This report was funded by the Bonneville Power Administration (BPA), US. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

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FIELD REVIEW OF FISH HABITAT IMPROVEMENT PROJECTS IN THE GRANDE RONDE AND JOHN DAY RIVER BASINS OF EASTERN OREGON

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Project No. 91-069
Contract Number DE-AP79-91BP21493

October, 1991

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INTRODUCTION

In mid-August of 1991, a field review of 16 habitat improvement sites in the Grande Ronde and John Day River Basins was undertaken. The review team visited various types of fish habitat improvements associated with a wide range of reach types, geology, channel gradients, stream sizes, and vegetation communities. Enhancement objectives, limiting factors, landuse history, and other factors were discussed at each site. This information, in conjunction with the reviewer's field inspection of portions of a particular habitat improvement project, provided the basis for the following report.

This report that follows is divided into four sections: (1) Recommendations, (2) Objectives, (3) Discussion and Conclusions, and (4) Site Comments. The first section represents a synthesis of major recommendations that were developed during this review. The remaining sections provide more detailed information and comments related to specific aspects of the field review. Although discussions with field personnel were often important in the development of recommendations and conclusions, the review team assumes full responsibility for the contents of this report.

FIELD REVIEW OF FISH HABITAT IMPROVEMENT PROJECTS IN THE GRANDE RONDE AND JOHN DAY RIVER BASINS OF EASTERN OREGON

RECOMMENDATIONS

The restoration of vegetation adapted to riparian environments and the natural succession of riparian plant communities is necessary to recreate sustainable salmonid habitat and should be the focal point for fish habitat improvement programs.

Elimination of livestock grazing though management or with corridor fencing were generally observed as the most effective means of improving riverine/riparian habitats. In those areas where fencing is not possible, grazing systems that focus on promoting the recovery of riparian plant communities must be implemented.

All Allotment Management Plans (AMPs) on public lands should immediately be brought up to date reflecting state-of-the-art grazing strategies necessary to restore riverine/riparian plant species. Any allotment that cannot be managed compatibly with its riverine/riparian ecosystem should be closed.

Where degradation of riverine/riparian ecosystems and the loss of fisheries habitat has occurred on private lands, corridor fencing, riparian pastures, or grazing strategies must be developed that promote restoration of riverine/riparian plants.

Several sites were visited where corridor fencing was used by the Oregon Department of Fisheries and Wildlife as a management practice to improve riverine/riparian ecosystems on private lands through 15-year leases. Grazing practices that sustain riverine/riparian ecosystems will need to be initiated if these fences are removed.

Exclosures that eliminate grazing effects of domestic and wild herbivores need to be established throughout the Grande Ronde and John Day River Basins. These exclosures would provide important demonstration areas of recovering and restored riparian areas and would indicate the differing effects of cattle and big game utilization on riparian plant species.

Because of their frequent negative effects, structural alterations to stream channels (particularly hard structures) should be generally eliminated as a fish improvement strategy. Where structural additions are deemed necessary for improvement purposes, only native, biodegradable materials should be used.

The dynamic characteristics of streams, particularly in unconstrained valley settings, need consideration in all habitat improvement programs. Hard structures that prevent channel adjustments should seldom be considered. Where corridor fencing is used, corridors should be wide enough to allow for local shifts in channel morphology and channel location as recovery occurs.

The narrow focus of limiting factors related to fish (i.e., high stream temperatures, lack of pools, and lack of cover) has often prevented the restoration and natural functioning of riverine/riparian ecosystems following many stream improvement projects. Fisheries biologists should use more than limiting factor analyses to assess the needs of a stream system. Management practices that promote the longterm establishment, growth, and succession of riparian plant species need to be implemented.

Where roads are creating significant and adverse impacts (particularly sedimentation) to streams and riparian systems, these impacts need to be curtailed. Existing roads which have drainage and sedimentation problems should be corrected immediately. The construction of new roads parallel to existing streams should generally be avoided since they often cause significant impacts to streams and riparian resources.

Fish habitat restoration must be considered from a landscape perspective. Entire drainages should be analyzed to determine relative severity of fish habitat deterioration. This information should provide the basis for developing basinwide priorities and plans for improving fish habitat. These plans should undergo interagency review to promote coordination of habitat improvement activities.

Resource specialists must have the support of line officers for implementing restoration activities associated with riverine/riparian ecosystems.

There were no monitoring or evaluation programs in place at 15 of the 16 sites we reviewed. The monitoring of fish populations and habitat (also riparian vegetation and stream/hydrologic conditions) should be instituted as an integral part of BPA fish improvement projects.

OBJECTIVES OF REVIEW

The review team met with technical staff from a variety of state and federal agencies on Tuesday, August 13, 1991 in LaGrande, Oregon. Participants at the LaGrande meeting were shown a video of the May 17-19, 1991 high flow event in the upper Grande Ronde Basin and slides of the same event in Meadow Creek. Comments by participants of the LaGrande meeting indicated that forest conditions had changed over the years because of various natural and management related factors such as fire control policies, extensive bug damage, harvesting, roading, livestock grazing, and mining. Negative impacts to fisheries had often resulted. A need for basinwide habitat evaluations was identified so that habitat improvement efforts could be coordinated and prioritized at the basin level. The classification of various reaches based on hydrology, geomorpholgy, soils, vegetation, and fisheries could be used for one aspect of a landscape scale evaluation.

Following the introductory session, the review team and other interested parties began a field review of 16 habitat improvement sites over a four-day period (August 13-16). The charge of the review team was to review fish habitat improvement projects and to provide BPA with a perspective of the efficacy and value of previous and ongoing improvement efforts. A secondary question involved asking, What should be the role of the BPA for improving fish runs in the Columbia Basin?"

DISCUSSION AND CONCLUSIONS

Livestock grazing, logging, road building, and mining have caused widespread degradation of riverine/riparian ecosystems in the Grande Ronde and John Day Basins. Impacts on channel morphology, aquatic habitat, water quality, and riparian vegetation have been dramatic, persistent, and unfavorable. Restoring riverine/riparian ecosystems represents a major environmental challenge to private and public land owners in these basins.

