MOSQUITO CONTROL DURING CONSTRUCTION OF THE TRANS-ALASKA PIPELINE

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ABSTRACT. Mosquito control operations during 1975–76 are described. Malathion or a pyrethrin mixture was applied with LondonAire® ULV aerosol machines with careful consideration being given to environmental effects. The number of applications at the various camps and work areas was smaller than had been anticipated. Repellents were used copiously and appeared to give protection to many workers.

INTRODUCTION

On June 20, 1977 the first barrel of oil from the Prudhoe Bay oil fields on the Arctic Ocean began an 800-mile trip south across Alaska to the ice-free port of Valdez on the Gulf of Alaska. This represented the culmination of a multi-billion dollar private construction effort that began in July of 1969 when the ARCO-Humble oil companies confirmed the existence of a vast oil field near Alaska's Prudhoe Bay.

In April 1969 a group of major oil producers[1] announced plans to build a 48-inch pipeline across Alaska and organized the Alyeska Pipeline Service Company (*Alyeska*) as the operating unit for the project. In the same month 800 miles of steel pipe was ordered from Japan, and on June 1, 1969 a right-of-way permit was requested from the Bureau of Land Management of the U. S. Department of the Interior. In September of that year the Department of the Interior specified the environmental restrictions to be met by *Alyeska*.

In April 1970 a number of Alaska villages, the Wilderness Society, Friends of the Earth, and the Environmental Defense Fund filed suit claiming that the pipeline, as planned, did not comply with the National Environmental Policy Act. This action eventually reached the United States Supreme Court and, although the pipe was delivered in October 1971, construction did not begin on the 360-mile service road from the Yukon River to Prudhoe Bay until April 29, 1974. In a remarkable feat of engineering Prudhoe Bay was linked with Alaska's existing highway system in November of that same year, while on March 27, 1975 the first section of pipe was installed (Allen and Campbell 1975). The major construction years were 1975 and 1976. Employment peaked in July 1975 when the service company and its contractors, Fluor, Inc., and Bechtel Incorporated, employed 20,000 workers.

THE GEOGRAPHY OF ALASKA ALONG THE ROUTE OF THE PIPELINE

On its 800-mile course from Prudhoe Bay the pipeline traverses Alaska from the Arctic Ocean to the ice-free fiord on which is located the Valdez terminal. The line originates at Pump Station One at Prudhoe Bay and crossing 50 mi. of arctic tundra reaches a maximum elevation of 4800 ft where it penetrates the Brooks Range at Atigun Pass. From Atigun to the Yukon River it crosses the tundra, muskeg and black spruce forest of Alaska's central basin-areas that prior to the building of the pipeline service road in 1974 saw only an occasional hunter or prospector. The only bridge across North America's 4th largest river is the half-mile span that carries road and pipe over the Yukon River near Fort Hamlin. Here they connect with the state's road system.

The approximate mid-point of the

[1] ARCO Pipeline Company, the Amerada Hess Corporation, Sohio Pipeline Company, Exxon Pipeline Company, Mobil Alaska Pipeline Company, Phillips Petroleum Company, Union Alaska Pipeline Company and BP Pipelines, Inc.

pipeline is near Fairbanks, Alaska's 2nd largest city. The route south from here is mainly through taiga, black and white spruce, willow and alder. Temperatures in this area are the most extreme in the state, ranging from over 90°F in the summer to minus 60°F in the winter months.

The line crosses another obstacle at Thompson Pass (2771 ft) where the Chugach mountains parallel the Gulf of Alaska. This area has some of the heaviest snowfall in the state. Although the tundra north of the Brooks Range receives less than 4 in of snow and rain each year, the permafrost prevents drainage, and moisture is retained for centuries. During the brief arctic summer, water floods each tiny depression in the tundra and produces millions of breeding pools for a new generation of mosquitoes. The wet flatlands and low rolling hills in the central basin share many of the tundra's mosquito producing characteristics. Streams that feed the Yukon River run unchecked by man. Interior floodplains hundreds of miles in extent produce dense and dependable mosquito populations. Along the southern coast of the state many insect species have penetrated the barrier of the Chugach mountains and *Aedes implicatus* Vockeroth has adapted well to a saltmarsh environment.

