
008	140783	Nonacho	6152	10914	Tree	154	1829		Nonacho	1
009	140783	Nonacho	6152	10914	Tree	154	1829		Nonacho	1
010	160783	Nonacho	6144	10919	Scar	168	1815	94	Nonacho	1
011	170783	Nonacho	6144	10919	Tree	74	1909	80	Nonacho	1
012	190783	Nonacho	6150	10920	Tree	167	1816	42	Nonacho	1
013	200783	Nonacho	6149	10916	Scar	73	1910	81	Nonacho	1
014	210783	Nonacho	6149	10916	Tree	154	1829		Nonacho	1
015	220783	Hjalmar	6139	10925	Know[4]	4	1979	100	Nonacho	1
016	230783	Nonacho	6148	10915	Scar	71	1912	125	Nonacho	1
017	240783	Nonacho	6146	10919	Scar	120	1863	64	Nonacho	1
018	250783	Taltson	6148	10848	Scar	61	1920	73	Nonacho	1
019	250783	Taltson	6148	10848	Scar	134	1849	173	Nonacho	1
020	260783	Nonacho	6148	10915	Scar	71	1912		Nonacho	1
021	280783	Taltson	6148	10848	Scar	16	1967	120	Nonacho	1
022	280783	Taltson	6148	10848	Tree	136	1847		Nonacho	1
023	290783	Nonacho	6146	10923	Scar	55	1928	54	Nonacho	1
024	100883	Nonacho	6144	10926	Tree	150	1833	95	Nonacho	1
025	120883	Nonacho	6144	10926	Scar	55	1928		Nonacho	1
026	120883	Nonacho	6144	10928	Tree	260	1723	94	Nonacho	1
027	140883	Nonacho	6144	10928	Tree	166	1817		Nonacho	1
028	160883	Nonacho	6141	10949	Scar	51	1932	113	Nonacho	1
029	170883	Nonacho	6141	10949	Tree	164	1819		Nonacho	1
030	180883	Nonacho	6146	10932	Scar	17	1966	193	Nonacho	1
031	180883	Nonacho	6146	10932	Tree	210	1773		Nonacho	1
032	190883	Nonacho	6148	10938	Tree	111	1872	84	Nonacho	1
033	200883	Nonacho	6148	10938	Scar	27	1956	90	Nonacho	1
034	210883	Nonacho	6149	10947	Tree	187	1796	146	Nonacho	1
035	210883	Nonacho	6149	10947	Scar	41	1942		Nonacho	1
036	220883	Nonacho	6149	10947	Scar	41	1942		Nonacho	1
037	230883	Nonacho	6155	10932	Scar	28	1955	134	Nonacho	1
038	240883	Nonacho	6155	10932	Tree	162	1821		Nonacho	1
039	250883	Nonacho	6137	10947	Tree	108	1875	57	Nonacho	1
040	260883	Nonacho	6137	10947	Scar	51	1932		Nonacho	1
041	270883	Nonacho	6139	10945	Scar	67	1916	98	Nonacho	1
042	280883	Nonacho	6139	10945	Tree	165	1818		Nonacho	1

Appendix 2 continued on next page

Appendix 2 (continued)

Site no.	Date DaMoYr	General location	Latit-ude	Long-itude	Age by	Age (yr)	Burn year	Burn int.(yr)	1:250 000 map	Burn type
043	290883	Nonacho	6141	10948	Scar	51	1932		Nonacho	1
044	290883	Nonacho	6139	10951	Known	12	1971		Nonacho	1
045	300883	Nonacho	6144	10937	Scar	19	1964		Nonacho	1
046	270684	Nonacho	6205	10919	Tree	146	1838	91	Reliance	1
047	280684	Nonacho	6205	10919	Scar	55	1929		Reliance	1
048	290684	Nonacho	6210	10912	Tree	220	1764	160	Reliance	1
049	020784	Nonacho	6210	10912	Scar	60	1924	179	Reliance	1
050	010784	Nonacho	6206	10916	Tree	234	1750	179	Reliance	1
051	030784	Nonacho	6208	10914	Scar	60	1924	150	Reliance	1
052	050784	Nonacho	6208	10914	Tree	210	1774	83	Reliance	1
053	040784	Nonacho	6208	10912	Scar	62	1922	148	Reliance	1
054	050784	Nonacho	6208	10912	Tree	210	1774	56	Reliance	1
055	060784	Nonacho	6205	10919	Scar	55	1929		Reliance	1
056	070784	Nonacho	6207	10919	Scar	55	1929	48	Reliance	1
057	080784	Nonacho	6205	10915	Scar	103	1881	131	Reliance	1
058	090784	Nonacho	6205	10914	Tree	189	1795	84	Reliance	1
059	090784	Nonacho	6205	10914	Tree	105	1879		Reliance	1
060	100784	Nonacho	6205	10914	Tree	189	1795		Reliance	1
061	110784	Nonacho	6159	10929	Scar	66	1918	94	Reliance	1
062	110784	Nonacho	6159	10929	Tree	160	1824		Nonacho	1
063	150784	Nonacho	6147	10932	Scar	75	1909	41	Nonacho	1
064	150784	Nonacho	6147	10932	Tree	116	1868		Nonacho	1
065	150784	Nonacho	6147	10934	Scar	75	1909	54	Nonacho	1
066	160784	Nonacho	6147	10934	Tree	129	1855		Nonacho	1
067	160784	Nonacho	6147	10934	Tree	122	1862		Nonacho	1
068	080884	Nonacho	6143	10944	Tree	160	1824	105	Nonacho	1
069	090884	Nonacho	6143	10944	Scar	55	1929		Nonacho	1
070	110884	Nonacho	6142	10943	Tree	164	1820	63	Nonacho	1
071	120884	Nonacho	6142	10943	Scar	101	1883		Nonacho	1
072	130884	Nonacho	6142	10943	Tree	155	1829	52	Nonacho	1
073	140884	Nonacho	6142	10943	Scar	103	1881	140	Nonacho	1
074	150884	Nonacho	6142	10943	Tree	243	1741	88	Nonacho	1
075	160884	Nonacho	6144	10937	Scar	20	1964		Nonacho	1
076	180884	Porter	6143	10757	Scar	229	1755	153	McCann	1
077	190884	Porter	6143	10757	Scar	76	1908	59	McCann	1
078	200884	Porter	6141	10759	Scar	74	1910	186	McCann	1
079	210884	Porter	6141	10759	Tree	260	1724		McCann	1
080	220884	Tejean	6128	10838	Tree	166	1818	143	Nonacho	1
081	220884	Tejean	6128	10838	Scar	23	1961		Nonacho	1
082	230884	Porter	6139	10815	Tree	62	1922	98	Nonacho	1
083	230884	Porter	6139	10815	Tree	160	1824		Nonacho	1
084	240884	McRea	6137	10748	Tree	203	1781	174	McCann	1
085	240884	McRea	6137	10748	Scar	29	1955		McCann	1
086	250884	Tejean	6130	10831	Tree	162	1822	103	Nonacho	1

Appendix 2 continued on next page

Appendix 2 (continued)

Site no.	Date DaMoYr	General location	Latit-ude	Long-itude	Age by	Age (yr)	Burn year	Burn int.(yr)	1:250 000 map	Burn type
087	250884	Tejean	6130	10831	Scar	59	1925		Nonacho	1
088	290884	Porter	6142	10800	Tree	267	1717	113	Nonacho	1
089	290884	Porter	6141	10758	Tree	154	1830		McCann	1
090	300884	Porter	6148	10752	Tree	225	1759	207	McCann	1
091	300884	Porter	6148	10753	Scar	18	1966		McCann	1
092	010785	Porter	6146	10758	Scar	127	1858		McCann	1
093	280685	Porter	6146	10758	Tree	225	1760	98	McCann	1
094	290685	Porter	6147	10758	Tree	236	1749		McCann	1
095	300685	Porter	6133	10812	Tree	163	1822	98	Nonacho	1
096	020785	Porter	6133	10812	Tree	226	1759	197	Nonacho	1
097	030785	Porter	6142	10801	Tree	240	1745		Nonacho	1
098	040785	DAoust	6206	10846	Tree	171	1814	147	Reliance	1
099	040785	DAoust	6206	10846	Scar	24	1961		Reliance	1
100	050785	Stewart	6201	10904	Tree	212	1773	151	Reliance	1
101	050785	Stewart	6201	10904	Scar	61	1924	127	Reliance	1
102	060785	Stewart	6156	10900	Tree	195	1790	165	Nonacho	1
103	060785	Stewart	6156	10900	Scar	30	1955		Nonacho	1
104	070785	Spearf	6049	10737	Scar	45	1940	92	Abitau	1
105	070785	Spearf	6049	10737	Tree	137	1848		Abitau	1
106	100785	Porter	6133	10812	Scar	29	1956		Nonacho	1
107	100785	Porter	6142	10802	Know	1	1984	192	Nonacho	1
108	110785	Porter	6132	10813	Tree	160	1825	95	Nonacho	1
109	110785	Porter	6132	10813	Scar	65	1920		Nonacho	1
110	120785	Porter	6148	10752	Know	3	1982		McCann	1
111	170785	Nonacho	6155	10917	Know	6	1979	171	Nonacho	1
112	180785	Nonacho	6147	10920	Scar	76	1909		Nonacho	1
113	190785	Nonacho	6147	10917	Scar	97	1888		Nonacho	1
114	200785	Taltson	6150	10858	Scar	52	1933	103	Nonacho	1
115	200785	Taltson	6150	10858	Tree	155	1830		Nonacho	1
116	210785	Taltson	6148	10842	Scar	55	1930	34	Nonacho	1
117	220785	Taltson	6148	10842	Scar	89	1896	150	Nonacho	1
118	230785	Nonacho	6149	10909	Scar	84	1901	52	Nonacho	1
119	230785	Nonacho	6149	10909	Tree	225	1760	71	Nonacho	1
120	080885	Thekul	6103	11008	Scar	53	1932	86	Taltson	1
121	090885	Thekul	6103	11008	Tree	139	1846	35	Taltson	1
122	100885	Heron	6105	10908	Scar	146	1839	103	Nonacho	1
123	100885	Heron	6105	10908	Scar	43	1942	31	Nonacho	1
124	120885	Kidder	6058	10915	Tree	85	1900	42	Hill Island	1
125	120885	Kidder	6058	10915	Scar	43	1942		Hill Island	1
126	130885	Grampus	6038	10912	Scar	43	1942	189	Hill Island	1
127	130885	Grampus	6038	10912	Tree	232	1753	54	Hill Island	1
128	140885	Salmon	6047	10945	Scar	58	1927	69	Hill Island	1
129	140885	Salmon	6047	10945	Tree	127	1858		Hill Island	1
130	160885	Thekul	6057	11012	Scar	44	1941	50	Ft. Smith	1

Appendix 2 continued on next page

Appendix 2 (continued)

Site no.	Date DaMoYr	General location	Latit-ude	Long-itude	Age by	Age (yr)	Burn year	Burn int.(yr)	1:250 000 map	Burn type
131	180885	Thekul	6059	11005	Scar	77	1908	63	Ft. Smith	1
132	190885	Thekul	6059	11005	Scar	77	1908		Ft. Smith	1
133	200885	Thekul	6059	11005	Tree	140	1845	99	Ft. Smith	1
134	210885	Thekul	6112	10950	Tree	133	1852	87	Nonacho	1
135	220885	Sparks	6116	10939	Tree	84	1901	55	Nonacho	1
136	220885	Sparks	6116	10939	Scar	29	1956		Nonacho	1
137	240885	Thekul	6112	10950	Tree	220	1765		Nonacho	1
138	270885	Thekul	6058	11019	Tree	84	1901	85	Ft. Smith	1
139	270885	Thekul	6058	11009	Tree	169	1816		Ft. Smith	1
140	060786	Selwyn	6007	10432	Scar	76	1910	118	Wholdaia	1
141	060786	Selwyn	6007	10432	Tree	194	1792		Wholdaia	1
142	070786	Selwyn	6005	10435	Scar	167	1819	91	Wholdaia	1
143	070786	Selwyn	6005	10435	Scar	76	1910		Wholdaia	1
144	080786	Selwyn	6011	10418	Know	14	1972	112	Wholdaia	1
145	080786	Selwyn	6011	10418	Tree	126	1860		Wholdaia	1
146	080686	Selwyn	6015	10417	Scar	56	1930	137	Wholdaia	1
147	090786	Selwyn	6015	10417	Tree	193	1793		Wholdaia	1
148	110786	Selwyn	6012	10417	Scar	57	1929	143	Wholdaia	1
149	110786	Selwyn	6012	10417	Tree	200	1786		Wholdaia	1
150	120786	Selwyn	6005	10434	Tree	180	1806	123	Wholdaia	1
151	120786	Selwyn	6005	10434	Tree	57	1929		Wholdaia	1
152	130786	Selwyn	6007	10428	Tree	206	1780	156	Wholdaia	1
153	130786	Selwyn	6007	10428	Scar	50	1936		Wholdaia	1
154	160786	Selwyn	6002	10440	Tree	218	1768	202	Wholdaia	1
155	160786	Selwyn	6002	10440	Scar	16	1970		Wholdaia	1
156	170786	Selwyn	6001	10429	Tree	163	1823		Wholdaia	1
157	170786	Selwyn	6001	10429	Tree	127	1859		Wholdaia	1
158	180786	Selwyn	6003	10438	Scar	73	1913	127	Wholdaia	1
159	180786	Selwyn	6003	10438	Tree	200	1786		Wholdaia	1
160	190786	Selwyn	6009	10431	Tree	170	1816	93	Wholdaia	1
161	190786	Selwyn	6009	10431	Scar	77	1909		Wholdaia	1
162	200786	Thye	6017	10428	Scar	31	1955	96	Wholdaia	1
163	200786	Thye	6017	10428	Tree	127	1859		Wholdaia	1
164	210786	Turner	6007	10452	Scar	36	1950	190	Wholdaia	1
165	210786	Turner	6007	10452	Tree	226	1760		Wholdaia	1
166	220786	Turner	6044	10510	Scar	43	1943	192	Wholdaia	1
167	220786	Southby	6044	10510	Tree	235	1751		Wholdaia	1
168	230786	Selwyn	6000	10559	Tree	180	1806	144	Wholdaia	1
169	230786	Selwyn	6000	10559	Scar	36	1950		Wholdaia	1
170	250786	Selwyn	6003	10428	Tree	197	1789	141	Wholdaia	1
171	250786	Selwyn	6003	10428	Scar	56	1930		Wholdaia	1
172	260786	Selwyn	6015	10428	Scar	34	1952	89	Wholdaia	1
173	260786	Selwyn	6015	10428	Tree	123	1863		Wholdaia	1
174	270786	Selwyn	6012	10427	Tree	201	1785	139	Wholdaia	1