Corridor fencing and other strategies for eliminating the impact of livestock utilization on riparian plants were observed during the field review. Possible negative ramifications of corridor fencing include high installation costs, maintenance problems and costs, difficulties in land management, negative visual impacts, injury to big game animals, and the loss of forage to livestock. In addition, it is physically impossible for land managers to fence all streams. However, there are also important advantages to corridor fencing. Unquestionably, complete exclusion of livestock was the most effective habitat restoration management strategy observed in the Grande Ronde and John Day Basins. Without livestock grazing, cottonwood and willows established more rapidly than with any other habitat improvement practice. Ungrazed willows often exceeded 3 ft (1 m) of growth in one season; willow growth greater than 6 ft (2 m) in height after two years of rest was observed in some reaches. Rapid rates of establishment were noted with herbaceous plants (such as sedges and rushes) which play critical functions in sediment retention, reforming of banks, and water quality improvement.

There are numerous advantages to private ranchers, as well as the public, when corridor fences are constructed. Vegetation recovery and associated channel aggradation may cause local water tables to rise. Where this occurs, increases in base flow and improved water quality would be expected. Similarly, a rise in the water table of a meadow system would provide more water available for plants, hence improved forage quality and quantity would be expected. These influences can extend well beyond the dimensions of a corridor fence. Restoration of both fish and wildlife habitat is associated with riparian recovery. Improved aquatic and riparian systems can provide an economic return in fishing, hunting, and nonconsumptive uses such as wildlife viewing.

At one site on public land, large amounts of money were being spent on hard structural additions to a channel when an inexpensive fencing project would have allowed increased forage utilization in the allotment and would have simultaneously initiated restoration of the riverine/riparian system. At another site on public land, the continued degradation of an important rearing stream by a few livestock was entirely inappropriate. Instead, several instream structures had been installed in the hopes of improving fish habitat. The small amount of revenue obtained from grazing fees was insignificant in relation to the lost value of fish and wildlife habitat, and the degradation of water quality. Why either of these grazing allotments were not being managed to improve riparian areas and water quality stirs the imagination. The addition of structures to a stream does not alleviate the overriding need of land managers to alter grazing practices on those streams that have been severely degraded by grazing.

In all areas where domestic livestock had been removed from riparian systems, dramatic increases in the density, cover, and height of willows and cottonwood were observed. Only one stream reach (i.e., Sheep Creek) was experiencing significant levels of elk utilization. However, willow recovery was still occurring at this site. In areas where wild ungulates may be a problem, small woven-wire exclosures around concentrations of willows could be used to decrease utilization and allow plants to grow above browse levels.

Fencing or management strategies which exclude livestock use are currently not feasible on all riparian/stream ecosystems. New approaches to grazing management are needed. Grazing systems that result in annual removal of streamside vegetation will limit the rate and extent of riparian/stream recovery. New and innovative grazing strategies that reflect the ecological requirements of riparian recovery are needed. Grazing management strategies will necessarily require long periods of rest if gallery forests of cottonwood, aspen, and willows are to be reestablished. Five years of rest alternating with five years of proper grazing is suggested as one strategy that may allow for establishment and growth of these critical riparian plant communities.

Revegetation or replanting of riparian hardwood species was frequently mentioned as a potential restoration approach. Few examples exist of successful, cost-effective willow or cottonwood plantings. Conversely, many examples of failures are available. All stream reaches that we examined had the potential to naturally revegetate with onsite propagules following the cessation of excessive levels of herbivory. However, natural recovery for some systems may be relatively slow; Meadow Creek is such an example.

If the decision is made to artificially revegetate riparian areas, a number of factors must be considered. These include a recommendation to use native species from the local area and preferably from the same reach. It would be ironic if managers were to degrade the biological diversity of riparian vegetation through the planting of exotics in order to preserve native fish species and genetic populations. Maximizing stream and fish biodiversity is closely associated with maximizing the native biological diversity of riparian vegetation.

If willows or cottonwoods are to be planted, a number of biological considerations are necessary. This includes protection from herbivory, planting in suitable microsites, and planting at the appropriate season. Livestock and native ungulates must be kept away from plantings, especially the first several years. Plantings should occur in microsites where woody species are normally found; meadow communities should be avoided. Finally, cuttings should be planted in the spring at a depth where roots can grow into the water table during the first year.

Although grazing management (other than lengthy periods of nonuse or total exclusion by fencing) might conceivably provide adequate protection of riparian vegetation, the application of alternative grazing strategies designed to specifically restore and improve riparian vegetation was not observed.

Few would argue that declines in the condition of riparian/stream ecosystems is a significant factor influencing the decline of salmonids in the Grande Ronde and Upper John Day River Basins. Land managers are not currently taking a holistic approach to the problem. Managers must question whether or not their approaches to fisheries improvement are sustainable. Sustainability refers to the need to restore ecosystems by allowing the dynamic vegetation, fluvial, and geomorphic interactions of a watershed to function in a manner that results in the perpetuation or optimization of salmonid habitats. Artificial means of habitat restoration (i.e. hard structures) or other practices that altered natural biotic or fluvial processes were observed to have largely failed. These treatments often resulted in declines in habitat quality, ecosystem productivity, and biological diversity.

Woody debris can be an important component of fish habitat for forested stream reaches. Measures to restore natural recruitment of woody debris along channels is of paramount importance. We often observed that the interactions of various wooden instream structures were dramatically different from natural wood inputs. Human-made structures may result in a longterm decline in restoring the relationships or interactions between woody vegetation and streams. For example, we observed structures that often resulted in wider and shallower streams and decreased sinuosity. The wide and shallow nature of these streams decrease the level of vegetation influence (shade, energy, food, and structural inputs). In addition, if natural channel dynamics are altered, the establishment of woody vegetation may be retarded. Finally, whereas healthy stream ecosystems are sustainable, human-made structures are not. Eventually structures wash out, become dysfunctional, or decompose. Without replacement from riparian vegetation, the addition of wood is a continual task.

