



Overview for Volume 5: Reclamation Approaches

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Restoration is often defined as the return of an ecosystem to its condition prior to human disturbance, recreating a landscape so that its structure and function closely resemble a natural community. Reclamation, on the other hand, is often defined as the reestablishment of some attributes of an ecosystem, ameliorating damage when a landscape is too degraded to return it to a pre-disturbance state.

A restoration project may convert a former agricultural field into a fully reconstructed prairie, for example, while a reclamation project may plant salt-tolerant grasses along a denuded roadside after highway construction. A restoration project may attempt to recreate an entire oak savanna, while a reclamation project may try to eliminate one invasive species from a site. A restoration project may take many years to return plant and animal communities to a wetland, while a reclamation project may take a few days to install geotextile fabric to check acute erosion on a hillside.

Yet, while restoration and reclamation often differ in their approaches and techniques, their scope and scale, their goals and objectives, they are closely linked. It can be helpful to think of restoration and reclamation as related across a continuum, where a starting point is the severely degraded landscape, an ending point is a fully functional ecosystem--and there are many points in between. The reclamationist, faced with a degraded soil, may apply a hydromulch laden with seeds of native species in order to capture and revegetate the soil. The restorationist, faced with polluted soil, must adopt reclamation techniques for toxin removal before vegetation can be reintroduced.

This volume of Restoration and Reclamation Review focuses exclusively on reclamation. The wide-ranging articles, covering both aquatic and terrestrial ecosystems, demonstrate the widespread need to repair human impacts on the environment. The scope and scale of reclamation in these articles is vast. We learn that some pollutants, such as polychlorinated biphenyls (PCBs), have become ubiquitous, spreading through aquatic and terrestrial systems in most industrial areas. We learn that a single industrial disaster--the Exxon Valdez oil spill--necessitated clean-up of 1,100 miles of shoreline, and that a single mining operation at Palmerton, Pennsylvania killed all vegetation and microbial soil activity on 2,000 acres of mountainside. We read that nearly 10 percent of the total land area in the world is affected by soil salinization, and that one dam in southern Minnesota has accumulated a sediment load of 11 million cubic yards since it was built in 1910.

These articles demonstrate that a wide variety of approaches and techniques is necessary to remedy such large-scale problems. Authors present us with reclamation techniques tailored to different ecosystems. Katherine Thering reports on dredging and dewatering efforts to remove PCB-contaminated sediments from the Lower Fox River, while Neal Hines discusses biostimulation and bioaugmentation methods for removing PCBs from soil. Different approaches to the same reclamation problem are examined. According to Becky Tlusty, trichloroethylene

(TCE), a volatile organic compound, may be treated by air stripping, carbon adsorption, soil venting surface bioreactors and *in situ* bioremediation. Jillian Lay's article focuses on the recent, experimental approach of phytoremediation to remove TCE from groundwater.

A key theme which emerges from the articles is the need to evaluate approaches and techniques in terms of specific sites. Each reclamation project must examine the cost of a technique, its effectiveness, its timeliness, when fitting an approach to a site. The side-effects and limitations of any approach must be carefully weighed. For example, Darlene Charboneau reports that alum, a commonly used treatment in lakes, can cause negative impacts at some pH levels rather than ameliorating phosphorus load. As Carrie Reinhardt remarks, there are no "cookbook recipes" for success, only "creative, cost-effective solutions."

The need for sound, thorough science in planning and implementing reclamation is another key theme. Anthony Randazzo reminds us that phytoremediation, "while attractive for cost and aesthetic reasons," has not been sufficiently tested and proven in the field, and thus is not yet a reliable approach to toxic sites. In her article on hot water cleaning in Prince William Sound, Andrea Hilla gives a sobering example of what may happen when scientific consensus is not reached and an unproven method is used. High pressure, hot water treatment of the aquatic oil spill at this site resulted in more damage than benefit, causing erosion and sediment loading, and killing bacteria and other flora and fauna.

Indeed, failures and near-failures, limitations and limited successes, are reported in these articles, giving us a sense of the true challenges of reclamation. Katherine Thering writes that dredging of the Lower Fox River has been considered helpful, yet has removed only 5% of total PCBs. Alyson Landmark writes that composting "is an effective and fairly safe way to restore ecosystem balance" in degraded soils, but that it often is not used because high collection and transportation costs keep it from being affordable. Some especially challenging reclamation problems are not addressed in this collection: decontamination of heavy metals, for example, which is more difficult to accomplish than removal of organic pollutants. Some emerging reclamation problems--such as those caused by current urban sprawl rather than past industrial development--have not been explored.

On the other hand, these articles describe projects where ingenuity and creativity have combined with sound research and implementation to make a difference. J. Hope Hornbeck examines wetlands and riparian buffer zones as effective tools for remediating excess nitrates and other agricultural pollutants in waterways. Dana Gardner describes how the right combination of fly ash/municipal sludge amendment and seed mixture revegetated a dead mountain landscape at the former Palmerton Zinc Smelter site.

The goals and objectives of reclamation projects must be more restrained than those of restoration projects. Fully repaired and functional ecosystems free of human disturbance are not the end results presented in these articles. Perhaps ecologist Daniel Botkin's definitions provide another way of understanding the relationship between restoration and reclamation. Restoration, a reminder of wilderness untouched by human disturbance, maintains biological diversity and provides a baseline for understanding our place in nature. Reclamation, a reminder of the

changes our human actions have wrought, calls for knowledge, understanding, monitoring and management as we accept responsibility for those actions.

LITERATURE CITED

Botkin, Daniel B. 1990. *Discordant Harmonies: A New Ecology for the Twenty-First Century*. Oxford: Oxford University Press.