MOSQUITO SPECIES FOUND ALONG THE ROUTE OF THE ALASKA PIPELINE

The genera that include the major nuisance species of mosquitoes in Alaska are *Culiseta* and *Aedes*. Adult *Culiseta*, or "snow mosquitoes," emerge from overwintering as early as May in south-central and central Alaska and on the arctic tundra bordering the Bering Sea and the Arctic Ocean. Their presence when the ground is covered with snow gives them their common name in the state. *Culiseta alaskaensis* (Ludlow) has been collected from southeast Alaska north to the Yukon River and is common in forested lowlands. Locally it may emerge in such numbers as to be a nuisance 1 month to 6 weeks before the *Aedes* begin to infest the taiga. *Cs. impatiens* (Walker) is a common species along the south coast of the state although it has been collected as far west and north as Nome.

The major Alaska mosquito pest species are within the genus *Aedes*. North to south along the pipeline route human biters include: *Ae. impiger* (Walker) and *Ae. nigripes* (Zetterstedt), common tundra species north of the Brooks Range; *Ae. riparius* Dyar and Knab, an uncommon, gold-colored species found along the Yukon River; *Ae. intrudens* Dyar, a nuisance in the Fairbanks area, and *Ae. pullatus* (Coquillett), a persistent biter where the pipeline penetrates Alaska's southern Chugach Range. *Ae. excrucians* (Walker), *Ae. diantaeus* Howard, Dyar and Knab, *Ae. decticus* Howard, Dyar and Knab, *Ae. pionips* Dyar, and *Ae. punctor* (Kirby), breed in the spruce and birch forests of South-central and Central Alaska. *Ae. implicatus* Vockeroth has been collected from the salt marshes in the area of the pipeline terminal at Valdez (Gjullin et al. 1961).

ENVIRONMENTAL RESTRICTIONS ON PIPELINE MOSQUITO CONTROL OPERATIONS

A total of 12 Federal and State agencies monitored construction of the Alaska pipeline. The United States Environmental Protection Agency had responsibility for environmental matters, especially air quality. The Alaska Department of Environmental Conservation was charged with issuing permits for air and water quality and effluent discharges. This overall responsibility included the issuing of permits for mosquito and biting fly control operations. Alyeska Pipeline Service Company first requested permission to spray both camps and construction sites by air. The Department restricted insect control operations to the use of ground equipment and limited applications to the gravel pads on which the camps and pump stations were to be constructed. The following restrictions were incorporated into the permits:

Sprays were not to be directed into

streams or applied when the wind was over 10 miles per hour. No prophylactic spraying was allowed. Public notice in the state's 2 largest newspapers was stipulated before the start of each spray season, and operators were required to demonstrate the ability to perform their jobs in strict accord with all label requirements. This last restriction was met in 1976 when pipeline supervisory personnel concerned with insect control were trained and tested in the mosquito and biting fly commercial applicator category as part of Alaska's State Plan meeting the requirements of the 1972 Federal Insecticide, Fungicide and Rodenticide Act.

Permits to apply low-volume sprays of either malathion or a mixture of pyrethrin, piperonyl butoxide and mineral oil[2] for adult mosquitoes and biting flies in 30 camps and pump stations were issued by the Department to Alyeska Pipeline Service Company for the years 1975 and 1976.

MOSQUITO CONTROL ALONG THE ROUTE OF THE ALASKA PIPELINE

Twelve London Aire® ULV Insecticidal Aerosol Generators, Model H, were purchased by Alyeska Pipeline Service Company (*Alyeska*) for insect control on the pipeline. (Figure 1.) Spraying was to be done "as necessary" during the insect season and the staff members authorized to order spraying were the project engineer in charge of pump station construction and, in the camps, the resident camp manager. There was no control along the pipeline extending north and south from the pump stations and construction camps; personnel "on the line" protected themselves with repellents. The amount of spraying depended on the intensity of insect infestations in an area and, more importantly on the interest of the resident camp managers and pump station engineers in the problem.

