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NATURAL REVEGETATION OF PLACER MINED LANDS OF INTERIOR ALASKA II

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Introduction:

To the uninitiated eye an aerial photo of Fairbanks' surrounding area includes patches of what might appear to be the channels left by the workings of a bark beetle grub. These series of parallel mounds with sequences of smaller undulations on their surfaces are actually composed of coarse gravel and are the product of some forty years of gold dredging. Started in 1928, dredging was concentrated in several of the tributary valleys of the Tanana River and Goldstream Creek. Some of these tailings piles support lush growth while others are relatively bare. At present, no ecologically oriented studies, either qualitative or quantitative, have been published concerning the gold dredge tailings. It was therefore the intent of this study to obtain a broad picture of the present stage of revegetation, in order that further ecological work and, hopefully, assisted rehabilitation may be facilitated.

Methods:

In an attempt to obtain preliminary baseline information on the present vegetational condition of the gold mine tailings, field work was carried out in a selected area of tailings near Fox, Alaska, approximately eight miles north-northeast of Fairbanks (64°57'N, 147°35'W). Field work involved an initial reconnaissance of a large area surrounding Fox, a subsequent semi-quantitative description of a number of stands, and a limited amount of quantitative sampling of a small number of selected stands.

A search for pertinent literature was begun in the spring of 1979 and is continuing. Consultations with Mr. Dan Eagan, vice president of the Alaska Gold Company and Dr. Earl Beistline, Dean, School of Mineral Industry, are greatly appreciated and were invaluable in the choosing of a study area and subsequent work. With the assistance of Mr. Eagan and the use of the dredging maps in the possession of Alaska Gold Co., approximate dates of mining were obtained for most tailings observed.

Selection of quantitative and semi-quantitative sites necessitated considerations of both physical and biological factors operating on individual tailings heaps that might possibly influence subsequent revegetation. Physical factors varying from site to site included micro- and mesotopography, gross shape and orientation of the mounds, microclimate, differing wind patterns, and state of weathering and geologic composition of substrate gravels and decayed bedrock. The main biological factor thought to be important to recolonization was nearness to seed source.

Because all of these conditions could not be held constant between masses of different ages, and not even between masses of tailings of the same age, it was decided that most of the intensive work should be done in one general area in an effort to minimize variability. The great complexity of physical and vegetational patterns of tailings of the same age made it impossible to include

in-depth studies of tailings of differing ages within the limited time and resources available, and these were given only cursory consideration. Intensive work, including all the quantitative work and a majority of the semi-quantitative work, was done in the lower Goldstream Creek area to the west of the Steese Highway and the Trans-Alaska Pipeline.

General reconnaissance of the area and collection of vascular and nonvascular plants began in May of 1979. Species identification is continuing with the use of the University of Alaska Herbarium.

Semi-quantitative work followed in June and representative homogeneous stands were singled out for further study. Homogeneity was determined largely by the general overall appearance of individual areas. Dominant life forms, density of vegetation and height of vegetation were three structural components used in making this decision.

Once the stand was selected, major floristic components were identified and given relative cover values. Occular estimates of species cover were based on an increasing familiarity with the vegetation in the area and are not of a highly precise nature. The following estimates were made for these sites: ground cover composition and percentages, percentage of fines mixed with gravels, average size of gravel, and height of and distance between consecutive undulations. In addition, average depth of the litter layer was estimated and the presence of decayed bedrock clumps was noted.

The following items were also obtained or observed on all semi-quantitative and quantitative stands: general orientation of the mounds, steepness of slope (if the stand was on a side slope) and whether or not the dredge was moving up-or downstream when depositing gravel.

At the more intensive level, four quantitative stands were chosen, three of them on adjacent mounds which represented three different degrees of revegetation. The fourth was an extremely densely vegetated area. The stands ranged from approximately 2,400 to 4,500 square feet in size. These were paced off and a grid was set up. All tree species were mapped, their heights were estimated and either their basal diameters or diameters at breast height (dbh) were measured. The largest trees in each stand were cored for aging purposes.

Mapping provides a permanent record of the vegetative status of these differing stands and will allow changes to be followed over a period of time. Mapping also furnishes the only practical method of securing reasonably precise quantitative data from a limited number of homogeneous stands that were too small to be sampled.

Hulten's Flora of Alaska and Neighboring Territories was used as a guide in field identification of vascular plants; Dahl and Krog's Macrolichens of Denmark, Finland, Norway and Sweden and Crum's Mosses of the Great Lakes Forest were used for field identification of nonvascular plants. Those species that could not be positively identified in the field were collected.

Tall shrubs were also mapped and much the same information that was gathered for tree species was collected for tall shrubs. Individual shrubs with more than one basal stem were assigned a clump diameter and an average stem diameter. Low shrubs and herbs were mapped in the cases where they could not be adequately sampled. Photographs supplemented information obtained on quantitative stands.

Ground cover, including herbaceous, low shrub, moss and lichen cover was obtained by systematic quadrat sampling. An equal number of quadrats from the tops and bottoms of undulations were sampled. Protruding clumps of what was thought to be decaying bedrock were sampled separately as they appeared to support lichens and mosses in amounts differing from the the surrounding gravel substrate. In addition, much of the information collected for the semi-quantitative stands was also obtained for the quantitative stands.

Soil and plant samples were gathered from each stand for subsequent nutrient analysis. Nutrient analysis will allow tentative conclusions to be drawn as to whether or not soil nutrient status is a factor in limiting plant growth. Complete nutrient analysis is being performed by the soils testing laboratory at the Palmer Research Center.