Appendix 2 continued on next page

Appendix 2 (continued)

Site no.	Date DaMoYr	General location	Latit-ude	Long-itude	Age by	Age (yr)	Burn year	Burn int.(yr)	1:250 000 map	Burn type
175	270786	Selwyn	6012	10427	Tree	71	1915		Wholdaia	1
176	270786	Selwyn	6012	10427	Tree	210	1785	160	Wholdaia	1
177	280786	Selwyn	6007	10429	Scar	50	1936		Wholdaia	1
178	140886	Slave	5955	11141	Scar	105	1881		Fitzsimm.	1
179	150886	Slave	5955	11141	Scar	49	1937	54	Fitzsimm.	1
180	180886	Beauvais	6027	10530	Scar	54	1932	173	Wholdaia	1
181	180886	Beauvais	6027	10530	Tree	227	1759		Wholdaia	1
182	200886	Beauvais	6030	10531	Scar	79	1907	133	Wholdaia	1
183	200886	Beauvais	6030	10531	Tree	212	1774		Wholdaia	1
184	220886	Beauvais	6022	10529	Scar	30	1956	174	Wholdaia	1
185	220886	Beauvais	6022	10528	Tree	204	1782		Wholdaia	1
186	230886	Beauvais	6027	10537	Tree	77	1909	148	Wholdaia	1
187	230886	Beauvais	6027	10537	Tree	225	1761		Wholdaia	1
188	250886	Beauvais	6019	10529	Tree		1751		Wholdaia	1
189	250886	Beauvais	6019	10529	Tree	235	1751		Wholdaia	1
190	260886	Beauvais	6027	10530	Scar	55	1931		Wholdaia	1
191	260886	Beauvais	6027	10530	Scar	80	1906		Wholdaia	1
192	270886	Wignes	6007	10533	Scar	33	1953	184	Wholdaia	1
193	270886	Wignes	6007	10533	Tree	217	1769		Wholdaia	1
194	280886	Marchant	5945	10606	Tree	222	1764	191	Fond-du-L	1
195	280886	Marchant	5945	10606	Scar	31	1955		Fond-du-L	1
196	290886	Breynat	5948	10521	Tree	176	1810	115	Stony	1
197	290886	Breynat	5948	10521	Scar	61	1925		Stony	1
198	010986	Tazin	5953	10846	Scar	51	1935	98	Tazin	1
199	010986	Carleton	6020	10654	Scar	36	1950		Abitau	1
216[5]	230783	Nonacho	6148	10915	Scar	71	1912	65	Nonacho	2
233	200883	Nonacho	6148	10938	Tree	197	1786	86	Nonacho	2
252	050784	Nonacho	6208	10914	Tree	210	1774	64	Reliance	2
254	050784	Nonacho	6208	10912	Tree	210	1774	91	Reliance	2
257	080784	Nonacho	6205	10915	Tree	103	1881	85	Reliance	2
263	150784	Nonacho	6147	10932	Tree	202	1782	86	Nonacho	2
307	100785	Porter	6142	10802	Know	1	1984	140	Nonacho	2
311	170785	Nonacho	6155	10917	Know	6	1979	96	Nonacho	2
321	090885	Thekul.	6103	11008	Tree	139	1846	42	Taltson	2
323	100885	Heron	6105	10908	Scar	43	1942	72	Nonacho	2
327	130885	Grampus	6038	10912	Tree	232	1753	53	Hill Island	2
331	180885	Thekul	6057	11012	Tree	94	1891	67	Ft. Smith	2
379	150886	Slave	5955	11141	Scar	49	1937	35	Fitzsimm.	2

[1] Burn type: 1 = most recent burn; 2 = second last burn at a location revealed by a fire scar.
[2] Scar refers to fire scars.
[3] Tree refers to adding appropriate number to number of annulations at 25 cm above grould.
[4] Known refers to known age.
[5] Site numbers >199 indicate a second burn interval with 200 added to a site number, e.g., 16 is site no. 216.

Appendix 3. Ages of forests sampled from 1980 through 1989 at locations scattered throughout winter range of the Beverly herd of caribou.

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spruce	Burn year	1:250 000 map[1]	Age by	Eco-zone[2]
001	130380	Leding.	6003	10755	179		1800	Abitau	Tree[3]	LSA
002	130380	VanDyke	6006	10937	84	56	1895	Hill Isl.	Scar[4]	HB2
003	140380	Carleton	6018	10702	119	110	1860	Abitau	Tree	LSA
004	140380	Kimiwan	5954	10555		106	1873	Stony	Tree	LSA
005	250380	Brazen1	6002	10807	68	61	1911	Hill Isl.	Scar	HB1
006	260380	Delight	6036	10817	68		1911	Hill Isl.	Tree	HB1
007	260380	Robbins	5950	10507		121	1858	Stony	Tree	LSA
008	270380	Hunting.	6001	10740		122	1858	Abitau	Tree	LSA
009	270380	Chamb.	5937	10524		132	1847	Stony	Tree	LSA
010	270380	Bedareh	6020	11002	125	130	1849	FtSmith	Tree	HB2
011	280380	Hughes	6000	10958	0, 61, 102		1979	Hill Isl.	Know[5]	HB2
012	280380	Hughes	6000	10958	0, 61, 102		1918	Hill Isl.	Scar	HB2
013	280380	Hughes	6000	10958	0, 61, 102		1877	Hill Isl.	Tree	HB2
014	280380	Portman	6001	10913	10, 108		1970	Hill Isl.	Know	HB1
015	280380	PortmanB	6001	10913	10, 108		1871	Hill Isl.	Tree	HB1
016	280380	Brazen2	6002	10807		179	1800	Hill Isl.	Tree	HB1
017	280380	Quinnell	6006	10937	27, 270		1952	Hill Isl.	Scar	HB2
018	280380	Quinnell	6002	10938	27, 270		1714	Hill Isl.	Tree	HB2
019	280380	Portman	6002	10913	10, 105	10	1970	Hill Isl.	Know	HB1
020	280380	PortmanB	6002	10913	10, 105	105	1874	Hill Isl.	Tree	HB1
021	290380	TazinR	6000	10737	165	300	1814	Abitau	Tree	LSA
022	290380	TazinRB	6000	10736	165	300	1675	Abitau	Tree	LSA
023	290380	Ena	6000	10811	1,21,117,165	112	1979	Hill Isl.	Know	HB1
024	290380	EnaB	6000	10811	1,21,117,165	112	1959	Hill Isl.	Scar	HB1
025	290380	EnaC	6000	10811	1,21,117,165	112	1862	Hill Isl.	Scar	HB1
026	290380	EnaD	6000	10811	1,21,117,165	112	1814	Hill Isl.	Tree	HB1
027	300380	Imogen	6013	10912	9, 71		1970	Hill Isl.	Know	HB1
028	300380	ImogenB	6013	10911	9, 71		1907	Hill Isl.	Tree	HB1
029	300380	Abitau	6000	10848	70, 135		1909	Hill Isl.	Scar	HB1
030	300380	AbitauB	6000	10848	70, 135		1844	Hill Isl.	Tree	HB1
031	300380	Abitau	6001	10848	24, 58, 134		1955	Hill Isl.	Scar	HB1
032	300380	AbitauB	6001	10848	24, 58, 134		1921	Hill Isl.	Scar	HB1
033	300380	AbitauC	6001	10848	24, 58, 134		1845	Hill Isl.	Tree	HB1
034	300380	Disapp.	6000	11024	25,53,79,130		1955	Ft.Smith	Scar	MB2
035	300380	Disapp.	6000	11024	25,53,79,130		1927	Ft.Smith	Scar	MB2
036	300380	Disapp.	6000	11024	25,53,79,130		1900	Ft.Smith	Scar	MB2
037	300380	Disapp.	6000	11024	25,53,79,130		1849	Ft.Smith	Tree	MB2
038	310380	Linwood	6001	10800	23,130		1956	Abitau	Scar	HB1
039	310380	LinwoodB	6001	10800	23,130		1849	Abitau	Tree	HB1
040	310380	Linwood	6001	10759	130, 205	195	1849	Abitau	Tree	HB1
041	310380	LinwoodB	6001	10759	130, 205	195	1774	Abitau	Tree	HB1

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Appendix 3 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spruce	Burn year	1:250 000 map	Age by	Eco-zone
042	310380	Charles	6000	11141	24, 105		1955	Ft.Smith	Scar	MB2
043	310380	Charles	6000	11141	24, 105		1874	Ft.Smith	Scar	MB2
044	310380	VanDyke	6006	10937	117		1862	Hill Isl.	Tree	HB2
045	130381	Abitau	6028	10707		180	1802	Abitau	Tree	LSA
046	130381	Porter	6137	10803	147		1833	Nonacho	Tree	LSA
047	160381	Hurric.	6048	10745	154		1826	Nonacho	Tree	LSA
048	280382	Vermette	6122	10547		185	1796	McCann	Tree	LSA
049	250382	Sylvan	6053	10645		155	1826	Abitau	Tree	LSA
050	280382	Brooks	6151	10646		190	1791	McCann	Tree	HSA
051	280382	Burpee	6122	10647		218	1763	McCann	Tree	LSA
052	300382	Tent	6232	10734		128	1853	Lynx	Tree	HSA
053	280382	Doran	6120	10747		112	1869	McCann	Tree	LSA
054	300382	Porter	6148	10752	15, 199		1966	McCann	Know	LSA
055	280382	PorterB	6148	10752	15, 199		1782	McCann	Tree	LSA
056	280382	Porter	6142	10801	210		1771	Nonacho	Tree	LSA
057	100382	Halliday	6118	10855	87		1894	Nonacho	Tree	HB1
058	280382	Nonacho	6153	10904	163		1818	Nonacho	Tree	HB1
059	250382	Thoa	6045	10908	220		1761	Hill Isl.	Tree	HB1
060	280382	Thekul.	6119	10954		112	1869	Nonacho	Tree	HB1
061	280382	Walker	6153	10956	100, 142		1882	Nonacho	Scar	HB1
062	280382	WalkerB	6153	10956	100, 142		1839	Nonacho	Scar	HB1
063	310382	Bedareh	6016	11003	56, 73		1925	Ft.Smith	Scar	HB2
064	310382	BedarehB	6016	11003	56, 73		1908	Ft.Smith	Scar	HB2
065	310382	Austin	6213	11015		141	1840	Snowdr.	Tree	HB1
066	280382	Lady	6046	11035	100		1881	Ft.Smith	Tree	HB2
067	310382	Alcan.	6052	10811		154	1825	Nonacho	Tree	HB1
068	050782	Gray	6146	10840	145, 158		1824	Nonacho	Tree	LSA
069	050782	Nonacho	6149	10941	17, 71		1966	Nonacho	Know	HB1
070	050782	NonachoB	6149	10941	17, 71		1911	Nonacho	Tree	HB1
071	080283	Tent	6232	10734		177	1805	Lynx	Tree	HSA
072	100283	Magpie	6223	10858	6	124	1976	Reliance	Know	HSA
073	100283	MagpieB	6223	10858	6	124	1858	Reliance	Tree	HB1
074	090283	Murphy	6207	10951	49, 100, 137	142	1933	Reliance	Scar	HB1
075	090283	MurphyB	6207	10951	49, 100, 137	142	1882	Reliance	Scar	HB1
076	090283	MurphyC	6207	10951	49, 100, 137	142	1840	Reliance	Scar	HB2
077	070283	Hill	6028	10954	71		1911	Hill Isl.	Tree	HB2
078	090283	Rutled.	6140	11033	11, 104	105	1971	Taltson	Know	HB2
079	090283	Rutled.B	6140	11033	11, 104	105	1878	Taltson	Tree	HB2
080	090283	Lady	6046	11035	54, 79, 128		1928	Ft.Smith	Scar	HB2
081	090283	LadyB	6046	11035	54, 79, 128		1903	Ft.Smith	Scar	HB2
082	090283	LadyC	6046	11035	54, 79, 128		1854	Ft.Smith	Scar	HB2
083	080383	Kasba	6040	10200		248	1734	Snowdr.	Tree	LSA

