

# The Physical, Chemical And Biological Effects Of Crude Oil Spills On Black Spruce Forest, Interior Alaska

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## INTRODUCTION

In the late 1960's, it became apparent that the large petroleum resources of the Alaskan and Canadian Arctic would soon be developed. Scientists from both the United States and Canada became increasingly concerned that transport of this large volume of crude oil across arctic and subarctic terrains would likely result in periodic spills. Information regarding the environmental effects of these types of terrestrial spills was largely nonexistent.

In the early seventies, several groups initiated small-scale studies documenting the effects of spills on arctic and subarctic vegetation (Deneke *et al.*, 1975; Hutchinson *et al.*, 1974) and identifying natural recovery mechanisms which would tend to restore impacted areas (Hunt, 1972; Cook and Westlake, 1974; McGill, 1977). Other studies directed at artificially enhancing biological recovery by methods such as fertilization were also conducted (Parkinson, 1974; Lehtomäki and Niemelä, 1975; Atlas, 1977). Another group of researchers documented the impacts resulting from past spillages of petroleum fuels from breaks in a military pipeline in southeastern Alaska (Deneke *et al.*, 1975; Rickard and Deneke, 1972; Hunt *et al.*, 1973).

Following the decision to construct the Trans-Alaskan Pipeline System (TAPS), information regarding the area and extent of impact from a potential leakage in the system was sought. While experimentation with small-scale controlled spills was essential to an understanding of the processes involved, it was of limited value in predicting the extent of impact expected from a large volume of oil such as would result from a failure in the pipeline. Except for several studies in the MacKenzie Valley of Canada (MacKay *et al.*, 1974; Hutchinson *et al.*, 1974; Cook and Westlake, 1974), little information was available regarding the spillage of larger amounts of oil on terrestrial sites and none with respect to the interior subarctic portions of Alaska.

It was, therefore, the goal of this study to conduct an experiment more realistic in size and mode of impact, utilizing crude oil from Prudhoe Bay. A temperature was selected that would be representative of the TAPS during full-scale operation. The site chosen was to be one representative of interior Alaska and similar to the terrain encountered by the TAPS south of the Brooks Range. Because of the large seasonal climatic variations in the

subarctic, it was decided that two similar spills differing in time of year would be conducted. The first was conducted in mid-winter and the second at the height of the growing season in mid-summer on sites with very similar topography and vegetation. The overall objectives of the study were threefold:

- 1) To detail the physical effects of crude oil spills in black spruce forests of interior Alaska emphasizing the mode of transport, area of impact vs. time, and effects on the active layer and underlying permafrost;

- 2) To determine the fate of petroleum contaminants once spilled in subarctic terrestrial environments;

- 3) To evaluate the effects of crude oil spills on vegetation.

A companion study, conducted simultaneously, describing the effects of the spill on microbial populations and activity is described elsewhere (Sparrow *et al.*, this volume).