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Effects on the forest of sulphur dioxide from a sulphur fire near Edson, Alberta

by Drake Hocking

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EFFECTS ON THE FOREST OF SULPHUR DIOXIDE FROM A SULPHUR FIRE NEAR EDSON, ALBERTA

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ABSTRACT

Sulphur was burnt in a sanitary landfill during August 9 and 10, 1974. Resulting sulphur dioxide impinged on the surrounding mixed forest for 29 h. About 4 ha of forest displayed visible injury symptoms of varying intensity soon after. However, only .4 ha remained permanently injured the next season. Here, white spruce (Picea glauca *(Moench) Voss) and scattered individuals of balsam poplar (*Populus balsamifera *L.), alder (*Alnus tenuifolia *Nutt.), and trembling aspen (*Populus tremuloides *Michx.) were killed.*

This report describes the extent of injury, relative sensitivities of affected plant species, and recovery in the spring of 1975.

RESUME

Les 9 et 10 août 1974, du souffre brûla à ciel ouvert. Le bioxyde de souffre qui en résulta se répandit durant 29 h sur la forêt mixte environnante. Peu après, environ 4 ha de forêt furent visiblement affectés mais l'intensité des dégâts varia. Cependant, 0.4 ha seulement demeurèrent affectés durant la saison suivante. Dans ce cas, l'Épinette blanche, Picea glauca *(Moench) Voss, et quelques arbres çà et là de Peuplier baumier,* Populus balsamifera *L., d'Aulne,* Alnus tenuifolia *et de Peuplier faux-tremble,* Populus tremuloides *Michx. furent tués.*

L'auteur décrit l'importance des dommages, la vulnérabilité relative des espèces affectées et leur guérison au printemps de 1975.

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INTRODUCTION

On Monday, August 12, 1974, Mr. Jerry Lack (Chief, Air Pollution Control Section, Alberta Environment) telephoned with information that elemental sulphur dumped in a sanitary landfill near Edson, Alberta (Fig. 1) had caught fire and that fumes had been impinging on the forest. He requested the Northern Forest Research Centre to undertake a survey to determine the extent of injury to vegetation.

BACKGROUND

The following information was obtained from interviews. A contractor engaged to clean out sulphur cars for the Canadian National Railway in Edson had been dumping recovered sulphur in the Town of Edson disposal site. On August 8 a truckload of sulphur was accumulated after closure of the town dump (6:00 p.m.). The sulphur was hauled out to the Improvement District No. 14 sanitary landfill site, located about 5 km N.W. of the town in the S.E. 1/4 of Section 29-53-17-W. 5th meridian. This sulphur was dumped and not buried.

About 11:00 a.m. on August 9 the sulphur was somehow ignited. It burned fiercely for about 5 h and smoldered for a further 24 h. It was partially extinguished by burial and then was drenched by heavy rain on August 10 and 11. There are no data on the total amount of sulphur burned or on concentrations of sulphur dioxide at any time or place nearby.

WEATHER

During the time the sulphur was burning weather was rather variable. The summary following was obtained from Mr. W. Campbell of

