LIVESTOCK GRAZING FOR MANAGEMENT OF RECLAIMED LAND AT NAVAJO MINE: ANIMAL RESPONSE[1]

by

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Abstract: Livestock responses during grazing of reclaimed land were monitored at the Navajo Mine since 1994. The Navajo Mine Grazing Management Program (GMP) began in 1991 to prepare for bond release and return of reclaimed land to the Navajo Nation by demonstrating the ability of the land to sustain the post-mining land use of livestock grazing. Local Navajos, whose livestock are used in the GMP, are interested in the ability of the land to sustain their livestock. Sustainable livestock grazing implies the ability of animals to thrive, successfully reproduce and maintain the health of the land. Daily care and monitoring of livestock health was carried out by herders hired by the mining company. General animal health parameters including blood selenium levels were monitored quarterly. Livestock responses to grazing reclaimed land have been largely positive. Cows have produced healthy offspring and owners indicate satisfaction with calf size, and overall performance of the cows. Selenium and other blood testing parameters indicate no adverse effect on animal health to date. Hazards associated with reclamation and ongoing mining activities are important considerations for lands being reclaimed for livestock grazing as a post-mining land use and must be monitored carefully during any grazing program. Preliminary results indicate that planned grazing by cattle on reclaimed land at Navajo Mine is feasible and does not adversely affect animal health.

Additional Key Words: herd health, livestock mortality, reclaimed land, selenium toxicity.

Introduction

The Navajo Mine in northwest New Mexico is a large surface coal mine operating on lands leased from the Navajo Nation. The reclaimed lands will be returned to the Navajo Nation for the post-mining land use of rangeland used primarily for livestock grazing. To determine that livestock grazing on reclaimed land in this arid region is sustainable, and to learn the effects of grazing reclaimed areas on animal health, BHP initiated livestock grazing in 1994.

All government agencies involved with the process of regulation on these lands have indicated that official transfer of liability for the land from the mining company back to the Navajo Nation will require acceptance of the land by local grazing permittees. Additionally, the law requires that the company demonstrate the ability of some reclaimed land to support the post mining land use (SMCRA 1977).

The complexity of the regulatory process, the need for acceptance by the local community, the lack of information concerning the impacts of grazing reclaimed land on livestock health in this region, and the scarcity of precedence in returning reclaimed land to the Navajo Nation, led the mining company (BHP) to seek out a process to guide decision-making and planning for the return of the land. Since the inception of the Grazing Management Program (GMP) in 1991 at the Navajo Mine, the company has used a decision making process called Holistic Management (HM) (Savory 1988) to accomplish the goal of the GMP (Estrada et.al. 1997).

Monthly meetings of the GMP management team have focused on the social, ecological and financial aspects of creating viable livestock grazing on the reclaimed land. A diverse group of participants in the project established a holistic goal detailing their values, production methods to support the values, and the desired future ecological conditions for the reclaimed land.

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Production aspects of the goal require that the reclaimed land be capable of supporting livestock grazing. Concerns had been expressed by some local grazing permittees, the mining company and others about possible selenium toxicity and other potential hazards to livestock which graze the reclaimed land. The concern about selenium is due to the possibility that animals grazing on reclaimed land over power plant fly ash disposal sites (fly ash contains varying, but potentially significant, amounts of selenium) (Navajo Mine 1989) may ingest enough forage with elevated concentrations of selenium in the plant tissues to constitute a potential hazard to the animals from selenium poisoning. Additionally, there was evidence that without grazing the ecological condition of the land was slowly deteriorating. These reasons prompted the team to institute a grazing management program that would utilize livestock provided by local permittees. Local individuals must ultimately judge the acceptability of the land for grazing. Although animal performance is not a criterion for liability release, the health and well being of livestock is important to the livelihood of the local grazing permittees. Therefore it was critical that the GMP involve the livestock owners in the decision-making process and that they be aware of the livestock health and vegetation monitoring results.

Methods

Monthly meetings of the GMP Management Team normally included an update on the status of the livestock health and grazing progress, including a tour of the grazed areas and an observation of the animals. Livestock owners were notified immediately in the event of any serious animal health concerns with their livestock. When an animal owned by a participant in the GMP died, the owner was compensated by BHP at the current market value for the loss of that animal . Owners were encouraged to visit their animals at any time provided notice is given in advance and mine safety procedures were followed.

