MICROCLIMATE OF CLEARCUTS IN WEST-CENTRAL ALBERTA

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ABSTRACT

The effects of clearcuts on the microclimate of forest lands are relatively unknown in Alberta. Any changes resulting from extensive clearings made in the canopy cover of forest vegetation are likely to influence the early growth and survival of planted seedlings in the cut blocks. A study was initiated in 1974 to determine microclimate changes in air and soil temperature in the Hinton leasehold forest where extensive clearcutting had occurred for pulpwood harvesting. Measurements were taken at half-hour intervals over the growing season at increasing distances from the stand edge (15, 46, 91, 137, and 183 m). Analyses are presented for two study areas in Athabasca and McLeod working circles, and comparisons are made for the changes in temperature microclimate of the cut blocks at 10 cm above ground, at ground surface, and at 7.6 and 15.2 cm below ground surface.

INTRODUCTION

Large-scale clearcutting operations are commonly practiced by pulp and paper mills in Alberta as economically acceptable harvesting techniques. Such cuts are normally 16-24 ha in area, but may often extend over 200 ha or more(Johnstone 1984). The microclimatic impact of such large openings in forest canopy is relatively unknown. A study was initiated in 1973 to determine the air and soil temperature variations of clearacuts as influenced by distance from stand edge. Results of the field data collected from two clearcut blocks during 1975 and 1976 are reported in this paper.

METHODS

Study Areas

The two clearcut blocks (Areas 262 and 566) are located in the leasehold (7770 km^2) of Champion Forest Products (Alberta) Ltd. (Fig. 1), which forms part of the boreal forest region. Elevations range from 853 m in the eastern portion of the leased area to 2621 m in the southwestern part, and the mean annual daily temperature varies from 1.0 to 2.9^0 C with a few exceptions (Hillman et. al 1978). Mean annual precipitation ranges between 510 and 560 mm, with July as the wettest and warmest month (Powell and MacIver