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Appendix 3 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spr.	Burn year	1:250 000 map	Age by	Eco-zone
084	080383	Striding	6001	10400		235	1747	Snowbird	Tree	LSA
085	080383	Millar	6110	10403		360	1622	Rennie	Tree	HSA
086	100383	Vermette	6122	10547	124	129	1858	Rennie	Tree	LSA
087	300383	Tent	6232	10734		177	1805	Lynx	Tree	HSA
088	080383	Esk	6040	10738		59, 204	1923	Abitau	Scar	LSA
089	080383	EskB	6040	10738		59, 204	1778	Abitau	Tree	LSA
090	100383	Alcant.	6100	10758	76	83	1906	Abitaul	Scar	LSA
091	290383	Siltaza	6211	10948	18, 185	198	1964	Reliance	Scar	HB1
092	290383	Siltaza B	6211	10948	18, 185	198	1797	Reliance	Tree	HB1
093	280383	Thekult.	6120	11006	89, 140	199	1893	Taltson	Scar	HB1
094	280383	Thekul.B	6120	11006	89, 140	199	1842	Taltson	Tree	HB1
095	280383	Thekul.C	6120	11006	89, 140	199	1783	Taltson	Tree	HB1
096	290383	LaLoche	6155	11120	18,75,125		1964	Taltson	Scar	HB2
097	290383	LaLocheB	6155	11120	18,75,125		1907	Taltson	Scar	HB2
098	290383	LaLocheC	6155	11120	18,75,125		1857	Taltson	Tree	HB2
099	290383	LaLoche	6154	11122	18, 75		1964	Taltson	Scar	HB2
100	290383	LaLocheB	6154	11122	18, 75		1907	Taltson	Scar	HB2
101	080383	Selwyn	6002	10428		50,126,282	1932	Wholdaia	Scar	LSA
102	080383	SelwynB	6002	10428		50,126,282	1856	Wholdaia	Scar	LSA
103	080383	SelwynC	6002	10428		50,126,282	1700	Wholdaia	Tree	LSA
104	010483	Tejean	6132	10842	16,56,145		1967	Nonacho	Scar	HB1
105	010483	TejeanB	6132	10842	16,56,145		1927	Nonacho	Scar	HB1
106	010483	TejeanC	6132	10842	16,56,145		1838	Nonacho	Tree	HB1
107	010483	Ander.	6117	10838	28	149	1955	Nonacho	Scar	HB1
108	010483	Ander.B	6117	10838	28	149	1834	Nonacho	Tree	HB1
109	010483	Alcan.	6052	10817	16, 50	130	1967	Hill Isl.	Scar	HB1
110	010483	Alcan.B	6052	10817	16, 50	130	1853	Hill Isl.	Tree	HB1
111	010483	Manch.	6123	10748	14,33,187		1969	McCann	Scar	LSA
112	010483	Manch.	6123	10748	14,33,187		1950	McCann	Scar	LSA
113	010483	Manch.C	6123	10748	14,33,187		1778	McCann	Tree	LSA
114	010483	McRae	6137	10748	28	194	1955	McCann	Scar	LSA
115	010483	McRaeB	6137	10748	28	194	1789	McCann	Tree	LSA
116	020483	Taltson	6156	10754	19,90,271		1964	McCann	Scar	LSA
117	020483	TaltsonB	6156	10754	19,90,271		1892	McCann	Scar	LSA
118	020483	TaltsonC	6156	10754	19,90,271		1712	McCann	Tree	LSA
119	020483	DAoust	6208	10852	28, 197, 287	46	1955	Reliance	Scar	LSA
120	020483	DAoustB	6208	10852	28, 197, 287	46	1788	Reliance	Scar	LSA
121	020483	DAoustC	6208	10852	28, 197, 287	46	1696	Reliance	Tree	LSA
122	030483	Spear.	6050	10738	42		1941	Abitau	Scar	LSA
123	030483	Esk	6036	10736	53, 148	55, 198	1929	Abitau	Scar	LSA
124	030483	EskB	6036	10736	53, 148	55, 198	1834	Abitau	Tree	LSA
125	030483	Hjalmar	6134	10917	73	77, 212	1910	Nonacho	Scar	HB1

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Appendix 3 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spruce	Burn year	1:250 000 map	Age by	Eco-zone
126	030483	HjalmarB	6134	10917	73	77, 212	1771	Nonacho	Tree	HB1
127	030483	Tronka	6136	10943	110	188	1873	Nonacho	Scar	HB1
128	030483	TronkaB	6136	10943	110	188	1795	Nonacho	Tree	HB1
129	040483	Nonacho	6139	10948	48, 151	52	1935	Nonacho	Scar	HB1
130	040483	NonachoB	6139	10948	48, 151	52	1832	Nonacho	Tree	HB1
131	040483	Nonacho	6139	10951	27	30, 129	1956	Nonacho	Scar	HB1
132	040483	NonachoB	6139	10951	27	30, 129	1854	Nonacho	Tree	HB1
133	040483	Thekul.	6115	10949	89	81	1894	Nonacho	Tree	HB1
134	040483	Heron	6115	10908	43, 147	46, 113	1940	Nonacho	Scar	HB1
135	040483	HeronB	6115	10908	43, 147	46, 113	1836	Nonacho	Tree	HB1
136	080783	Camp	6147	10918	73,115,155		1910	Nonacho	Scar	HB1
137	080783	CampB	6147	10918	73,115 155		1868	Nonacho	Scar	HB1
138	080783	CampC	6147	10918	73,115,155		1828	Nonacho	Tree	HB1
139	080783	Non.	6147	10917	72,100,159		1911	Nonacho	Scar	HB1
140	080783	Non.B	6147	10917	72,100,159		1883	Nonacho	Scar	HB1
141	080783	Non.C	6147	10917	72,100,159		1824	Nonacho	Tree	HB1
142	080783	Non.	6154	10916	4, 150		1979	Nonacho	Know	HB1
143	080783	Non.B	6154	10916	4, 150		1833	Nonacho	Tree	HB1
144	080783	Non.NrN	6154	10916	77,168,274		1906	Nonacho	Know	HB1
145	080783	NonNrNB	6154	10916	77,168,274		1815	Nonacho	Scar	HB1
146	080783	NonNrNC	6154	10916	77,168,274		1709	Nonacho	Tree	HB1
147	080783	Non.Trap	6152	10910		219	1764	Nonacho	Tree	HB1
148	080783	Taltson R	6150	10909		214	1769	Nonacho	Tree	HB1
149	150783	Non1Isl	6137	10925	114	163	1820	Nonacho	Scar	HB1
150	150783	Non2Isl	6133	10917		263	1720	Nonacho	Tree	HB1
151	150783	Nonacho	6144	10918	72		1911	Nonacho	Scar	HB1
152	150783	Non6miS	6143	10920		83, 239	1900	Nonacho	Scar	HB1
153	150783	Non6miSB	6143	10920		83, 239	1744	Nonacho	Tree	HB1
154	160784	Non.	6149	10915	133,170,226,289		1850	Nonacho	Scar	HB1
155	160784	Non.B	6149	10915	133,170,226,289		1813	Nonacho	Scar	HB1
156	160784	Non.C	6149	10915	133,170,226,289		1757	Nonacho	Scar	HB1
157	160784	Non.D	6149	10915	133,170,226,289		1694	Nonacho	Tree	HB1
158	220783	Hjalmer	6141	10924	104, 153		1879	Nonacho	Tree	HB1
159	220783	Hjalmer	6141	10924	104, 153		1830	Nonacho	Tree	HB1
160	220783	EHjalmar	6140	10924	46,96,153		1937	Nonacho	Scar	HB1
161	220783	EHjalmarB	6140	10924	46,96,153		1887	Nonacho	Scar	HB1
162	220783	EhjalmarC	6140	10924	46,96,153		1830	Nonacho	Tree	HB1
163	220783	WHjalmar	6140	10923	95	226	1888	Nonacho	Scar	HB1
164	220783	WhjalmarB	6140	10923	95	226	1757	Nonacho	Tree	HB1
165	170883	NonCart	6143	10937	19, 125		1964	Nonacho	Scar	HB1
166	170883	NonCartB	6143	10937	19, 125		1858	Nonacho	Tree	HB1
167	170883	E Carter	6143	10935	145		1838	Nonacho	Tree	HB1

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Appendix 3 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spruce	Burn year	1:250 000 map	Age by	Eco-zone
168	170883	S Carter	6142	10937	141, 276		1842	Nonacho	Scar	HB1
169	170883	S Carter	6142	10937	141, 276		1707	Nonacho	Tree	HB1
170	170883	Non.1	6138	10944	104, 170		1879	Nonacho	Scar	HB1
171	170883	Non.1B	6138	10944	104, 170		1813	Nonacho	Tree	HB1
172	170883	Non.2	6138	10944	117, 184		1866	Nonacho	Scar	HB1
173	170883	Non.2B	6138	10944	117, 184		1799	Nonacho	Tree	HB1
174	170883	Non.3	6138	10943	106, 159		1877	Nonacho	Scar	HB1
175	170883	Non.3B	6138	10943	106, 159		1824	Nonacho	Tree	HB1
176	170883	Non.4	6142	10942	101		1882	Nonacho	Tree	HB1
177	170883	Non.5	6142	10944	68, 157		1915	Nonacho	Scar	HB1
178	170883	Non.5B	6142	10944	68, 157		1826	Nonacho	Tree	HB1
179	170883	Non.6	6143	10942	123, 163		1860	Nonacho	Scar	HB1
180	170883	Non.6B	6143	10942	123, 163		1820	Nonacho	Tree	HB1
181	200184	Thubun	6139	11133	21		1961	Taltson	Scar	HB2
182	240284	Siltaza	6211	10948	39	214	1944	Reliance	Scar	HB1
183	240284	SiltazaB	6211	10948	39	214	1769	Reliance	Tree	HB1
184	300384	Selwyn	6007	10427		50, 220	1933	Wholdaia	Scar	LSA
185	300384	SelwynB	6007	10427		50, 220	1763	Wholdaia	Tree	LSA
186	030784	Nonacho	6213	10903		134	1850	Reliance	Tree	LSA
187	030784	Nonacho	6212	10902		134	1850	Reliance	Tree	LSA
188	030784	Nonacho	6214	10900		138	1846	Reliance	Tree	LSA
189	291284	Smith1	5955	11141	42, 105		1942	Fitzsimm.	Scar	MB2
190	291284	Smith1B	5955	11141	42, 105		1879	Fitzsimm.	Tree	MB2
191	291284	Smith2	5956	11142	47, 102		1937	Fitzsimm.	Scar	MB2
192	291284	Smith2B	5956	11142	47, 102		1882	Fitzsimm.	Tree	MB2
193	291284	Smith3	5959	11150	48, 71,102		1936	Fitzsimm.	Scar	MB2
194	291284	Smith3B	5959	11150	48, 71,102		1913	Fitzsimm.	Scar	MB2
195	291284	Smith3C	5959	11150	48, 71,102		1882	Fitzsimm.	Tree	MB2
196	291284	Smith4	5954	11153	41, 121		1943	Fitzsimm.	Scar	MB2
197	291284	Smith4B	5954	11153	41, 121		1863	Fitzsimm.	Tree	MB2
198	291284	Smith6	6001	11205	41, 101		1943	Grand D	Scar	MB2
199	291284	Smith6B	6001	11205	41, 101		1883	Grand D	Tree	MB2
200	291284	Smith7	6002	11210	26, 89,122		1958	Grand D	Scar	MB2
201	291284	Smith7B	6002	11210	26, 89,122		1895	Grand D	Scar	MB2
202	291284	Smith7C	6002	11210	26, 89,122		1862	Grand D	Tree	MB2
203	291284	Smith8	6001	11156	66		1918	Ft.Smith	Tree	MB2
204	291284	Smith9	6001	11154	104		1880	Ft.Smith	Tree	MB2
205	051285	Jost	6102	10355		226	1758	Boyd	Tree	LSA
206	170185	Sandy	6056	10530	140		1844	Wholdaia	Tree	LSA
207	170185	Halliday	6118	10855	81		1903	Nonacho	Tree	HB1
208	170185	VanDyke	6020	10937	56		1928	Hilll Isl.	Tree	HB2
209	170185	Lady	6046	11035	54, 127		1930	Ft.Smith	Scar	HB2

