TWENTY YEARS OF REHABILITATION WORK IN BULL CREEK, HUMBOLDT REDWOODS STATE PARK

by

Douglas Jager and Richard LaVen[1]

Bull Creek Watershed is located in California's Humboldt Redwoods State Park. Lower Bull Creek meanders through 700 acres of superlative redwood groves. Land use and abuse in the upper watershed, as well as large floods in 1955 and 1964, have caused accelerated erosion in the basin and severe damage to the alluvial redwood groves. Public and private concern have led to an aggressive land acquisition and channel protection program. Today the basin is in public ownership and is being managed to protect park values. Revegetation has been successful and surface erosion problems appear to be minimal. Large slope failures in the upper basin continue to supply excessive sediments to the Bull Creek channel system. Much of the lower channel has been effectively armored with rock riprap to minimize channel erosion and loss of alluvial groves.

[1] Associate Professor and Lecturer, College of Natural Resources, Humboldt State University, Arcata, CA.

The 27,000 acre Bull Creek Watershed is located in southern Humboldt County about three miles northwest of the town of Weott. Basin elevations range from around 150 feet above sea level at Bull Creek's confluence with the South Fork of the Eel to a 3,000 ft. rim of ridges surrounding the upper watershed. The upper ridges, with slopes of 50% to 75%-plus, drop rapidly to a gently sloping valley with an elevation of about 500 ft. near Cuneo Creek. Channels draining those upper slopes have gradients of about 1,000 ft/mile. Bull Creek, the main stream draining the crescent-shaped watershed, has a total length of about 14 miles. Channel gradients are very low in Bull Creek's lower six miles.

Precipitation on the watershed exhibits strong orographic control. It averages about 88 inches/year, ranging from 115 inches on the basin rim to about 60 inches in the lower valley flats. Considerable storm runoff is generated during major events.

The original forest cover was of three major types: tanoak-madrone-Douglas fir-redwood, 14,000 acres; redwood-Douglas fir, 8,000 acres; and pure redwood on alluvial flats, 900 acres. Grasslands, brush, and oaks made up the balance of 4,100 acres. The size and quality of the alluvial redwood stands on the lower Bull Creek flats is impressive. Proposals to include the flats in a state park originated in 1917. About 8,100 acres in the lower watershed became a part of Humboldt Redwoods State Park and are now known as the Rockefeller Forest. Enchanting though they might be, the redwood stands offered little to the pioneers. Instead, early settlers were attracted to the more open lands of the middle and upper basin. Most of the basin had been claimed by 1895. Subsistence ranching and small scale logging occupied the residents for the next 50 years. Livestock grazing was widespread and the use of fire as a forage improvement technique was commonplace.

Logging came to Bull Creek in earnest in 1946 and continued unabated until 1961. By 1954, 50% of the upper watershed had been cutover. By 1960, the cutover area had increased to 85%, or 60% of the entire watershed. Logging methods employed were normal for the period. Almost no erosion control work or reforestation was attempted.

Timberland was converted to grazing land as a part of many logging operations. By 1959, conversion affadavits were filed on nearly 4,000 acres in the upper basin. Fire was used in the conversion process. Between 1950 and 1959, eight major fires burned 8,700 acres in the upper basin. The same period saw 48 fires of less than 100 acres. The largest fire burned 5,600 acres in the southern portion of the basin during the summer of 1955.

Prior to the 1955 flood, Bull Creek's lower reaches could be characterized as a narrow (40 to 60 ft. wide), deep, meandering channel with dense streamside vegetation. The 1955 flood entrained a sawmill cold deck, cull logs, charred stumps, slash, houses, car bodies, propane tanks, mattresses, tires and a few coffins, mixed them liberally with the products of erosion, and deposited them in the lower six miles of the Bull Creek channel. Scores of large redwoods were toppled by bank failure and the 16,000 CFS flood crest and added to the mix. The county highway bridge over Cuneo Creek was buried by gravel. A program of channel clearance and debris burning was begun as soon as the water receeded.

Massive gravel movements from the upper watershed were in evidence, particularly in the upper reaches of Bull Creek and in Cuneo Creek. The gravel continued to move during high water in the years following 1955. A number of studies led to a recommendation that the entire watershed be purchased for inclusion in the park, both to protect the park and to permit maximum opportunity for controlling gravel movement. The acrimonious accusations and counter charges we have come to expect as normal behavior where resource conservation measures are concerned were soon heard, but most of the basin had state park status by the late 1960's.

Drs. Walter Lowdermilk and Hans Einstein were employed as consultants and studied Bull Creek and its problems. Dr. Lowdermilk designed a basin-wide channel protection and watershed rehabilitation program while Dr. Einstein developed a program for managing the enormous deposits of gravel sized sediment, estimating the volume to be on the order of thousands of acre feet.