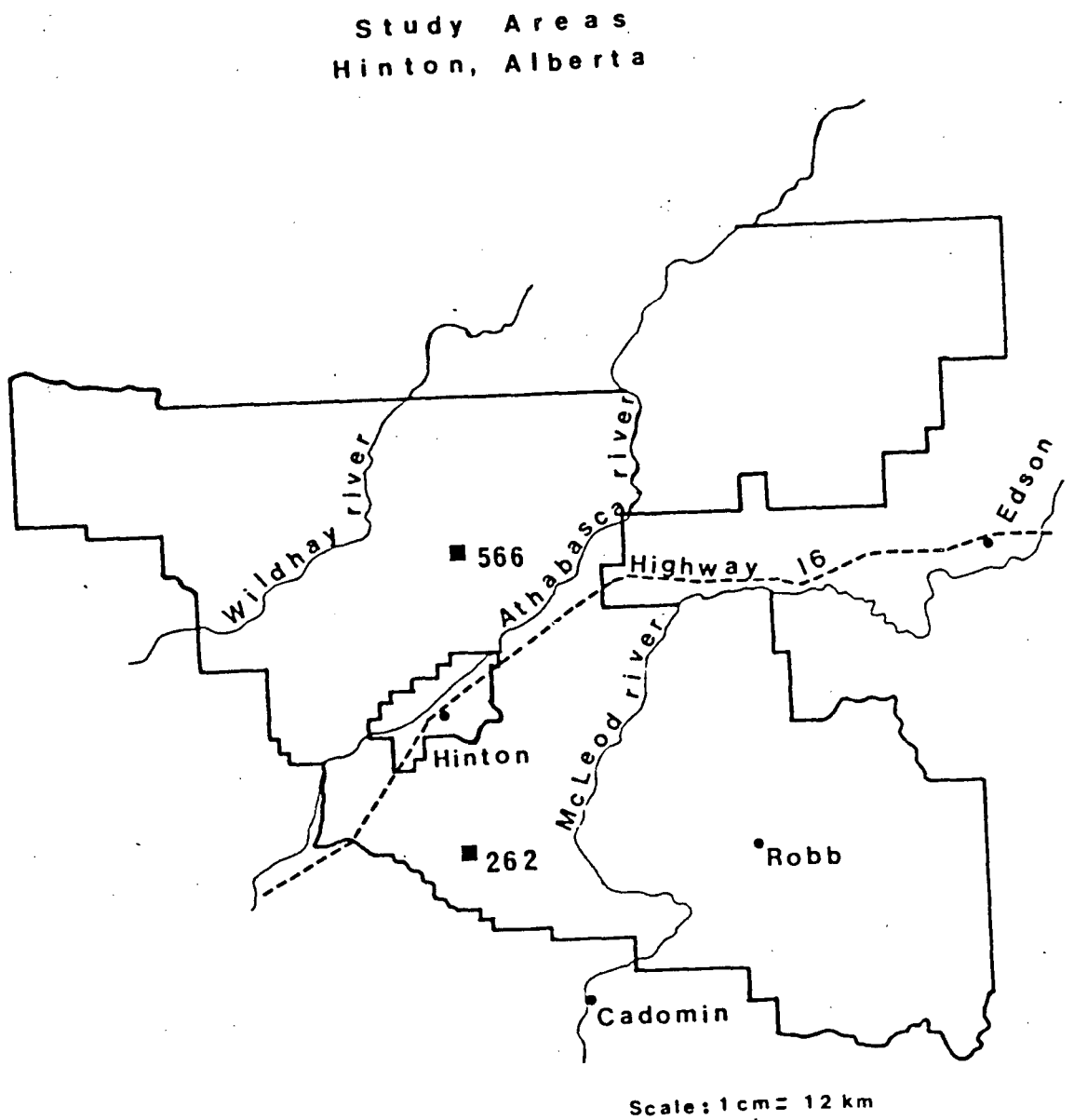

Fig. 1. Location of the clearcuts studied in the forest management lease area of Champion Forest Products (Alberta) Ltd., near Hinton, Alberta.

1976).

Area 262 forms part of McLeod Working Circle south of Hinton, whereas Area 566 is in Athabasca Working Circle north of Hinton. Prior to clearcutting, Area 262 supported 90-year old lodgepole pine (Pinus contorta Dougl. var. latifolia Engelm.), whereas the dominant vegetation in Area 566 was a 160-year old stand of white spruce (Picea glauca (Moench) Voss) and alpine fir (Abies lasiocarpa (Hook.) Nutt.). The slope and aspect of the study area were: 15-30 % and southwest for area 262, and 5% and northeast for area 566. Areas 566 and 262 were clearcut in 1969 and 1970, respectively. Both areas were drag-scarified prior to replanting with white spruce and lodgepole pine seedlings; area 566 was also blade-scarified with bulldozer, which removed up to 15 cm of mineral soil and created drier microclimatic conditions compared to area 262. Information on soils and other site factors in the two clearcuts is provided by Johnstone (1984).

Microclimate Data

Air and soil temperatures of clearcuts were measured by thermocouples and recorded at half-hour intervals. The measurements were made along two transects at 15, 46, 91, 137, and 183 m from the stand edge. At each point four readings were taken: air

temperature at 10 cm above ground, and soil temperatures at ground surface and at depths of 7.6 and 15.2 cm below the surface. There were thus 48 x 40 = 1920 readings for each day of data collection in each area. Data collection was done through the growing season of 1975 for Area 262 and 1976 for Area 566.

RESULTS AND DISCUSSION

The data presented for Area 262 were collected from 29 June to 31 August, 1975. The data obtained for Area 566 cover the period from 10 June to 2 September 1976. For each half-hour the readings are the average of the two transects.

The temperature trends in the two studied areas showed these patterns:

1. In terms of individual months, the intensity of variation of the four levels of temperature measurements with respect to each other was more in July than in August (Fig. 2, 3). Area 262 showed greater monthly variation among July and August months than Area 566. The differences between ground surface and air temperatures were greater in area 566 than in area 262 (Table 1). These differences were all statistically significant for area 566, and non-significant only in one case in area 262.

