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Analysis of vegetation, its composition, and its habitat for mine reclamation

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Project Description and Objectives:

Our project supports post-mine planning and reclamation by identifying pre-mine vegetation types, determining the composition of pre-mine vegetation types and determining the habitats (landscape environments) of the pre-mine types.

Applicability to Mining and Reclamation:

The assumption that post-mine environments might mimic pre-mine environments provides a basis for extending studies of the natural pre-mine vegetation of a heterogeneous landscape to support reclamation. Classification of the vegetation will identify target communities adapted to the regional climate and environments of landscape facets of the site. Description of these vegetation types will include species lists needed for designing a reclamation seed mix for each type. Identification of the habitats of each will provide the basis for either vegetating an existing surface or designing a surface for a particularly desirable vegetation type.

Methodology:

At a single mine scale we combined standard statistical methods to achieve our ends and tested them by application to data (800 pre-mine points) from the Absaloka mine, SE Montana. First, we identified vegetation types for the mine-site by use of three steps. Ordination, which related the vegetation of each point to others, showed a structured near-continuum. Classification hierarchically divided the continuum into quasi-discrete segments (Figure 1). Pruning analysis was refined to objectively determine the hierarchical level with the strongest i.e. the 'ecologically optimal' number of types. Second, we described the target vegetation types with a summary releve table, and third, the habitats of the types were identified by correlating vegetation types with landscape/environmental factors

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Photo A

Photo B

Above Photo: Native vegetation (A) and reclamation vegetation of a similar site (B). The background in (A) is a natural rock outcrop while that in (B) was constructed of spoil to support reinstallation of the original pine-vegetation.

Above Figure 1: A classification tree for vegetation of the Absaloka mine. The topmost [split] divides the entire data set into four bottomland communities (left) and, on the right, three upland types. Subdivision is repeated till the 'ecologically optimum' level (8 types) is reached. Vegetation types include an upland grassland (Stco/1), two upland forests (Agsp-Pipo/2 and Feid-Pipo/3) and increasingly moist bottomland sites (Agsm/4, Syoc/5, and Prvi/6, and Sppe/7), all identified in our final report.

Methodology (continued):

measured at each point sampled (slope/aspect, topography/configuration, and soil texture/rockiness). Two analytical methods, logistic regression models (glm) and classification and regression tree (cart) were used. Detailed descriptions and rationales are included.

In contrast, for a regional analysis we tried two parallel approaches. First we sampled- - via high resolution air photographs- vegetation and environment at three sites on the principle ecological factor gradient of the region (pptn 13-17 inches). Vegetation types of a site were defined physiognomically and related to environment (topography and aspect) by correlation. Seed mix design will depend on correlation of physiognomic type and vegetation composition measured on the ground. This analysis was extended to the region by comparing the results across the precipitation gradient of the region). Second, we tested combination of on-the-ground data from multiple (two) mines for creation of a regional vegetation classification. This was unsatisfactory, due to inconsistency of vegetation and environmental data.

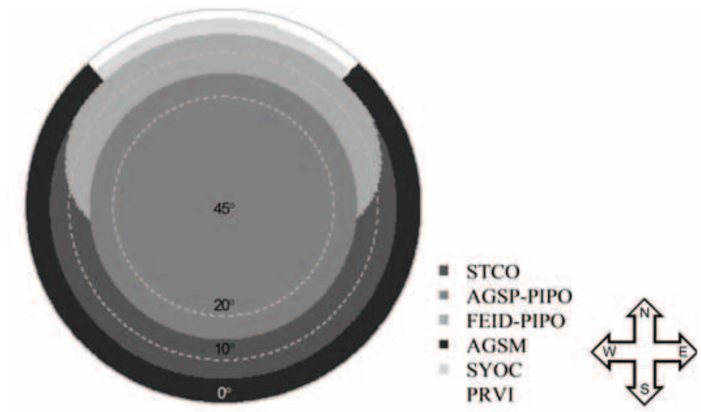
Highlights:

We developed methods (outlined above) for identifying, seeding, and siting vegetation types for reclamation in any region of the world. For single sites, they were highly specific, statistical, and detailed. For regional analysis they were on all counts, less so, but never the less useful.

Results/Findings:

We demonstrate both a mine-specific approach and a regional approach. First, our demonstration of single-site methods- - based on on-the-ground sampling - - shows seven native vegetation types (Photo B), shows that seed mixes can be similar or very different, and sites the types in hills (2 types), plains (1 type) and bottomlands (4 types) (Figure 2). Second, at the regional level, we demonstrated vegetation typing (physiognomic) and siting for a single site- - via remote sensing- - and extrapolated it region-wide by observing its changes on the principle environmental gradient of that region.

Work with the data emphasizes three applications. First, our methods will apply at least as well to other disturbances (e.g. reclamation of old fields (CRP) and roadsides) as in mine reclamation. Second, siting via correlation of vegetation type and landscape factors supports both re-vegetation of a given surface, and creation of a surface which will support a desirable vegetation type (Photo 1) Third, use of existing public data is efficient and economical. In that regard, while fine-grained public data (e.g. high definition aerial photo, and pre-mine field sampling) were extremely valuable, maps created by combining pixels (e.g. NRIS and NCRS) were too coarse for our needs.



Above Figure 2: A CART based model showing the most probable distribution of vegetation types with respect to slope, aspect and derivatives. Circumferential position indicates aspect, with north at the top, and slope declines from the center out. Vegetation types as in Figure 1. Application discussed in Weaver et al. 2010.

Website Information:

The final project report can be found at **http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/2005appscience/CompletedProjects/MSUVegetationHabitatAnalysis2005.pdf**

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