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Reclamation of the Usibelli Coal Mine Near Fairbanks, Alaska

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INTRODUCTION

Alaska, the fiftieth and largest state, has abundant resources available. Alaska has abundant wildlife and resources, but it is also fragile. Alaska has extreme environmental conditions which make for a delicate ecosystem. A major human disturbance can easily destroy what took thousands of years to create. The short growing season along with a layer of permafrost in most of the interior is an area of slow recovery from disturbances. Human intervention must be applied to insure that the damage is reversed, however, as in other mining situations the restoration process is challenging and experimental.

Alaska's ecological health and stability is sometimes compromised by the need for fossil fuels. Alaska has as much coal as all the lower 48 states together. The qualities of the coal at the Usibelli site were suitable for strip mining, and were a desirable prospect for the mining industry. The Usibelli Coal Mine Company started strip mining in 1943. Through the strip mining process of scraping off the overburden, they have displaced the native soil horizons and mixed them with tailings (Mitchell 1985)

The Reclamation Act of 1977 required the study of strip mine conditions and implementation of restoration projects. It also set aside extra money to do so. The job of restoring the Usibelli site was then put in the hands of the Alaskan Forestry Service and people associated with the University of Alaska. This purpose of this paper is to describe the restoration attempts at Usibelli dating back to 1982 and to provide some suggestions for increasing the success of the restoration process.

SITE DESCRIPTION

The Usibelli coal mine is the largest strip mine in Alaska. At 64 degrees northern latitude, it has an interior climate resembling Fairbanks, which is just north of the site. It has an average air temperature of 26 degrees F and an average yearly precipitation of 17 inches (Mitchell 1985) The original vegetation at Usibelli was boreal forest. In a 1984 progress report (#9502587) on the reclamation project, three test sites in the Usibelli mine were studied. Poker Flat which is at 1500 feet above sea level, Vitro at 2000 feet, and Gold Run Pass at 2500 feet. Poker Flat has two major types of soils. Typic Cryorthods exists in the mounded areas north of Lignite Creek. These soils are relatively organically rich and deep and have a layer of silty loam that covering permafrost. South of the creek, a Pergelic Cryohemist-Pergelic Histic cryaquept complex exists in the basin area and extends southward. This was a deep gravelly loam that exists over a frozen gravel substratum (Mitchell 1985) Vitro which is north of Poker Flat, consisted of Typic cryocherpts that existed on the lower gently sloping terraces that extended to the mountains beyond. It has various stratified layers of alluvial sediments with varied texture (Mitchell 1985) The lower area in the mountains called Gold Run Pass consisted of a Typic Cryochrept complex that formed steep terraced slopes that extended to the river. The coal-covered gravelly mine spoils were left in mounds between the coal seams. All plant growth was not prohibited even though some of the subsoil sulfates were exposed and oxidized, which decreases the soils pH (Dent 1992). The low sulfur content in the coal decreased the risk of the soil becomming acidic.

Leeching of the pollutants was not a problem on this site because water capacity was low in the permafrost sub-soil (Mitchell 1985)

RECLAMATION PROCESS

Data was collected from Usibelli for assessing its condition. USGS topographic maps and aerial photography were used to create a basemap which was used for reference to the site as a whole and to create a template for natural vegetative patterns. Usibelli was largely devoid of vegetation. Ground covers and grasses were planted first to stabilize the soil and prevented further erosion. Amending or adding to the topsoil is the best way to counteract the toxicity, but is not economically feasible for large areas such as the Usibelli mine. Specific selection of tolerant native plants helped the site by covering the exposed soil, which slowed erosion, and held the pollutants, thereby giving less tolerant species a chance to establish themselves (Vangronsveld 1995) Re-vegetatation is a challenge because of low (if any) organic N in soil around a strip mine (Nossner & Hons 1992) Continued fertilizer application was necessary to maintain the vigor in the plantings (Mitchell 1985) Applying sewage is an option on large sites, but it is not a long term solution and does not release nutrients as slowly and as consistently as naturally occurring organic N (Nossner & Hons 1992) Sewage sludge can be sprayed on the soil from a distance, which prevents the need for excessive machine travel across the soil and reaches the steeper areas (Bureau of Mines 1990).

Sewage for fertilization is available from facilities in nearby Fairbanks (Mitchell 1985) Sewage application is not an environmental problem if applied properly and if not used for agricultural crops. (Sopper 1992) Proper application consists of sludge incorporated into the soil. Sludge should not be applied if the ground is saturated frozen or covered with precipitation (Sopper 1992) The short warm season in Alaska creates a small window of time when application is appropriate. As the ground thaws in the spring, the nutrients flow with the melted precipitation into the root zone, where the seedlings lie (Sopper 1992) So, fertilizer and sludge were applied in the late fall before the first snowfall.

The soil was compacted, so imprinting was implemented. Imprinting the ground with bulldozers greatly improved the quality and persistence of the stands (Mitchell 1985). The seeds then have a place to enter the soil and germinate. Raking the soil and spreading the seeds into the furrows by use of agricultural machinery was a cost effective way of planting the ground covers and grasses in this large area. In some places, the seeds and seedlings were planted by drilling divots in the soil with a hoe. Several planting method trials showed that aerial planting was effective where adequate moisture was available. In places that it was not, drilling was better. Drilling was especially effective and useful for establishing plants on the sloped areas (Mitchell 1985).