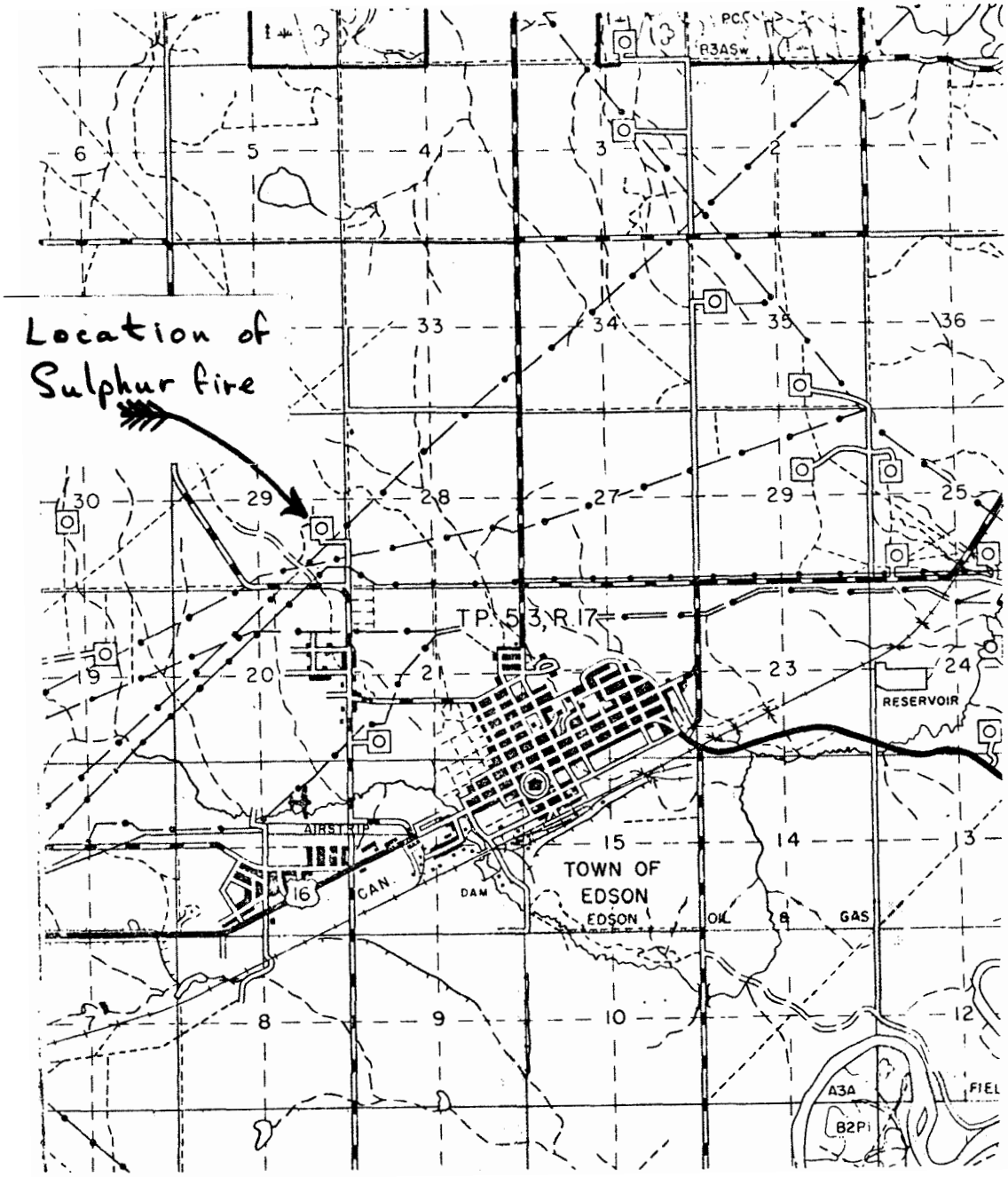

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Fig. 1 Edson area showing location of sulphur fire.

the Edson Health Unit.

August 9. Light trace of rain at 9:30 a.m. Temperature high: 22°C. Wind W and SW, calm to 24 km/h, average 8-10 km/h.

August 10. Light rain showers between 12:45 and 1:30 p.m. and between 2:00 and 3:00 p.m.; thundershowers from 4:30 to 5:30 p.m. Wind W and NW, calm to 24 km/h, average 11 km/h.

August 11. Light rain from 3:05 to 10:47 a.m. and showers all afternoon. Wind W and N and NE, light to 16 km/h, average 8-10 km/h.

IMPACT ON VEGETATION

The area was examined on August 13 and 21 and again on September 13, 1974. There was no clear and apparent progression of injury beyond that observed on the first date, except as noted below. Affected vegetation was photographed and sampled for herbarium preservation. The extent of injured vegetation was mapped (Fig. 2), with injury zones based on severity and frequency of symptoms.