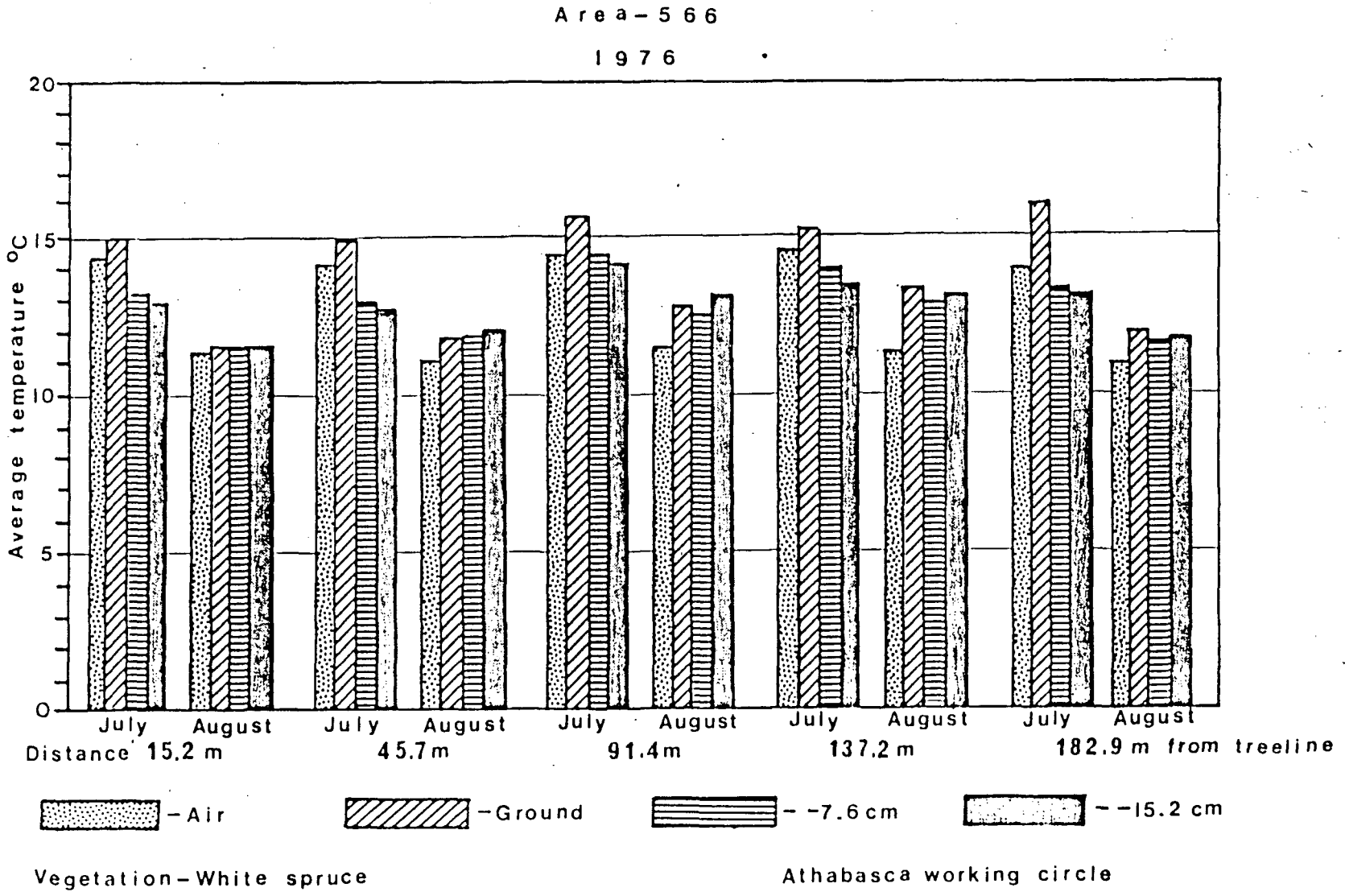

Fig. 2. The mean monthly temperature at increasing distance from the stand edge in clearcut Area 566 for the months of July and August.