Most of the work in and around the camps was done indoors. Line workers remained in camp only to sleep and eat and it is not surprising that the greatest numbers of sprayings were made around the pump stations. (Table 1). Data from Table 1, summarizing pipeline spray operations during 1975 and 1976, indicate that north of the Brooks Range only Pump Stations Three and Four and Toolik Camp sprayed and that the last 2 stations made only 1 application each.

All control activity was performed north of the City of Fairbanks (Fig. 2) except for 8 applications made at Pump Station Eight. Prospect Camp and Pump Station Five are located close together and the sudden increase in activity during 1976 at Pump Station Five probably reflects a change in management rather than an increase in the mosquito populations. Most informative when investigating practical mosquito control in the arctic is the data from Pump Station Three (Tables 2 and 3.). In July and August 1976 I traveled along the pipeline to investigate the relatively small number of sprayings reported by the pipeline company. No spraying was encountered during the visits. Existing spray records were checked and pump station engineers and camp managers were interviewed as to the extent of their mosquito problem and control programs. During these visits personnel who worked outdoors were asked their opinions. As might be expected their analysis of insect infestation rates differed sharply from those of the resident camp managers; however, we observed that the majority of work around the camps was done in closed areas.

At Pump Station Three during 1975 a total of 28 applications was made for mosquito control, using malathion. In 1976, 32 applications were made with pyrethrin. There, in 1975 the 1st application was made to the 25-acre site on July 15, and

[2] CYTHION (R), 95% premium grade malathion and pyrethrins (5%) piperonyl butoxide (25%), petroleum distillates (20%) and mineral oil (50%). The D.E.C. recommended application rate for vehicle-mounted units was 1.0 to 2.1 fluid ounces per minute at 5 miles per hour covering a 300-ft swath.

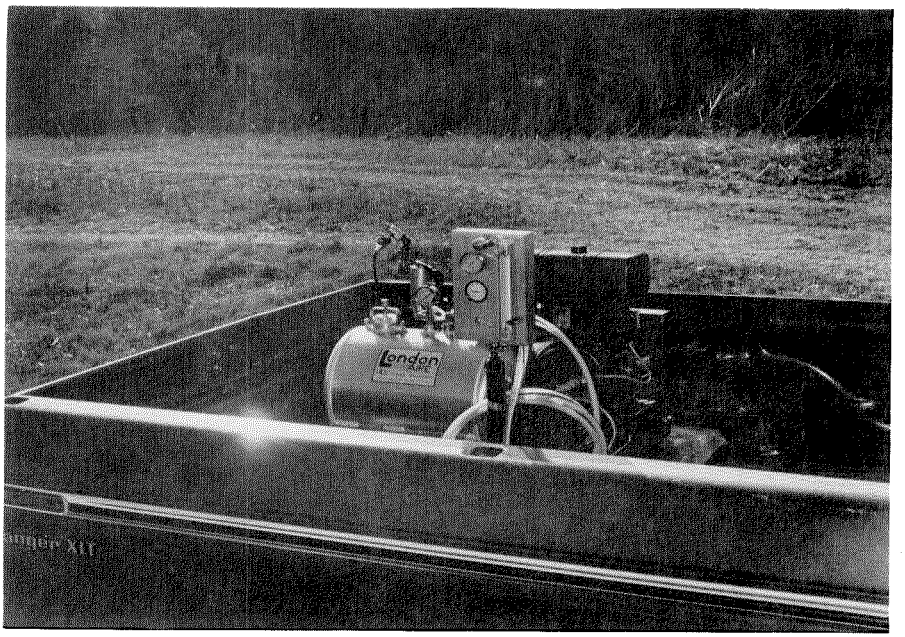

Fig. 1. Pick-up mounted London Aire ULV Insecticide Aerosol Generator, Model H. In operation the flowmeter and pressure gauges are mounted inside the driver's cab. London Fog Co., Crystal Bay, Minn.