Among the most significant obstacles to creating sustainable salmonid habitats is the degraded conditions of the riparian tree-dominated communities. In almost all reaches that were visited, establishment of cottonwood, alder and willow-dominated communities had not occurred in 50-100 years. Stand-age structures of gallery forests consisted largely of a few mature or decadent individuals. In some cases, woody vegetation had all but disappeared from the site. The greatest barriers to reestablishment are losses in natural channel dynamics due to the construction of hard structures and excessive levels of utilization by grazing animals. The former prevents conditions for adequate seedbed formation and the latter prevents establishment and growth. If managers are to accomplish the restoration of sustainable fish habitat, structures which limit gravel bar formation and dynamics should be removed. Young willows, cottonwood, and other riparian tree species are extremely palatable to grazing and they need protection until their growth exceeds the grazing reach of animals.

Riparian forest species, such as black cottonwood, thin-leaf alder, and willows evolved with stream ecosystems subject to natural floods and disturbances. Channelization decreases sinuosity, increases the hydraulic forces along the banks, and alters the delicate balance of streamside hydroperiods required for the establishment and survival of riparian plant communities. Channelization was observed to have significant detrimental effects on aquatic habitat.

The widespread use of hard structures (e.g., low rock check dams, boulder clusters, rock riprap, rock berms, log weirs, and other log configurations) reflects a philosophy that the engineering and reconstruction of channel habitat is of the highest priority for improving fisheries productivity in degraded systems. Unfortunately, scientific validation of this concept is lacking. We propose that the reestablishment of riparian vegetation is a much higher priority. Even where vegetative recovery was identified as the primary improvement goal, a stream was usually treated with a series of hard structures. Vast sums of money have been spent in structural treatments, yet such treatments have little basis from an ecosystem perspective.

We found no concensus amongst field biologists regarding <u>when</u> structures should be added to a degraded riverine/riparian system. Some biologists thought that structural additions should be added immediately to provide habitat diversity to an otherwise simplified channel environment. Others would indicate that more important benefits could be gained by adding structures several years after vegetation recovery was well underway. We concurred with neither philosophy. It was our opinion, in most instances, that recovery of streamside vegetation was the most efficient mechanism for improving fish habitat. The need for adding human-made structures was seldom justified.

Studies of unconstrained streams (generally characterized as having a valley width that is twice the active channel width) in western Oregon indicate that these reaches are highly productive for fisheries resources. Unconstrained streams are usually sinuous, low gradient, geomorphically diverse and may have numerous local side channels. Streamside vegetation interacts to alter channel morphology and a variety of channel substrate sizes occur. We expect the same is true for unconstrained streams in eastern Oregon. However, the widespread use of instream structures has effectively shifted the geomorphic potential of many unconstrained reaches to those that function as constrained reaches. Constrained streams are often relatively straight, high gradient, and geomorphically simple with coarse substrates comprising both beds and banks. The current emphasis of using hard structure approaches for stream improvement is in direct conflict with the geomorphic context of naturally occurring and highly productive unconstrained systems. Similarly, channelization and many habitat improvements have served to prevent the interaction of vegetation with the routing of water and sediment by tightly constraining entire reaches and altering channel gradients. Channelization of fish bearing streams in the Grande Ronde and John Day River Basins should be discontinued along with the wide spread use of hard structures.

During site visits, naturally occurring trees in streams were observed with their complex array of attached branches and rootwads. These trees provide diverse channel morphology, local variations in flow patterns, cover, and other effects. Their hydraulically rough multiple surfaces provide resistance to flow and dissipation of stream energy.

As flows vary, these pieces could adjust locations to accommodate the continually changing flows. The functions of these dimensionally complex trees on a streambed or along channel margins were entirely different than the typical log structure used in fish improvement projects. In the later instances, straight, simple logs, usually without limbs or rootwads attached, are partially buried and pinned or cabled to other structural elements. Thus, immobile log and rock weirs focus stream energy at a specific location and, if successfully engineered to remain stable, prevent natural channel adjustments for many years to come.

Many instream structures utilized woven wire and/or geotextile fabrics to lengthen design life. Over their design life, structures either fail or become buried. Structures that are moved, broken, or otherwise destroyed by water, ice or sediment transport release wire and fabric into a stream. These materials are not found naturally in streams and should not be added to channels in an attempt to increase fish production. No rational ecosystem argument for their use was provided by field personnel. A fundamental rule for any structural improvement work should be to use native and biodegradable materials.

Natural functioning and intact meadow and riparian systems are a rare commodity in eastern Oregon. Those still functioning need to be protected. Those that are degraded need stresses eliminated. Unfortunately, considerable diversity of opinion by fisheries biologists exists as to the best way to improve degraded habitats. Why such a situation developed is beyond the scope of this report. However, there appears to be the widespread concept that the use of structural approaches is the most effective means to overcome any limiting factor. Simplistic approaches to complex ecosystem problems are common but destined to failure. Without objective longterm monitoring it will difficult, if not impossible, to determine fisheries responses to the wide range of improvement applications that have been tried in the upper Grande Ronde and John Day River Basins. Monitoring programs are needed with specific, attainable objectives. Without a strong scientific research base, the effect of various improvement activities will be difficult to sort out from the array of other stressful factors (e.g., dams, agriculture, roads, and fishing pressures) affecting fish populations.

Riparian vegetation controls a wide array of ecosystem functions related to streams (e.g., shading and temperature control, litter inputs, nutrient cycling, food web support, hydraulic roughness, bank stability, infiltration and storage of floodplain flows). In forested reaches, large organic debris (LOD) provides additional and important functions to streams. Although LOD represents the last influence a tree can exert on a stream, it is often the first addition to a stream when improvement activities begin. A reversal of priorities should be considered for future improvement efforts. If we are to provide a longterm source of LOD for streams, we must begin today the process of reestablishing missing woody plant species so that they can grow, mature, and ultimately provide LOD to stream systems. Furthermore, reestablishing a healthy riparian plant community will have a pronounced affect on a wide range of ecosystem processes and characteristics such as the transport and sorting of bed sediments, stream and subsurface water interactions, water chemistry, bank building, fish and wildlife habitat and numerous others.