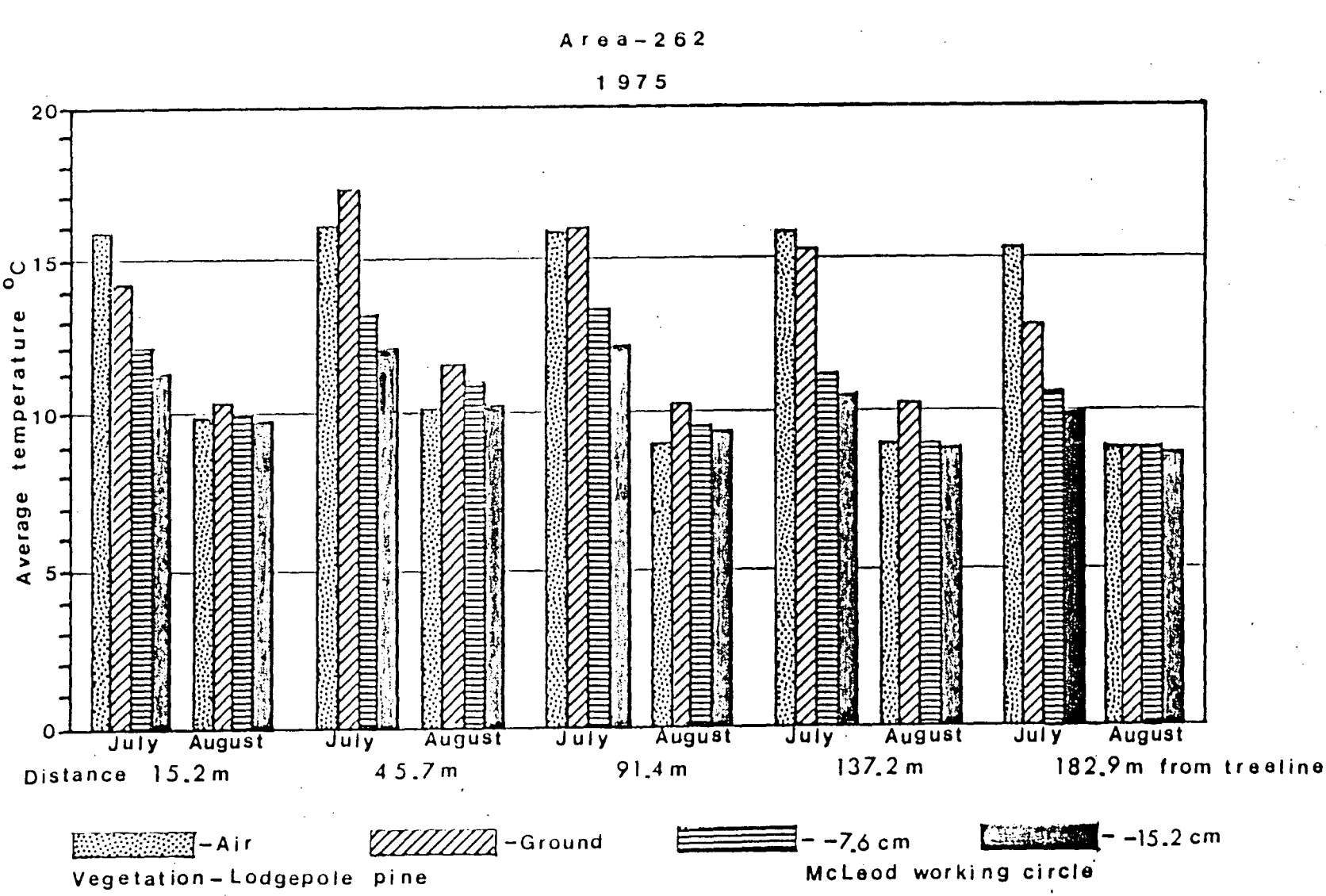

Fig. 3. The mean monthly temperature at increasing distance from the stand edge in clearcut Area 262 for the months of July and August.