Channel improvement and gravel control projects were well underway when the 1964 flood, with a 6,000 CFS peak, deposited up to 30 feet of sand, silt, and gravel in the upper reaches of Bull and Cuneo Creeks and buried another Cuneo Creek Bridge. In places, the Bull Creek channel was 400 ft. wide. Aggradation raised the channel in the lower reaches by 4 to 6 ft., a large alluvial delta developed at the point where Bull Creek discharges into the South Fork of the Eel, and the total of large tree losses from bank failure passed 850. Channel improvement and gravel control projects were begun anew.

Since 1955, much sediment and debris have moved through the Bull Creek channel and into the Eel. Much more has moved downstream, but is still in temporary storage within the Bull Creek basin. The basin has many large, active, sediment producing sources capable of contributing enough sediment to replace the evacuated material many times over.

We must report that the problems associated with sediment deposition in the lower Bull Creek channel today are nearly as serious as they were 15 years ago. The natural tendency of aggraded streams is to widen themselves rather than to deepen as they strive to regain their former channel capacity. In the lower reaches, this action, if unchecked, will result in renewed bank erosion and the loss of many more large redwoods.

At present, large quantities of sediment are being removed from the upper reaches and are being carried downstream by moderate flows. Moving downstream, this sediment encounters decreasing channel gradients and reduced velocities. Larger sized particles drop out and a decreased channel capacity is perpetuated.

Our reconnaissance of the main Bull Creek channel, supplemented with old cross-sections and longitudinal profiles, suggests that four distinct reaches are operative:

1. The upper Bull Creek channel, including everything upstream from a point about one-half mile upstream from the confluence of Cuneo Creek. This reach is rapidly regaining its pre-1955 level, but still exports sediment.

2. The middle Bull Creek channel, which extends from a point a half-mile above the confluence of Cuneo Creek to the reef barrier, a rock filled permeable concrete cribbing serving as an artificial intermediate base level. This reach is slowly degrading, but enormous amounts of gravel are stored in the filled-in valley.

3. The upper portion of lower Bull Creek, from the reef barrier downstream to the cascade created by the cut through the meander neck known as the old horseshoe. This channel reach was shortened by 1,900 feet by accelerated meandering during the 1964 flood. It has been in a degrading mode since then.

4. The lower portion of lower Bull Creek channel, a 2 1/2 mile long reach extending from the old horseshoe cascade to the South Fork of the Eel. This reach is actively aggrading.

Most reviewers can easily drive to and see much of the upper two reaches, both of which have been actively degrading. After viewing these reaches, they may acquire a feeling of optimism. We did; and it was not until we studied the old longitudinal profiles and walked the lower reaches of the channel twice that we began to recognize the degree of aggradation presently taking place in the lowest reach.

The old profiles show that this reach aggraded by two to six feet between 1961 and 1974. We also know that the 1961 channel bottom was several feet above the pre-1955 level. And while we do not have data more recent than 1974, we believe the trends shown have continued through 1981.

With their key purpose being the protection of the alluvial redwood groves, the specific objectives of the park's management program can be stated as:

1. Reduce the amount and influence the rate of sediment being contributed from key areas.

2. When and where appropriate, maintain large volumes of sediment in storage within the channels. Work towards a controlled release of this sediment.

3. When and where appropriate, maintain flow velocities capable of evacuating large volumes of coarse sediments from selected reaches.

4. Minimize channel bank erosion.

Because of the need for immediate downstream work and the initial lack of legal access to the upper watershed, the 20-year program has been one of land acquisition, channel manipulation, and channel maintenance while relying on natural revegetation to restore the hydrologic integrity of the watershed. Natural revegetation was slow in developing, but now provides some ground cover in all but the most unstable areas. The decision to wait for natural regeneration probably increased downstream maintenance costs and contributed to the volume of material presently working its way through the system.

Park managers have utilized a variety of techniques to control the movement of gravel and minimize channel erosion in the two lower reaches of Bull Creek, including channel clearing and shaping, flow spreading, gabions, revetments, groins, rock riprap, sediment retention structures, and artificial cascades.

Some of these techniques have worked well. Others lasted only temporarily. Channel clearing, channel shaping, and flow spreading were effective means of providing for the transport of large volumes of sediment. The need for an active channel clearing and shaping program remains evident today. Flow spreading, if practiced today, would only aggravate problems in the lower channel.

Initially gravel was piled against raw banks to protect the remaining flats from channel erosion. Piled gravel offers marginal protection against the erosive effects of low and moderate flows. It offers no protection against, and in fact disappears with, the first high flows. It is, however, an excellent way to prepare gravel for transport.

Later, wire gabions, log revetments, and log groins were employed. The gabions were short lived. Rock sizes, wire gauges, and gabion size were too small. Log revetments and groins were undercut and lacked the flexibility to adjust to changing channel conditions. Eventually they were replaced or covered with rock riprap.