Table 1. Pipeline stations reporting pesticide applications for mosquito control 1975–1976

	No. Applications									
	1975				1976				Total	
Station	May	June	July	Aug.	May	June	July	Aug.	1975	1976
PS 3	—	—	10	18	—	17	14	1	28	32
PS 8	—	—	4	2	—	2	—	—	6	2
PS 4	—	—	—	—	—	—	1	—	—	1
PS 5	—	—	—	—	—	5	13	3	—	21
Prospect	—	6	2	—	—	—	8	—	8	8
Five Mile	—	4	—	—	3	7	2	—	4	12
Toolik	—	—	1	—	—	—	—	—	1	—
Livengood	—	—	—	—	—	4	3	—	—	7

Fig. 2. Route of the Trans Alaska Pipeline locating pipeline camps and pump stations.

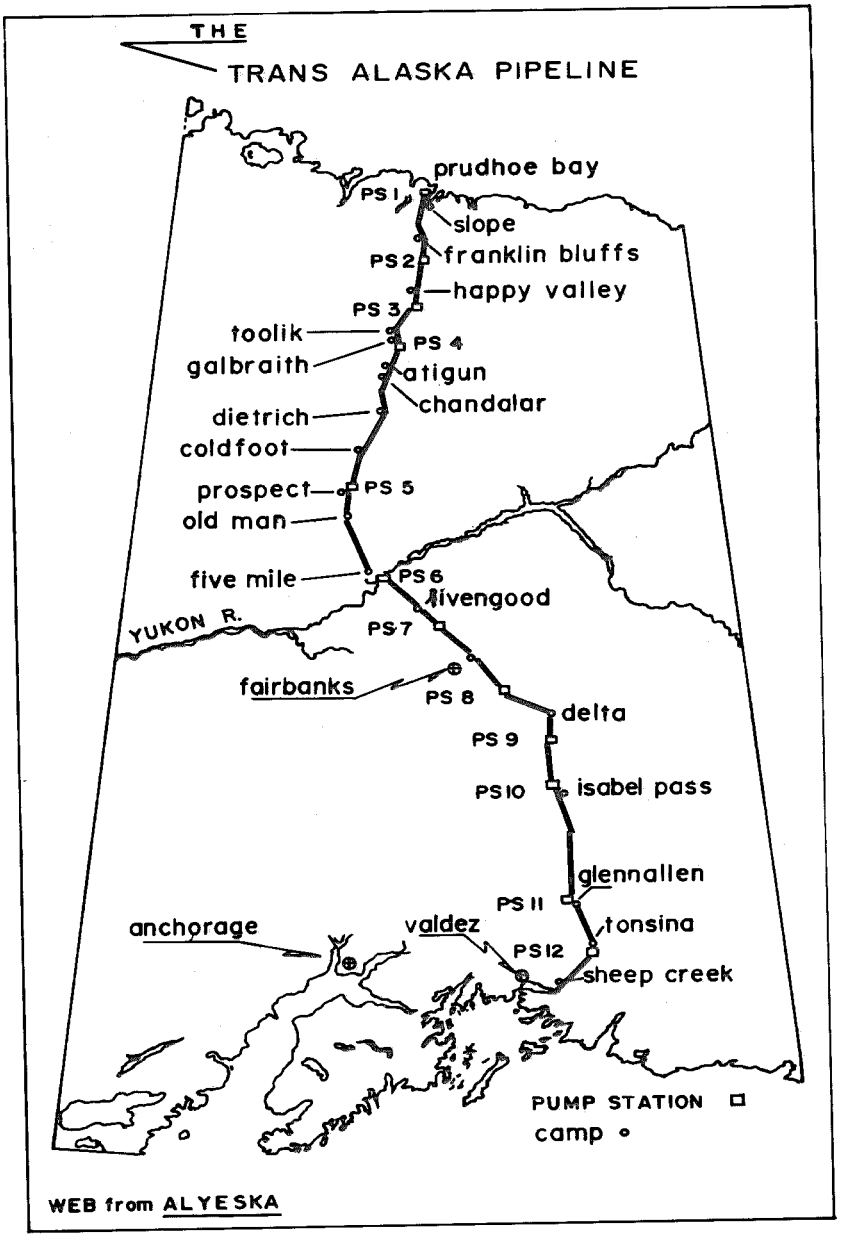
THE
TRANS ALASKA PIPELINE
prudhoe bay
PS 1
slope
PS 2
franklin bluffs
happy valley
PS 3
toolik
PS 4
galbraith
atigun
chandalar
dietrich
coldfoot
prospect
PS 5
old man
five mile
PS 6
livengood
YUKON R.
PS 7
fairbanks
PS 8
delta
PS 9
PS 10
isabel pass
glennallen
PS 11
anchorage
valdez
tonsina
PS 12
sheep creek
PUMP STATION
camp
WEB from ALYESKA