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Appendix 3 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spruce	Burn year	1:250 000 map	Age by	Eco-zone
210	170185	Lady B	6046	11035	54, 127		1857	Ft.Smith	Tree	HB2
211	130285	McKin.	6252	11144		114,241	1870	Snowdrift	Scar	LSA
212	130285	McKin.B	6252	11144		114,241	1744	Snowdrift	Tree	LSA
213	130385	Jones	6218	10823	22	270	1961	Reliance	Scar	HSA
214	130385	Jones.B	6218	10823	22	27,270	1714	Reliance	Tree	HSA
215	130385	Jones	6217	10827		198	1786	Reliance	Tree	HSA
216	140385	Ft.Smith	6000	11158	103		1882	Ft.Smith	Tree	MB2
217	270385	McArthur	6136	10655		152	1832	McCann	Tree	HSA
218	120385	Flett	6025	10355		235	1749	Snowbird	Tree	LSA
219	290385	LaLocheS	6202	11050	57		1927	Snowdrift	Tree	HB2
220	070585	Flett	6023	10427		29, 127	1955	Wholdaia	Scar	LSA
221	070585	Flett.B	6023	10427		29, 127	1858	Wholdaia	Tree	LSA
222	150783	Non.W	6147	10920	78, 133		1907	Nonacho	Scar	HB1
223	150783	Non.W	6147	10920	78, 133		1852	Nonacho	Tree	HB1
224	160783	Non.8	61??	109??	104, 175		1879	Nonacho	Scar	HB1
225	160783	Non.8B	61??	109??	104, 175		1808	Nonacho	Tree	HB1
226	280386	Kasba	6002	10215		150	1835	Snowbird	Tree	LSA
227	280386	Dunveg.	6004	10723	59, 136	61	1926	Abitau	Scar	LSA
228	280386	Dunveg.B	6004	10723	59, 136	61	1849	Abitau	Tree	LSA
229	280386	Cobb	6153	10844	5, 43	189	1980	Nonacho	Scar	LSA
230	280386	CobbB	6153	10844	5, 43	189	1942	Nonacho	Scar	LSA
231	280386	CobbC	6153	10844	5, 43	189	1796	Nonacho	Tree	LSA
232	280386	Cobb	6155	10846	44, 78, 189	183	1941	Nonacho	Scar	LSA
233	280386	CobbB	6155	10846	44, 78, 189	183	1907	Nonacho	Scar	LSA
234	280386	CobbC	6155	10846	44, 78, 189	183	1796	Nonacho	Tree	LSA
235	280386	Cobb	6156	10840	24	60	1961	Nonacho	Scar	LSA
236	290386	Anderson	6109	10849	74	76	1911	Nonacho	Tree	HB1
237	290386	Siltaza	6218	10859	22, 41		1964	Reliance	Scar	LSA
238	290386	SiltazaB	6218	10859	22, 41		1944	Reliance	Scar	LSA
239	290386	Louison	6140	10911	74	72	1911	Nonacho	Tree	HB1
240	290386	LaLoche	6202	11046	39		1946	Snowdrift	Tree	HB2
241	250386	Thubun	6134	11136	19, 74		1966	Taltson	Scar	HB2
242	250386	ThubunB	6134	11136	19, 74		1911	Taltson	Tree	HB2
243	250386	Thubun	6134	11140	20, 77		1965	Taltson	Scar	HB2
244	250386	ThubunB	6134	11140	20, 77		1908	Taltson	Tree	HB2
245	080786	Selwyn	6010	10424		13, 113	1973	Wholdaia	Scar	LSA
246	080786	SelwynB	6010	10424		13, 113	1873	Wholdaia	Tree	LSA
247	290786	TrainN	5948	10655	64		1921	Fond-du	Scar	LSA
248	010986	Nichol.	5938	10720	5, 57		1981	Fond-du	Scar	LSA
249	010986	Nichol.B	5938	10720	5, 57		1929	Fond-du	Tree	LSA
250	161286	Franc.	6227	11225	68, 150		1919	Hearne	Scar	LSA
251	161286	Franc.B	6227	11225	68, 150		1836	Hearne	Tree	LSA

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Appendix 3 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	Age of pine	Age of spruce	Burn year	1:250 000 map[1]	Age by	Eco-zone[2]
252	171286	Bradford	6001	10306		235	1751	Snowbird	Tree	LSA
253	171286	Alcan.	6058	10755		209	1777	Abitau	Tree	LSA
254	260387	Robinson	6048	11054	59		1927	Ft.Smith	Tree	HB2
255	290387	Rutled.	6124	11101	41	75	1945	Taltson	Scar	HB2
256	290387	Rutled.B	6124	11101	41	75	1911	Taltson	Tree	HB2
257	290387	Payne	6249	11203		51, 147	1935	Hearne	Scar	LSA
258	290387	Payne B	6249	11203		51, 147	1839	Hearne	Tree	LSA
259	250887	MacInnes	6117	11012	76		1911	Taltson	Scar	HB2
260	250887	Pilot	6017	11050	6, 62		1979	Ft.Smith	Know	HB2
261	250887	Pilot B	6017	11050	6, 62		1925	Ft.Smith	Scar	HB2
262	250887	Pilot	6017	11114	8, 76		1979	Ft.Smith	Scar	HB2
263	250887	Pilot B	6017	11114	8, 76		1911	Ft.Smith	Tree	HB2
264	250887	Schaefer	6006	11117	78		1909	Ft.Smith	Tree	HB2
265	120889	Halliday	6118	10852	87		1902	Nonacho	Tree	HB1
266	130889	McCann	6113	10625		35	1954	McCann	Scar	LSA
267	140889	Doran	6117	10823	62, 212		1927	Nonacho	Scar	LSA
268	140889	Doran B	6117	10823	62, 212		1777	Nonacho	Tree	LSA
269	140889	Doran	6117	10820	62, 213, 257	1927	Nonacho		Scar	HB1
270	140889	Doran B	6117	10820	62, 213, 257	1776	Nonacho		Scar	HB1
271	140889	Doran C	6117	10820	62, 213, 257	1732	Nonacho		Tree	HB1

[1] See Fig. 3 for location of map areas.
[2] See Fig. 5 for ecozone names and locations.
[3] Tree refers to adding appropriate number to number of annulations at 25 cm above grould.
[4] Scar refers to fire scars.
[5] Known refers to known age.

Appendix 4. Interval between burns at sites sampled in 1983 through 1986 where detailed information was obtained on vegetation on the winter range of the Beverly herd of caribou.

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	1:250 000 map	Study area	Eco-zone[1]	Forest limit(km)[2]	Burn int-erval(y)[3]	Burn chron[4]
001	070783	Nonacho	6149	10915	Nonacho	Nonacho	HB1	90	62	1
002	080783	Nonacho	6148	10915	Nonacho	Nonacho	HB1	90	56	1
006	120783	Nonacho	6152	10914	Nonacho	Nonacho	HB1	85	73	1
010	160783	Nonacho	6144	10919	Nonacho	Nonacho	HB1	95	94	1
011	170783	Nonacho	6144	10919	Nonacho	Nonacho	HB1	95	80	1
012	190783	Nonacho	6150	10920	Nonacho	Nonacho	HB1	95	42	1
013	200783	Nonacho	6149	10916	Nonacho	Nonacho	HB1	90	81	1
015	220783	Hjalmar	6139	10925	Nonacho	Nonacho	HB1	110	100	1
016	230783	Nonacho	6148	10915	Nonacho	Nonacho	HB1	90	125	1
017	240783	Nonacho	6146	10919	Nonacho	Nonacho	HB1	95	64	1
018	250783	Taltson	6148	10848	Nonacho	Nonacho	HB1	70	73	1
019	250783	Taltson	6148	10848	Nonacho	Nonacho	HB1	70	173	1
021	280783	Taltson	6148	10848	Nonacho	Nonacho	HB1	70	120	1
023	290783	Nonacho	6146	10923	Nonacho	Nonacho	HB1	95	54	1
024	100883	Nonacho	6144	10926	Nonacho	Nonacho	HB1	105	95	1
026	120883	Nonacho	6144	10928	Nonacho	Nonacho	HB1	105	94	1
028	160883	Nonacho	6141	10949	Nonacho	Nonacho	HB1	120	113	1
030	180883	Nonacho	6146	10932	Nonacho	Nonacho	HB1	105	193	1
032	190883	Nonacho	6148	10938	Nonacho	Nonocho	HB1	115	84	1
033	200883	Nonacho	6148	10938	Nonacho	Nonacho	HB1	115	90	1
034	210883	Nonacho	6149	10947	Nonacho	Nonacho	HB1	115	146	1
037	230883	Nonacho	6155	10932	Nonacho	Nonacho	HB1	90	134	1
039	250883	Nonacho	6137	10947	Nonacho	Nonacho	HB1	125	57	1
041	270883	Nonacho	6139	10945	Nonacho	Nonacho	HB1	120	98	1
046	270684	Nonacho	6205	10919	Reliance	Nonacho	HB1	75	91	1
048	290684	Nonacho	6210	10912	Reliance	Nonacho	LSA	65	160	1
049	020784	Nonacho	6210	10912	Reliance	Nonacho	LSA	65	179	1
050	010784	Nonacho	6206	10916	Reliance	Nonacho	HB1	70	179	1
051	030784	Nonacho	6208	10914	Reliance	Nonacho	LSA	65	150	1
052	050784	Nonacho	6208	10914	Reliance	Nonacho	LSA	65	83	1
053	040784	Nonacho	6208	10912	Reliance	Nonacho	LSA	65	148	1
054	050784	Nonacho	6208	10912	Reliance	Nonacho	LSA	65	56	1
056	070784	Nonacho	6207	10919	Reliance	Nonacho	HB1	70	48	1
057	080784	Nonacho	6205	10915	Reliance	Nonacho	HB1	70	131	1
058	090784	Nonacho	6205	10914	Reliance	Nonacho	HB1	70	84	1
061	110784	Nonacho	6159	10929	Reliance	Nonacho	HB1	90	94	1
063	150784	Nonacho	6147	10932	Nonacho	Nonacho	HB1	105	41	1
065	150784	Nonacho	6147	10934	Nonacho	Nonacho	HB1	105	54	1
068	080884	Nonacho	6143	10944	Nonacho	Nonacho	HB1	115	105	1
070	110884	Nonacho	6142	10943	Nonacho	Nonacho	HB1	115	63	1
072	130884	Nonacho	6142	10943	Nonacho	Nonacho	HB1	115	52	1

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Appendix 4 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	1:250 000 map	Study area	Eco-zone	Forest limit(km)	Burn int-erval(y)	Burn chron.
073	140884	Nonacho	6142	10943	Nonacho	Nonacho	HB1	115	140	1
074	150884	Nonacho	6142	10943	Nonacho	Nonacho	HB1	115	88	1
076	180884	Porter	6143	10757	McCann	Porter	LSA	50	153	1
077	190884	Porter	6143	10757	McCann	Porter	LSA	50	59	1
078	200884	Porter	6141	10759	McCann	Porter	LSA	55	186	1
080	220884	Tejean	6128	10838	Nonacho	Porter	HB1	95	143	1
082	230884	Porter	6139	10815	Nonacho	Porter	LSA	70	98	1
084	240884	McRea	6137	10748	McCann	Porter	LSA	50	174	1
086	250884	Tejean	6130	10831	Nonacho	Porter	LSA	90	103	1
088	290884	Porter	6142	10800	Nonacho	Porter	LSA	55	113	1
090	300884	Porter	6148	10752	McCann	Porter	LSA	40	207	1
093	280685	Porter	6146	10758	McCann	Porter	LSA	50	98	1
095	300685	Porter	6133	10812	Nonacho	Porter	LSA	75	98	1
096	020785	Porter	6133	10812	Nonacho	Porter	LSA	55	197	1
098	040785	DAoust	6206	10846	Reliance	Nonacho	LSA	70	147	1
100	050785	Stewart	6201	10904	Reliance	Nonacho	HB1	70	151	1
101	050785	Stewart	6201	10904	Reliance	Nonacho	HB1	70	127	1
102	060785	Stewart	6156	10900	Nonacho	Nonacho	HB1	75	165	1
104	070785	Spearf.	6049	10737	Abitau	Spearfish	LSA	110	92	1
107	100785	Porter	6142	10802	Nonacho	Porter	LSA	55	192	1
108	110785	Porter	6132	10813	Nonacho	Porter	LSA	75	95	1
111	170785	Nonacho	6155	10917	Nonacho	Nonacho	HB1	85	171	1
114	200785	Taltson	6150	10858	Nonacho	Nonacho	HB1	80	103	1
116	210785	Taltson	6148	10842	Nonacho	Nonacho	LSA	65	34	1
117	220785	Taltson	6148	10842	Nonacho	Nonacho	LSA	65	150	1
118	230785	Nonacho	6149	10909	Nonacho	Nonacho	HB1	85	52	1
119	230785	Nonacho	6149	10909	Nonacho	Nonacho	HB1	85	71	1
120	080885	Thekul.	6103	11008	Taltson	Thekulthili	HB2	185	86	1
121	090885	Thekul.	6103	11008	Taltson	Thekulthili	HB2	185	35	1
122	100885	Heron	6105	10908	Nonacho	Thekulthili	HB1	130	103	1
123	100885	Heron	6105	10908	Nonacho	Thekulthili	HB1	130	31	1
124	120885	Kidder	6058	10915	Hill Island	Thekulthili	HB1	160	42	1
126	130885	Grampus	6038	10912	Hill Island	Thekulthili	HB1	185	189	1
127	130885	Grampus	6038	10912	Hill Island	Thekulthili	HB1	185	54	1
128	140885	Salmon	6047	10945	Hill Island	Thekulthili	HB1	190	69	1
130	160885	Thekul.	6057	11012	Ft. Smith	Thekulthili	HB2	200	50	1
131	180885	Thekul.	6059	11005	Ft. Smith	Thekulthili	HB2	200	63	1
133	200885	Thekul.	6059	11005	Ft. Smith	Thekulthili	HB2	195	99	1
134	210885	Thekul.	6112	10950	Nonacho	Thekulthili	HB1	160	87	1
135	220885	Sparks	6116	10939	Nonacho	Thekulthili	HB1	155	55	1
138	270885	Thekul.	6058	11019	Ft. Smith	Thekulth	HB2	200	85	1
140	060786	Selwyn	6007	10432	Wholdaia	Selwyn	LSA	85	118	1

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Appendix 4 (continued)