Table 1. Mean difference of ground surface temperature (^{0}C) from air temperature in clearcut blocks during July and August, 1975-76.

	Distance (m) from stand edge				
	15	46	91	137	183
Clearcut Area 262 (1975)					
Mean difference	-0.65*	1.28**	0.64**	0.41NS	-1.30**
Standard error of mean	0.26	0.08	0.19	0.26	0.31
Maximum difference	2.5	2.3	2.7	2.5	2.1
Minimum difference	-5.6	-0.2	-3.6	-5.1	- 7.3
Clearcut Area 566 (1976)					
Mean difference	0.59*	0.91**	1.31**	1.26**	1.49**
Standard error of mean	0.23	0.20	0.14	0.21	0.18
Maximum difference	2.5	3.3	2.9	3.9	4.2
Minimum difference	-3.7	-2.2	-1.0	-1.6	-1.4

**Significance at 1 %level. *Significance at 5% level.
NS Not significant at 5% level.

2. The growing season temperatures at the ground surface for the observed time period remained higher than the air mean temperatures throughout the studied distances in Area 566 (Fig. 4). The difference was less persistent in Area 262 (Fig. 5), although majority of the recording stations showed higher mean temperature for the ground surface than air.

3. Soil mean temperatures at depths 7.6 and 15.2 cm were lower than the air mean temperature all through the reported growing period in Area 262, and for distance up to about 70 m from the stand edge in Area 566. However, the soil mean temperatures at these depths in Area 562 exceeded the air mean temperatures at greater distances (approximately 70 - 120 m), and the soil mean temperatures at depth 7.2 cm remained higher than the air mean temperatures at distances of approximately 70 - 183 m from the stand edge.

4. The overall effects of the clearcuts on ground and soil temperatures extended over comparatively greater distance from the stand edge in Area 566 than in Area 262.

The small increases in ground and soil mean temperatures during July and August have to be considered in conjunction with rainfall patterns to determine their combined effect on the growth and survival of seedlings planted in the clearcut areas.