Table 2. Mosquito control applications at pump station three 1975

Station	Application Date	Acres Sprayed	Rate fl. oz./A	Total Concentrate[1]
PS 3	7/15	25	0.6	15 fl oz.
	7/16		0.8	20
	7/17		0.8	20
	7/20		0.6	15
	7/21		0.7	17
	7/24		0.6	16
	7/26		0.9	22
	7/27		1.0	24
	7/30		0.7	18
	7/31		0.8	21
	8/3		0.6	14
	8/5		0.7	17
	8/6		0.6	15
	8/8		1.0	26
	8/9		0.7	17
	8/10		1.0	26
	8/11		1.2	28
	8/12		1.0	26
	8/14		0.7	17
	8/15		1.0	24
	8/16		1.0	26
	8/18		1.2	28
	8/19		1.1	27
	8/21		1.0	24
	8/22		1.0	26
	8/23		0.9	23
	8/25		1.2	28
	8/29		1.2	29

[1] CYTHION (R), 95% premium grade malathion.

sprayings were scheduled on almost a daily basis until August 29. The rate at which the malathion was applied varied from 0.6 to 1.2 fluid ounces per acre and on no day was more than 1 application made.

In 1976 pyrethrin was the pesticide of choice at Pump Station Three. 1.3 ounces of pesticide per acre and 1 quart of material was used per application. The first spraying was on June 8 and the last on August 2. Unlike the malathion applications applied only once each day, there were more than 20 days when 2 applications were put on the 25-acre site and 6 days when there were 3. Once started with pyrethrin in their 1976 spray program, Pump Station Three remained with this material until the end of the season. In September 1977, after the pipeline was completed, staff of Fluor, Inc., affirmed that, in their opinion, malathion was the more effective and persistent pesticide. The longest interval between applications was from July 18 to August 2. (Table 3.).

No population studies or adult counts were made along the pipeline and any analysis of mosquito infestations must be subjective and based on personal observations and interviews. There were no complaints about mosquitoes when Pump Station Three was visited, and good control seemed to be taken for granted by workers in the sprayed area. Neighboring Happy Valley and Franklin Bluffs Camps reported no spraying at all. Interviews at

Table 3. Mosquito control applications at pump station three 1976

Station	Application Date	No. of Applications	Acres Sprayed	Rate fl. oz./A	Total Mix/day[1]
PS 3	6/8	1	25	1.3	32 fl. oz.
	6/10	2	50	1.3	64
	6/11	2	50	1.3	64
	6/14	2	50	1.3	64
	6/15	1	25	1.3	32
	6/16	2	50	1.3	64
	6/18	3	75	1.3	96
	6/19	3	75	1.3	96
	6/20	2	50	1.3	64
	6/22	3	75	1.3	96
	6/24	2	50	1.3	64
	6/25	3	75	1.3	96
	6/26	3	75	1.3	96
	6/27	2	50	1.3	64
	6/28	2	50	1.3	64
	6/29	2	50	1.3	64
	6/30	2	50	1.3	64
	7/1	3	75	1.3	96
	7/2	2	50	1.3	64
	7/3	2	50	1.3	64
	7/4	3	75	1.3	96
	7/5	2	50	1.3	64
	7/7	2	50	1.3	64
	7/9	2	50	1.3	64
	7/10	2	50	1.3	64
	7/12	2	50	1.3	64
	7/13	1	25	1.3	32
	7/15	2	50	1.3	64
	7/16	2	50	1.3	64
	7/17	2	50	1.3	64
	7/18	2	50	1.3	64
	8/2	1	25	1.3	32

[1] 5% pyrethrins, piperonyl butoxide (25%), petroleum distilates (20%) and mineral oil (50%).

these sites indicated that mosquitoes were no great problem as long as strong winds blew across the tundra and kept the insects "down" in the ground cover. Winds on the North Slope blow strongly almost all the time. The managers of both camps said that they would order spraying if there were a period of calm lasting more than 3 days. This had not occurred in their experience.

