REVEGETATION MONITORING OF THE ALASKA HIGHWAY GAS PIPELINE PREBUILD

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ABSTRACT

Vegetation monitoring of the Alaska Highway Gas Pipeline Southern B.C. Prebuild was undertaken in 1982 and again in 1983. The study was unique in that the same quadrats were re-examined in the second year. This permitted an evaluation of the year-to-year changes in vegetative cover on both the 2- to 3-year old Foothills Pipeline (FHPL) right-of-way and also on an adjacent 22-year old Alberta Gas Trunk Line (AGTL) right-of-way. The data suggests that considerable vegetative perturbations are occurring on both.

INTRODUCTION

In 1982 and again in 1983 the Northern Pipeline Agency let a contract to monitor the state of revegetation on the Foothills Pipe Lines (South B.C.) Ltd right-of-way (R.O.W.) following Phase I (Prebuild) construction

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in southern British Columbia. Monitoring of this revegetation is required by the Environmental Guidelines issued in 1980 under the Northern Pipeline Act (1978).

A major consideration when undertaking a monitoring program of this nature relates to the processes of plant succession. Odum in 1969 redefined what has become the classical concept of plant succession:

1. It is an orderly process of community development that is reasonably directional and therefore predictable.
2. It results from the modification of the physical environment by the community.
3. It culminates in a stabilized ecosystem.

In a reclamation monitoring program based on this classical concept we can theoretically determine the stage of the vegetative development and, knowing the time since abandonment, we can predict to some extent the rate and direction of community development. We can therefore determine whether plant succession is proceeding along a desired line and at a desired rate. If this is not the case we can suggest management practices which would manipulate the revegetation processes. However, can we make such deductions based on only one year's observation of the vegetative cover?

It should be noted that much of the data on which the concept of succession has been built comes from 'static-approach' studies which examined different vegetation types within similiar vegetation zones and then related them to hypothetical successional sequences (Maarel and Werger 1978). Recently, data is being obtained on the results of the vegetation changes monitored at one site over a period of many years. The results of some of these studies are now casting doubt upon the classical interpretation of successional processes (Connell and Slayter 1977, Glenn-Lewin 1980, Collins and Adams 1983, Peet and Christensen 1980, Beetink 1979). These authors suggest that succession may be individualistic in that plant community development is site specific and a relatively unpredictable stochastic process. Successional sequences in this model relate to factors such as the initial seed densities in the soil (Moore and Wein 1977, Egler 1954, Archibold 1980), the plant populations existing in the vicinity (Glenn-Lewin 1980) and the vegetative and seed dynamics of the initial species to become established (Peet and Christensen 1980).

The implications of the individualistic theory on a revegetation monitoring program are that:

- A one-time survey of the plant cover can not be used to establish the place in a successional sequence which would lead to a climax vegetation.
- There is no apriori reason why a disturbed site would reach a climax cover similiar to that in the surrounding area and the final cover may in fact remain quite different.
- Certain vegetation types such as shrub or grass cover within a forested region need not necessarily be unstable or transitional.
- Elements influencing plant community such as site and initial seed populations can be controlled or manipulated.

Since site condition and seed content are factors that greatly influence the type of vegetative cover in the establishing community, the manipulation of these factors can be used to influence the development of the desired type of cover. For example, the type and quantity of seeds present as well as the soil conditions will influence cover development. If the quantity of agronomic seed on a pipeline is very high, native species may be excluded and a strictly agronomic grass-legume cover formed. This may be desirable or undesirable depending upon the requirements.