All grazing was carefully planned and monitored. The grazing plan remained flexible to meet a variety of animal, land, and mine operation needs. Livestock were allotted areas of land that provide sufficient forage for the herd given their physiological state. Grazing area size was controlled with the use of electric fencing. Drinking water was provided through a combination of methods: including the existing irrigation delivery pipeline, hauling to drinking troughs in the grazing areas, or through semi-permanent ponds fed by seepage from adjacent irrigated lands. Routine testing of water quality was performed, including areas where irrigation seepage is the only water supply.

Mineral supplements in the form of mineral blocks formulated for local soil and nutritional needs, and including macro-nutrients such as phosphorous, and potassium as well as micro-nutrients such as copper, iron, selenium, and zinc, were available free choice to the livestock at all times. Supplements without selenium in the formulation were unavailable to purchase locally and the amount available in the mineral blocks was a controlled and known quantity. Grass hay and locally formulated protein supplement blocks were provided in certain areas as needed. These supplements were used both as an attractant to apply herd impact (concentrated trampling, dunging, and other effects of purposefully concentrating animals on a piece of land) and to augment low forage quantity and/or quality.

Herders hired for the GMP construct new paddocks, move livestock to new areas, and care for the animals. The livestock were observed on a daily basis for any signs of stress, sickness, reproductive difficulties or other problems. Animals that died for any reason were subjected to a general necropsy by Dr. Quintana.

Livestock owners were regularly asked to express any concerns and general impressions of the GMP, particularly in reference to animal health and performance measures. An outreach and education program with the local community was a regular part of the GMP. Field Days on the mine were held in 1994 and 1996 to show local community members, government agency representatives, and local political leaders; the grazing areas, the livestock and the overall results of the GMP. Other topics of information included, biological planning, overall livestock health program, review of the problems and complications encountered in the GMP, and future plans. Open discussion was invited and questions about the program were answered by members of the GMP team.

1994

The first planned grazing on the reclaimed land took place in the spring of 1994. Portable electric and conventional fencing was utilized to create small pastures according to designs created by the GMP (Grazing Management Program Team, 1994). The

original objectives of this first grazing included monitoring the impact of the grazing on the vegetation, soils, and animal health. One objective of the 1994 grazing program was to remove much of the old standing vegetation and cycle it biologically. There was no plan for returning to a grazing area once it was utilized. As soon as all planned areas were grazed, the livestock were removed. As a part of the overall herd health monitoring program, selenium concentrations in the blood of the livestock were analyzed.

Animal health testing

Animal health testing began with the first grazing in the summer of 1994. One hundred and twelve head of cattle from 4 individual local permittees began to arrive at the mine on April 4, 1994. Livestock received eartags for identification and were weighed individually. Dr. Joe Quintana, the GMP's local veterinarian, weighed and examined each animal and administered the following medicine and vaccinations:

1. Siteguard MLG - protects against 8 strains of Clostridium bacterium diseases;
2. Triangle 9 PH-K - protects against Bovine rhinotracheitis, Bovine Virus Diarrhea, Parainfluenza-3 viruses, Pasturella hemolytica bacteria, and 5 different types of Leptospira organisms.
4. Pinkeye - protects against Moraxells bovis bacteria;
5. Haemophilus - protects against Hemophilus somnus bacteria;
6. Ivomec-F - protects against internal and external parasites.
7. Pregnancy test by palpation.

Samples of blood were drawn from each animal for the following analyses:

1. Complete blood count;
2. Blood chemistry (blood urea nitrogen, creatinine, aspartase aminotransferase, creatine phosphokinase, total bilirubin, indirect bilirubin, alkaline phosphatase, glucose cholesterol, total protein, albumin, and glutathione peroxidose;
3. Beta hydroxybutyrate;
4. Total blood and serum selenium.

Samples were taken by Dr. Quintana before grazing began, under an agreed-upon protocol for quality control from Dr. Merl F. Raisbeck, who is the GMP's consulting veterinary toxicologist. In conjunction with blood selenium levels, the other blood parameter sampling was recommended by Dr. Raisbeck to provide a more complete profile of animal health. From each animal four vials of blood were drawn. Vials 1., 2., and 3. were analyzed by Antech Diagnostics in Phoenix, Arizona for parameters listed above under 1., 2., and 3., respectively. Vial 4. was analyzed for selenium at the Olson Biochemistry Lab, South Dakota State University, under the supervision of Dr. Ivan Palmer. Sampling was repeated at the conclusion of the 5-month grazing period in late August of 1994.