It may seem that the almost daily sprayings at Pump Station Three violated the stipulation in Alyeska's permit against prophylactic spraying; however it must be noted that the pump stations were under construction during 1975 and 1976 while the camps had been completed at the same time as the haul road, 1974. As noted above, most of the operations within the camps were sheltered.

Data from the other sites were much less informative than those from Pump Station Three. The second largest number of applications, 21, was made in 1976 at Pump Station Five. This facility did not spray in 1975. Here the first spraying was June 19

and the last August 4. The longest gap in their spray operations was between June 26 and July 12, 1976. Pump Station Eight, the only site south of the Yukon River to spray for insects (Table 4), sprayed 8 times during the 2 major construction years.

Table 4. Mosquito control applications at pump station eight 1975–1976

Station	Application Date	Acres Sprayed	Rate fl. oz./A	Total Concentrate[1]
PS 8	7/19/75	20	10.0	195 fl. oz.
	7/22/75	20	8.0	162
	7/25/75	20	7.0	156
	7/30/75	12	4.8	57
	8/05/75	12	5.5	66
	8/10/75	12	6.8	81
	6/17/76	12	1.7	14
	6/21/76	12	2.5	15

[1] CYTHION (R), 95% premium grade malathion.

Our data indicate that this may have been the only site to spray more than the recommended 3.0 fluid ounces per acre of active material. The August 1975 sprayings probably reflect infestations of black fly ("whitesox"), *Simulium venustum* (Say), a persistent pest in the central and southern Alaskan forests.

Prospect Camp sprayed 8 times in each construction year. In 1975 they last sprayed on July 17 and in 1976 on June 24. This early termination of spraying reflects the increased pace of construction in the months of July and August rather than any decline in mosquito populations. It should be noted that Prospect Camp is in the vicinity of Pump Station Five which sprayed 21 times in 1976.

Five Mile Camp made 4 applications in the month of June 1975. In 1976 they were the first of all stations to spray-3 applications in the month of May. Their last spraying was on July 5, 1976. Observations of mosquito populations in mid-July support the conclusion that spraying was terminated because of pressures to assign every available worker to the "line."

DISCUSSION AND RECOMMENDATIONS

I made 2 visits to construction sites along the Alaska pipeline in July and August 1976 and confirmed that *Alyeska* and its principal contractors had done far less spraying than they or our Department anticipated when the permits were prepared in 1974. Workers, both in the camps and on the construction sites, depended mainly on repellents for personal protection.[3] The pipe was laid north and south from the camps in many sections. Workers were scattered along a narrow construction corridor in a manner that made it almost impossible to protect them even with aircraft spraying. In addition, the width of the "line" is narrow, often measured in yards, and unless a wide band of tundra or forest is sprayed mosquitoes can reinfest a swath in a matter of minutes. The pump stations, 25 to 50 acres in extent, were more amenable to control as demonstrated by the regular and suc-

[3] During the pipeline construction repellents were used in great quantities. The most common formulation was CUTTER INSECT REPELLENT® in spray cans: N,N-Diethylmetatoluamide 28.74%, other isomers 1.51%, Dimethyl Phthalate 1.5%, Butyl dimethyl dihydro-gamma-pyrone carboxylate 1.25% plus inert ingredients 67.0%.

cessful applications made at Pump Station Three.

