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RESEARCH REPORT

More efficient livestock grazing may lead to improvements in environmental and plant diversity

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Introduction

Documented evidence shows that grazing of domesticated animals in riparian areas is a cause of non-point source water pollution. No longer can cattlemen allow their livestock to freely roam pastures when riparian areas are present without causing detrimental effects to the landscape and water quality. Cal Poly's outside laboratories and grazing land offered a tremendous opportunity to implement Management Measures and Practices (MMPs) which provided an excellent laboratory for monitoring research and instruction for good stewardship of our western rangeland. The main objectives of this project were to identify sediment loading in the creek, to monitor stream temperature, to identify MMPs which would reduce non-point source pollutants, to implement selected MMPs, and to assess the impact of the selected MMPs on non-point source pollutant reduction. This project focused on areas of concern affecting water quality in the Upper San Luis

Watershed and more specifically in the sub watershed of Upper Brizzolari Creek, confined to the Peterson Ranch on the Cal Poly Campus.



Left: Unstable hill slope in winter 2001.

Methodology

Research was conducted at Cal Poly's Peterson Ranch, a 435-acre ranch in San Luis Obispo County, California. Grazing was conducted with the use of Cal Poly's purebred beef cattle herd. The opportunity for this research was provided by a cooperative investigation by Cal Poly's Animal, Soil, and Biological Sciences departments.

Additional Fencing and Rotation: During the summer of 2001, the 435 acres of the ranch was further sub-divided from six into 27 smaller fields, including a riparian corridor. These additional fences allowed for a rotational or high intensity short duration (HISD) grazing management schedule. It also allowed for limited grazing on unstable upland areas as well as critical riparian areas.



Above: Unstable hill slope in spring 2002.

Transects: Six representative transects were developed throughout the ranch with the aim of sampling different soil types, topographies, plant communities, and hydrological components. Transect data allows the calculation of species percentages, percent bare ground, average plant height, and specific species statistics.

Biomass Sampling: A one-foot steel square was tossed at four random locations throughout the length of each transect each time sampling was in progress. Average height was measured and forage that was confined within the square was collected. The clipped biomass samples were oven dried and weighed and pounds of residual dry matter per acre were calculated and assessed.

Photomonitoring: Digital photography was used in order to create a photographic record of baseline conditions. Thereafter, photomonitoring was used to establish a record of change over time. Photographs were also used to highlight the effects of extreme storm events and critical areas.

Results

Transect 1: It has been observed that, if given the opportunity, cattle will tend to congregate, or "loaf," in riparian areas 5 to 30 times more than in drier upland areas. Reasons for this include higher forage volume and relative palpability in the riparian area as opposed to uplands, distance to water, distance and slopes to upland grazing sites, and microclimatic features. The concentration of grazing livestock in riparian areas leads to several direct effects that can reduce water quality. This transect reach has been identified as a typical loafing area and was incorporated into the upper riparian corridor pasture, which was put into a treatment of deferred grazing. Initially, residual dry matter (RDM) values were far below the minimum of 800 lbs/acre. However, these values are on an upward trend.

Transect 2: This reach ran cross-sectionally through a portion of the upper riparian corridor, upstream from the above-mentioned "loafing area." RDM increased throughout this transect as well, a possible indication that the increased rest period between grazing cycles promoted increased upland growth.

Transect 3: This transect represents a typical community of noxious weed invasion that often results in large masses of dead matter both standing and prone after the grazing rotation. Throughout this reach, the intent was to reduce the amount of residual matter left after each rotation.

Transect 4: This transect represents another area in which an undesirable plant species, wild mustard, has become prominent. It was the goal of the management plan to stabilize growth in this area and reduce the total amount residual stalk remaining after the grazing season while promoting grass growth.

Transect 5: The middle riparian corridor pasture was designed to be treated with deferred grazing, typically being skipped periodically throughout the grazing rotation. RDM values for this plot have been far above the 800 lbs/acre. This is an important consideration as vegetative cover is an important cornerstone in riparian health.

Transect 6: The lower riparian pasture was designed to be an exclusionary riparian pasture. Typically, this pasture will be grazed every four years to maintain adequate control over woody species. RDM values are high in this area, as was the intent.

Temperature and Dissolved Oxygen: Thermal pollution through the means of stream temperature increase may occur when there is a widening of the stream channel due to stream bank degradation. This exposes more water to surface and solar radiation as well as increased solar exposure due to a lack of shade as streamside vegetation is consumed by grazing animals. Increased temperatures may in turn impact fish populations because of a continual decrease in dissolved oxygen levels triggered by higher temperatures. Proper management of riparian vegetation through the use of a riparian corridor may allow for more appropriate shading of the stream channel, thereby reducing mean



*Cal Poly's Peterson Ranch
and the Upper Brizzolari
Creek Watershed*

temperature of the creek. On average, the mean temperature of the creek decreased two degrees after the first year of management and an additional degree in the following year. Dissolved oxygen levels did not change significantly through the testing period.