Corridor fencing has been used in the upper Grande Ronde and John Day Basins to eliminate streamside grazing by domestic livestock over a period of time. Corridor fencing resulted in the most successful examples observed of vegetation recovery, diversity of channel morphology, and improved fish and wildlife habitat. Although structural modifications were often a component of these projects, habitat improvements were due primarily to the recovery and restoration of riparian vegetation.

For some habitat improvement projects, specific examples were observed where individual structures or groups of structures may have had beneficial fisheries effects. However, many other examples were encountered where individual structures and groups of structures appeared to have detrimental effects (some structures were currently being considered for removal). In addition, many hard structural additions to streams had no apparent ecological context. For example, large wood and boulders were generously added to meadow systems that had never experienced the presence of these materials. The addition of these materials to unconstrained stream reaches is likely to create longterm erosion problems. Structurally controlling channel morphology in naturally unconstrained channels or creating a continuous series of log steps in a boulder system where log steps are naturally uncommon also represent treatments with no ecological basis. Considering the high cost and lack of geomorphic context associated with many structural additions to channels, the continued use of this approach to habitat improvement is unwarranted. Impacts to other resources seldom seemed to be a consideration for improvement projects using hard structures; economics were generally ignored (especially federal projects).

There is widespread perception that stability of stream channels is an important goal for many habitat improvement projects. However, ecological evidence (i.e., sediment transport and flow dynamics, streambank processes, plant establishment and plant community succession) indicates that riverine/riparian ecosystems are diverse and dynamic. This is particularly true for unconstrained streams. Incremental channel adjustments (to annual variations in sediment transport and streamflow) and their interaction with healthy riparian plant communities are important processes that are characteristic of functioning stream ecosystems. Creating the conditions whereby natural stream adjustments can occur is a particularly pressing need in the Grande Ronde and John Day Basins.

A common feature of productive riverine/riparian ecosystems for fish and other resources is the strong interaction between the riparian vegetation and the aquatic/channel system. Hence, vegetation restoration and plant succession provided the best field indicator of recovery in degraded riverine/riparian ecosystems.

Most habitat improvement projects appear to be conducted in a piecemeal approach wherein specific reaches are selected and a treatment implemented. Basinwide planning and the consideration of alternative strategies was not apparent from site visits or discussions with field staff. Coordination between agencies is generally verbal. Because agencies are not preparing basinwide rehabilitation plans, it is difficult to determine how each individual project fits into the needs of an entire watershed. Nor is it possible to determine how projects are integrated to meet identified priorities.

Funding of habitat improvement or protection by the Bonneville Power Administration is likely to receive increasing scrutiny in the coming years from a wide range of interest groups. Already large numbers of fish habitat improvement projects have been completed and substantial sums of money have been spent. Yet, the widespread lack of information regarding the value of improvement activities and the inconclusive results regarding the success of specific projects for improving fisheries productivity represent major problems. Fisheries and other ecological benefits derived from past and future habitat management projects must be displayed for the public. Indepth monitoring programs with appropriate research efforts need to be established that evaluate the success of projects. No quantitative data on fish response to any treatment was provided to the review team for any of the sites visited.

Project monitoring was generally lacking. Although monitoring of one or more habitat variables (such as stream temperature or number of pools) was occurring at a few sites, important additional information (e.g., changes in channel morphology, plant communities, food web support, and water tables) was not being collected. The absence of data prevents rigorous evaluation of project success or failure, and the reasons why. Where successful projects have occurred, documentation is needed to assist in the transfer of information to other watersheds; monitoring is also needed to avoid repeated mistakes. Furthermore, a lack of monitoring information makes it difficult to understand when and if project maintenance is needed. A Great Experiment of fish habitat alteration has been implemented in the Grande Ronde, John Day, and other watersheds throughout the Columbia River Basin. Millions of dollars have been spent and many miles of streams have been altered. Interdisciplinary evaluations must be undertaken to confirm the types and amounts of benefits derived.

The most commonly identified limiting factors associated with streams in the Grande Ronde and John Day Basins were high stream temperatures and inadequate pools for holding and rearing. (No documentation was provided to the review team as to how these limiting factors were identified.) Given the apparent concensus of the two most important factors limiting fish habitat, there was no universal applicability of solutions to these problems. A wide array of treatments have been implemented and the rationale for improving either of the assumed limiting factors with these widely divergent approaches is inconsistent. Many stream rehabilitation projects are not addressing the identified limiting factors. We suggest that the limiting factors approach, as it currently being applied, is an overly simplified and flawed technique. The limiting factors analyses have done little to improve the overall habitat of fish in the Grande Ronde and John Day basins, and perhaps elsewhere. The application of this analytical methodology to degraded systems may be entirely inappropriate and lead to erroneous conclusions about improving habitat. Productivity of natural ecosystems is seldom limited by one limiting factor. Typically, losses in habitats are associated with a variety of changes in ecosystem structure and function. Results of a limiting factors analysis must be moderated by an indepth understanding of the functional complexity of aquatic and riparian ecosystems.

Although field biologists are increasingly aware of the complexity of riverine/riparian ecosystems, there is a overriding need to involve an interdisciplinary approach to ecosystem problems. Workshops and continuing education programs that emphasize the interdisciplinary aspects of ecosystems with range, forestry, watershed, fisheries, wildlife, engineering and administration specialists are needed to improve their understanding of ecosystem functions, interactions, and values. The consequences are too great for us to continue the relatively narrow vision of most improvement practices. For example, we cannot reasonably replicate a productive riverine/riparian ecosystem by simply adding structures to a stream. Similarly, improved range condition on upland areas cannot be used to indicate the relative status of riparian ecosystems.

