CLARK CANYON (MONO COUNTY) RIPARIAN DEMONSTRATION AREA[1]

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Abstract: The Clark Canyon riparian demonstration area was established in 1984 within the East Walker River subbasin of Mono County, California. Destabilization of the meadow sections of the stream and the upper stream reaches contributed to an increase of suspended sediments, turbidity, and stream channel widening in the lower stream reaches where a viable population of rainbow trout is found. Several different treatments have been implemented to (1) restore meadow riparian areas to high levels of productivity, (2) stabilize active erosion and gully development (headcutting), (3) improve aquatic habitat from poor to good condition, and (4) improve wildlife cover and downstream fish habitat. These treatments include changes in grazing management practices and the construction of several types of instream structures.

In 1984, the Bishop Resource Area of the Bureau of Land Management (BLM) established the Clark Canyon erosion control project. This project implemented several different treatments to restore riparian meadow areas and to stabilize active erosion and gully development. Riparian meadow areas are unique and among the most productive and important ecosystems on the public lands. They display a greater diversity of plant and wildlife species and vegetation structure than adjoining ecosystems (Bureau of Land Management 1987). Riparian meadows are narrow, highly productive plant communities located along streams. These meadows are usually dominated by grasses and grass-like plants with shrubs often as a major vegetative component. Livestock preference on riparian meadows has been reported as a major influence on overall grazing distribution on mountain rangeland (Gillen and others 1985, Platts 1986). Livestock are attracted to these areas for water, shade, and vegetation that remains green after upland forage has dried out.

Riparian watershed values include water table recharge, soil erosion reduction, flood water control, and sediment and nutrient collection (Thomas 1986). Surface flooding and elevated water tables have been reported as having a definite influence on plant vigor of certain shrub species (Ganskopp 1986). This erosion control project has become a successful example of riparian area management using the Coordinated Resource Management and Planning (CRMP) process and serves as a demonstration area for several different techniques for riparian area rehabilitation.

The Clark Canyon Riparian Demonstration Area

The Clark Canyon Riparian Demonstration Area is located about 5 kilometers east of the town of Bridgeport, Mono County, California. The climate of the area is cold and semi-arid. Annual precipitation ranges from 20 to 40 centimeters and occurs mainly as snow in the winter. The elevation is 2200 to 2260 meters. The soils on the canyon bottom are formed in mixed stratified alluvium. They are dark colored, deep, moderately fine textured and poorly to somewhat poorly drained along the drainage bottoms; and dark colored, deep, moderately coarse to fine textured, and well drained along the drain ways and side slopes. Soils on the canyon sides are rocky and shallow to moderately deep, with moderately coarse textures over moderately fine textured subsoils.

Clark Canyon Creek covers a total of 6.4 stream kilometers within the East Walker River subbasin. It is a perennial stream which receives much of its flow from subsurface water as it flows through the canyon. Stream flow is fairly constant through the summer months, and at the junction with Aurora Canyon Creek it is as cool or cooler than the upper reaches. In 1979 an intensive stream survey recorded an average stream width of 0.9 meters and an average stream depth of 3 centimeters and a discharge rate of 0.0057 cubic meters per second (cms). Constituent water analysis from stream samples taken at the time of the 1979 stream survey revealed undesirably high levels of iron (Fe) and manganese (Mn). Also, heavy algal growth was reported in the meadow sections of the stream, attributed to livestock trailing and heavy grazing use. An increase in suspended sediments (turbidity) was also reported in the lower stream reaches where a viable rainbow trout population occurs.

The four major vegetation types in Clark Canyon (Barbour and Major 1977, Ratliff 1985) are:

The **montane meadow vegetation type** is located on the moister alluvial sites. The ecological grouping of major meadow species in the riparian demonstration

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area is as follows:

Scientific Name (Munz and Keck 1973, Messick 1982)	Common Name
Primary Meadow Species	
Carex lanuginosa	Woolly Sedge
C. nebraskensis	Nebraska Sedge
C. rostrata	Beaked Sedge
Deschampsia caespitosa	Baltic Rush
Secondary Meadow Species	
Aster adscendens	Long-leaf Aster
Eleocharis pauciflora	Common spikerush
Hesperochiron californicus	Centaur
Hordeum brachyantherum	Meadow Barley
Muhlenbergia asperifolia	Alkali Muhly
M. richardsonis	Mat Muhly
Poa cusickii	Cusick Bluegrass
P. nevadensis	Nevada Bluegrass
Ranunculus cymbalaria	Desert Buttercup
Senecio hydrophilus	Swamp Groundsel
Invader Meadow Species	
Iris missouriensis	Western Iris

This meadow type is dominated by Nebraska sedge, Common spikerush, and bluegrasses. Vegetative cover is more than 85 percent and vegetative production is high. The riparian meadow vegetation is found in stringers along the creek. Several small bogs with peat moss (*Sphagnum fimbriatum*) are found at major spring sources of Clark Canyon Creek within the project area.

The **Great Basin sagebrush vegetation type** is located on the drier alluvial sites. Vegetative cover was inventoried at about 30 percent and vegetative production was low. Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) *is* the dominant species with 35 to 90 percent composition.

The **pinyon-juniper vegetation type** is located in shallow, moderately coarse textured soils on the stony canyon sides and the rocky uplands surrounding Clark Canyon. One leaf pinyon pine (*Pinus monophylla*) and Utah juniper (*Juniperus osteosperma*) dominate this vegetative type.

The **deciduous woodland vegetation type** is located along perennial streams in the canyon. It is dominated by a dense growth of narrow-leaved willow (*Salix exigua*) and arroyo willow (*S. lasiolepis*). These willows are accompanied by a large undergrowth of wood rose (*Rosa woodsii*) and, where willows adjoin a meadow, squaw current (*Ribes cereum*) is found.

Erosion Control and Rehabilitation

The 1979 intensive stream survey of Clark Canyon rated aquatic habit at from fair to poor condition. Non-meadow riparian areas rated poor due to the heavy livestock damage. Streambanks were badly trampled and denuded of vegetation; willows and other stream-side vegetation were severely hedged. Riparian meadow areas were on a downward trend with streambanks being impacted by heavy live-stock use. This condition was causing the elimination of natural overhanging banks and concomitant widening of the stream. The stream profile was changing to wide, shallow, and saucer shaped; water was becoming warmer due to les s shade. Erosion problems were evident with active gullying at the upper reaches of the perennial flow. Shallow gullying was occurring throughout the riparian meadow areas and large headcuts (active erosion and gully development) were rapidly lowering the water table in two of the moist meadows along the stream by draining them.

Plans to rehabilitate the riparian areas in Clark Canyon were started in 1982. A combination of several treatments including grazing management were proposed to (1) restore meadow riparian areas to high levels of productivity, (2) stabilize headcutting, (3) improve aquatic habitat from poor to good condition, and (4) improve wildlife cover and downstream fish habitat. Representatives from the Bureau of Land Management, Forest Service, and California Department of Fish and Game visited the area and assisted with the preliminary plan development to repair stream channel damage caused by livestock grazing. The complete erosion control project included improved grazing management and the construction of gully control structures. Improved grazing management would restrict grazing until gully development has been stabilized. The gully control structures were designed to fill gullies, elevate water tables, and control further erosion until natural vegetation becomes vigorous enough to become permanent.

A series of instream structures were planned for construction to control active erosion and gullying (Key 1987). Two major headcuts were planned to be stabilized to control further cutting. The upper 2.4 kilometers of Clark Canyon were divided into different stations and site-specific recommendations developed for each station. The watershed erosion control project consisted of two large wire mesh structures, three small gabion basket structures, three single fence rock-check dams, four double fence rock-check dams, and one loose rock headcut treatment.

In 1984 the project was started at the headwaters of Clark Canyon Creek with the goal of contouring the steep side slopes for natural revegetation, raising the water table in the riparian meadow portions, and preventing further degradation of the remaining riparian meadows.

The two large wire mesh structures were constructed in 1984 near the head-waters of the stream, where the gullying was the most severe (fig. 1). These two structures were lined with an erosion filter fabric to trap fine soil particles behind the structures (fig. 2).

Figure 1 — Site of large wire mesh structure, Clark Canyon, California, June 22, 1983.

Figure 2 — Large wire mesh structure covered with an erosion control filter fabric, Clark Canyon, California, July 24, 1984.