Native plants were used when reseeding because of their natural adaptations to the weather conditions. At the Usibelli site, a complex mixture of native ground covers and grasses were selected for their hardiness and tolerance to pollutants. Several introduced, but northern species along with some legumes with similar traits were also included. Most native species are not available commercially. Seeds must be gathered and grown in controlled conditions to provide the seeds and seedlings needed (Mitchell, 1985). The following plants were tested:

Alopecurus pratnsis	Meadow foxtail
Alopecurus arundinaceus	Creeping foxtail
Agropyron desertorum `Nordan'	Crested wheatgrass
Agropyron riparium `Sodar'	Streambank wheatgrass
Agropyron spicatum	Bluebunch wheatgrass
Agropyron subsecondum	Bearded wheatgrass
Agropyron trachycaulum	Slender wheatgrass
Arctagrostis latifolia	Polargrass
Bromus inermus `Polar'	Smooth bromegrass
Bromus biebersteinii	Meadow bromegrass
Calamagrostis canadensis	Bluejoint reedgrass
Calamagrostis purpurascens	Purple pinegrass
Deschampsia beringensis	Bering hairgrass
Deschampsia caespitosav	Tufted hairgrass
Elymus sibericus	Siberian Wildrye
Festuca rubra `Arctared'	Red Fescue
Festuca longifolia `Scaldis'	Hard fescue
Festuca arundinacea `Alta'	Tall fescue
Medicago media	Varigated alfalfa
Modicago falcata	Yellow-flowered alfalfa
Paccinellia sp.	Alkaligrass
Panucum clandestinum	Deertongue
Phalaris arundinascea	Reed canarygrass
Phelum pretense `Engmo'	Timothy
Poa pratensis `Nugget'	Alaskan Bluegrass
Poa compressa	Canada bluegrass
Poa glauca `Tundra'	Glaucous bluegrass
Trifolium hybridum	Alsike clover
Trifolium repens	White clover

* bold plants are native to the site

At the test sites, the seedlings responded well to fertilizer application. Without the continued application of fertilizer, plantings loose their vigor and die off within 3 to 4 years (Mitchell 1985). Intensive an repeated intervention is required to get the plants to become established. The soil conditions at the Usibelli site were too severe for most of the plantings. Most did not survive their second winter. The red fescue, smooth bromegrass, foxtail and timothy persisted throughout the site. As expected, different plants were more apt than others to survive in the extreme situations in the site. For example, plants like alsike clover and some sainfoin preferred areas that were protected from the winter winds, such as roadsides that were covered with heavy snow from plows. Red fescue and smooth bromegrass were the only survivors of the winter winds at

Gold Run Pass. Plants like foxtails and timothy both favored swales and gullies. The introduced Nordan crested wheatgrass, tufted grass, and Sodar streambank wheagrass initially grew throughout the sites, but never established. Bromegrass grew in clumps when it normally is a vigorous spreader (Mitchell 1985).

DISCUSSION

Aerial planting produced high mortality rates for the seeds. Places where laborers hand planted seedlings produced higher survival rates (Mitchell 1985). Random hand planting of the most vigorous grasses chosen improved the success rates of the other seedlings (Mitchell 1985) The sterility caused by the pollutants also had an effect on the soil microbes, mainly the mycorrizae. Mycorrhizae is found naturally in soil but not in coal polluted soil. (Bureau of Mines 1990). Mycorrhizae increases the survival rate of the seedlings by increasing the exchange rate of nutrients between the roots and the soil. Seedlings infected with mycorrhizae had a better chance of survival (Miller 1987). When and if the soil can eventually become stabilized and established with grasses, trees could be planted in various areas. A selection of trees were made to accommodate the conditions at the site. The following trees are native and hardy to the site: *Abies balsamea*, Balsam Fir, *Alnus incana,* Lodgepole pine, *Populus deltoides,* Cottonwood, *Populus tremuloides,* Quaking aspen. These trees tolerate poor, gravelly moist and polluted soils. *Abies balsamea* is especially suitable for the higher elevations because of its tolerance to wind. *Alnus incana* is valuable because of its nitrogen fixing properties (Dirr 1990). In places where trees would be planted, the site should be disked to incorporate the grass organic material. The soil will be prepared and easy to plant. In places where aerial seeding was unsuccessful, hand planting of seedlings should be implemented to insure some vegetative establishment. In places where the public will observe the restoration project, denser plantings and larger seedlings should be planted so the public can see that there is progress being made. Besides educating people on a restoration efforts importance, their opinion of it is essential for continuing the project and future reclamation efforts.

BIBLIOGRAPHY

Dent, D. 1992. Reclamation of Acidic Sulfate Soils. Advances in Soil Science p331-50

Department of Alaskan Coal Mining. 1982. Alaskan Coal: Resources and Developmental Constraints. 139p.

Dirr,MA. 1990. Manual of Woody Landscape Plants. Stipes Publishing Company.

Mitchel, WW. 1985. Revegetation of Alaskan Mine Spoils. Alaska University. 98p.

Nossner, LR and Hons, FM. 1992. Reclamation of Mine Tailings Soils. Advances in Soil Science. p351-431

Sopper,WE. 1992. Reclamation of Mineland Using Sewage Sludge Soils. Advances in Soil Science. p351-431.