Although road system evaluation was not a primary purpose of this field review, road systems have permanently altered the characteristics of many of the riverine/riparian ecosystems observed. In particular, roads located in valley bottoms (1) caused channels to be relocated and straightened, (2) constrained channels for long distances where roads were constructed parallel to a stream, (3) constrained channels at stream crossings, (4) altered the composition of bed and bank materials, (5) removed streamside vegetation, and (6) accelerated local sediment inputs. Although most roads were generally in good condition for transportation purposes, their historical impacts on streams and riparian systems have been considerable. Particular care should be taken regarding new road construction and the maintenance of old roads to minimize the direct and indirect impacts on stream systems.

In recent years, the effects of tractor logging along stream systems has become an important concern. As a result, efforts are often made to minimize the effects of tractors in riparian areas and to minimize (or eliminate) stream crossings. Similarly, during the construction of roads, efforts are usually made to minimize the occurrence of equipment in streams. Increases in turbidity and sedimentation are to be prevented because of potentially undesirable impacts to fisheries and water quality. In contrast, the extensive use of heavy equipment on floodplain soils, on stream banks, and in channels has become totally acceptable by practicing biologists when such use is associated with fisheries projects. Perhaps it is time for land managers to reassess which of these contrasting views is appropriate.

USFS technical staff were frustrated by organizational pressures and institutional constraints which limited their ability to improve the management of riverine/riparian resources. These internal pressures sometimes precluded the application of legislated policies and regulations related to multiple use, water quality, and environmental protection. Strict functional approaches for narrowly defined projects did not create the desired interchange between specialists which is necessary to manage complex riverine/riparian ecosystems. Technical staff seldom indicated that an interdisciplinary approach to resource restoration and management was being used. This is, in our opinion, a fundamental shortcoming of many projects designed to improve fisheries resources.

Resolution of stream and riparian impacts from land uses such as livestock grazing, logging, and mining is prerequisite to initiating future stream rehabilitation projects.

SITE COMMENTS

At each field site, agency personnel familiar with the area briefly described the site and management history for the review team. Factors considered limiting to fisheries productivity were addressed. The short length of time typically spent at each site resulted in only a portion of each treated reach being reviewed. Hence, the specific observations, interpretations, and comments reported herein are not necessarily representative of entire streams reaches, only those sections we observed.

MEADOW CREEK, STARKEY EXPERIMENTAL RANGE, WALLOWA-WHITMAN NATIONAL FOREST, GRANDE RONDE BASIN (August 13, 1991)

Site Description

In 1990 massive amounts of large woody debris structures (850 pieces of large wood) were placed in two miles of stream. An additional 11 large structures ("ice racks") were installed to prevent downstream movement of ice. The entire valley bottom is fenced to exclude livestock grazing. Elk-proof fencing is to be constructed along specific sections of Meadow Creek during the summer of 1991 as part of an on-going research project.

During the spring runoff event of May 17-19, 1991 (the flood was approximately a 5-year event at Enterprise) most of the instream log structures moved downstream. The event was rainfall driven and did not involve rain-on-snow conditions, nor did it involve ice flows in the channel. The majority of displaced log structures accumulated at downstream ice racks or were floated onto gravel bars and meadow surfaces. Eight of the original eleven ice racks held. Photographs of the storm event showed that flows in unconstrained reaches flows generally inundated the entire valley.

Streambank vegetation was generally lacking from years of overgrazing by livestock or big game prior to the treatment. Vegetation was also depressed by severe ice flow effects. Hence, streambanks were unstable from past and present land management practices. The pretreatment channel had little diversity in channel morphology and there was a general lack of pools. The pretreatment active channel was wide and vertical eroding banks common. Except for shading provided by topography and coniferous forests on adjoining hillslopes, riparian plant species provided little shading.

The large woody debris added to this stream represents a major experiment. The underlying hypotheses of this treatment that large woody debris in streams will improve fish habitat and massive amounts of LOD are more efficient than limited additions. USFS personnel indicated that is was hoped the treatment would create more pools, increase aggradation of channels, and provide additional storage of subsurface water.

Limiting factors

High stream temperature, anchor ice, and a lack of pool and overwintering habitat were noted as important limitations to fish production. Anchor ice buildup and resulting ice flows are also important factors affecting fish populations and disturbance to channel habitat.

Observations/Interpretations/Comments

Meadow Creek riparian vegetation is a depauperate composition stemming from a history of poor land management. Observations indicate a potential exists for increases in woody composition; scattered willow and cottonwood plants are present. Leader growth has exceeded 28 inches (70 cm) by many plants in the one-year absence of livestock grazing. However, willows or cottonwoods greater than 6 feet (2 m) tall are rare. Because of a long history of excessive levels of herbivory (domestic and wild), little reproduction of shrub and tree species has occurred. Although abundant areas suitable for establishment of black cottonwood and willows were created by the May 1991 flood, no seedlings have established; of all the ungrazed riparian zones examined on this review, this scenario was unique. Rest from excessive grazing would benefit the riparian ecosystem of Meadow Creek. An ongoing study to quantify willow, alder, and cottonwood response to three treatments (i.e., no elk, deer, cattle grazing; no cattle grazing; and cattle, elk, and deer grazing) should provide important insights to the establishment and growth of these plants.

The direct cost for adding large logs to this stream was $125,000. This cost does not include planning and administrative costs. Additional costs will be incurred for installing the elk-proof fences. Although it may be argued that such high costs are justifiable for research purposes (to test hypotheses, to evaluate ideas and processes, to determine resultant effects on fish productivity, and to better understand forest/stream ecosystems), these costs quickly become exorbitant in even a moderately sized basin. Because anadromous fish bearing streams in the Grande Ronde Basin are underseeded, the need to undertake major and expensive changes to stream systems for the purpose of improving habitat is even less justifiable. Apparently, the real limiting factors are offsite.