STUDY OBJECTIVES

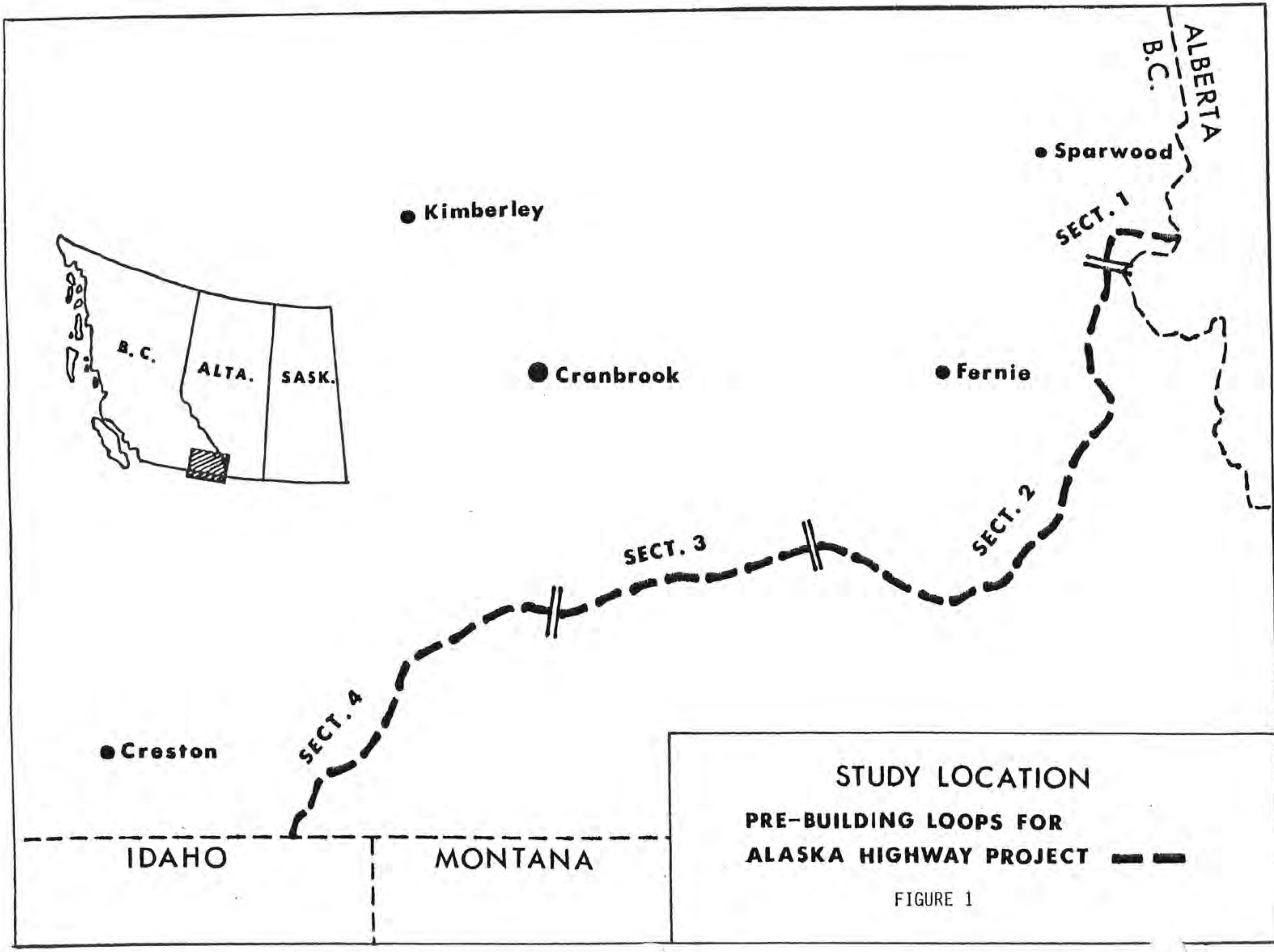
Objectives of this study were:

- To assess the establishment success of seeded agronomic species.
- To compare the year-to-year variation in vegetative cover on two right-of-ways of different ages.

LOCATION

The study area is located in the East Kootenay Mountains and the adjoining lowlands of southern British Columbia. The area is divided into four sections which comprise Phase I looping of the existing 36-inch (914 mm) pipeline of Alberta Natural Gas Company Ltd built in 1961. Very little new R.O.W. required clearing of vegetation. Distances and elevation of the four sections studied are shown in Figure 1 and listed in Table 1.

Regional climate is largely determined by local topographic and wind conditions. Along the pipeline R.O.W. climatic zones range from semi-arid



STUDY LOCATION

PRE-BUILDING LOOPS FOR
ALASKA HIGHWAY PROJECT

FIGURE 1

to cool alpine. Despite these diverse climatic conditions, three biogeoclimatic zones can be identified along the route (Table 1).

Table 1

ELEVATION (METRES A.S.L.) OF PIPELINE SECTIONS MONITORED

Section	Length (km)	Elevation Range (m)	Biogeoclimatic Zones
1	4.6	1341-1615	Engelmann Spruce/Subalpine Fir
2	33.4	1212-2134	Engelmann Spruce/Subalpine Fir
3	24.5	762-1381	Interior Douglas Fir
4	26.7	800-1052	Interior Western Hemlock

CONSTRUCTION AND RECLAMATION

Construction of the South British Columbia Phase I sections began in mid-August 1980, when permission to proceed with clearing on Section 2 was granted, and was completed by late winter. The cleanup and revegation program was carried out in late summer of 1982. The revegetation sequence was by Sections in numerical order. Topsoil was salvaged at only on lands designated as agricultural. On non-agricultural lands compacted soil was loosened by dragging a heavy harrow over the graded surface with a skidder. This procedure was not always effective on hard packed or baked surfaces.