Nineteen seventy-six was a "good" year for mosquitoes in many areas of Alaska, that is, populations were low in the central and south-central parts of the state following a severe 1975–76 winter. However the justly famous populations on the North Slope were as usual, and credit for the successful meeting of their 1975–1976 construction schedules by *Alyeska* and its contractors must be given to a generous and effective use of repellents. Prior to the 1975 construction season an allotment of spray apparatus and pesticide was shipped to the pipeline camps and pump station sites. Effective use of these supplies depended on the interest in mosquito control of the resident camp managers and the pump station supervising engineers. Fluor, Inc., trained operators to use the London Aire equipment, but when these

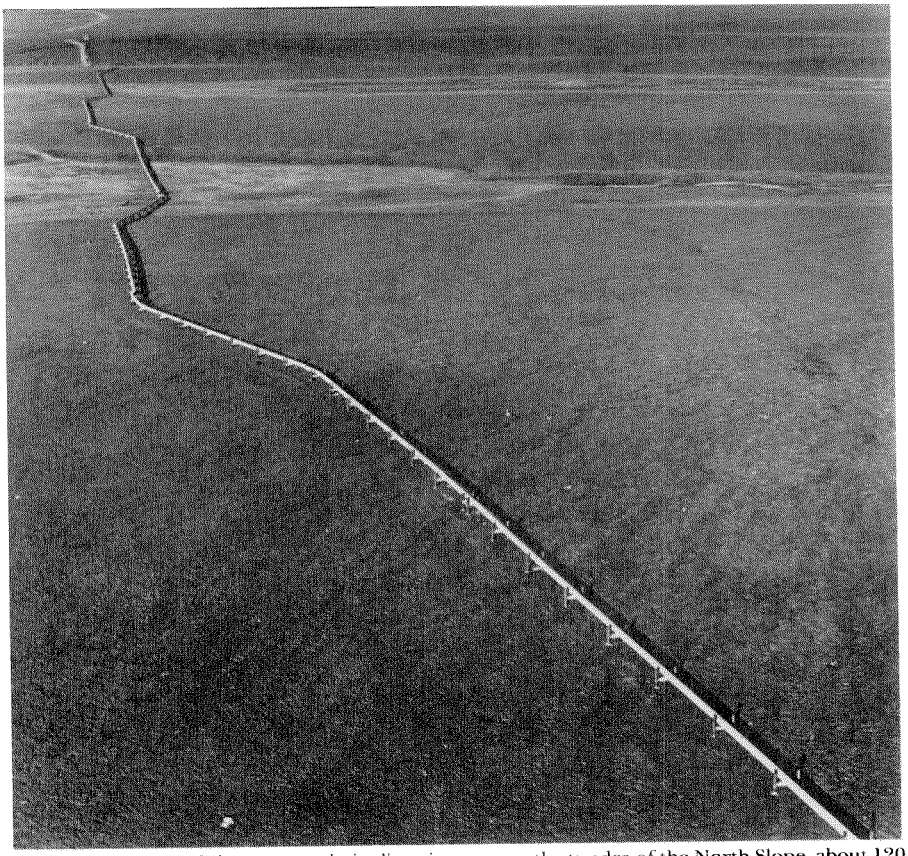

Fig. 3. A section of above ground pipeline zigzags over the tundra of the North Slope, about 120 miles south of Prudhoe Bay. More than half of the 800-mile-long trans Alaska pipeline is elevated above ground in areas of ice-rich permafrost. Alyeska Pipeline Service Company 9/76 PC1–62276.