Site no.	Date DaMoYr	Lake name	Lat-itude	Long-itude	1:250 000 map	Study area	Eco-zone	Forest limit(km)	Burn int-erval(yr)	Burn chron.
142	070786	Selwyn	6005	10435	Wholdaia	Selwyn	LSA	95	91	1
144	080786	Selwyn	6011	10418	Wholdaia	Selwyn	LSA	45	112	1
146	080686	Selwyn	6015	10417	Wholdaia	Selwyn	LSA	65	137	1
148	110786	Selwyn	6012	10417	Wholdaia	Selwyn	LSA	70	143	1
150	120786	Selwyn	6005	10434	Wholdaia	Selwyn	LSA	90	123	1
152	130786	Selwyn	6007	10428	Wholdaia	Selwyn	LSA	85	156	1
154	160786	Selwyn	6002	10440	Wholdaia	Selwyn	LSA	100	202	1
158	180786	Selwyn	6003	10438	Wholdaia	Selwyn	LSA	95	127	1
160	190786	Selwyn	6009	10431	Wholdaia	Selwyn	LSA	80	93	1
162	200786	Thye	6017	10428	Wholdaia	Selwyn	LSA	75	96	1
164	210786	Turner	6007	10452	Wholdaia	Selwyn	LSA	100	190	1
166	220786	Turner	6044	10510	Wholdaia	Selwyn	LSA	85	192	1
168	230786	Selwyn	6000	10559	Wholdaia	Selwyn	LSA	115	144	1
170	250786	Selwyn	6003	10428	Wholdaia	Selwyn	LSA	90	141	1
172	260786	Selwyn	6015	10428	Wholdaia	Selwyn	LSA	75	89	1
174	270786	Selwyn	6012	10427	Wholdaia	Selwyn	LSA	80	139	1
176	270786	Selwyn	6012	10427	Wholdaia	Selwyn	LSA	80	160	1
179	150886	Slave	5955	11141	Fitzsimm.	Ft. Smith	MB2	340	54	1
180	180886	Beauvais	6027	10530	Wholdaia	Selwyn	LSA	115	173	1
182	200886	Beauvais	6030	10531	Wholdaia	Selwyn	LSA	110	133	1
184	220886	Beauvais	6022	10529	Wholdaia	Selwyn	LSA	115	174	1
186	230886	Beauvais	6027	10537	Wholdaia	Selwyn	LSA	115	148	1
192	270886	Wignes	6007	10533	Wholdaia	Selwyn	LSA	130	184	1
194	280886	Marchant	5945	10606	Fond-du	Selwyn	LSA	180	191	1
196	290886	Breynat	5948	10521	Stony	Selwyn	LSA	145	115	1
198	010986	Tazin	5953	10846	Tazin	Sask	HB1	235	98	1
216	230783	Nonacho	6148	10915	Nonacho	Nonacho	HB1	90	65	1
233	200883	Nonacho	6148	10938	Nonacho	Nonacho	HB1	105	86	2
252	050784	Nonacho	6208	10914	Reliance	Nonacho	LSA	65	64	1
254	050784	Nonacho	6208	10912	Reliance	Nonacho	LSA	65	91	1
257	080784	Nonacho	6205	10915	Reliance	Nonacho	HB1	70	85	1
263	150784	Nonacho	6147	10932	Nonacho	Nonacho	HB1	105	86	2
307	100785	Porter	6142	10802	Nonacho	Porter	LSA	55	140	2
311	170785	Nonacho	6155	10917	Nonacho	Nonacho	HB1	85	96	1
321	090885	Thekul.	6103	11008	Taltson	Thekulthili	HB2	185	42	2
323	100885	Heron	6105	10908	Nonacho	Thekulthili	HB1	130	72	2
327	130885	Grampus	6038	10912	Hill Island	Thekulthili	HB1	185	53	2
331	180885	Thekul.	6057	11012	Ft. Smith	Thekulthili	HB2	195	67	2
379	150886	Slave	5955	11141	Fitzsimm.	Ft. Smith	MB2	340	35	2

[1] See Figure 5 for ecozones.
[2] Distance from site to forest limit and not limit of trees.
[3] Burn interval is years between adjacent forest stands or between fires at one location.
[4] Chronology 1 is age difference at burn edge; 2 is interval between fire scars.

Appendix 5. Interval between burns at locations scattered throughout the winter range of the Beverly herd of caribou.

No.	Date DaMoYr	Lake name	Lat-itude	Long-itude	1:250 000 map	Study area[1]	Eco-zone[2]	Km to tundra[3]	Burn int-erval(y)[4]	Burn chron[5]
001	280380	Hughes	6000	10958	Hill Island	Border	HB2	265	60	1
002	280380	Hughes B	6000	10958	Hill Island	Border	HB2	265	41	2
003	280380	Portman	6002	10913	Hill Island	Border	HB1	240	98	1
004	280380	Portman	6001	10917	Hill Island	Border	HB1	240	95	1
005	280380	Quinnell	6006	10937	Hill Island	Border	HB2	240	243	1
006	300380	Imogen	6013	10911	Hill Island	Border	HB1	215	62	1
007	300380	Abitau	6000	10848	Hill Island	Border	HB1	225	65	1
008	300380	Abitau	6000	10848	Hill Island	Border	HB1	225	34	1
009	300381	Abitau	6028	10708	Abitau	Border	LSA	125	76	1
010	300380	Disapp.	6000	11029	Ft. Smith	Border	HB2	285	28	1
011	300380	Disapp.	6000	11029	Ft. Smith	Border	HB2	285	26	1
012	300380	Disapp.	6000	11029	Ft. Smith	Border	HB2	285	51	1
013	310380	Linwood	6001	10800	Hill Island	Border	HB1	195	107	1
014	310380	Linwood B	6001	10800	Hill Island	Border	HB1	195	75	2
015	310380	Charles	6001	11000	Hill Island	Border	HB2	265	81	1
016	310380	Tazin R.	6000	10736	Abitau	Border	LSA	185	135	1
017	290380	Ena	6000	10811	Hill Island	Border	HB1	205	20	1
018	290380	Ena B	6000	10811	Hill Island	Border	HB1	205	96	2
019	290380	Ena C	6000	10811	Hill Island	Border	HB1	205	48	3
020	280382	Walker	6153	10956	Nonacho	Nonacho	HB1	115	42	1
021	300382	Porter	6148	10752	Nonacho	Porter	LSA	40	184	1
022	310382	Bedareh	6016	11003	Ft. Smith	Border	HB2	245	23	1
023	050782	Nonacho	6153	10937	Nonacho	Nonacho	HB1	100	54	1
024	090283	Murphy	6207	10951	Reliance	Nonacho	HB1	90	51	1
025	090283	Murphy B	6207	10951	Reliance	Nonacho	HB1	90	37	2
026	090283	Rutledge	6140	11033	Taltson	Nonacho	HB2	155	93	1
027	090283	Lady	6046	11035	Ft. Smith	Thekulthili	HB2	220	25	1
028	090283	Lady B	6046	11035	Ft. Smith	Thekulthili.	HB2	220	49	2
029	100283	Magpie	6223	10858	Reliance	Nonacho	LSA	35	118	1
030	080383	Esk	6040	10738	Abitau	Spearfish	LSA	125	145	1
031	280383	Thekul.	6120	11006	Taltson	Nonacho	HB1	155	51	1
032	280383	Thekul.B	6120	11006	Taltson	Nonacho	HB1	155	59	2
033	290383	Siltaza	6211	10948	Reliance	Nonacho	HB1	80	167	1
034	290383	LaLoche	6155	11120	Taltson	West	HB2	175	57	1
035	290383	LaLoche B	6154	11120	Taltson	West	HB2	175	75	2
036	290383	LaLoche N.	6155	11122	Taltson	West	HB2	175	57	1
037	080383	Selwyn	6002	10428	Wholdaia	Selwyn	LSA	90	76	1
038	080383	Selwyn B	6002	10428	Wholdaia	Selwyn	LSA	90	156	2

Appendix 5 continued next page

Appendix 5 (continued)

No.	Date DaMoYr	Lake name	Lat-itude	Long-itude	1:250 000 map	Study area[1]	Eco-zone[2]	Km to tundra[3]	Burn int-erval(y)[4]	Burn chron[5]
039	080383	Esk	6036	10736	Abitau	Spearfish	LSA	135	145	1
040	010483	Tejean	6132	10842	Nonacho	Porter	HB1	85	40	1
041	010483	Tejean B	6132	10842	Nonacho	Porter	HB1	85	89	2
042	010483	Anderson	6117	10838	Nonacho	Porter	HB1	110	121	1
043	010483	Alcantara	6052	10817	Hill Island	Spearfish	HB1	130	34	1
044	010483	AlcantaraB	6052	10817	Hill Island	Spearfish	HB1	130	80	2
045	010483	Manch.	6123	10748	McCann	Porter	LSA	75	19	1
046	010483	Manch.B	6123	10748	McCann	Porter	LSA	75	154	1
047	010483	McRae	6137	10748	McCann	Porter	LSA	55	166	1
048	020483	Taltson	6156	10754	McCann	Porter	LSA	25	71	1
049	020483	Taltson B	6156	10754	McCann	Porter	LSA	25	181	2
050	020483	DAoust	6208	10852	Reliance	Nonacho	LSA	55	169	1
051	020483	DAoust B	6208	10852	Reliance	Nonacho	LSA	55	90	2
052	030484	Esk	6036	10736	Abitau	Spearfish	LSA	135	95	1
053	030484	Hjalmar	6134	10917	Nonacho	Nonacho	HB1	110	139	1
054	030484	Tronka	6136	10943	Nonacho	Nonacho	HB1	120	78	1
055	040484	Nonacho	6139	10948	Nonacho	Nonacho	HB1	125	103	1
056	040484	Nonacho	6139	10951	Nonacho	Nonacho	HB1	125	100	1
057	040483	Heron	6115	10908	Nonacho	Nonacho	HB1	125	104	1
058	080783	Non.	6147	10918	Nonacho	Nonacho	HB1	95	42	1
059	080783	Non.B	6147	10918	Nonacho	Nonacho	HB1	95	40	2
060	080783	Non.	6147	10917	Nonacho	Nonacho	HB1	95	28	1
061	080783	Non.B	6154	10917	Nonacho	Nonacho	HB1	90	59	2
062	080783	Non.	6154	10916	Nonacho	Nonacho	HB1	90	146	1
063	080783	Non.	6154	10916	Nonacho	Nonacho	HB1	90	91	1
064	080783	Non.B	6154	10916	Nonacho	Nonacho	HB1	90	106	2
065	150783	Non. Isl.	6144	10918	Nonacho	Nonacho	HB1	100	49	1
066	150783	Non.S	6143	10920	Nonacho	Nonacho	HB1	100	156	1
067	160783	Non. Isl	6149	10915	Nonacho	Nonacho	HB1	90	37	1
068	160783	Non.Isl.B	6149	10915	Nonacho	Nonacho	HB1	90	56	1
069	160783	Non.Isl.C	6149	10915	Nonacho	Nonacho	HB1	90	63	1
070	160783	Hjalmar	6141	10924	Nonacho	Nonacho	HB1	105	49	1
071	160783	Hjalmar	6140	10924	Nonacho	Nonacho	HB1	105	50	1
072	160783	Hjalmar B	6140	10924	Nonacho	Nonacho	HB1	105	57	2
073	160783	Hjalmar	6140	10923	Nonacho	Nonacho	HB1	105	131	1
074	160783	Hjalmar B	6140	10924	Nonacho	Nonacho	HB1	105	49	1
075	170783	Non.	6143	10937	Nonacho	Nonacho	HB1	110	106	1
076	170783	Non.S	6142	10937	Nonacho	Nonacho	HB1	110	135	1
077	170783	Non.1	6138	10944	Nonacho	Nonacho	HB1	120	166	1

Appendix 5 continued next page

Appendix 5 (continued)

No.	Date DaMoYr	Lake name	Lat-itude	Long-itude	1:250 000 map	Study area[1]	Eco-zone[2]	Km to tundra[3]	Burn int-erval(y)[4]	Burn chron[5]
078	170783	Non.2	6138	10944	Nonacho	Nonacho	HB1	120	67	1
079	170783	Non.3	6138	10943	Nonacho	Nonacho	HB1	120	53	1
080	170783	Non.5	6142	10944	Nonacho	Nonacho	HB1	115	89	1
081	170783	Non.6	6143	10942	Nonacho	Nonacho	HB1	115	40	1
082	240284	Siltaza	6211	10948	Reliance	Nonacho	HB1	80	175	1
083	300384	Selwyn	6007	10427	Wholdaia	Selwyn	LSA	80	170	1
084	291284	Smith1	5955	11141	Fitzsimm.	Ft. Smith	MB2	330	63	1
085	291284	Smith2	5956	11142	Fitzsimm.	Ft. Smith	MB2	330	55	1
086	291284	Smith3	5959	11150	Fitzsimm.	Ft. Smith	MB2	335	23	1
087	291284	Smith3B	5959	11150	Fitzsimm.	Ft. Smith	MB2	335	31	1
088	291284	Smith4	5954	11153	Fitzsimm.	Ft. Smith	MB2	340	80	1
089	291284	Smith6	6001	11205	Grand D	Ft. Smith	MB2	335	60	1
090	291284	Smith7	6002	11205	Grand D	Ft. Smith	MB2	335	63	1
091	291284	Smith7B	6002	11205	Grand D	Ft. Smith	MB2	335	33	2
092	170185	LadyGrey	6046	11035	Ft. Smith	Thekulthili	HSA	220	73	1
093	130385	Jones	6218	10823	Reliance	Nonacho	HSA	25	247	1
094	070585	Flett	6013	10427	Wholdaia	Selwyn	LSA	75	98	1
095	280386	Dunvegan	6004	10723	Abitau	Border	LSA	85	77	1
096	280386	Cobb	6153	10844	Nonacho	Nonacho	LSA	60	38	1
097	280386	CobbB	6153	10844	Nonacho	Nonacho	LSA	60	146	2
098	280386	Cobb	6155	10846	Nonacho	Nonacho	LSA	60	34	1
099	280386	CobbB	6155	10846	Nonacho	Nonacho	LSA	60	111	2
100	290386	Siltaza	6218	10859	Reliance	Nonacho	LSA	40	19	1
101	250386	Thubun	6134	11136	Talston	West	HB2	200	55	1
102	250386	Thubun	6134	11140	Taltson	West	HB2	200	57	1
103	080786	Selwyn	6010	10424	Wholdaia	Selwyn	LSA	80	100	1
104	161286	Francois	6227	11225	Hearne	North	MB2	100	82	1
105	010986	Nichol.	5938	10720	Fond-du-L	Sask.	LSA	215	52	1
106	290387	Rutledge	6124	11101	Taltson	Nonacho	HB2	190	34	1
107	290387	Payne	6249	11203	Hearne	North	LSA	55	96	1
108	250887	Pilot	6017	11050	Ft. Smith	Border	HB2	265	56	1
109	250887	Pilot	6017	11114	Ft. Smith	Border	HB2	285	68	1
110	140889	Doran	6117	10623	Nonacho	Porter	LSA	30	150	1
111	140889	Doran	6117	10620	Nonacho	Porter	LSA	30	151	1
112	140889	Doran B	6117	10620	Nonacho	Porter	LSA	30	44	2

[1] See Figure 4 for study areas.
[2] See Figure 5 for ecozones.
[3] Distance from site to forest limit and not limit of trees.
[4] Burn interval is years between adjacent forest stands or between fires at one location.
[5] Chronology 1 is age difference at burn edge; 2 is interval between fire scars.

