

Native Seed Bank Brooklyn Reclamation Project

By Carol A. Pollio and Walter H. Davidson

The 1977 Surface Mining Reclamation and Recovery Act (SMRCA) requires the reclamation of land disturbed by surface mining. This law also addresses the issue of areas mined prior to 1977, by establishing a fund to begin emergency reclamation of the most hazardous sites. Within New River Gorge National River, there are hundreds of such mine hazards eligible for abandoned mine land (AML) reclamation funding, and many others that, although not hazardous, need reclamation work. The site used for this study, the Brooklyn Mine Refuse Area, (BMRA), was considered a low priority for emergency funding because it was not a serious threat to health and safety or to the environment. The Brooklyn site created an aesthetic problem, however, because of its visibility from the river and the air.

The BMRA consists of a large, almost completely unvegetated mound of unstable refuse. The NPS has developed resource management guidelines that encourage the use of native species for revegetation projects within natural zones. This project was developed in order to determine if the native seed bank technique would encourage natural succession to reclaim disturbed sites, allowing for increased stabilization, increased adaptation of plants to local climatic conditions, and at the same time, produce a source of food and shelter for wildlife.

Another consideration was the cost associated with assembling a native seed mixture from commercial sources. The native seed bank method uses local topsoil that already contains seeds of existing native plant communities. These seed banks are excellent sources of both primary and secondary succession species thought necessary to the development of natural ecosystems (Wade 1986).

Native seed banking is not a new technique. It has been used by a number of researchers since the mid 70s, at first in the arid western regions of the country, and more recently in the Appalachian Mountains of the eastern United States. Farmer, et. al. (1982) experimented with spreading Appalachian forest topsoils for reclamation, producing 134 taxa on two mine sites and



Biological Technician Judy Weese in 1st replication plot (June 1989). Photo by Carol A. Pollio

one nursery site (Farmer et al 1982). This study, conducted in Tennessee, also concluded that a large amount of nitrogen and phosphorous was taken up by the plants growing in the native seed banks. These essential nutrients, they suggested, might be important in the development of later plant communities, possibly enhancing the diversity of species.

Objectives of this project were twofold. One was to encourage the emergence of native plant species in order to reclaim disturbed sites, such as minespoils. The second was to determine if seasonal variations would change the composition of plant species that emerged. Other considerations, though not specific objectives, were cost effectiveness and personnel time necessary for implementation of native seed banking for future reclamation projects.

Methods

In June of 1989, three 20' x 20'' experimental plots were delineated on the refuse pile at the Brooklyn site.

During each phase of implementation, 3 additional plots were installed, creating a total of 12 experimental plots. Phases, or replications (Reps), were installed in June and October, 1989, and April and June, 1990.

Prior to installation of the plots, soil samples were taken from the project site and analyzed by the USDA Laboratory in Berea, KY. Soil analysis data were collected for six plots, two samples from the top and four samples from the slope of the spoil pile. Samples were tested for the following parameters: pH, Aluminum, PO_4 , Sulphur, Total Carbon, Calcium, Magnesium, Potassium, Sodium, Barium, Silicon, Zinc, Phosphorous, Iron, Copper, Manganese, Cobalt, Nitrogen, Titanium, Chromium and Lead. This information was then compared to baseline soil composition data to determine the application rates of lime and fertilizer.

Each of the plots had a pH in the range of 3.5 to 4.8, or relatively acidic. Below a pH of 5.0, aluminum, iron and manganese often are soluble in sufficient quantities to be toxic to some plants (Brady 1971). Soil sample results showed high levels of aluminum and iron were present. Treatment with agricultural lime rated at 105 lbs/acre, equivalent to 600 lbs/acre, was performed as a site preparation to reduce the concentration of iron, aluminum and manganese in the experimental plots.

Plots also were pretreated with fertilizer, 100 lbs rated 10-20-20, equivalent to 40 lbs N, 80 lbs P and 80 lbs K per acre. The "native seed bank" material, the top 2 to 3 inches of forest floor and litter, was removed from preselected sites manually and distributed on the plots at approximately the same thickness. The availability of suitable borrow material in the area presented a problem and caused a difference in the soil used for each installation. The highest quality soil was used for the initial plots in June 1989, and suitable material of a lesser quality was used for all subsequent plots. The latter contained a higher percentage of coal refuse material and less organic material (visual observation). In spite of these limitations, all plots exhibited comparable growth of both woody and herbaceous species.