Nitrate and Phosphate Levels: Nitrate is one of the key inorganic forms of nitrogen that readily contributes to nonpoint source pollution. Nitrates are transported with ease through surface runoff, percolation through soil, and open bodies of water. Once prevalent in a body of water, rapid aquatic plant growth and algae blooms may occur. In addition to oxygen depletion, excessive amounts of dissolved ammonia may be highly toxic to aquatic species. The levels recorded during the project period fell well below maximum levels for pollutants.

Total Suspended Solids (TSS) and Total Dissolved Solids (TDS): Erosion is a natural process that can be accelerated by human management activities. When upland and riparian vegetation is removed at improper rates, sediment loading may drastically increase. Proper management of grazing livestock has been hypothesized as a key tool to limiting these factors. Testing for total suspended solids and total dissolved solids is one way to assess sediment loading. In this situation, the TSS level is far below polluting levels and is continuing a declining trend. TDS levels were also below typical pollutant standards.

Pathogens: The extent of pathogens in bodies of water depends largely on livestock density, access to bodies of water, and timing and frequency of grazing. While the fecal coliforms themselves are not pathogenic, they indicate the possibility that pathogens could flourish in the habitat and are practical indicators of infectious bacterial contamination. It is typical to have high pathogen values at the start of the wet season, as the biotic system flushes itself. However, for the two seasons of samples that were assessed, both fecal coliforms and *E. coli* levels decreased and system flush levels were never as high as initially tested.

Summary: California agriculturalists must assume a proactive role as land stewards and make a concentrated effort to improve water quality and sustainability on the farms and ranches that they manage. Grazing herds do have the capabilities of coexisting with natural environments in a beneficial manner. Using livestock as a tool can increase the biodiversity of plant and animal species. In order to achieve these benefits, however, land managers must take it upon themselves to be educated on the current status of their land and the direction that their goals will take them. Most driving forces that alter ecosystems result from interactions of factors. Therefore, careful evaluation of the relationship between vegetation structure and water quality as well as how grazers interact with these systems should be the foundation of any practical grazing management strategy or restoration effort.



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Changes in these types of dynamic systems may take years to become evident. There is still a great deal of increased management to be completed throughout the Brizziolari Creek watershed. Access roads need increased maintenance and possible resizing; stream crossings need to be resized, and additional studies in the form s of sediment sourcing and macro invertebrate testing need to be done. Even at the time of this report, alternative livestock species are being used to help aid in the reduction of noxious weeds and invasive species.

The water parameters tested are influenced by a vast number of factors, many of which are only slightly influenced by human interaction. However, the combination of improving upland grazing management and allowing for a more functional riparian system has in this circumstance appeared to have enhanced the watershed through increased forage production, reduced mean channel temperature, increased dissolved oxygen levels and reduced amounts of nitrates found in the creek. An overall reduction of nutrients and pathogens will lead to a greater biodiversity in both the flora and fauna of the riparian ecosystem, which in turn will enhance the multiple beneficial uses of this watershed.

Impact Statements

- ◆ The project provides a valuable reference tool for Cal Poly's livestock managers in assessing future projects in both planning and goal setting
- ◆ This project provides valuable information for livestock producers and the scientific community on the interrelation between upland management and riparian health.
- ◆ The scientific evidence from this research will assist managers in making decisions about strategic rangeland and riparian management.
- ◆ If desired, livestock operators will have the opportunity to view this project as a template and may incorporate innovative practices that they view as feasible and that may lead to more efficient livestock grazing, improvements in environmental and plant diversity, and wildlife habitat.

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For More Information

This research report contains summarized results of Michael Hall's study entitled "Implementation and Comparison of Management Measures and Practices (MMPs) in Reducing Non-Point Pollution and Improving Water Quality in Brizziolari Creek on the Cal Poly Campus," ARI Project No. 01-3-006 (Research Focus Area: *Biodiversity*). To view and/or obtain a copy of the complete final report, or to obtain additional information about this or other research projects, visit the ARI website at ari.calstate.edu. For information on projects specific to Cal Poly San Luis Obispo, visit the Cal Poly ARI website at ari.calpoly.edu.

The Agricultural Research Initiative (ARI) is a California State University (CSU) multiple campus collaborative partnership between the CSU colleges of agriculture and the state's agriculture and natural resources industries and allied business communities. ARI provides public funds that are matched with industry resources to fund high impact applied agricultural and natural resources research, development, and technology transfer, as well as related public and industry education and outreach. ARI projects and programs improve the economic efficiency, productivity, profitability, and sustainability of California agriculture while providing for consumer sensitive and environmentally sound food and agriculture systems and fostering public confidence in food safety and agricultural research and production systems.