

TWENTY-TO-ONE: THE NEVADA EXPERIENCE¹

by

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Abstract. The key to mine land reclamation is the reestablishment of healthy natural resources. These resources include the whole spectrum of above and below ground components, but special emphasis is put on creating the optimum conditions for healthy, diverse soil microbial activity. This is accomplished through the use of livestock to incorporate organic matter and enhance the conditions for microbial activity on mine site. Results and lessons learned from experience with four mine sites in Nevada are presented.

Additional Key Words: mine land reclamation, soil microbial activity, livestock.

Introduction

First, people need to realize that we approach mine dump and leach pad reclamation from a different perspective (or paradigm) than individuals who have a formal education in those related subjects. Our 'business' is ranching, production livestock and resource management. We also evaluate healthy natural resources (soils, plants, etc.) differently than most ranchers and government agency personnel (USFS, BLM, state wildlife groups, etc.). I believe that it is due to those two things that we have had such success in mine site reclamation and native rangeland restoration in conditions that range from extremely arid to semi-arid.

Austin Gold Venture Mine Site

The first mine site reclamation job we did was in October 1989. At the time, we had livestock permits southwest of Austin, Nevada and the Austin Gold Venture Mine (an FMC-Inspiration property) mill site was on USFS land within our grazing land. The mill site sat at 6500' in elevation. We had restored some of the adjacent rangeland, using livestock, and our ranch management team³ convinced the mine managers that we could reclaim the 10-acre tailings pond dam on the mill site. One

reason the managers agreed to let us try was we guaranteed growth on the site. The mine was in production at the time, running two 12 hour shifts. The tailings dam had been constructed for 5-6 years at the time, and had no vegetation on it. We used 300 head of pairs with some bulls, or the equivalent of 600+ animals for the job. We built a one wire electric fence around the top of the tailings dam to keep the animals out of the tailings pond, and hand broadcast the mine's approved seed mix on the soil surface. We then fed the cattle for five days on the slope. For each of the five days we fed three times what the animals could eat per day, in order to get enough organic material into the soil to create a favorable seed bed.

The cattle did an amazing job of creating a terraced effect on the face of the slope as they moved from one area to the next. These 'terraces' were 2'-3' in vertical height and created a 'well' effect for winter moisture. From October 1989 to October 1990 the mine recorded 6.34" of precipitation (rain and snow) and in November 1990 we clipped and weighed 6800 pounds of dry matter per acre on the site. About half of the production was annual rye which came from the mature rye hay we had fed the cattle, the other half of the production was perennial grass/forbs from the seed mix. The down side of this was, the mine and the USFS were so pleased with the results that they wanted to protect the growth and no animals were allowed back into the site for seven

¹ Paper presented at the 16th Annual National Conference of the American Society for Surface Mining and Reclamation, Scottsdale, AZ, August 13-19, 1999.

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³ Management Team consisted of Tony, myself, USFS personnel, BLM personnel, Nevada Department of Wildlife personnel, NRCS personnel, other ranchers, and representatives of the Nevada Cattlemen's Assn. And Nevada Farm Bureau.

years. Once the nutrients were locked up in standing material and non-re-incorporated into the soil, the microbial activity associated with the plant roots returned to a dormant stage⁴ When this occurred, productivity of the site reduced drastically.

Northumberland Mine Site

The second reclamation job we did was at Northumberland Mine, a Western States Minerals property, located near Smokey Valley, Nevada at 9000'+ elevation. This job was for 130 acres total of overburden dumps and an old tailings site. Most of the dumps had been re-contoured but some were still at the angle of repose. We trucked 350 head of pairs (equivalent to 700+ head) into the site on October 28, 1991 and completed the job on December 2, 1991. The approved seed mix was broadcast using a 3-wheeler, and then the cattle were fed on top of it. This property had a higher elevation and more than twice the annual moisture than the first job (AGV at Austin), but less than a third of the production within the first year. We believe this was for two main reasons.

1. The mine wanted to do the reclamation as cheap as possible and did not want us to 'waste' as much hay as we had done on the AGV job. Therefore, we had very little organic material in or on the soil surface, and
2. We had used a petroleum-based pesticide (a major pesticide/insecticide product used by the livestock industry, nationwide and 'totally safe') on the cattle to get rid of lice and worms when we unloaded them off the trucks onto the mine site.

The product used is a systemic product and we realized that for the first couple of weeks the cow manure would kill any flies or insects, which came into contact with it. What we did not realize was the further detrimental effects of that product. What occurred was not only did the systemic properties kill insects above the soil surface, but it also killed any bacteria/fungi below the soil surface. On a mine site,

where there is minimal bacteria and fungi in the soil to begin with (due to the lack of organic material in the soil), by using that product we further reduced the diversity and numbers of the bacteria and fungi. This was a lesson we did not learn at the time. It wasn't until the next job did we fully (I)earn this college equivalency unit.

While the production on the WSM Northumberland site was not near as great as on the AGV site, it was still enough for the mining company to receive a reclamation award from the USFS in 1992. So, although the mining company and the Government agency were satisfied, we felt like it was, at the least, a partial failure.