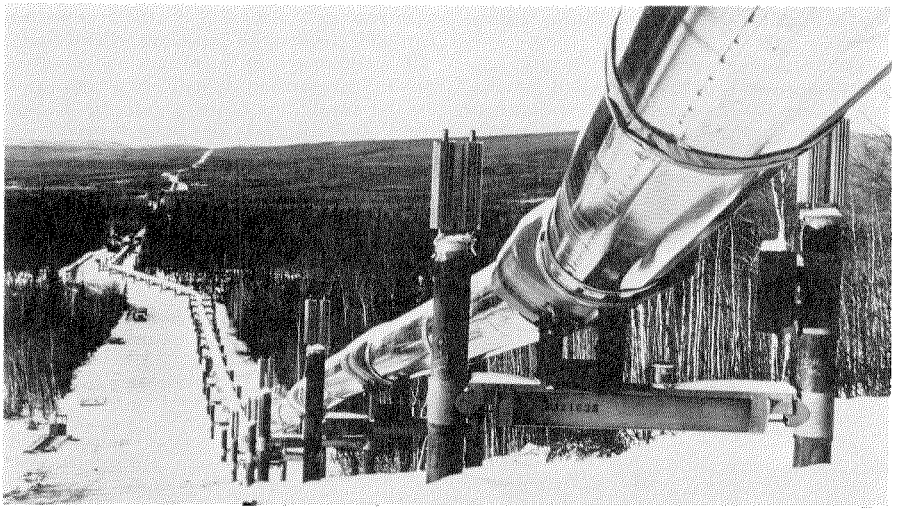

Fig. 4. Completed above ground pipeline winds its way to the north through the Tatalina River Valley in this view of the pipeline right-of-way, about 15 miles south of Livengood Camp on the trans Alaska pipeline project. Alyeska Pipeline Service Company 12/75PC1–60342.

individuals were on leave or on other assignments, they alone were responsible for briefing their replacements. The Department of Environmental Conservation in April 1976 trained eighteen mosquito and biting fly commercial applicators for *Alyeska*, but these were supervisory personnel who did no actual spraying.

In general, the level of mosquito control achieved along the pipeline in the construction years 1975–1976 did not justify the time and expense invested by *Alyeska* and the Department of Environmental Conservation. On my July 1976 visit to the North Slope 4 (perhaps 6) London Aire units were assigned to the area between Dietrich and Prudhoe Bay, but the only equipment used effectively was at Pump Station Three. The picture was much the same when construction from the Valdez terminal to Pump Station Eleven was surveyed in August. Applications made at Pump Station Three in both construction years and at Pump Station Five in 1976 demonstrated that effective relief from mosquitoes could be provided by spraying around the camps and permanent construction sites. On the other hand, the small amount of spraying that was done along the pipeline relieved much of the Department of Environmental Conservation's concern for the environmental impact of the spray program. The initial locating of spray apparatus and pesticide along the route of the pipeline was, of necessity, arbitrary. However, *Alyeska's* planning failed to include the operational flexibility for moving this equipment to locations where it was most needed and most wanted. The most serious fault in the pre-construction phase of planning for insect control along the pipeline was a failure to assign a professional (in the insect season) with the authority to promote, schedule and supervise spraying as needed.

The 48-inch Alaska Pipeline may be only the first of many to cross the 49th State. In the fall of 1977 a 24-inch line

collects oil from platforms in the lower Cook Inlet, and plans are underway to construct a natural gas line parallel to all or part of the *Alyeska* project. If reserves in what was Naval Petroleum Reserve Number Four are to be tapped there will have to be an extension of the pipeline west from Prudhoe Bay to near Point Barrow. Data from the construction years 1975 and 1976 indicate that the mosquito and biting fly populations can be controlled in semi-permanent camps and around areas, such as pump stations, where construction occurs over a long period of time within a compact and restricted location. Alaska's short insect season tempted Alyeska Pipeline Service Company to make insect control along the pipeline a local responsibility and to assign the problem no full-time staff. The result was satisfactory control at only 1 location on the pipeline's 800 mile length, and an under-utilization of spray equipment and pesticide stocks. When both planning and executing the control program the amount of training and the level of professionalism needed by mosquito control operators was underestimated.

Future projects of this nature in the arctic and sub-arctic should employ from the early planning stages an entomologist who will train and supervise the applicators assigned to insect control. If those employed are recruited at a professional and semi-professional level, the contractors should have no difficulty finding them work during the off-season. Jobs as paramedics, sanitarians, firemen and traffic controllers are a few possibilites.

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References Cited

Allen, L. and J. M. Campbell. 1975. *The Trans Alaska Pipeline*, Volume 1. Scribe Publishing Corporation, Seattle, Wash.

Gjullin, C. M., R. I. Sailer, A. Stone and B. V. Travis. 1961. The Mosquitoes of Alaska. Agric. Handbook No. 182, U. S. Dept. Agric. 98 pp.