

Stream and Floodplain Restoration On Watersheds Disturbed by Mining

By Kenneth Karle and Roseann Densmore

Placer mining for gold has severely disturbed many riparian ecosystems in northern regions. Placer mining involves removing riparian vegetation and topsoil, excavating gravel from the active floodplain, old terraces, and/or the active stream channel, and processing the gravel to remove the gold.

Processing also removes most of the "fines" from the gravel. Until recently, topsoil and fines usually were buried under tailing piles or washed down the stream, and processed rock and gravel were left in large tailing piles. These tailing piles often revegetated very slowly – some more than 50 years old still have little or no vegetative cover.

Glen Creek, in the Kantishna region of Denali NP and Preserve (DENA), is typical of many placer-mined streams in the area. It is characterized by significant stream channel adjustments and disfunctioning riparian zones. Specifically, unstable or excessively confined streambeds, as well as over-steep floodplains, are evident along many reaches of the 6-mile length. Piles of mine tailings have replaced much of the native streambed material. Riparian vegetation is absent along most channel bank and floodplain reaches. Floodplain soils, necessary for vegetative recovery, are relocated in separate, distinct piles, or absent altogether. Soil replenishment, normally a function of annual flooding, is impossible because of confined streambeds.

The importance of a properly functioning riparian zone cannot be overstated. Riparian habitat in undisturbed conditions is characterized by greater species diversity, density, and productivity than any other habitat type. In addition to supplying the basic habitat needs of water, food, and cover, riparian habitat provides travel corridors and affects wildlife productivity in adjacent habitats.

Evidence indicates that the value of riparian habitat for wildlife in the Glen Creek watershed and other



Brush bars for floodplain stabilization may be seen on either side of the channel in this aerial view of the lower half of the 1991 study reach on Glen Creek in Denali NP.

mined drainages of the Kantishna Hills is severely reduced where large amounts of riparian vegetation and soils are absent (USNPS 1990). Long-term habitat loss for grizzly bear, black bear, moose, furbearers, and birds has been documented. Additionally, aquatic zone habitat has been similarly disturbed. Populations of many of the macro and micro invertebrates, as well as slimy sculpin and grayling, are suspected to have been severely impacted or even eliminated.

With such a disturbed hydrologic regime, any riparian ecosystem recovery from placer mining in the Glen Creek watershed by means of natural processes

is significantly hindered. In channel reaches where the streambed is incised and straightened, bed scouring continues to occur.

During annual flooding, erosion of over-steep banks results in excessive sediment loading of the stream. This sediment load is then deposited in the channel downstream in areas of shallower gradient, resulting in additional problems such as cementing of substrates and clogging of benthic invertebrates. Incised stream channels also prevent flood waters from reaching the floodplain, thus interrupting the natural process of floodplain sediment deposition necessary for enhancement and creation of moist, nutrient rich zones.

Pilot Study

Abandoned placer claims on lower Glen Creek represent a unique opportunity for conducting research to improve riparian habitat. A pilot study was begun in 1991 to evaluate techniques for rehabilitation of disturbed stream channels and floodplains. The study involved a 1400' reach of Glen Creek, and focused specifically on restoration of over-steep floodplains in that reach. The study's goal was to develop techniques to allow for the evolution of certain hydrologic characteristics such as sinuosity, pool/riffle ratio, and other natural habitat features with minimum construction needs.

Channel adjustments will provide for a streambed capacity to contain a 1.5-year flood, and a floodplain capacity to contain a 1.5- to 100-year flood. Sediment loading from bank erosion and other sources must be minimized. Channel controls, such as riprap or gabions, will not be used, as these generally hinder natural stream restoration.

Methods and Discussion

The BLM, in an attempt to enhance riparian zone recovery in a portion of Badger Creek, Colo., developed a scheme for designing stable channels in coarse alluvium based on pertinent geomorphic, hydraulic,

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Feltleaf willow cuttings for revegetation are shown here, along with brush bars for floodplain stabilization on a reclaimed section of Glen Creek.

and hydrologic principles (Jackson and Van Haveren, 1984). This scheme is based on the premise that a channel in coarse alluvium is considered stable if design discharges and sediment loads can be carried without causing excess bank or bed erosion or deposition. This design, with modifications for subarctic conditions, was the basis for the 1991 pilot study.

An important aspect of this channel design scheme is consideration of the process of adjustment from the initial stable channel geometry in noncohesive materials to the final regime geometry. When streamflow or sediment loading rates increase, channel widening may be expected to occur.

However, channel depth decreases with an increase in sediment loading rates. When conditions that have caused channel impacts such as widening and depth reduction begin to abate, and riparian zone revegetation begins to occur, the channel should begin to adjust itself toward a narrower, deeper geometry. Therefore, any design should plan for and incorporate this modification.

The central channel design is based upon a capacity to transport the bankfull flow of more stable reaches in the same setting. Incipient bed instability should be attained at bankfull flow, allowing upstream bed material to pass and enabling channel geometry to adjust to bank revegetation. Bankfull discharge may be considered as the 1.5-year flood.

Floodplain design objectives include a capacity for the 100-year flood. With this parameter, the floodplain should act to dissipate high water flow energy while encouraging deposition of sediments for vegetation habitat enhancement. Ideally, the floodplain design should minimize earthwork and expense while approximating, as closely as possible, a natural or stable channel flood plain condition.

Once the design parameters for channel banks and floodplains were calculated, preparation work began on the ground along a 1400' reach. Design elevations and distances were surveyed and staked, and a crawler-dozer, front-loader, and dump truck were employed to move the ground to the desired configuration. Where the stream channel was incised, the adjacent floodplain was cut back and lowered, with the excess material graded into the slope of the valley wall. Additionally, flat braided sections were filled in, encouraging a single channel. The floodplain surface was roughened by the dozer to retard erosion and capture fines.

Undisturbed floodplains in the Kantishna area are

stabilized by riparian vegetation (primarily feltleaf willow (*Salix alaxensis*) and alder (*Ainus crispus*), which anchors the substrate and decreases the velocity of floodwaters. The drop in water velocity accelerates the deposition of sediment and organic debris.

Several methods are being tested to temporarily stabilize the new floodplains until natural revegetation becomes adequate, which is predicted to take 5 to 10 years. Methods include well-anchored brush bars 15 to 20 feet long, oriented perpendicular to the channel. Bars are constructed of alder branches tied in bundles, partially buried and spaced at intervals of three channel widths. Streambank plantings of feltleaf willow cuttings and alder seedlings also have been established.

A comprehensive hydrologic monitoring effort was enacted, the objective being to evaluate the current "health" and recovery status of Glen Creek following channel and floodplain reclamation. Cross-sections were established for sampling selected parameters above, in, and below the reclaimed reach. Parameters sampled include suspended sediment, stream chemistry, and biological communities. Stream discharge measurements were made at all sampling times. Effects of stabilization techniques will be evaluated by monitoring floodplain morphology, sediment deposition, and natural revegetation on floodplains with and without stabilization.

Future Studies

In order properly to evaluate the effects of an active reclamation effort on a disturbed stream channel and floodplain, a much longer reach of stream channel is needed. Funding from NPS-WRD (Water Resources Division) will allow an adjoining 3200' reach to be included in the study. Additional techniques will be tested on this section during the 1992 season, including some channel reconstruction. This study, combined with the 1991 pilot study, will serve as a demonstration project for other mined stream reclamation efforts in DENA and other areas of Alaska.

Karle is Hydraulic Engineer at Denali NP; Dr. Densmore is Denali Park Ecologist.

Literature Cited

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