Today, much of the lower channel is lined with large (1/2 ton) rock. Where this riprap was properly placed, it withstood the impact of the 1964 flood and became the treatment of choice. Because of continuing aggradation problems, additional rock riprap is needed in the lower channel.

Sediment retention structures were also utilized. Shortly after the 1955 flood the Army Corps of Engineers built a sediment retention dam in lower Cuneo Creek. It was completely filled with sediment in one year. We have not seen any evidence of it during our reconnaissances. Evidently, it was either buried or destroyed during subsequent floods. Dr. Walter Lowdermilk suggested a reef barrier be installed just above the alluvial flats. First constructed in September 1963, it failed during the winter of 1963 and was rebuilt in the summer of 1964. The 1964 flood covered the barrier with gravel. The barrier is now visible and though slightly damaged is functioning as an intermediate base level and as a gravel retention structure. We are recommending that the reef barrier be raised.

Dr. Lowdermilk also recommended that an artificial cascade of large boulders be placed just downstream from the reef barrier. Installed in the summer of 1964, today only a few large boulders remain in the vicinity.

This program is now undergoing intensive review, and the need for continuing with this or a modified program is presently being evaluated. We are certain that whatever the Park's course of action might be, the program will need continuity of management, annual maintenance, and periodic evaluation if it is to remain effective.

References

Becking, R.W. The ecology of the coastal redwood forests of Northern California and the impact of the 1964 flood upon redwood vegetation. Final report. National Science Foundation grant GB #3468. 1967.

Becking, R.W. The ecology of the coastal redwood forests of Northern California and the impact of the 1964 flood upon redwood vegetation. Final report, National Science Foundation grant GB #4690. 1968.

Bradley, R.M. et al. Report on protection of the Bull Creek Flats. State of California, Dept. of Natural Resources, Division of Soil Conservation. 1961 June.

California State Park Commission. Testimony at special meeting of State Park Commission. Sacramento, CA. 1961 March 24.

Einstein, H.A. Short report on the sediment problems in Bull Creek, California. (Letter to Dept. of Parks and Recreation) 1966 Jan.

Heinze, H.,; Espinosa, C. Humboldt Redwoods State Park, Bull Creek status report. California Dept. of Parks and Recreation file report. 1966 August 1.

Jager, D.; LaVen, D. Watershed review of Bull Creek. California Dept. of Parks and Recreation interagency agreement no. 4-100-1141. Humboldt State University Foundation, Arcata, CA. 1981 Oct.

Lowdermilk, W.C. A report to the Save-the-Redwoods League on critical problems in the Bull Creek basin, Humboldt County, California. Morongo Valley, CA. 1961 Oct. 20.

Lowdermilk, W.C. Report to the Division of Beaches and Parks and the Save-the-Redwoods League on a field trip on February 19-23, 1962 to Bull Creek Basin. 1962 March 9.

Lowdermilk, W.C. Memorandum to Division of Beaches and Parks, and to Save-the-Redwoods League on field trip in Bull Creek basin. 1962 June 25.

Lowdermilk, W.C. Memorandum report to Save-the-Redwoods League and to the Division of Beaches and Parks on field consultations on Bull Creek basin. 1963 June 1.

Lowdermilk, W.C. Memorandum report to the Division of Beaches and Parks and the Save-the-Redwoods League on the aftermath of floods of December 1964 - January 1965. 1965 Feb. 12.

Lowdermilk, W.C. Preliminary evaluation of consequences of the "thousand year" flooding in December 1964-January 1965, especially in Bull Creek basin within the drainage of the South Fork of the Eel River, Northern California. Memorandum report to Division of Beaches and Parks. 1965 June 5.

Merriam, L.C. Review of files on Rockefeller Forest--Bull Creek watershed, relating to stabilization of the upper watershed and protection of Bull Creek flats against a recurrence of conditions in the 1955 and 1964 floods. California Dept. of Parks and Recreation file report. 1971 Jan. 19.

Stone, E.C.; Vasey, R.B. Redwood physiology: Key to recreational management in redwood state parks. California Agriculture 16(8):2-3; 1962 August.

Stone, E.C.; Vasey, R.B. Preservation of coast redwoods on alluvial flats. Science 159(3811):157-161; 1968.

University of California, Wildland Research Center. Redwood Ecology Project Annual Reports to California Dept. of Parks and Recreation. 1959, 1960, 1961, 1962, 1964, 1966, 1967.

University of California, School of Forestry. Management for park preservation --- a case study at Bull Creek, Humboldt Redwoods State Park, California: proceedings of a symposium; 1966 May 13-14; Scotia, CA 97 p.

Wayburn, T. The tragedy of Bull Creek. Sierra Club Bulletin. 1960 Jan.