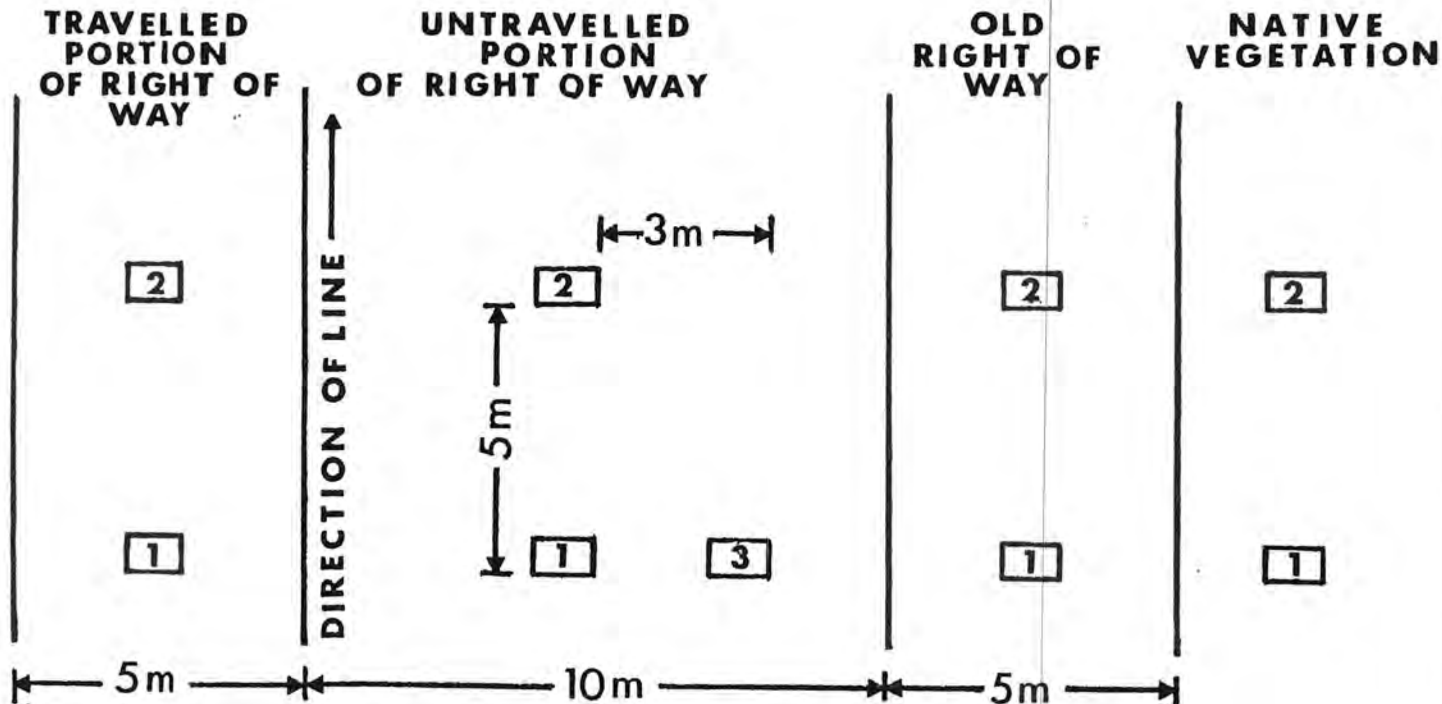
Seed and fertilizer were broadcasted by two John Deere 1840 4-wheel-drive tractors equipped with front and back cyclone seeders. A chain harrow was then used to incorporate the seed and fertilizer into the soil.

In addition to this general procedure, hydroseeding and mulching of approximately 6 ha of terrain with a slope greater than 18 degrees was carried out on parts of Sections 2 and 4.

Seed mixes of agronomic grasses and legumes were applied at the rate of 20 kg/ha. Fertilizer (16-20-0) was applied at a rate of 300 kg/ha.

METHODOLOGY

In August 1982 a total of 82 vegetative monitoring sites were established in the 4 zones. Sites consisted of 3 one-half square metre permanently marked quadrats placed on both the 2-year old (FHPL) and on the adjacent 22-year old (AGTL) R.O.W. The bottom right and top left corner of each quadrat was permanently marked. The location of the first quadrat in each site was a point near the centre of the R.O.W. The corner pin of this initial quadrat was randomly located, the second quadrat was located 5 metres down the R.O.W. from the first. The third quadrat was 3 metres to the right of the initial marker. The sites within each sample zone were selected to cover the area of concern, thus on a hill, sites were placed at 3 to 5 slope positions depending upon the length of the slope, its steepness, and the extent of erosion.