After the flood, woody debris accumulations provided some additional pool habitat with woody debris for cover. However, such debris accumulations are totally inadequate for providing shade necessary to lower stream temperatures in summer or for reducing thermal losses from the stream (and the buildup of ice) in winter. Even the best of structures can only serve one or two purposes and they seldom begin to replicate the variety of functions provided by streamside vegetation. Without the restoration of streamside plant communities and the associated narrowing and deepening of the channel, the stream will continue to stay too warm in summer and too cold in winter. Restoration of riparian plants is necessary if major shifts of the thermal balance of Meadow Creek are to be significantly altered. Because of historical grazing management, shrubs >2 ft in height are almost entirely absent along any of the unconstrained portions of Meadow Creek.

Prior to the large wood additions to Meadow Creek, the channel and its degraded riparian area had poor potential for holding large logs in place. The stream channel consisted predominantly of exposed gravels. Even where finer textured soils prevailed (mostly silt and sand textures), the general lack of vegetation provide little root strength to resist the erosive forces of flowing water that was redirected by the numerous instream structures.

Following the May high flow, widening of the active channel appears to have occurred. Additional losses of streambank soils were common and gullies sometimes formed where large wood accumulations or gravel deposits deflected flows across meadow soils. Bedload sediments (coarse sands, gravels, and cobbles) were sometimes deposited on top of existing flood plain surfaces. Bank-building processes (including the deposition of fine sediments) were generally lacking. Hence, fine sediments needed for revegetation are being lost from the treatment area. All factors indicate a channel system that has a large active channel, high sediment transport, and is generally unstable. In comparison to other sites visited, this portion of Meadow Creek appeared to experience the greatest amount of floodplain soil loss, deposition of gravel bars on flood plain surfaces, and general channel changes. The large amounts of added wood accelerated soil losses and exacerbated bedload transport. Meadow Creek was not ready for a hard structure approach; instead, the stream and its valley needed a long period of vegetation recovery.

The occurrence of anchor ice is apparently an important problem in Meadow Creek because of its immediate effects on channel form and winter fish habitat. The scouring of channels by floating ice during spring flows creates additional direct and indirect affects on fish habitat. It is not known if Meadow Creek had heavy icing problems in its natural condition. It is possible that icing problems were exacerbated by historical management of the riparian zones.

The mechanisms of anchor ice formation are not well understood and additional research is needed. Factors that would promote the occurrence of anchor ice might include increased energy losses in winter due to the removal of streamside vegetation, increased width-to-depth ratios in channels, reduced interchange of stream water with subsurface water stored under floodplains, exposed cobble and rock within the wetted perimeter which may accelerate thermal losses, etc. The complexity of factors potentially affecting anchor ice formation will make identification of simple cause-and-effect relationships difficult; basic research is needed to evaluate the effects of various factors. However, restoration of riparian vegetation may provide the most effective means of controlling thermal regimes of mountain streams and reducing the occurrence of anchor ice in Meadow Creek. The large ice trash racks are designed to stop anchor ice flows, but will be of little value in preventing its occurrence.

Where winter and summer water temperatures are a problem, the appropriateness of adding boulders to channels was discussed. There is some evidence that such boulders may cause the stream to remain wider (hence a greater area exposed to incoming solar radiation in summer and greater longwave radiation losses in winter). Furthermore, the energy transfers occurring with instream boulders may accentuate heat transfer to water in summer and increase thermal losses in winter. Because boulders cool slower than water after daytime heating has occurred, it is possible that high stream temperatures during summertime conditions could remain longer into the night. Again, this is an area where research is needed.

The pros and cons of the Meadow Creek treatment (i.e., the addition of substantial amounts of log structures) were discussed in the field. The diversity of expressed viewpoints indicates the imperfect state of knowledge regarding the effects of various factors upon fisheries, vegetative recovery, sediment transport, channel morphology, etc. However, if a major shift in the geomorphology of Meadow Creek towards increasingly unstable stream systems and the accelerated loss of meadow soils is necessary to increase fisheries production, it is reasonable to ask--Can we afford the impacts to soil, water, and other riparian resources? Even if the large wood additions in Meadow Creek were important for fisheries purposes, it would be desirable to delay the treatment until riparian shrub communities (willows and cottonwoods, in this case) and the appropriate grass and sedge species associated with streambanks and wet meadows are present along the channel.

Field discussions only briefly covered experimental design and research objectives. The discussion was not thorough enough to fully understand experimental design but several objectives may be of concern. For example, Objective 3 called for identifying and prioritizing areas within Meadow Creek Basin suitable for stream habitat restoration. This objective was not met based on resulting actions of the stream. Objective 4 (based on limiting factor analysis) was to identify stream restoration techniques that will increase production of steelhead trout smolts. The total rearrangement of stream structures by high flows in an attempt to gain increases in anadromous smolts would indicate that this objective had not been met. Objective 6 was to collect posttreatment data on habitat characteristics, fish populations, and smolt production in Meadow Creek. With only three years of pretreatment data in a completely underseeded stream, meeting this objective may be difficult. It is well known that salmonid populations fluctuate widely from year to year and even decade to decade. Objective 7 calls for an economic effectiveness evaluation of habitat restoration on Meadow Creek. This objective should continue to be pursued and results displayed. The field discussion did not deal with this objective, although it has wide application for stream rehabilitation practices in the Columbia River drainage. Because of previous land management influences along Meadow Creek (e.g., livestock grazing, elk grazing, and logging), cause-and-effect responses will be difficult to document.

The study may suffer from selection bias (why Meadow Creek was selected over other streams should be explained). In addition, the low degrees of freedom for analysis, the unmatched control and treatment sites, and the failure to randomize treatments all represent potential evaluation problems. It would be appropriate to reevaluate study design and objectives because of the major changes in anticipated results and objectives. Because of the apparent lack of replication and randomization, results from this research project may best represent those of a case study.