Appendix 6. Areas and proportions of water, tundra, and non-caribou range of the Beverly herd of caribou in the Northwest Territories, by 1:250 000 map sheets.

	Area (km^2) or proportion (%)							
1:250 000	Water		Large lakes		Small lakes			Outside
map sheet	Area[1]	(%)[2]	Area[3]	(%)[3]	Area[4]	(%)	Tundra	range
Fort Smith	2080	16.9	0	0	1561	16.9	0	3072
Hill Island L.	1884	15.5	96	0.8	1774	14.7	0	0
Abitau L.	2685	22.0	0	0	2685	22.0	0	0
Wholdaia L.	3177	26.2	1398	11.5	1574	14.7	0	0
Snowbird L.	3750	30.8	1150	9.4	2355	21.4	0	0
Ennadai L.	3747	30.8	215	1.8	2054	29.0	4877	0
Boyd L.	2859	24.0	147	1.2	680	22.8	8774	0
Rennie L.	2825	24.0	245	2.1	1250	21.9	5825	0
McCann L.	2132	18.1	498	4.2	1338	13.9	1636	0
Nonacho L.	2535	21.5	774	6.6	1646	14.9	0	0
Taltson L.	3027	25.6	709	6.0	2180	19.6	0	0
Ft.Resolution	3014	25.6	925	7.9	662	17.8	0	7118
Hearne L.	2924	25.6	979	8.6	966	17.0	0	4775
Snowdrift	5305	46.5	4295	37.6	630	8.9	0	0
Ft.Reliance	2256	19.8	1249	11.0	796	8.9	1138	0
Lynx L.	2259	19.8	186	1.6	117	18.2	10561	0
Walmsley L.	2652	24.0	0	0	254	24.0	9989	0
MacKay L.	2190	19.8	254	2.3	317	17.5	8980	0
Carp L.	2830	25.6	300	2.7	628	22.9	0	8008

[1] For entire map area and not just caribou range.
[2] Estimated from data on percent areas of large and small lakes within the study area and extrapolated to map areas where such data was not available.
[3] Measured areas of lakes >10 km^2 within caribou range. Percent calculated as: *area large lakes/total area* (Table 1).
[4] Small lakes (<10 km^2) calculated for study area from systematic aerial surveys of cover types.

Appendix 7. Areas and proportions of water and non-caribou range of the Beverly herd of caribou in Saskatchewan, Alberta, and Manitoba, by 1:250 000 map sheets.

1:250 000 map sheet	Area (km²) or proportion (%)						
	Water		Large lakes		Small lakes		Outside range
	Area[1]	(%)[2]	Area[3]	(%)[3]	Area[4]	(%)	
Saskatchewan							
Tazin L.	7243	58.0	5518	44.2	963	13.8	0
Fond-du-Lac	3368	27.0	1625	13.0	1515	14.0	0
Stony Rapids	3137	25.0	1413	11.3	1530	13.7	0
Phelps Lake	3093	25.0	1237	10.0	1 670	15.0	0
Wollaston L.	4394	34.0	2509	19.4	1 519	14.6	0
Pasfield L.	1408	10.9	762	5.9	608	5.0	0
Livingstone L.	941	7.3	294	2.3	632	5.0	0
William R.	911	7.0	265	2.0	634	5.0	0
Alberta							
Fitzgerald	3157	25.3	1052	8.4	879	16.9	6206
Ft. Chipewyan	3247	25.0	1338	10.3	596	14.7	7597
Manitoba							
Kasmere L.	3036	24.2	430	3.4	2516	20.8	0
Whiskey Jack L.	2584	20.0	483	3.7	2022	16.3	0

[1] For entire map area and not caribou range.
[2] Estimated from data on percent areas of large and small lakes within the study area and extrapolated to map areas where such data was not available.
[3] Measured areas of lakes >10 km² within caribou range. Percent calculated as area large lakes/total area (Table 1).
[4] Small lakes (<10 km²) calculated for study area from systematic aerial surveys of cover types.

Appendix 8. Percentage of land surface dominated by cover types within 1:250 000 map areas of winter range of the Beverly herd of caribou, estimated by constant-interval, spot samples on systematic aerial transects, 1983 - 1986.[1]

1:250 000 map sheet	No. spot obs.	Total water[2] (%)	Small lakes[3] (%)	Burns <40 years Land[4] surface	Burns <40 years Include small L.[5]	%ann. burned land[6]	%ann. burned[7] w/sm.L.	Fire cycle[8] (yr)
Fort Smith	718	19.1	16.9	50.1	41.6	1.25	1.04	96
Hill Isl. L.	741	15.5	14.7	39.5	33.7	0.99	0.84	119
Abitau L.	853	22.0	22.0	6.9	5.4	0.17	0.14	714
Wholdaia L.	843	26.2	14.7	18.1	15.4	0.45	0.39	256
Snowbird L.	669	30.8	21.4	15.3	12.0	0.38	0.30	333
Taltson L.	797	25.6	19.6	46.2	37.1	1.16	0.93	108
Nonacho L.	814	21.5	14.9	20.3	17.3	0.51	0.43	233
McCann L.	756	18.1	13.9	13.1	11.3	0.33	0.28	357
Rennie L.	466	24.0	21.9	0.4	0.3	0.01	0.01	1000
Snowdrift/ Reliance	564	17.7	8.9	18.2	16.6	0.46	0.42	238
Totals/ave.	7221	21.8	16.9	24.0	19.9	0.60	0.50	200

[1] Data from Thomas et al. 1998 (Table 29).
[2] *Total water* is proportion of all water in spot samples within area surveyed (Fig. 2).
[3] Calculated as *Total water (spot samples) minus large lakes* (App. 6) in area surveyed.
[4] *Land surface* excludes all water.
[5] Adjusted to exclude large lakes but include small lakes (App. 6) as part of winter range to make data comparable to data in Table 6 (See Table 8).
[6] Average annual proportion burned of land surface (excludes all water). Calculated as *proportion burned in last 40 years/40.*
[7] Average annual proportion burned including small lakes (estimated proportion).
[8] Fire cycle (years) is *1/average annual proportion burned* (including small lakes).

Appendix 9. Burn history maps for winter range of the Beverly herd of caribou.

MAP (See index at bottom of page)

Page

1. Northwest Territories between 61°N and 63°N and west of 112°W on the Slave River map sheet 88

2. Northwest Territories between 60°N and 64°N and between 108°W and 112°W 89

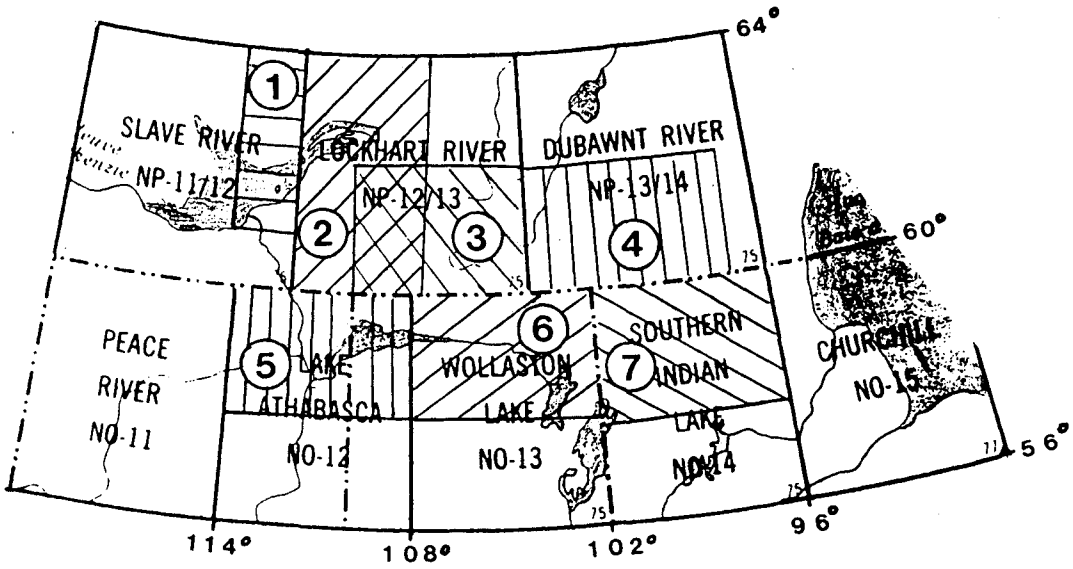
3. Northwest Territories between 60°N and 62°N and between 104°W and 109°W 90

4. Northwest Territories between 60°N and 62°N and between 97°W and 104°W 91

5. Saskatchewan and Alberta north of 58°N, west of 108°W, and east of the Slave and Athabasca rivers 92

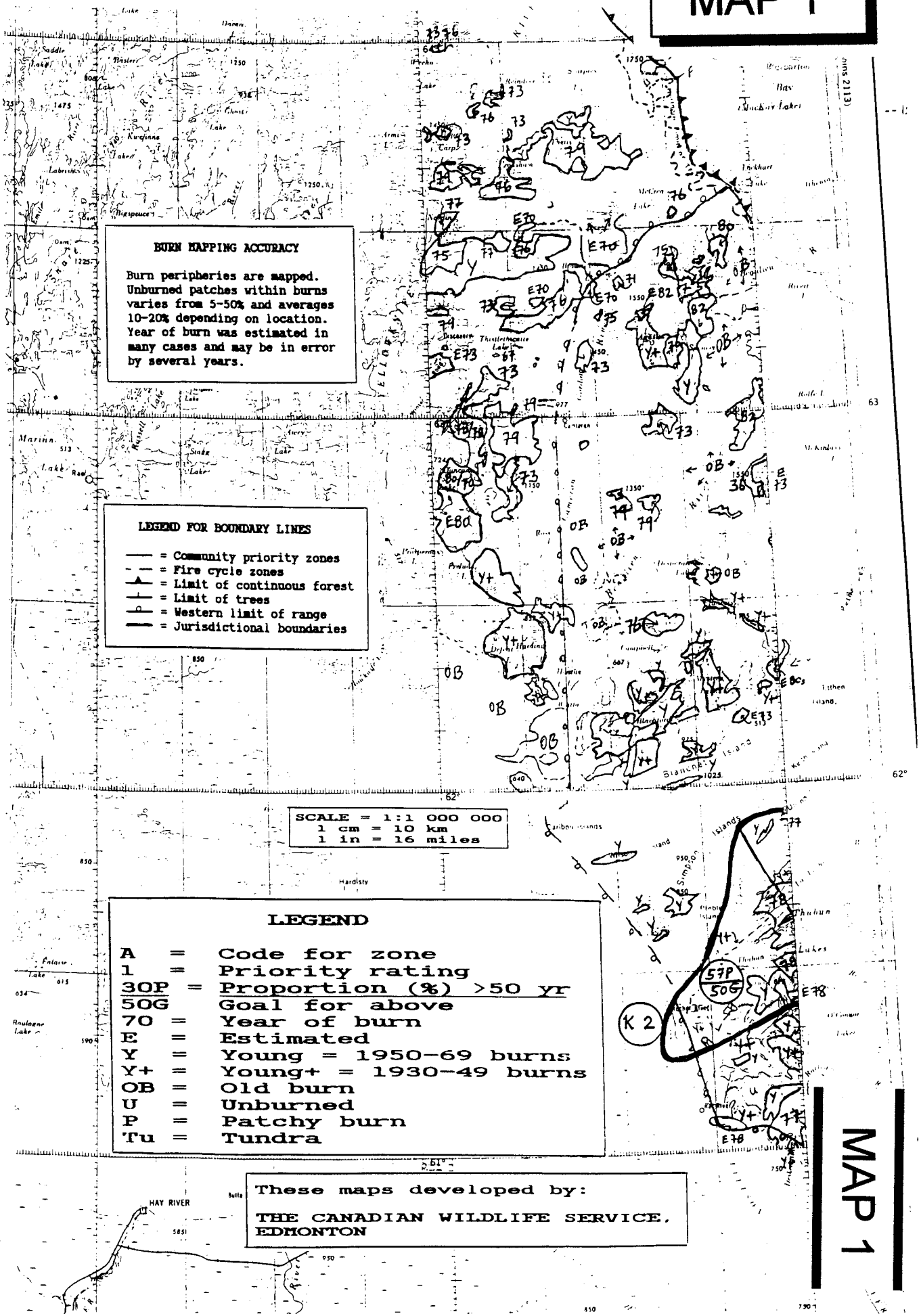
6. Saskatchewan north of 58°N and east of 108°W 93