LAYOUT OF A TYPICAL PLOT SITE

FIGURE 2

In 1982 and again in 1983 the species in each quadrat were recorded and the percentage cover in each quadrat estimated. A list also was made of all species found in the 10 m x 5 m area surrounding the nest of quadrats. A 35 mm slide photograph was made of each quadrat and of the general site. These slides are on file at the Northern Pipeline Agency. The plant nomenclature in this report largely follows that of Taylor and McBride (1977).

RESULTS

A comparison of the 1982 and 1983 plant covers on the untravelled 2-year old FHPL R.O.W. is presented in Table 2 and on the 22-year old AGTL R.O.W. in Table 3. On both R.O.W.'s the vegetation cover of the sites monitored on Sections 1 and 2 had significantly increased.

Section 3 was of some interest since the overall vegetation cover on the untravelled R.O.W. sites had increased 50% over 1982 even though, on four of the 17 sites the cover had decreased. At the same time on the 22-year old AGTL R.O.W. there was a significant decline (13.5%) in the cover from that of 1982.

The mean cover values of the plots on Section 4 nearly doubled from 1982 to 1983(Table 2). The highly significant increase from 32% to 61% cover suggests that plant establishment is being achieved at a rapid pace.

The mean increase in cover on all plots on the untravelled portions of the FHPL R.O.W. was 14.2% (Table 3). Such an increase would be expected of

Table 2

CHANGES IN VEGETATION COVER ON THE 2-YEAR OLD FHPL RIGHT-OF-WAY

Section		1982	1983	Change	Significance
1	Mean Cover	17.7%	29.5%	+11.8%	**
2	Mean Cover	8.1%	16.6%	+ 8.5%	**
3	Mean Cover	18.2%	27.9%	+ 9.7%	**
4	Mean Cover	31.8%	61.1%	+29.3%	**

** Significant at the 99% confidence level.

Table 3

CHANGES IN VEGETATION COVER ON THE 22-YEAR OLD
AGTL RIGHT-OF-WAY

Section		1982	1983	Change	Signficance
1 + 2	Mean Cover	72.8%	92.8%	+20.0%	**
3	Mean Cover	56.7%	43.2%	-13.5%	**
4		No old R.O.W. in this Section.			

** Significant at the 99% confidence level.

Table 4

DIFFERENCES BETWEEN 1982 AND 1983 VEGETATION COVERS

	FHPL R.O.W. 2 Years Old	AGTL R.O.W. 22 Years Old
Mean of Differences in Cover	14.7% ± 15.3	17.2% ± 10.0
Range of Changes in Cover	-5% to +63%	-34% to +23%
Mean Overall Change in Cover	+14.2%	-5.9%

a vegetation cover which is still in the establishment stage. However, over the same year the cover on the 22-year old R.O.W. showed a decline of 5.9% (Table 3). This decline occurred mainly on the lower elevation Section 3 of the line, an area which may have been suffering because of a very dry year.

In comparing the cover on the two R.O.W.'s it should be noted that there was no difference in the mean variation of the covers (14.7% vs 17.2%) or in the magnitude of the ranges of variation of covers (68% vs 53%). Only the overall direction of change (fluctuations from 0) is positive on the FHPL R.O.W. (+14.2%) and is negative on the 22-year old AGTL line (-5.9%) (Table 4).

It must be remembered in an overall comparison of sections that the sites are not randomly located within the sections but were located at critical, or potential problem areas. The overall figures for the vegetation covers therefore do not represent the more favorable conditions found along much of the R.O.W. They can be used to give more insight into what is happening along the 'worst case' portions of the route. Areas not monitored were frequently observed to have a much greater vegetation cover than the monitored portions.

DISCUSSION

The year-to-year changes in plant cover result from two factors, a stochastic one which operates on both the 2- and 22-year old R.O.W.'s and an establishment component operating mainly on the 2-year old R.O.W.. The latter represents the natural year-to-year increase as the cover becomes established.

Although the data from this study cannot be used to lend any weight to either the individualistic or classical theories of plant successsion, they do point out several factors:

1. The year-to-year variability in plant cover was large.
2. The amount of fluctuation in plant cover was not different on the 2- and 22-year old pipeline R.O.W.'s.
3. Variation in cover has a stochastic component and in the early years a plant establishment component.

The implications of the results for pipeline monitoring programs are:

1. A one-time evaluation of the R.O.W. is not sufficient to make definitive statements about the adequacy of long-term vegetation cover. This would be the case no matter which theory of plant succession is correct.
2. Permanently-installed quadrats are a good method of monitoring year-to-year vegetative changes as they permit objective evaluation of the vegetation dynamics along the R.O.W.
3. Comparison among R.O.W.'s of different ages and with adjacent vegetation are important in determining the overall vegetation dynamics of a reclaimed site.

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