Enabling Diversity in Reconfigured Landscapes

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During the noble but uncharted voyage toward reestablishment of vegetation with very specific attributes on lands surface-mined for coal over the past 30+ years in the western U.S., opportunities to explore the ecology of vegetation in semi-arid landscapes have likewise been vast. Seeking simultaneous achievement of prescribed levels of plant cover, forage production, woody plant density, and species diversity in a "permanent" reconstructed vegetation has invited use of a "gardening" approach to revegetation. This approach makes the assumption that planting of a carefully planned list of plant species could/should be expected to produce a vegetation entity of prescribed characteristics. With substrates in replaced in conformance with regulatory topsoil suitability and depth requirements, the garden is ready for "vegetation installation." Right? ---Not so fast.

Ecologists have long given lip service to the dynamic nature of natural vegetation as mediated by varying climate conditions, competitive interaction of component plant populations, and such adjusting forces as differential herbivory etc. However, the full extent of the truth of this concept has rarely been more apparent than it is in the accumulated experience associated with coal land revegetation. Young vegetation, that often fairly closely reflects the varying recipes envisioned by creators of the seed mix/planting plans has time and again drifted toward the same relatively simplified composition dominated by grasses. It is abundantly clear on most western U.S. coal reclamation sites that the competitive nature of grasses is the dominant dynamic. This is true because soils of uniform depth and relatively high agricultural suitability spread across landscapes of gentle and unbroken slope perfectly describe what the dense root system of grasses most effectively dominates. It is ever more apparent that in western landscapes, with large expanses of unconsolidated relatively fine-textured substrate and an average deficiency of moisture, that the grass lifeform is extremely advantageously positioned. The extensive presence of fine grass roots in the upper 12 to 18 inches of soil is an extremely effective pre-emptor of moisture passing into the soil. Intense grass competition strongly limits the chances of forbs, shrubs, and trees to successfully establish themselves in the young vegetation. However, grasses are not immune to damage by external forces such as drought or overgrazing. On substrates that possess great rockiness, or steep slope, or active erosion, they often are unable to establish the overwhelming competitive advantage that they have on more moderate sites.

It is posited that plant diversity on western landscapes is partly the product of diverse environments <u>and</u> partly the product of a slow accumulation of species that have entered the site upon the occasion of an ebb in the competitive ability of the existing primary ground cover. Such ebbs in competitive intensity are thought to be driven by stresses such as drought and overgrazing (though a period of exceptionally great moisture availability could also diminish the "bite" of grass competition; however, in the semi-arid West, drought is realistically the more likely driver of competition relief).

In the pursuit of improved species diversity in reclamation sites, there are some important approaches that will directly facilitate reduced grass competition such as variable topsoil depth and, even more extremely, 1) the use of partially exposed highwall faces in the post-mining landscapes and 2) the use of coarse, even rocky substrates to improve moisture infiltration and root accessibility to that moisture as well as discourage choking development of grass cover. In 1), the exposed faces of consolidated rock add an environment not possible in the midst of the zones of backfill in which no consolidated material can still exist – in other words take advantage of the edge of the "asteroid effect" (as so aptly termed by Nicholas Bugosh during this conference). The accumulations of colluvium at the base of these rock faces also contributes important substrate diversity. In 2), placement of rocky growth media interjects dramatic substrate diversity into what has heretofore been so uniformly set up for the well-being of shallow-rooted and highly competitive grasses. These rocky materials greatly enhance variety of

microhabitats and especially facilitate root access to deep moisture that supports so many forbs, shrubs and trees in the West.

Perhaps the most important reality related to species diversity on coal reclamation sites in the west to be placed in our consciousness is the fact that ultimately *Plant Diversity will be ENABLED and NOT CAUSED*. Though we humans prefer to work under the assumption that we are In Control (the Gardening metaphor), the complexity of the accumulated adaptations of native plants and their ecological interactions with other plants and environmental conditions puts the "achievement" of long-term high species diversity outside the realm of feasible direct control. In the Field of Dreams metaphor, the answer is that if you build it (truly diverse environments in conjunction with wrenching, scarring effects of future droughts and other severe stresses), they (diverse plant species) will come.

(This of course begs the question of how to adequately judge the future of species diversity on coal reclamation sites. Exploration of this subject was included in the paper by this author that was included in the 2006 Billings Land Reclamation Conference – See Buckner, D.L. 2006. Alternative Performance Standards for Species Diversity: A Consideration of Ecological and Temporal Reality. Proceedings, Billings Land Reclamation Symposium (in conjunction with American Society of Mining and Reclamation) June 4-8, 2006.)