All vegetation (foliage) immediately downwind (NE) of the fire was totally and uniformly brown for a distance of about 20 m into the bush. Beyond the totally brown area, symptoms typical of sulphur dioxide injury were found on most plant species. On some species in some locations, injury occurred in irregular patches, suggesting the presence of moisture droplets on leaf surfaces at the time of fumigation. In some

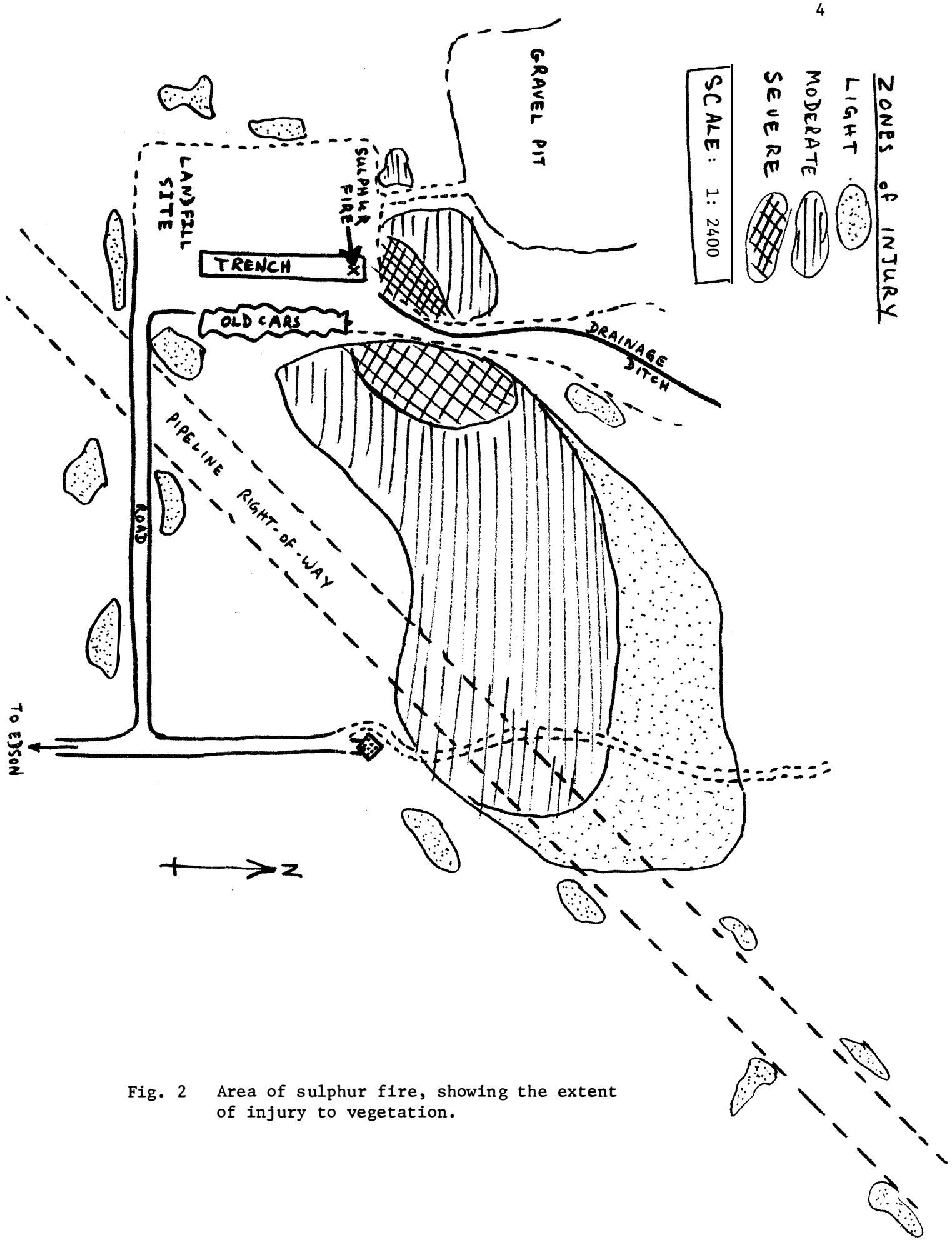

Fig. 2 Area of sulphur fire, showing the extent of injury to vegetation.

understory species (notably wild rose and low bush cranberry), symptoms resembled fall senescence. Severity and frequency of injury symptoms declined with distance downwind from the fire. The greatest distance at which visual symptoms were found (on balsam poplar, alder, and fireweed) was about 800 m, on the fringes of cleared pipeline right-of-way (Fig. 2).

