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Overview of Vol.2, No.7 – Drastically Altered Lands

Tools for Reclaiming Drastically Altered Landscapes

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The earth's productive land base is decreasing as residential areas replace farmland, pushing agriculture onto marginal land. As long as the human population continues to grow, the demand for land and natural resources will also increase. With a shrinking land base and increasing population we need to maximize the landscape's biological productivity. The mining industry contributes natural resources to meet societal needs, while causing drastic alterations of the landscape which result in unproductive land. Productivity can be restored to an area radically degraded by agriculture, mining, or construction by re-establishing ecosystem function. Relative to ecological restoration projects, extremely degraded sites require major intervention. Reclaiming these sites focuses on re-establishing ecosystem function rather than restoring an historical natural community type. The four reclamation tools discussed in this section stabilize soils and improve chemical and physical soil properties.

The goals of reclaiming a drastically altered site include restoring an area's historical hydrology, stabilizing soils, and improving soil structure and biota. Ecological limits on many drastically altered sites are extreme changes in soil properties and hydraulic cycles. Reclamation projects require a mulitdisciplinary approach. Specialists in many fields, such as soil scientists, landscape architects, and hydrologists, must collaborate to make reclamation successful. Because topsoil may be marginal, establishing desired vegetation may be difficult and invasive species may be a subsequent problem. Topsoil on these sites generally lacks organic matter, good physical structure, good drainage, and biological activities including microbial development and nutrient cycling. However, the most limiting factor to restoration on drastically altered sites is toxic soil.

Agriculture and construction remove existing vegetation and may change local hydrology, which can result in degraded rivers and streams. John Bobrowski reports five techniques for stabilizing slopes and reducing gully erosion in riparian areas impacted by agriculture and construction. The importance of local climatic conditions and the degree of site degradation are stressed as key to the success of reclaiming degraded riparian zones.

Modern technology has increased the intensity of mining's impacts and put mining on a large spatial-scale, which has lead to governmental regulation. Mining operations completely remove a site's vegetation and soil. Mined lands have been likened to islands of environmental extremes. Typically, there is a large disparity between drastically altered landscapes and surrounding natural communities. However, these islands occur in the context of a fragmented landscape so there is no possibility of relying on natural regeneration and recolonization to restore a site. Because intervention is so important, regulation plays an important role in mine land reclamation. The mining industry is legally obliged to restore productivity to the areas it utilizes. The Surface Mining Control and Reclamation Act of 1977 was enacted to regulate the impact the mining industry has on the environment by requiring mine land reclamation.

Mined sites have special problems due to the removal of an entire ecosystem, changes in slope, and the potential for toxic soil. On mined sites, toxic soil is either covered with a non-toxic soil or physical and chemical soil characteristics are ameliorated. Soil remediation needs to be cost efficient and have long term effects. Irrigation and fertilization are costly so long term soil remediation which restores soil fertility and structure are preferred. Restoring hydrology and terrain may require changes in slope. Modifying landform to the approximate original contour and connecting mined contours with the rest of the landscape are also important to mine land reclamation.

The methods described in this section develop soil chemical, physical, and biological properties so vegetation and microorganisms can establish. Soil amendments are a key element to successful vegetation establishment on mined sites. Mining lowers soil pH thereby increasing the solubility of toxic metals and causing soil nutrients to be lost. Ron Reuter explains how sewage sludge is used as a soil amendment for infertile mine soils. Sewage sludge is rich in organic matter, nitrogen, phosphorus, and other essential plant nutrients. Sewage sludge improves soil horizon development, which in turn improves plant growth. Inoculation of soil with mycorrhizae is another method of improving plant establishment on degraded sites. Mycorrhizal association with plants increase the ability of plants to take up nutrients. Susan Sturges describes techniques for inoculating mine soil with mycorrhizae.

One of the most serious effects mining has on the landscape is acid mine drainage (AMD), which is increased acidity and heavy metals in soil and soil water. AMD increases the solubility of heavy metals making nutrients unavailable. Kathryn Smith discusses creating wetlands on abandoned mine sites as an AMD remediation technique. Wetland vegetation slows water velocity and encourages suspended solids to settle. Wetland vegetation and sediment can transform soluble metals to their insoluble form. Successfully established wetlands offer a long-term solution to AMD issues.

The methods described in this section are important, but they have limitations. As pointed out by Kathryn Smith, it is possible that plants taking up heavy metals on abandoned mine sites may introduce heavy metals into the food web. Stabilizing river and stream banks does not eliminate the source of degradation in an agricultural or construction setting - it merely fixes the damage of cultural use. Like any reclamation tool, each technique in this section has limitations and cannot be applied to all sites under all conditions.

When applied on a large spatial scale, failure of these tools is of major consequence to our land’s productivity. It is necessary for techniques used on drastically altered sites to be appropriate for large-scale and long term problems; however, reclamation techniques are not a susbstitute for sustainable development practices.