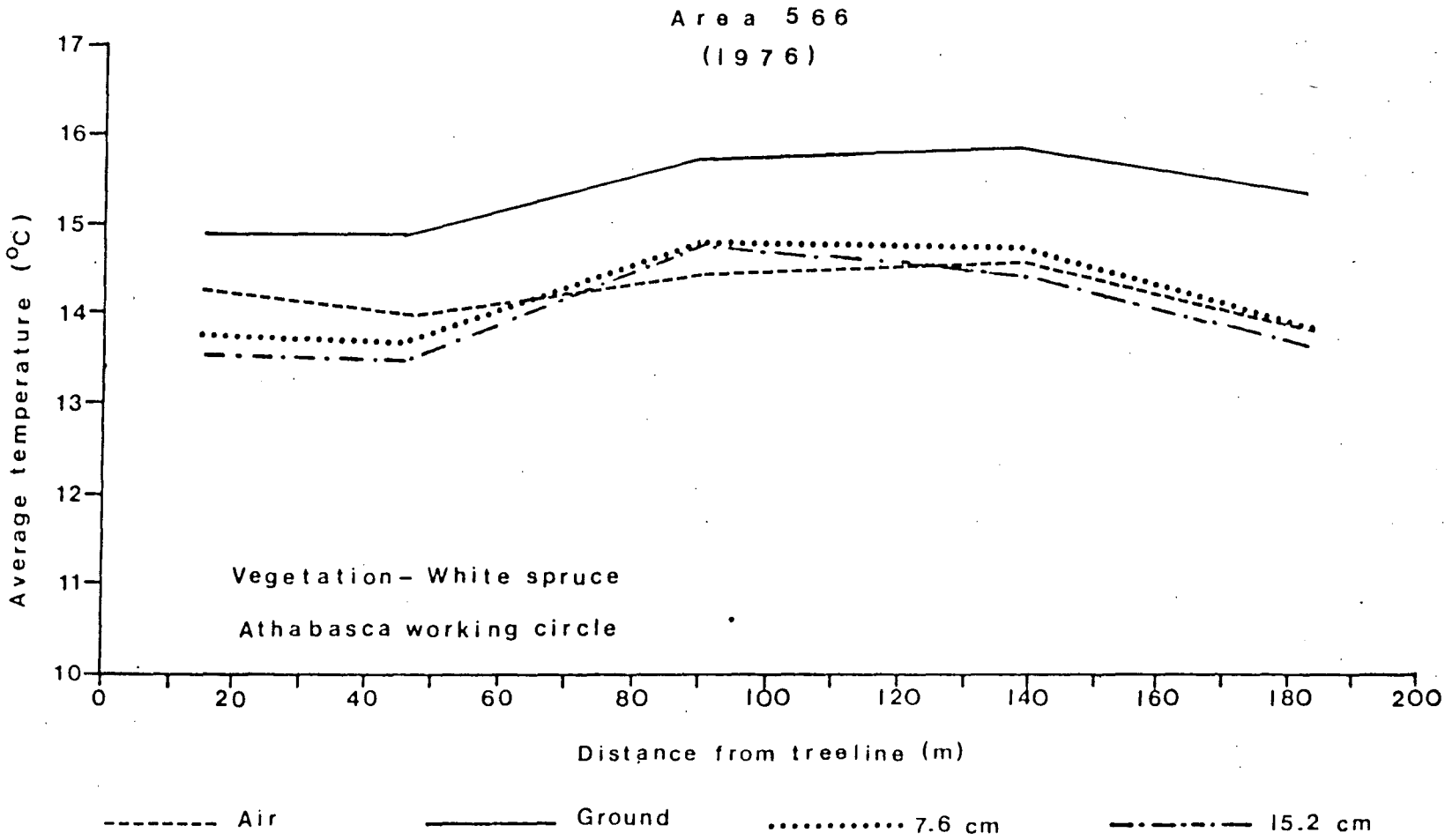

Fig. 4. Comparative daily variability of four levels of temperature measurements in clearcut Area 566 at increasing distance from the stand edge.