There were small patches of injured vegetation on all sides of the main clearing for the landfill site, suggesting minor veering of the wind direction during the intense burning.

On the September 13, 1974 inspection fall senescence of foliage was more advanced on trees that had been mildly injured by the sulphur dioxide, and on trees peripheral to them but originally observed without visible symptoms. The winter buds and cambium were also examined. Trees very close to the burn appeared to have suffered injury to buds and cambium, but those more than about 10 m from the edge of the bush appeared normal.

The affected species included the following, listed under each main heading in order of decreasing foliar sensitivity to acute injury as indicated by severity of symptoms and maximum distance at which symptoms were observed. (Note that foliar sensitivity is not the same as overall resistance or ability to recover after injury.) The list is not exhaustive, but includes most of the prominent common plants of the area. Reference collections showing symptoms are lodged in the herbarium at the Northern Forest Research Centre, Edmonton.

Trees

Most Sensitive: (to foliar injury)	balsam poplar	*Populus balsamifera* L.
	alder	*Alnus tenuifolia* Nutt.
	trembling aspen	*Populus tremuloides* Michx.
	white birch	*Betula papyrifera* Marsh
	willow	*Salix* spp.
Least Sensitive: (to foliar injury)	white spruce	*Picea glauca* (Moench) Voss

Shrubs

Most Sensitive:	wild raspberry	*Rubus strigosus* Michx.
	wild gooseberry	*Ribes lacustre* (Pers.) Poir.
	wild rose	*Rosa acicularis* Lindl.
	honeysuckle	*Lonicera involucrata* (Richards.) Banks
	dogwood	*Cornus stolonifera* Michx.
	saskatoon	*Amelanchier alnifolia* Nutt.
	low bush cranberry	*Viburnum edula* (Michx.) Raf.
	bog birch	*Betula pumila* L. var. *glandulifera* Regel
	wolf willow	*Elaeagnus commutata* Bernh.
Least Sensitive:	bear berry	*Arctostaphylos uva-ursi* (L.) Spreng.

Herbs

Most Sensitive:	fireweed	*Epilobium angustifolium* L.
	sweet coltsfoot	*Petasites palmatus* (Ait.) A. Gray
	bunchberry	*Cornus canadensis* L.

	wild strawberry	*Fragaria virginiana* Duchesne
	arnica	*Arnica mollis* Hook
Least Sensitive:	wild aster	*Aster ciliolatus* Lindl.

Grasses - generally rather resistant

Bryophytes - generally rather sensitive

Re-examination in the spring of 1975 (May 28) showed tree mortality only in the severely injured area. In all other areas that were affected by the fumigation no trace of injury was detectable. New foliage was normal on deciduous species and new buds were normal on the white spruce.

In the severely injured area immediately downwind from the burning sulphur (Fig. 2), all white spruce (these were few) were killed to a distance of 60 m. Most needles had fallen off, there were no new buds, and the cambium was brown on main stems and on twigs. Other tree species showed little and variable mortality; possibly the variation relates to other stress factors. On some individuals of balsam poplar, alder, and trembling aspen the leaves had not emerged and buds were internally discoloured.

Shrubs and ground vegetation appeared to be recovering well, although in the severely affected area the cover seemed somewhat more sparse and retarded than elsewhere.

DISCUSSION

This sulphur fire initially affected about 4 ha of vegetation, with varying degrees of injury. Because it occurred in August, the trees

that were defoliated did not grow new leaves the same year as have other similarly injured trees which were defoliated in early summer.

Some trees showed evidence of bud and cambium injury in the fall and failed to produce new growth in the following spring. In the area so affected, less than .4 ha, all white spruce and scattered individuals of balsam poplar, alder, and trembling aspen were killed.

Most of the other trees and the herbs and grasses show no signs of permanent injury.

ACKNOWLEDGEMENTS

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