The three smaller gabion basket structures were constructed in 1984 in shallow gullies in the meadow area. Initially, they were not lined with erosion control filter fabric (fig. 3). In 1985, the upper gabion basket was modified and lined with erosion control filter fabric to improve its effectiveness (fig. 4).

The three single fence rock-check dams were installed in October 1985 with hand labor, erosion control filter fabric, woven wire fence, and metal fence posts (fig. 5). These small instream structures have been very successful (fig. 6) in elevating the water table and controlling further erosion.

The four double fence rock-check dams were installed in 1986 and 1987, and have proven to be successful in both controlling further erosion and elevating the water table. Proper spacing between structures depends upon the gradient of the gully and stream. The minimum interval used had the crest of one structure level with the apron of the structure above it. Key locations for the structures are immediately below a junction of two or more small gullies, at narrow points of the gully, and at points where the gully is not eroding rapidly.

The loose rock headcut treatment was implemented in 1986. The head wall was cut back so rock could be placed easily under the sod crest. Foundation rock was placed at the toe of the loose rock rip-rap to ensure that the rip-rap would not slide away from the headcut. Rock was carefully placed and hammered into the head wall soil to ensure close contact. Rip-rap was built under the lip of the sod crest and over the foundation rock to form an apron. Flat wedge shaped rock was used and hammered into and under the sod crest. Water was allowed to flow over the sod crest across the rock rip-rap, across the apron, and downstream in the stream channel.

Coordinated Resource Management and Planning

Because of the involvement of both public and private land in the project, Coordinated Resource Management and Planning (CRMP) was used to prepare a resource plan for the public land grazing allotments and associated private lands. CRMP is a resource planning process used to address resource problems, based upon a philosophy that resource conflicts can best be solved at the local level by direct communication among all interested groups and individuals. It is based on the premise that people who meet together voluntarily will find common ground as they interact with one another and have a chance to observe resource problems firsthand on the ground (Nevada Coordinated Resource Management and Planning Task Group 1983).

Initiating action in the Clark Canyon area was complicated by the fact that Clark Canyon was an unfenced grazing allotment boundary between two different grazing allotments (Aurora Canyon and Travertine Hills). As a result, two CRMP activities were started—one for each grazing allotment. Major issues to be resolved specific to Clark Canyon were (1) evidence of accelerated erosion in Clark Canyon, (2) poor vegetation conditions in meadows and other riparian areas in Clark Canyon, and (3) livestock grazing use conflicts caused by using Clark Canyon as the grazing allotment boundary between two grazing allotments and the impact of historic livestock trailing through Clark Canyon.

In order to resolve livestock grazing impacts in Clark Canyon, BLM personnel from the Bishop Resource Area in January 1984 consulted with the livestock permittees affected by the plan. Concerns focused on availability of water and forage for livestock, livestock trailing through the canyon, and livestock drift between the Travertine Hills and Aurora Canyon allotments.

Written consensus was reached for the following:

Fencing and Livestock Water—Two fence projects were implemented to create watering gaps for livestock. The upstream water gap fence was constructed between the exclosures surrounding the two large wire mesh structures. These exclosures were constructed to protect the recovering streambanks from livestock trampling. Approximately 36 meters of stream between the exclosures were left accessible for livestock watering. The second water gap fence was constructed approximately 0.8 kilometers downstream near the public-private land boundary. This fence controls cattle drift along an easily accessible portion of Clark Canyon and provides a water gap at a commonly used draw west of the creek. It also provides a means to confine cattle within the 0.8 kilometer intensive management area. Both fences are inspected and maintained annually by BLM personnel.

Livestock Trailing—Sheep trailing through the intensive management area was continued with the stipulation that no bedding, grazing, or watering occur, and that all allotment boundary gates are kept closed. One sheep permittee on a neighboring allotment traditionally trails two bands of sheep through the project area during the first week of June on the way to his allotment and in mid-October on his return to his home ranch. The sheep permittee in the Travertine Hills allotment does not use Clark Canyon for trailing. Cattle trailing through the project area is not authorized.

Figure 3 - Unlined gabion basket structure, Clark Canyon, California, July 28, 1984.