Candeleria Mine Site

The next job was for Kinross Mines, the Candeleria Property, near Mina, Nevada. Elevation is 6000'+ and for the past seven years the mine has recorded an average of 3.8" of annual moisture, per year. Once again, grazing leases, which we use, surround this property. This job was for 160 acres of overburden dump, which was 700' high and a test plot on three acres of a retired heap leach pad. Due to the size and location of the dump and difficulty of using a seed broadcaster, we had the seed flown on the dumpsite by airplane. It took the pilot about 2 ½ hours, from the time he arrived until he left, to apply the seed to the dump. The cost of this was about \$15.00 per acre to apply the seed. The mine and the Mina Management Team⁵ agreed upon the seed mix to be used and it was mostly native species of grass, browse and forbs. The seed was flown on January 12, 1998 and we began to feed 800 head of animals on top of it. The dumpsite was fed on until mid-April. Although we had small storms through the winter, the weather was fairly warm and about 5 weeks into the job we discovered a lot of the cattle had lice. So, we gathered everything and used a non-systemic lice killer on all the animals.

After completing the dumpsite in mid-April that bunch of cattle were sold. We then used 70+

⁴ Bacteria, fungi and nematodes need available carbon, nitrogen, oxygen, hydrogen and trace element sources for their food chain. They get those things from healthy plant roots, their own predator/prey relationships and decomposing plant material within the soil.

⁵ MMT consists of Tony and I, BLM personnel from both grazing and mining, Nevada Department of Wildlife personnel, US Fish and Wildlife personnel, other ranchers, environmentalists, wild horse activists, and people from the local area.

head of other animals to carry out the feeding test on the heap leach pad. We began the heap leach pad trial about May 1, 1998 and completed it in five days. We used electric fence to contain the animals to the 'test' area. The heap leach pad the feeding was done on had two different treatments prior to feeding. These treatments were:

1. One area had been rinsed with 6 inches of fresh water and was considered to be 'clean' of cyanide and mineral salts.
2. One area had no rinsing beyond natural moisture.

Prior to feeding, all three areas were ripped with a cat, wheat straw was applied at the rates of 1 ton and 2 ton per acre (equivalent) and then drug with a rail to break up the soil surface and incorporate some organic material into the soil. The mine, the Mina Management Team and the BLM agreed upon the seed mix applied to the site. The species used are native to the area and were chosen for their ability to survive drought and mineral salts in the soil. The seed was applied using a seed hopper mounted on the front of the feed truck and was applied while feeding the cattle. Soil baseline monitoring data was gathered prior to the feeding test on both the heap leach pad and adjacent areas for comparisons of existing mineral salts, microbial activity, etc. Forage tests were performed on native plants in adjacent, undisturbed sites to be used for future mineral absorption comparisons with any forage produced on the heap leach pad.

The results of the dump reclamation were both positive and negative. The areas which were fed on prior to us spraying the animals for lice were producing 1200 pounds of dry matter per acre by July 28, 1998. (By the end of the growing season, around the middle of September the site was producing about 1500 pounds of dry matter per acre.) The vegetation growing on those areas was about half-annual and half perennial and included every specie which was planted. One of the neat things was the fact that we had seedlings sprouting and growing all season. At the end of the season there were seedlings from 2 inches to 2 feet tall of most of the species planted. Those areas also had the greatest incidence of insect, bird and reptile (lizard and horned toad) species associated with the vegetation. The area that was fed on after we sprayed the cattle for lice had tremendous annual

weed (forb) production (like Russian thistle) and very little production on the planted species, and very little biological activity. We now believe that the lack of production of planted species is because of the insecticide used on the cattle. We are quite sure that it affected the microbial activity in the soil and therefore, the plant production. Monitoring of the soil, vegetation and biological activity will continue on the site and there will be some updated information by the time this symposium meets in August.

The results on the heap leach pad were also varied. The area, which had been rinsed with fresh water, had vegetation production of everything from Australian Pea and oats (from the hay fed to the animals) to browse, grass and forb species, which were planted. The area rinsed with re-circulated water had sporadic vegetative growth. This will be monitored again this summer (and for the next few years) for any changes in forage production, mineral absorption, soil microbial activity, etc.

Sleeper Mine Site

The most recent reclamation activity we accomplished was in December 1998 at the Kinross-Amax Sleeper Mine, located north of Winnemucca, Nevada. This job consisted of a 40-acre area that initially was the north and west walls of the open pit mine. Since mining activity has ceased, the pit has filled with ground water to create a lake about 360 feet deep x 1 mile in length. The slope is about 300 feet long and consists of blow sand with the top 70 feet being fine silt. The site had been mechanically ripped and seeded but no vegetation had established. Because of the sandy soil and constant presence of water, the mine personnel felt that vegetation was necessary to minimize erosion. Based on the positive results we had at the Kinross Candelaria property, the mine contacted us to see if we would reclaim the site with cattle. The seed was flown on at a cost of \$5.50 per acre and we used 300 head of pairs (equivalent to 600 head) that belonged to a local rancher. The job took 22 days to complete. Tests for soil microbial activity were conducted prior to making compost on the site. About a month after we finished feeding, we applied a compost tea to some of the area. The site will be monitored during the growing season this year to determine results. This information will be available for the symposium in August.

Summary

When we evaluate a piece of land, whether for reclamation or restoration, we have learned to look at the whole spectrum of above and below ground predator/prey relationships. These include:

- plant phenology,
- the relationship of soil microbial activity to available carbon and minerals sources in the soil,
- the relationship of microbial activity to healthy root systems,
- the relationship of grazing animals (both large and small) to available forage above the soil surface, and
- the relationship of large animals to insect, bird and small animal activity.

We recognize that if there is healthy, diverse communities of bacteria, fungi and nematodes in the soil, that production of vegetation on that soil can be unlimited. Therefore, when we begin to restore or reclaim land, we try to create the optimum conditions for healthy, diverse soil microbial activity. We also realize that once vegetation is produced, the vegetation must be managed for health and diversity for the microbes to remain healthy, diverse, functioning communities. We just happen to be able to achieve these conditions with livestock.