Measurements

Once the plots were installed, the emergence of



Range pole in 1st replication plot. Photo by Carol A. Pollio

herbaceous and woody plants was monitored by park staff. An initial inspection occurred in August, 1989. At that time, there was approximately 80 percent cover in Rep. 1, 50 percent cover in Rep. 2, and 70 percent cover in Rep. 3. Six woody and 13 herbaceous species were noted. Another inspection in November, 1989, indicated that germination was occurring in the October plots, however, the germinants were too small to identify. In August, 1990, the 12 plots were inventoried and the data recorded. The data represent two growing seasons for the June 1989 treatment and one growing season for all subsequent treatments.

Results

One of the objectives of this project was to determine the effectiveness of the native seed bank method to encourage the germination of native plant species. Of the 40 herbaceous species present, 10 were non-native or introduced species (25%). Of the 17 woody plants present, only 1, the Princess-tree or Paulownia, was a non-native. It was interesting to note that the Princess-tree (*Paulownia tomentosa*), considered a take over species, had apparently succumbed to competition. Significant numbers of Paulownia had been identified in several plots during the early part of the study, but very few were present during the inventory process. The herbaceous species present also were primarily shade intolerant species, which will more than likely disappear as woody species develop.

These data also were analyzed based on the time of year the plots were installed. The plot installed in October, 1989, appeared to exhibit more varied species diversity. It is also important to note that several interim species observed prior to the inventory, such as mayapple, are primarily forest floor species and did not survive due to intolerance. Woody species that emerged in the plots might possibly have come from the adjacent natural forest. White ash, yellow poplar, black birch, river birch and red maple are all present in the surrounding forest and, therefore, make it difficult to determine whether or not this seed came from the seed bank.

Although no statistical analysis was attempted because seed bank materials came from different borrow areas, results indicate that a great variety of viable seed was indeed present in the seed bank. Many of the herbaceous species may not persist because of their individual intolerances, however, their presence allows additional organic material to be available for the next generation of germinants.

There were 191 trees, 160 shrubs and vines, and over 1,981 herbaceous plants counted during the August 1990 inventory. Using a multiplier of 100 (the replicates are approximately 0.01 acres) and dividing by 12 (the number of replicates) gives a result of about 1,590 trees per acre, 1,330 shrubs and vines per acre, and 16,508 herbaceous plants per acre. In addition, during the inventory process, several species of wildlife were observed using the plots, namely Eastern box turtle, Northern fence lizard, and black rat snake.

Discussion

This study demonstrates that native materials can be established on abandoned deep mine refuse using the native seed bank technique. Germination of native species did occur, and in some cases, crowded out non-native species that appeared. The scarcity of quality topsoil in this area of the Appalachians did affect our ability to analyze the data statistically, however, it did prove that the native seed bank technique can be successful even with poor quality soil. For the first time in 40 years, there is vegetative cover on a virtually bare coal refuse pile. In addition, it was accomplished at minimal cost and with existing day labor, making this method more cost effective than other revegetation methods.

(For tables showing soil sample results, herbaceous plant species and distributions at 3 different times of year, woody plant species and distributions at 3 different times of year, and the names of all herbaceous and woody plants found at BMRA, contact the authors at New River Gorge National River, P.O. Drawer V, Oak Hill, WVA 25901; (304) 465-1447.)

Pollio is an NPS Resource Management Specialist at New River Gorge; Davidson is a Research Forester with the USDA, stationed at PA State University.

Literature Cited

- Wade, Gary L. "Forest Topsoil Seed Banks for introducing Native Species in Eastern Surface-Mine Reclamation." A Symposium paper for a National Meeting of the American Society for Surface Mining and Reclamation, March 17-20, 1986.
- Farmer, R.D. Jr., M. Cunningham, and M.A. Barnhill. 1982. First-year development of plant communities originating from forest topsoils placed on southern Appalachian minesoils. *Journal of Applied Ecology* 19:283-294.
- Brady, N.C.. *The Nature and Property of Soils*, 8th Edition. 1974. MacMillan Publishing. New York, NY.