Figure 4 - Same gabion basket structure as in Figure 3 after modification and lining, Clark Canyon, California, July 17, 1986.

Figure 5 — Installation of single fence rock-check dam, Clark Canyon, California, October 10, 1985.

Figure 6 — Single fence rock-check dam, Clark Canyon, California, August 4, 1987.

Stocking Level–The grazing capacity within the intensive management area was determined by calculating the animal-unit months (AUM) based upon the 1980 forage inventory. Twenty AUM were determined available for annual use during the period of June 15 through October 31. The AUM authorized allows only a few cattle to use the area season long or not at all. The normal use by each permittee is as follows:

	AUM	Season of Use
Travertine Hills cattle permittee:	10 cows	6/16 - 8/15
Aurora Canyon cattle permittee:	6 cows	6/16 - 9/30

The cattle numbers are generally pairs (the cow and her calf). The grazing plan allows the Travertine Hills permittee to use the area for two consecutive seasons of use followed by three consecutive seasons of use by the Aurora Canyon permittee.

Utilization levels at season's end approach the high end of the moderate class, for herbaceous vegetation, using the Key Forage Plant Method. The moderate class is described as: "The rangeland appears entirely covered uniformly as natural features and facilities will allow. From 15 to 25 percent of the number of current seed stalks of key herbaceous species remain intact. No more than 10 percent of the number of herbaceous forage plants are utilized."

Monitoring

The following methods were used to monitor the success of the erosion control project: trend and photo plots, stream profile and sediment deposition, stream stability indicators, and weather.

A total of four trend plots were established within the project area to monitor grazing impacts–one inside the two exclosures and two outside the exclosures (one upstream of the second large wire mesh structure and one downstream of the second large wire mesh structure). Each plot was 0.9 meters by 0.9 meters square and was placed on the streambank close to the water's edge. The plot locations were also selected on the basis of having some existing vegetation in place as opposed to purely bare ground. The methodology used was the Photo Plot Method which involves taking an overhead photo of the plot and a panoramic photo of the background from a located photo point marker. Plot readings involve determining species identification, the number of mature plants or seedlings by species, and estimating the number of 1/16 units per square foot (0.0929 square meters) each plant species and litter occupies within each plot (table 1). These data are then multiplied by a factor for plot size to determine plot totals.

Plots 2 and 3 were permanently obliterated by deposited sediments after spring runoff in 1986 and were not reestablished. Plot 4 was partially obliterated in 1987.

An initial stream profile utilizing sag tape transects was conducted at the time the two large wire mesh structures were constructed. A total of 10 sag tape transects (fig. 7) were made annually since 1984 to document changes in stream profile and sediment deposition collection behind each of the two large wire mesh structures. The transects followed procedures described by Ray and Megahan (1979).

Stream stability indicators were evaluated initially in 1984 at the two large wire mesh structures and on an annual basis since that time. The results of this rating is used in conjunction with the stream profile and sediment deposition measurements and revegetation monitoring to determine stream condition and trend. Weather information collected at the Bodie State Park is used to evaluate the influence of annual weather patterns on the other components being monitored. Results of all the monitoring studies are evaluated each fall to determine progress towards stated objectives.

Table 1. Three years of vegetation monitoring data

	1985	1986	1988
Plot 1 (Inside Upper Exclosure)			
Percent Composition	95.4	96.0	73.1
Percent Cover	3.7	33.4	60.8
Number of Seedings	7.0	7.0	0
Percent Litter	0.2	1.4	22.4
Plot 2 (Outside Upper Exclosure)			
Percent Composition	87.7	Obl.	Obl.
Percent Cover	0.5		
Number of Seedings	24.0		
Percent Litter	0.1		
Plot 3 (Inside Lower Exclosure)			
Percent Composition	53.1	Obl.	Obl.
Percent Cover	7.9		
Number of Seedings	3.0		
Percent Litter	7.0		
Plot 4 (Outside Lower Exclosure)			
Percent Composition	94.6	95.3	Obl.
Percent Cover	16.5	17.6	
Number of Seedings	7.0	26.0	
Percent Litter	0.9	1.3	

Figure 7 – Sag tape transect, Clark Canyon, California, July 17, 1986.

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