Calves have been born in the reclaimed grazing lands in virtually every month, which reflects local breeding practices for range cattle prior to their arrival at the mine. Breeding of females in the 1994 season was done by 2 Beefmaster bulls provided by the GMP, based on a 25 cows/1 bull ratio. Young heifers were separated from mature cows and not bred.

1995-1996.

Grazing resumed on the reclaimed land in December of 1995. Forty eight head of cattle from the same local grazing permittees arrived at the mine in early December. Livestock numbers were reduced from 1994 levels to reflect a change in grazing management strategy to allow year-round grazing, in which a herd of livestock would remain permanently on the mine. Because animals in this program must regraze vegetation following plant regrowth and recovery, animal numbers were reduced to an amount closer to the long-term estimated carrying capacity of the reclaimed land. The 1995/96 average stocking rate of 1 Animal Unit (AU) / 17 ha is similar to the average stocking rate of 1 AU per 16.7 ha in similar areas of the Navajo Nation (Navajo Department of Agriculture, 1995).

The cattle in the year-round grazing program received the same veterinary care from Dr. Quintana as the animals did in the 1994 grazing program. Recommendations by Dr. Raisbeck for improved selenium sampling following the 1994 results included the planned addition of sampling animals off the mine as a control group, and the beginning of a multi-generational sampling of a select group of animals through at least three generations to address the question of long-term selenium effects (Raisbeck, 1994).

A group of 18 cows in the initial herd of 50

was purchased by BHP to add permanency to the selenium sampling regime and provide a 3-year data base on selenium concentrations for cattle grazing reclaimed land. Progeny of these livestock are added to the original sample group during the study.

In 1996, a 3 year old polled hereford bull and a 2 year old beefmaster bull provided by one of the livestock owners, were placed with the cows for a 90 day breeding period which commenced on June 7, 1996. The bulls were removed from the herd on September 9, 1996 and returned to the owners.

Results

1994.

Non-selenium blood test results from the 1994 season indicated statistical differences in a number of the measured parameters (Raisbeck, 1994). All three forms of bilirubin decreased between April and August. There was also a decrease in serum creatnine concentration and in various white blood cell indices over the season.

Large increases in bilirubin could indicate subclinical liver or blood damage. However, slight decreases in the bilirubin concentrations, as recorded in the 1994 samples, indicate that the cow is processing less chlorophyll as a result of range vegetation becoming mature after the growing season. Likewise the decrease in serum creatnine concentration is a normal response of the animal to such seasonal changes in diet.

Declines in white cell blood indices by the end of summer were attributed by Dr. Raisbeck to possible improvement in the animal's plane of nutrition and/or to a lessening of stress factors associated with body defense mechanisms and animal handling. White blood cells are involved with the animal's defense against various kinds of parasites such as ticks, worms, viruses, and bacteria. Declines in white blood cell indices over the 1994 season may therefore be related to a lessening of the normal immune system load caused by BHP's animal health program of worming and vaccinating. The planned grazing and constant movement onto fresh pastures may also have been a factor because increasing an animals nutritional plane will often produce similar drops in white blood cell indicators.

Blood glucose levels as measured both before and after the grazing season, were abnormally low. However, this measure was probably related to faulty procedures in collecting and storing the samples and differences in temperature between the two seasons when samples were taken.

Blood selenium sampling indicated that both plasma and whole blood selenium concentrations increased somewhat (0.021 and 0.086 ug/ml, respectively) over the 1994 season (Raisbeck, 1994). However, the recorded amount of increase in selenium levels remained well within the limits of what is observed in healthy cattle. The increase was also well below the 1 ppm threshold where adverse health effects might occur. The data indicated that the dietary selenium concentration increased slightly over the 1994 season, but remained substantially below any levels associated with selenium toxicity. As with other blood indices, the amount of increase in blood and plasma selenium recorded is of the magnitude associated with normal seasonal changes in pastures.