All field data were collected in the summer of 1979 and are currently being analyzed and reduced. This report represents the present status of the project and the final results will be written up and included in a graduate thesis which will be submitted to the funding agency.

Preliminary Results:

Few conclusive results are available at the present stage of analysis but the following observations can be tentatively presented.

Although the dates of mining of most of the tailings heaps looked at in the lower Goldstream area did not vary more than 10 years, the amounts of vegetation present on those tailings varied widely. A direct correlation between age (date mined) and degree of growth seemed doubtful, at least on those equal-age mounds observed.

The only physical factor that was conspicuously correlated with degree of revegetation was the amount of fines mixed in with surficial gravels. Presence of fines ranged from about 5% of the total rooting depth substrate to over 50%.

Further data analysis may allow other correlative factors involved to be detected. Many things were discovered over the course of the field season, that, had they been known prior to investigation, would have changed some approaches to the study. It was anticipated that more obvious correlations between both age and amount of fines and vegetative state would be found. Many aspects could not be dealt with and will have to be left to further study.

Stands With Little Vegetation:

The initial reconnaissance and subsequent semi-quantitative work revealed a wide array of vegetative types. At one end of the spectrum, there were the relatively bare sites. A small percentage of fines was intermixed with the gravel on these sites. Except for an occasional birch sapling there were no tree species present. Willows, or any of the other tall shrub species found on the more developed sites, were also found in small amounts.

Bare gravel predominated in the ground cover and any accumulated litter was negligible. Members of the moss genus, Grimmia, were the most common of the moss species, though again they were not found in abundance. The only plant types that occurred in substantial amounts were species of lichens, especially Stereocaulon species, Umbilicaria species and different crustose forms. Even in the case of Stereocaulon, however, it was observed that the lichen was found in denser mats when associated with patches of mineral soil.

Intermediate Stands

Between the bare sites and those with nearly 100% tree cover were a wide variety of vegetation types. Most of these stands included a few trees (dbh 2" and taller than 10') and an equal or greater number of saplings (dbh 2" and less than 10' tall). Paper birch, Betula papyrifera, was the predominant tree species occurring to some extent in all sites observed. Quaking aspen, Populus tremuloides, and balsam poplar, Populus balsamifera, were less widespread and in general found in lesser abundance than birch. Where balsam poplar grew, it was often either dying out or had dead tops or dead limbs. This may be a consequence of a lack of water during particularly dry summers. It was not found in great abundance when in association with birch.

Varying proportions of three willow species were found in these intermediate stands: Salix bebbiana (the most prevalent of the three), S. alaxensis and S. arbusculoides. Other shrubs including Alnus crispa, Rosa acicularis and Viburnum edule were found only occasionally; Shepherdia canadensis and Ribes triste were rare in these stands. Many of the willows had dead branches.

Low shrubs included Ledum palustre ssp. decumbens and ssp. groenlandicum, Arctostaphylos uva-ursi, Vaccinium uliginosum and Empetrum nigrum, and, to a lesser extent, Linnaea borealis and Vaccinium vitis-idaea. In the sites observed, none of the low shrubs were in great abundance or had high cover values.

Major herbaceous plants were Epilobium angustifolium, grasses, Equisetum spp. and Pyrola spp. Herbaceous cover rarely exceeded 10%. Other herbs were present in lesser amounts.

A much larger range of mosses and lichens were found in these intermediate sites than in the sites previously mentioned. The most important moss genera were Polytrichum, Drepanocladus and Rhacomitrium; many others also contributed to total Bryophyte cover. Lichens of major importance were Stereocaulon spp., Peltigera spp. and Cladonia spp. Ground cover included varying percentages of litter (up to 30%) and bare rock (up to 80%).

Well Developed Stands

The sites with the heaviest growth had a much smaller percentage of exposed bare rock and attendant higher litter cover percentages. The gravels in these sites were mixed with a higher percentage of soil-sized particles.

Tree species present on these sites paralleled those growing on the more intermediate stands. However, densities, average height and dbh measurements were substantially greater. White spruce, Picea glauca, also appeared to occur more regularly in these more developed sites.

The composition of tall shrubs was also similar to those of the more intermediate sites with some increases in percentages of Viburnum edule and perhaps Rosa acicularis. The tallest willows occurred on these sites with some exceeding 30' in height.

Low shrub species composition was much the same as in the intermediate stands with apparent increases in the abundance of Ledum palustre ssp. groenlandicum and Vaccinium uliginosum.

Grass species, especially Calamagrostis canadensis, and Epilobium angustifolium continued in these denser stands to be the major herbaceous groups present.

Moss and lichen species composition showed perhaps the greatest change from that found in the intermediate stands. Stereocaulon, which was a dominant ground cover on less shaded sites, was rare on these sites and Peltigera and Cladonia species predominated. Hylocomium splendens, which was rare on more open sites, assumed a position of dominance among the moss species. This position of dominance was shared by the genus Drepanocladus. The abundance of Polytrichum did not appear to have changed much through the transition.

Concluding Remarks

At the present stage of analysis, the only definitive conclusion that can be made with respect to "causes" of vegetational pattern is that there is a positive correlation of percent fines with vegetative cover on a large scale. The patterns of vegetation on the mine tailings are extremely complex and undoubtedly are related to many interacting factors. Further analysis and data reduction may provide evidence of possible vegetation patterns (both large- and small-scale) which at this point are not obvious. There is no question but that establishment of most of the woody plant species common on disturbed sites, in interior Alaska have been successful on many sites on these 30-40 year old tailings. Judging by the age of some specimens, successful establishment occurred in some sites very soon after the tailings were deposited. Preliminary analysis, however, does not explain why apparently similar sites were not vegetated. The causes of such unconformities remains to be determined.