Dr. Orsborn did an intensive and costly design ($25,000) for the proposed Meadow Creek improvement project but this design was apparently disregarded. An evaluation should be made to determine how the Orsborn plans would have functioned under the same set of conditions.

The Meadow Creek research may be too small a reach to have much input into basin approach needs. Future research could be directed towards informations that assists in improved basinwide planning and implementation. Research is needed that encompasses valley forming processes and how enhancement projects affect these processes.

A large gravel bar formed at the mouth of Meadow Creek during the mid-May runoff event and shows that upstream reaches are not retaining gravels and fine sediments. In contrast, old channels of Meadow Creek contain deep layers of fine sediments, producing high vegetation production potential. These same features do not appear along the present Meadow Creek channel. Because of a lack of untreated sections, research may not be able to determine what the channel condition would have been if the treatment had not been installed.

Trespass livestock grazing had occurred along Meadow Creek riparian areas even though grazing was supposed to be excluded this year. This is another indication that researchers may not have control of outside factors affecting fish habitat and populations.

In spite of the issues and concerns identified above, it is important that fisheries research continue in Blue Mountain streams. For example, the general lack of research data on smolt production and riparian habitat for eastern Oregon ecosystems is a major obstacle to improved fisheries management. Juvenile production integrates a wide range of factors influencing fisheries in mountain streams.

MEADOW CREEK FROM MCINTYRE ROAD DOWNSTREAM TO CONFLUENCE WITH MCCOY CREEK, GRANDE RONDE BASIN (August 13, 1991)

Site Description

The stream was corridor fenced in October of 1988 by ODF&W in cooperation with the landowner to exclude livestock grazing; the riparian area has had three years of nonuse. In some areas the landowner allowed fences to be placed some distance from the stream, offering more land for rehabilitation than just a narrow corridor. Prior to fencing, large willows were present along much of the stream. An icing event occurred in 1989. Stream morphology was simplified due to icing effects.

Limitina factors

Stream temperature in summer was believed to be the primary limiting factor. The stream experienced huge ice flows in 1989 which could have been another major limiting factor.

Observations/Interpretations/Comments

ODF&W periodically photographs changes in channels and vegetation. More detailed monitoring should be undertaken where areas are corridor fenced. Such monitoring might measure baseline (pretreatment) stream temperatures, channel shading, age classes and distribution of riparian shrubs, wetted channel widths, channel sinuosity and thalweg variability, water table location and elevations, and fish data. Not all variables need to be measured for all projects, but some documentation of environmental changes is needed to provide a basis for understanding ecosystem responses that occur through time.

This exclosure had a good composition of older age class willows. Because a seed source is available, the potential for vegetation recovery is high. Numerous small shrubs have established within the exclosure and vegetation diversity was high.

The channel is sinuous and is developing several deep pools where flows interact with the root systems of shrubs and trees. Increased shrub cover will provide more shade to the stream, increase litter inputs, provide additional stability to alluvially deposited sediments, alter food web support systems, and provide other important functions. The presence of beavers along this reach should assist in creating ecosystem diversity and improvement of overall fish habitat. Beaver ponds may provide important over-winter rearing habitat. The mere presence of beaver in secondary channels along this section of stream represents a positive indicator of a functioning ecosystem.

At several locations, the outside of meander bends are eroding towards existing fences. Soft architecture approaches to bank stabilization (e.g., the use of junipers or brushy coniferous trees) could be employed to increase hydraulic roughness along the banks for trapping fine sediments and to provide a suitable microclimate for the establishment of willows or sedges at the base of eroding banks. Preferably, if the landowner agreed, the fenceline could be moved back to allow channel sinuosity to continue to develop. A hard structure approach (i.e., riprap the outside banks) was also discussed but not recommended.

Where the stream is attempting to cutoff meanders, the addition of limby trees or junipers may provide sufficient roughness to prevent additional erosion of cutoff channels. However, the significance of such practices in assisting the recovery of Meadow Creek is problematic. While cutoff channels are a natural occurrence in floodplain systems, assisting the maintenance of channel sinuosity may assist in establishing floodplain functions in a recovering channel.

The widespread presence of shrubs prior to fencing may be an important factor relating to the general good condition of this stream. Utilization of shrub species by big game was evident, but the utilization levels do not appear to be hampering shrub establishment or growth.

MCCOY CREEK, TRIBUTARY TO MEADOW CREEK, GRANDE RONDE BASIN (August 13, 1991)

Site Description

McCoy Creek, from McIntyre Road downstream to its confluence with Meadow Creek, is a deeply incised stream that was channelized after 1964 (based on aerial photos). Channelization also occurred upstream from McIntyre Road, but based on culvert elevations where McIntyre Road crosses the stream, the extent of channelization may not have been as deep. Sediment deposition occurred during the high flows in May of 1991. ODF&W is monitoring stream temperatures at two locations along McCoy Creek.

Limitincf factors

High summer stream temperatures and lack of pools are believed to be limiting factors.

Observations/Interpretations/Comments

The 1964 aerial photographs show that McCoy Creek previously had a sinuous channel. However, even in 1964 McCoy Creek was showing signs of channel deterioration (e.g., general straightening of the channel, smoothing of meanders, and increased occurrence and size of point bar deposits) in comparison to earlier photos.

The deep channelization of McCoy Creek downstream from McIntyre Road has created a major and longterm effect on channel morphology. Although some minor meandering is occurring along the reach, continued stream widening and increases in sinuosity will probably require decades before significant increases in the diversity in channel morphology will develop. The active floodplain along the entrenched system needs to widen before meaningful recovery can proceed. Even then, the stream will be well below its natural flood plain (the meadow surface is currently several feet above the stream) and its hydrologic interaction with the adjacent meadows during high flows will be nonexistent. This section of channel represents an excellent example of the undesirable ecosystem impacts caused by channelization. These types of channel alterations devastate the riparian functions of meadow systems.