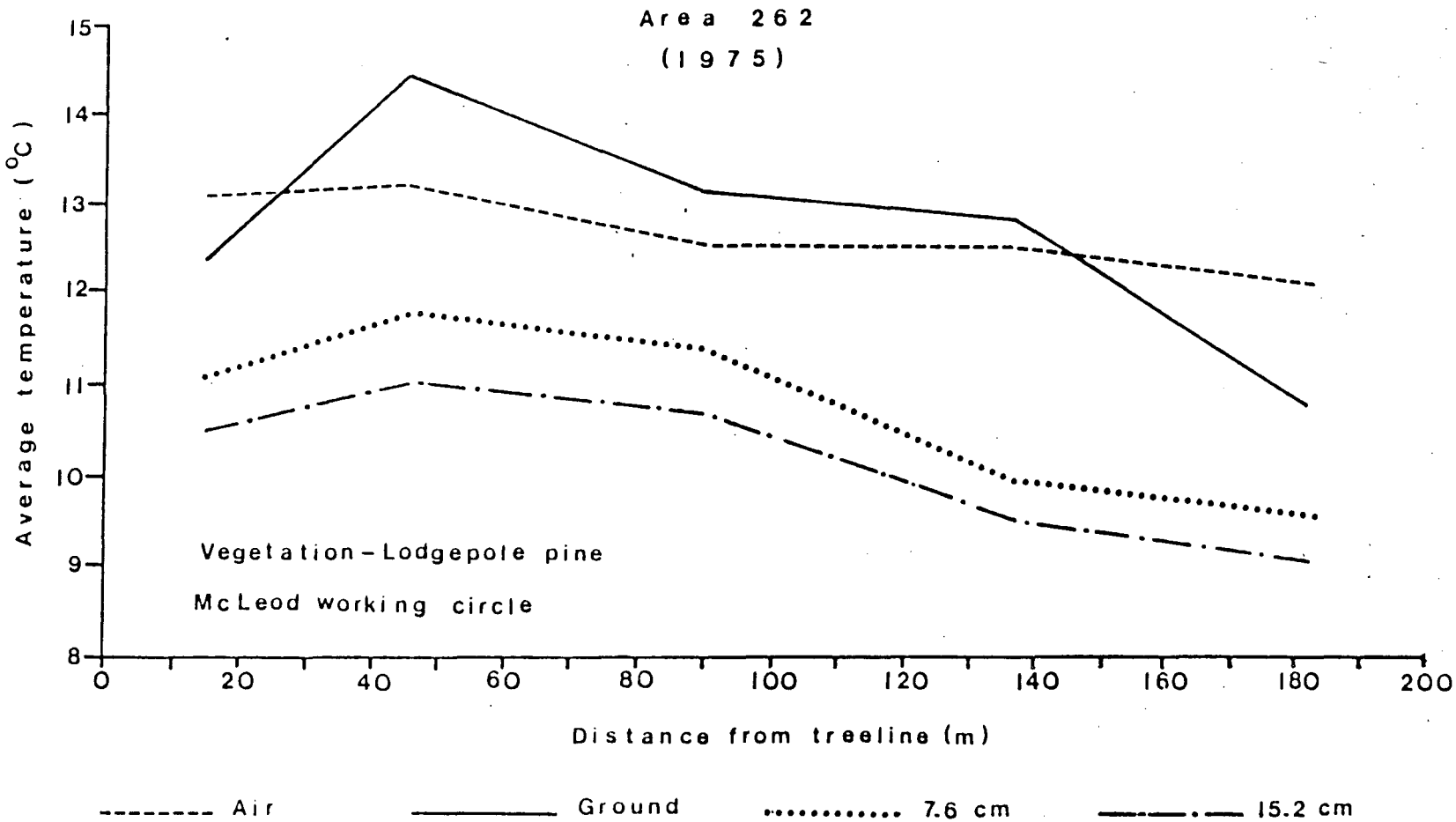

Fig. 5. Comparative daily variability of four levels of temperature measurements in clearcut Area 262 at increasing distance from stand edge.

Whereas the reported increase in mean temperatures could be beneficial in case of adequate moisture supply, the reverse could be true under drought conditions.

ACKNOWLEDGMENTS

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Alberta Climatological Association

CURRENT CLIMATOLOGICAL ACTIVITY IN ALBERTA

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FORWARD

The Alberta Climatological Association (ACA) continues to promote the exchange of scientific and technical information on climate activities in Alberta. Individuals and agencies, both private and public, are encouraged to share their climatological experiences and concerns. The general theme of climate activities in Alberta has brought forward a very interesting and diverse selection of technical papers for this 10th Anuual General Meeting of the ACA.

The Keynote address to open the General Meeting dealt with the relatively new area of marketing climatology. This topic indicates that climate related concerns are becoming more important to a wider and more diverse group of Albertans. Later, as part of the Technical Session, a paper was presented on the related issue of climate applications and their worth. The remainder of the technical papers considered areas encompassing agriculture, forestry and special applications such as the 1988 Olympic Winter Games.

A new addition to the proceedings this year is an inventory of climatological research which has been compiled by Alberta Environment. This is a very important part of the ACA mandate to provide information to the membership. Projects outlined in this summary provide members with an indepth view of the activities of the many agencies in Alberta that are conducting climatological research. The Executive was also very pleased to introduce to the membership the Alberta Climatological Association's newsletter, the General Circulation. It is intended that the newsletter will be used to communicate climatological information and concerns.

Publication of these proceedings was made possible by the allocations of funds from Environment Canada. Special thanks are extended to Dr. A. MacPherson of Environment Canada for his continued support of the ACA and to the secretarial staff of Research Management Division of Alberta Environment for their assistance in the preparation of the proceedings. Also, the assistance of the Executive, the speakers and all of the participants is greatly appreciated.

Bruce Thomson, Chairman