During the 1994 grazing of the reclaimed area, several modifications were made to the original grazing plan. The grazing period was lengthened from the originally planned 2 months because of increased forage availability and growth. This extension required that a group of 33 young heifers be separated from the mature cows to prevent them from being bred at too early an age. The reduction in size of the main herd increased the available feed supply and further lengthened the grazing period. Both herds were removed from the mine at the end of August, following a five month grazing period on the reclaimed land.

A total of 28 calves were born in 1994, with mostly in April and May. Branding, castration, vaccinations, and dehorning were provided for the owners while the animals were on the mine. Several problem births were experienced in the herd. These were the result of young heifers either being bred at too early an age the previous year, or because of being bred to a bull that produced too large a calf for a young heifer. One cow died while giving birth. The death was attributed by Dr. Quintana to dystocia, or birthing difficulty due to the small pelvic size of the cow relative to the calf size. Prevention of this problem in succeeding years was the major reason that young heifers were separated from the main herd and brought to another area to graze.

The other mortality during the 1994 grazing

season was a mature cow that experienced gastro-intestinal impaction, commonly known as "hardware disease", attributed by Dr. Quintana to ingestion of baling twine left on the land during the reclamation process. Herders began picking up twine and other potentially hazardous materials following this incident. No further problems of this nature were encountered. One calf was cut severely on a piece of discarded dragline cable, but recovered under veterinary care. The causes of the two mortalities encountered during 1994 are common in livestock grazing on native and pasture lands off the mine lease, as is the 2% mortality rate (Dr. Quintana, personal communication, 1996).

During midsummer of 1994, a large fly population emerged and caused the cattle to appear increasingly stressed. Modifications were made to the grazing plan to change the herd movement pattern so that the animals were not in close proximity to newly emerging flies. Dust bags containing a fly control insecticide were also placed for temporary control of flies. The fly population was significantly reduced by these actions, and fly population buildups have not reoccurred.

1995-1996.

Blood selenium data collected during the 1995 and 1996 grazing season is shown in Table 1 (Raisbeck, 1996). The data indicated a similar pattern of change in blood selenium levels over the season as was experienced in 1994. It is likely that the selenium concentrations changes reflect the normal seasonal influence of pasture quality. The changes may also have been related to drought conditions. Again, total blood selenium was significantly below the 1ppm threshold where possible animal health problems might occur.

Significant changes were made to accommodate year-round grazing in 1996. Particularly as a result of a severe drought. A total of only 94 mm of precipitation fell from October 1995 through October 1996, which is approximately 44% of the average precipitation of 203 mm for this period. In addition, most of the precipitation which came in small scattered amounts accompanied by high wind and temperatures. Lack of precipitation necessitated movement of the livestock herd into areas of reclaimed land not originally planned for grazing at that time. As a result, forage quantity and quality was highly variable, but an adequate forage base was insured by varying the size of the grazing area, the length of the grazing period, and by supplementation when necessary.

The drought produced greatly reduced levels of growth on forage species. Regrowth of grazed plants during the growing season (May - September) was very limited. The water supply for the livestock in the new grazing areas was taken from a large irrigation pipeline by means of a 2.5 cm. black polyethylene pipe to a drinking trough located in each grazing area. This arrangement produced very hot water by the time it reached the trough, which apparently inhibited the animals intake of water.

Another major problem with the water supply in the summer of 1996 resulted from the irrigation pipeline being switched temporarily to carry pit water. The GMP was unaware that this switch had occurred until livestock refused to drink the water. A high concentration of sulfate caused the pit water to be unpalatable to the livestock and they ceased grazing and drinking for 2 days until use of pit water could be discontinued.

A total of 38 calves were born between December 1995 and October 1996. This represents an 80% calf crop. Calf crops on the Navajo Nation reservation are commonly around 55% (Navajo Dept. of Agriculture, 1995.) Several problem births were again encountered and attributed to dystocia from heifers being bred at too early an age or to too large a bull. One newborn calf died as a result of dystocia. Other herd health problems included a cow that developed a prolapsed uterus. Her calf also died and the cow was spayed by Dr. Quintana to prevent further complications. One mature cow died during this period. A necropsy by Dr. Quintana indicated that the death may have been an indirect result of the stress encountered because of the low water quality, but the direct result was an uncontrolled clostridium bacterial infection (Quintana, 1996). One cow which arrived with a respiratory problem similar to asthma did not improve during the grazing program, and was returned to her owner. Ongoing problems and unreliability of the electronic portable scale readings caused weight gain data to be highly suspect. Visual scoring of cattle body condition showed normal fluctuations and nearly all cattle remained in good body condition.