7. Manitoba north of 57°40'N and west of 96°W 94



Fire history

MAP 1



MAP 1

Fire history

MAP 2

89

BURN MAPPING ACCURACY

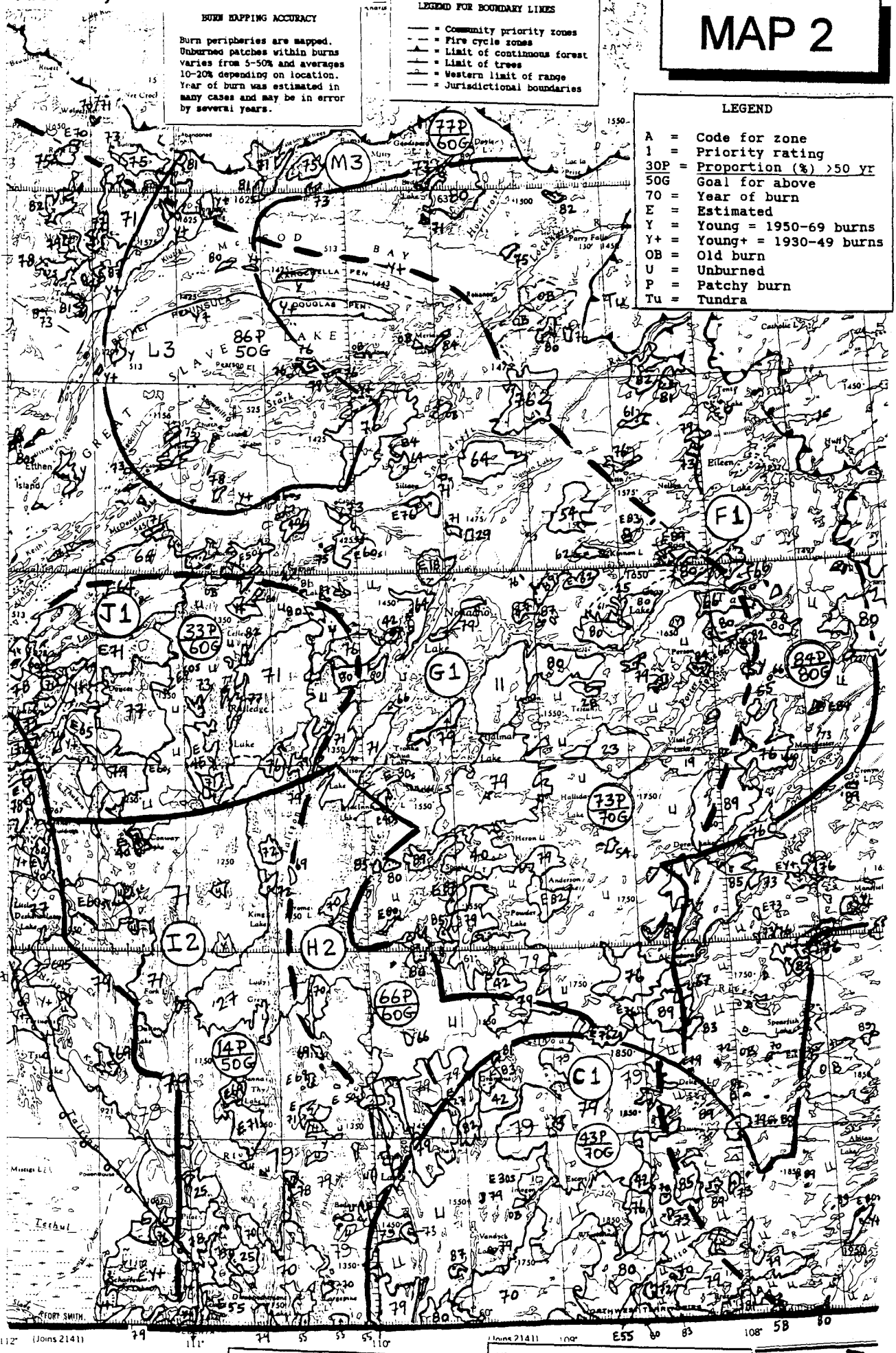
Burn peripheries are mapped. Unburned patches within burns varies from 5-50% and averages 10-20% depending on location. Year of burn was estimated in many cases and may be in error by several years.

LEGEND FOR BOUNDARY LINES

- = Community priority zones
- = Fire cycle zones
- = Limit of continuous forest
- = Limit of trees
- = Western limit of range
- = Jurisdictional boundaries

LEGEND

A	=	Code for zone
1	=	Priority rating
30P	=	Proportion (%) >50 yr
50G		Goal for above
70	=	Year of burn
E	=	Estimated
Y	=	Young = 1950-69 burns
Y+	=	Young+ = 1930-49 burns
OB	=	Old burn
U	=	Unburned
P	=	Patchy burn
Tu	=	Tundra



SCALE = 1:1 000 000
1 cm = 10 km
1 in = 16 miles

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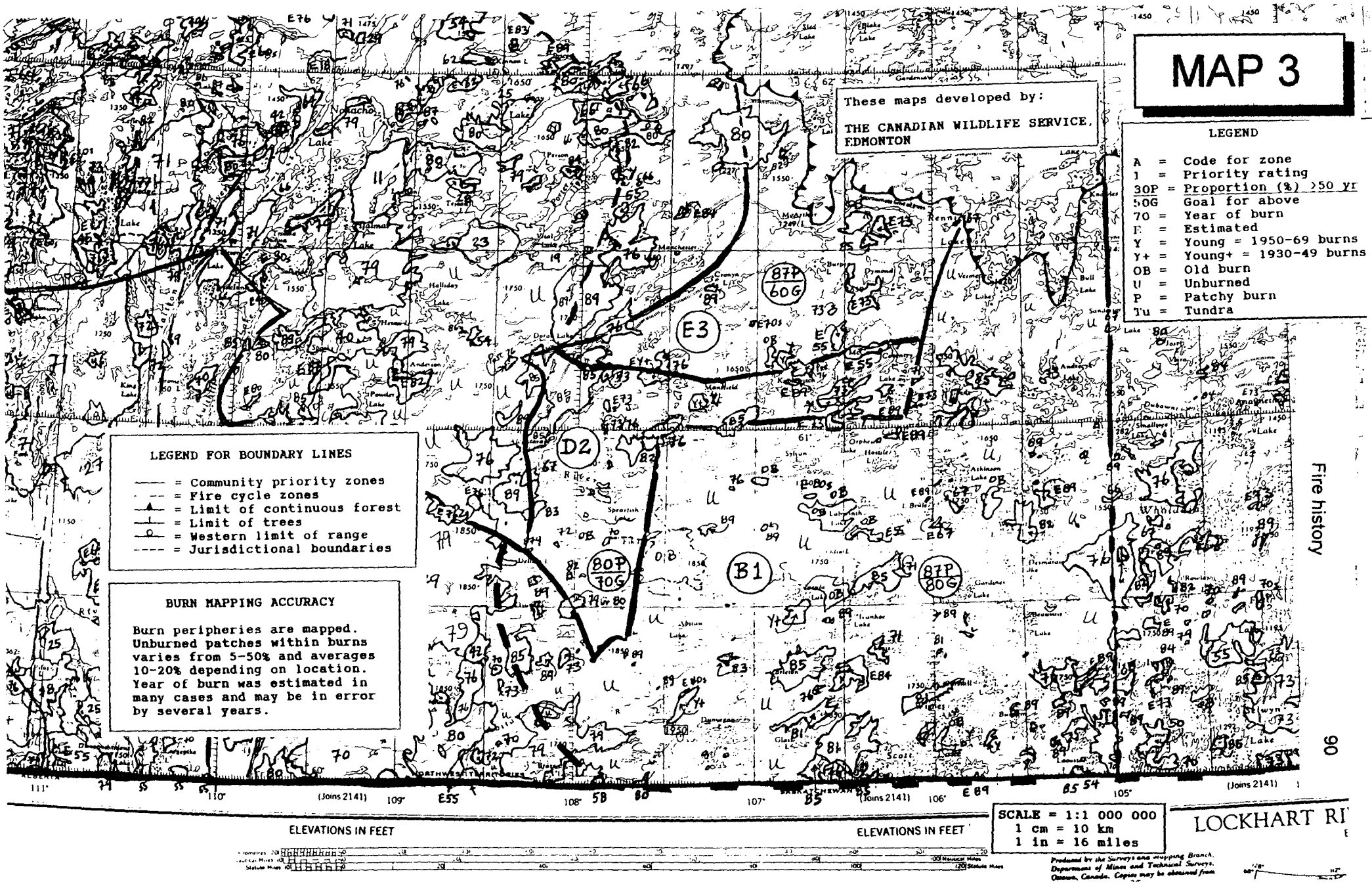
Base Map, 2nd Edition 1966
ELEVATIONS IN FEET

MAP 2



Fire history

MAP 4

Fire history

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EDMONTON

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BURN MAPPING ACCURACY

Burn peripheries are mapped. Unburned patches within burns varies from 5-50% and averages 10-20% depending on location. Year of burn was estimated in many cases and may be in error by several years.

LEGEND

A	=	Code for zone
1	=	Priority rating
30P	=	Proportion (%) >50 YR
50G		Goal for above
70	=	Year of burn
E	=	Estimated
Y	=	Young = 1950-69 burns
Y+	=	Young+ = 1930-49 burns
OB	=	Old burn
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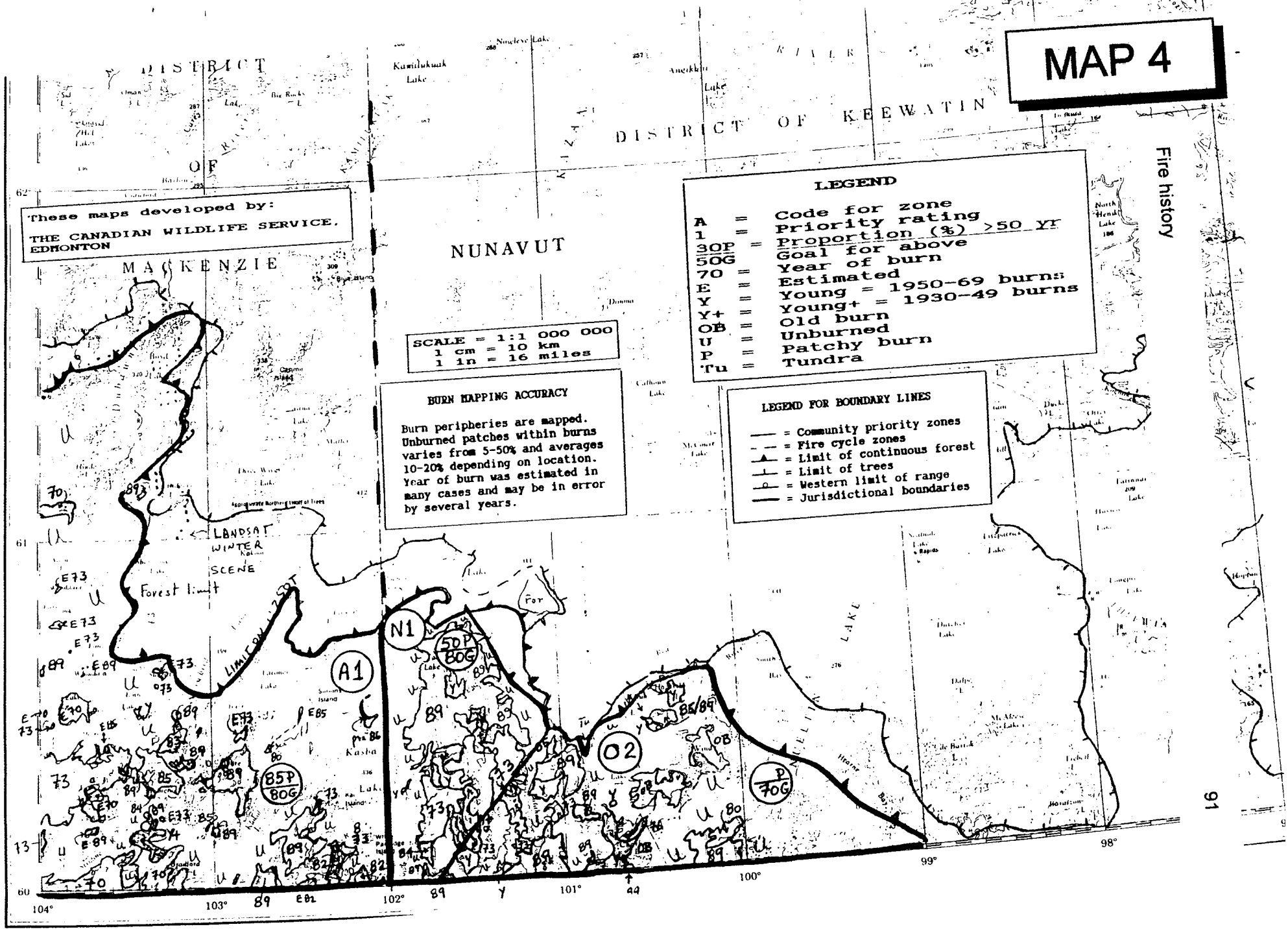
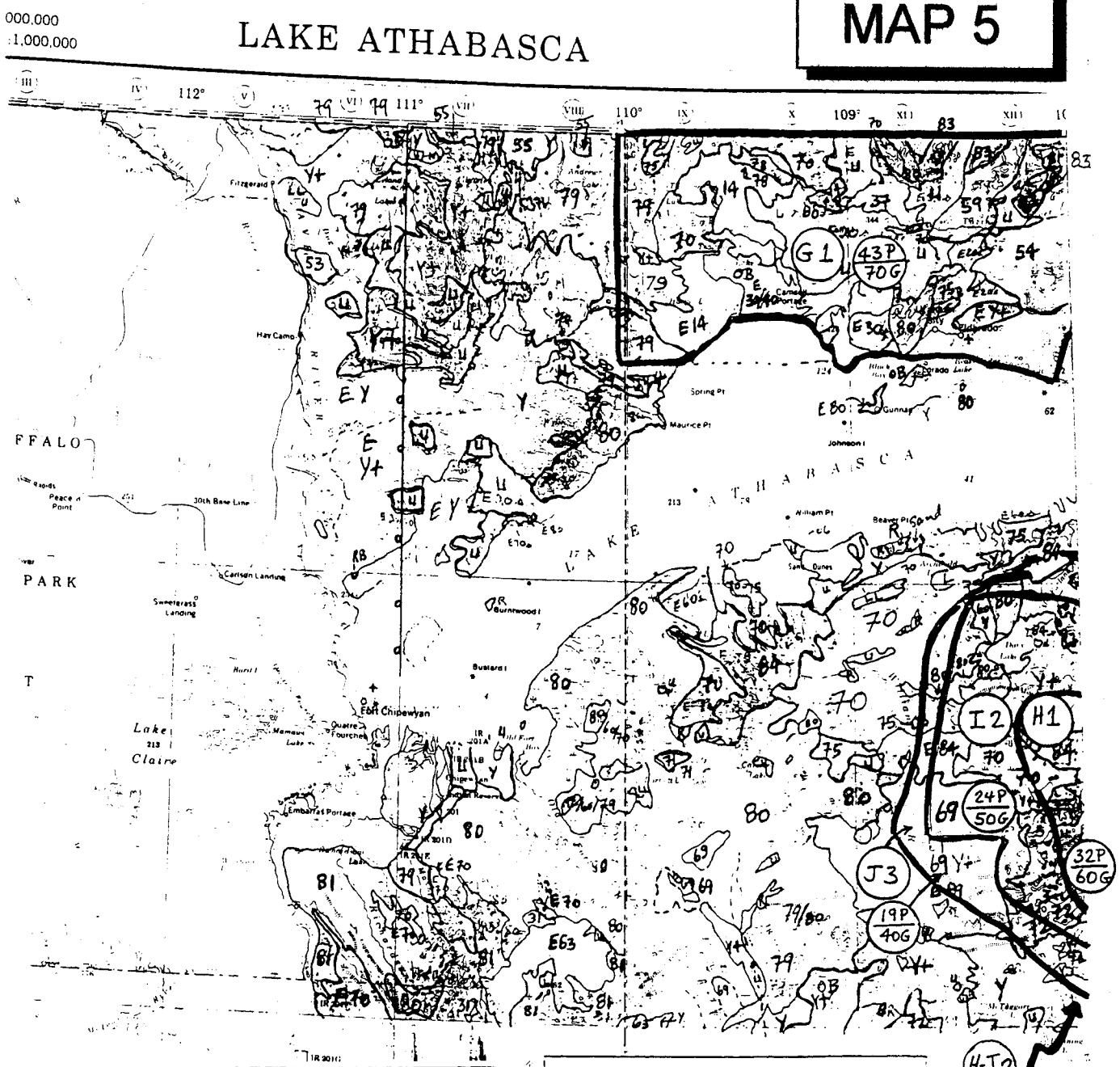
P	=	Patchy burn
Tu	=	Tundra