As in 1994, animal health on the reclaimed land was not significantly different from what would be expected elsewhere (Dr. Quintana, personal communication, 1996).

Table 1.
NAVAJO MINE GRAZING MANAGEMENT PROGRAM
12/95 - 12/96
Cattle Blood Analyses for Selenium
(ppm)

Animal ID #	Sampling Dates						Average	Range
	12/15/95	3/29/96	6/18/96	10/17/96	10/22/96	12/31/96		
Study Herd								
BHP 1	0.104	0.115	0.145	0.103	0.102	0.102	0.112	0.102 - 0.145
BHP2	0.088	0.086	0.116	0.093	0.090	0.103	0.096	0.086 - 0.116
BHP3	0.095	0.086	0.121	0.098	0.094	0.091	0.098	0.086 - 0.121
BHP4	0.062	0.092	0.121	0.099	0.090	0.103	0.095	0.062 - 0.121
BHP5	0.093	0.095	0.146	0.107	0.098	0.114	0.109	0.093 - 0.146
BHP6	0.099	0.178	0.147	0.123	0.110	0.127	0.131	0.099 - 0.178
BHP7	0.098	0.101	0.137	0.103	0.100	0.108	0.108	0.098 - 0.137
BHP8	0.057	0.115	0.137	0.109	0.101	0.120	0.107	0.057 - 0.137
BHP9	0.087	0.110	0.122	0.087	0.080	0.086	0.095	0.087 - 0.122
BHP11-96*				0.077	0.071	0.074	0.074	0.071 - 0.077
BHP12-96*				0.073	0.070	0.082	0.075	0.070 - 0.082
Control Herd								
BHP26		0.061	0.118	0.099	0.091	0.103	0.094	0.061 - 0.118
BHP27		0.060	0.130	0.104	0.094	0.107	0.099	0.060 - 0.130
BHP28		0.057	0.126	0.098	0.091	0.106	0.096	0.057 - 0.126
BHP29		0.068	0.133	0.099	0.094	0.108	0.100	0.068 - 0.133
BHP30		0.064	0.120	0.091	0.087	0.093	0.091	0.064 - 0.120
BHP31		0.060	0.127	0.128	0.119	0.130	0.113	0.060 - 0.130
BHP32		0.053	0.118	0.102	0.099	0.100	0.094	0.053 - 0.118
BHP33		0.042	0.120	0.102	0.100	0.105	0.094	0.042 - 0.120
BHP34		0.058	0.124	0.097	0.092	0.105	0.095	0.058 - 0.124

*BHP 11 and BHP 12 are replacement heifers born in 1996, first sampled 10/17/96.

Conclusions

Although livestock grazing will continue on reclaimed land at Navajo Mine for several years, preliminary conclusions can be drawn after the first two years of experience. There is no indication that animals are negatively affected by grazing on reclaimed land. Concerns about selenium toxicity appear to be without foundation. Results of blood selenium concentrations have remained within normal range and in some cases are low enough that the animals might be considered selenium deficient. The response of livestock owners has been positive in every respect including their reactions to cattle condition and health. Additionally, a higher level of trust has been established with the local livestock grazing community involved in the GMP.

Livestock grazing on reclaimed land appears to be quite different from, but no more difficult than, a conventional ranching operation. The major differences involve regulatory requirements for monitoring, documentation and safety and the need to closely integrate herd management with rapidly changing mine operations and hazards associated with previous mining and reclamation activities, so as to minimize negative impacts on animals.

The principal advantages of holistic management as practiced at Navajo Mine included the open decision-making process that provided community members and local political leaders the opportunity to participate directly in the procedure that will eventually lead to the return of reclaimed land to their control. The grazing planning process, including the initial brainstorming, careful estimating of available forage, close attention to regrowth of grazed plants before re-grazing, and regular monitoring to provide early warning of potential problems, constitutes a structured, deliberate procedure that can serve to allay the fears of regulatory agencies and environmental groups regarding the potentially negative results of grazing reclaimed land. Moreover, the emphasis of holistic management on the health of the entire ecosystem, including grazing animals, helps remind managers of the importance of careful planning and monitoring.

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