LEGEND FOR BOUNDARY LINES

- = Community priority zones
- = Fire cycle zones
- = Limit of continuous forest
- = Limit of trees
- = Western limit of range
- = Jurisdictional boundaries



MAP 5



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SCALE = 1:1 000 000
1 cm = 10 km
1 in = 16 miles

LEGEND

A	=	Code for zone
1	=	Priority rating
30P	=	Proportion (%) >50 yr
50G		Goal for above
70	=	Year of burn
E	=	Estimated
Y	=	Young = 1950-69 burns
Y+	=	Young+ = 1930-49 burns
OB	=	Old burn
U	=	Unburned
P	=	Patchy burn
Tu	=	Tundra

BURN MAPPING ACCURACY

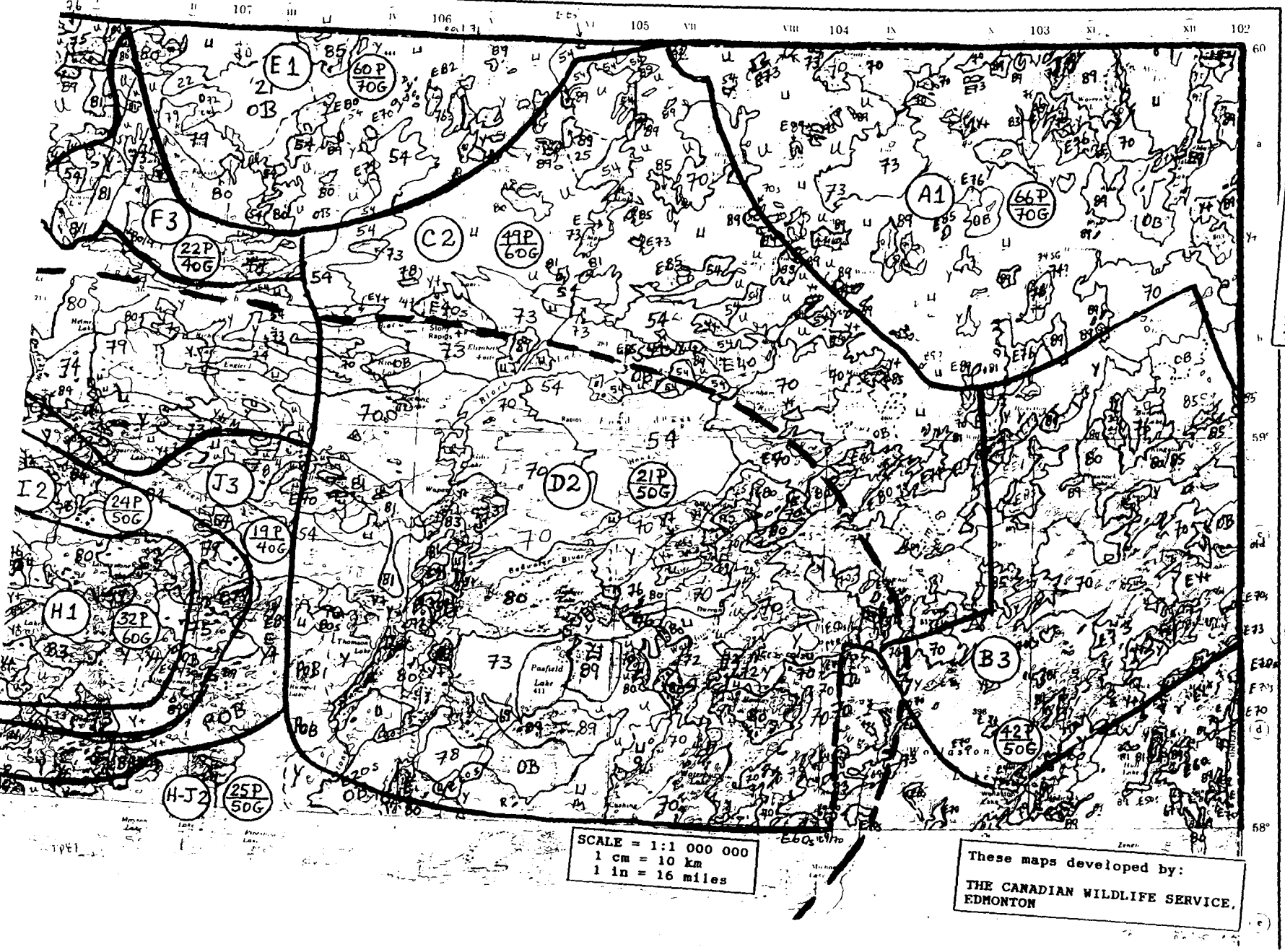
Burn peripheries are mapped. Unburned patches within burns varies from 5-50% and averages 10-20% depending on location. Year of burn was estimated in many cases and may be in error by several years.

LEGEND FOR BOUNDARY LINES

- = Community priority zones
- = Fire cycle zones
- = Limit of continuous forest
- = Limit of trees
- = Western limit of range
- = Jurisdictional boundaries

MAP 5

WOLLASTON LAKE



MAP 6

LEGEND

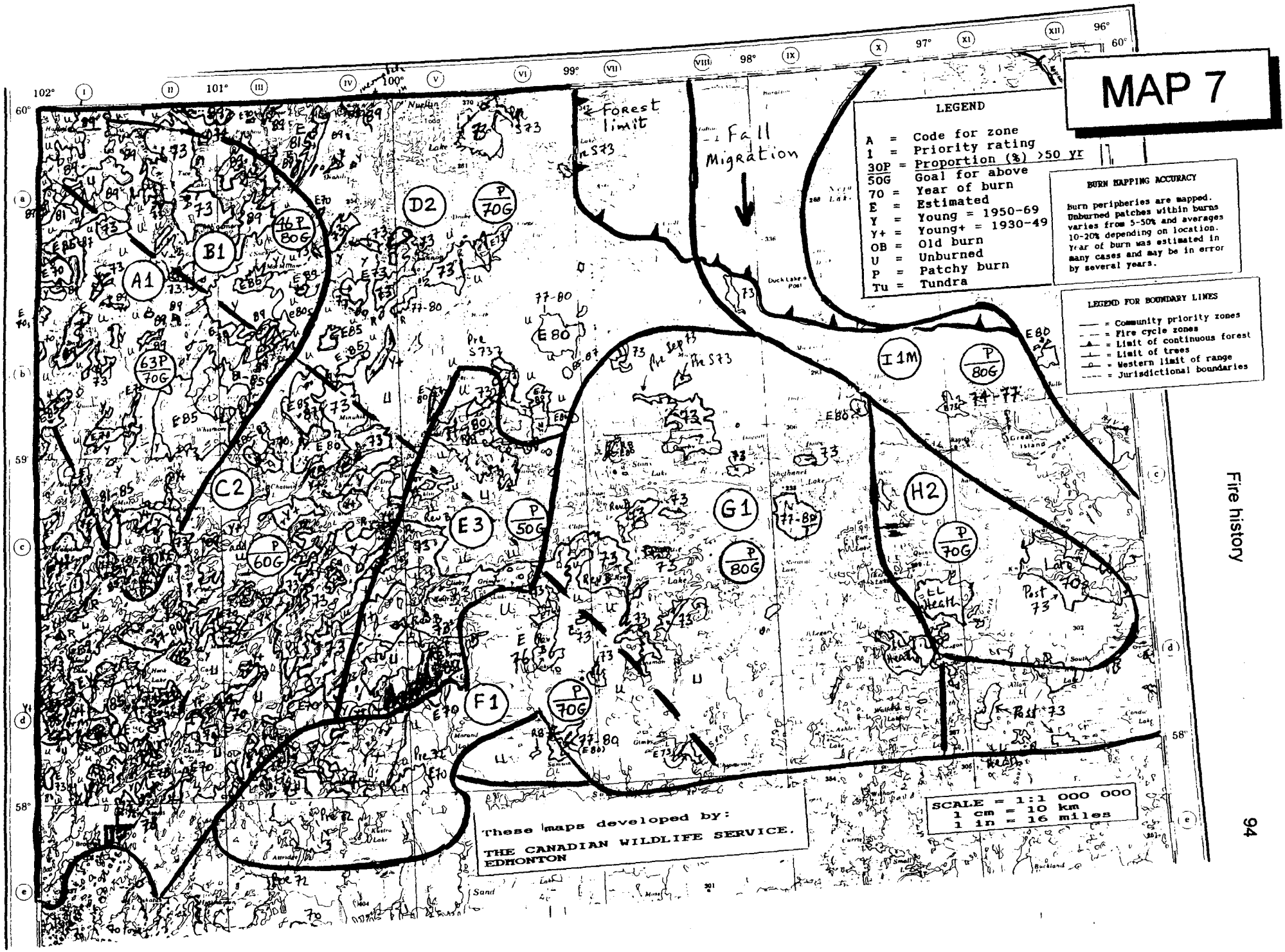
A = Code for zone
1 = Priority rating
30P = Proportion (%) >50
50G = Goal for above
70 = Year of burn
E = Estimated
Y = Young = 1950-69 burn
Y+ = Young+ = 1930-49 bur
OB = Old burn
U = Unburned
P = Patchy burn
Tu = Tundra

LEGEND FOR BOUNDARY LINES

= Community priority zones
= Fire cycle zones
= Limit of continuous forest
= Limit of trees
= Western limit of range
= Jurisdictional boundaries

BURN MAPPING ACCURACY

Burn peripheries are mapped. Unburned patches within burns varies from 5-50% and averages 10-20% depending on location. Year of burn was estimated in many cases and may be in error by several years.


MAP 7
LEGEND
A = Code for zone
1 = Priority rating
30P = Proportion (%) >50 yr
50G = Goal for above
70 = Year of burn
E = Estimated
Y = Young = 1950-69
Y+ = Young+ = 1930-49
OB = Old burn
U = Unburned
P = Patchy burn
Tu = Tundra
BURN MAPPING ACCURACY
Burn peripheries are mapped. Unburned patches within burns varies from 5-50% and averages 10-20% depending on location. Year of burn was estimated in many cases and may be in error by several years.
LEGEND FOR BOUNDARY LINES
= Community priority zones
= Fire cycle zones
= Limit of continuous forest
= Limit of trees
= Western limit of range
= Jurisdictional boundaries
Forest limit
Fall Migration
A1
B1
C2
D2
E3
F1
G1
H2
I1M
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1 cm = 10 km
1 in = 16 miles

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