Because of channelization, vegetative recovery is slow and few willows have established. This creek has limited potential for vegetative recovery; the channelization has greatly reduced the amount of area available for the establishment of a functioning riparian vegetation complex. Little vegetation shades McCoy Creek and most shade is topographic, formed by the steep cutbanks of the incised channel.

An upstream V-log structure at the lower end of McCoy Creek caused a pool to form with some cover from the undercutting of the logs. Although geotextile fabrics used on the upstream side of the structure probably allowed the structure to continue to function, biodegradable materials exist that can perform the same function as the geotextile fabric. Non-biodegradable materials should no longer be used as components of structural additions to streams.

Upstream from the road, considerable sediment deposited in the entrenched channel during the large mid-May storm of 1991. Overbank flows did occur. At high flows, McIntyre road creates backwater effects and is currently causing sediment deposition upstream from the road. This reach of McCoy Creek is beginning to recover hydrologically (e.g., the water table is within l-2 feet of the meadow surface which is much closer than other portions of the stream). Woody vegetation is increasing (willows are becoming reestablished) and, over time, this reach could become a much improved riverine/riparian ecosystem that will function in conjunction with a wet meadow. Adjacent to the existing channel a short reach of abandoned channel (pre-1964?) is currently providing a small but important wetland. Three years of livestock nonuse has improved this section of McCoy Creek.

McIntyre Road may currently be perceived as providing beneficial effects on the recovery of McCoy Creek upstream from the road. The size and elevation of the road culverts and the presence of the road across the meadow represent important factors affecting the longterm recovery of this stream system. However, the road has hydrologically severed the meadow system into two major components whereas previously (pre-1964) it functioned as one.

GRANDE RONDE RIVER UPSTREAM OF STARKEY GENERAL STORE AND BEAVER PONDS (August 14, 1991)

Site Description

This reach was recently corridor fenced by ODF&W. Boulder placements were already in place and ODF&W was in the process of adding wood and additional boulders. Most wood pieces had root wads attached. Planned structural treatments include the addition of boulders and with wood cabled to them.

Limitina factors

Warm stream temperatures and a lack of pools were believed to be the major limiting factors.

Observations/Interpretations/Comments

As with many of the reaches we examined, the long term impacts of improper grazing were apparent through examination of the age structure of the black cottonwood. Only a few large, mature (and in most cases decadent) cottonwoods were present. Yet, no reproduction had taken place until the exclosure was constructed. Within the exclosure numerous cottonwood seedlings have established in sediments deposited by the May 1991 storm event. Recent whiplash and sandbar willow establishment was also evident indicating a high potential for recovery at this site.

Several boulder clusters from previous improvement activities were observed upstream from a deteriorating wooden bridge. The location and pattern of placement may be increasing the rate of bank scour. In degraded systems that have little vegetation along the banks, the addition of large roughness elements in the channel increases the likelihood of accelerated bank erosion.

The pros and cons of implanting boulders in streams was discussed. In particular, the potential thermal effects of placing boulders in channels with high width to depths ratios was discussed. From a thermal perspective, these boulders may be adding to the streams thermal load in summer and increasing the rate of water cooling in winter (see comments for the Meadow Creek Site, Starkey Experimental Range). However, the overall significance of energy exchange processes associated with boulders upon instream water temperatures has had little research and models are unavailable that provide quantitative estimates of the general magnitude of change. Another effect of scattered boulders in unstable channels is to increase the wetted width and increase the wetted surface area exposed to incoming solar radiation.

The bridge abutments may be providing shortterm benefits to fish (e.g., a deep pool under the bridge, local cover from the bridge, and limiting the amount of lateral channel erosion in a degraded system). However, bridge abutments are constraining the general channel evolution along this section of the Grande Ronde. They were probably also an important factor affecting overbank deposition of fines (sand and silt sized sediments) and gravels which occurred on banks upstream of the bridge during the 1991 mid-May high flows. Thus, what appears to represent a shortterm fisheries and channel morphology benefit to this specific reach may also represent a longterm detriment to the restoration of riverine/riparian ecosystem. After vegetative recovery is well underway within the fenced corridor, the bridge abutments should be removed (perhaps within 5 to 10 years).

SHEEP CREEK AT VEY MEADOW, GRANDE RONDE BASIN (August 14, 1991)

Site Description

The lower section of the Sheep Creek cattle exclosure was inspected. Sheep Creek flows through a low-gradient meadow system well removed from the forested hillslopes which comprise the valley walls. One stream mile was corridor fenced by ODF&W in 1987; an additional four miles was corridor fenced in 1988. Twenty-two log (i.e., digger logs, V's, and K dams) and rock structures were added to the stream with vegetation plantings. ODF&W installed two water temperature recorders to monitor year-round water temperatures.

The Meadows along Sheep Creek were heavily grazed by sheep before the turn of the century and by cattle since then. The meadows reflect the heavy influence of over a century of heavy use. At one time, Sheep Creek apparently had excellent pools and a high fish population.

Limiting factors

High water temperatures in summer and lack of pools are believed to be limiting fish populations.

Observations/Interpretations/Comments

Within the exclosure, we observed dramatic changes in vegetation composition and structure which were beginning to influence streambank physiognomy. Sheep Creek had the highest diversity of willows of all sites examined (8 taxa of willow were present). The willows were rapidly expanding in this area. However, use of willows by large wild herbivores was high and may be retarding succession. It would be of interest to fence small concentrations of willows with woven wire fence. These fenced areas might be only 5 yards wide by 10 yards long. Exclosure heights of 5 to 6 ft would generally be adequate because big game do not typically enter small exclosures. This was the only site where herbivory by big game was great enough to warrant additional fencing within the cattle exclosures. The released willows within the small woven-wire exclosures will provide seed sources and stems for additional willow establishment.

Increases in more hydric herbaceous species such as large-seed bullrush (*Scirpus macrocarps)* was occurring in the wet meadows bordering the creek. In areas this species was providing shade, allocthonous inputs, and bank stability. Often, it was replacing exotic grasses in dominance.

This was one of the most interesting sites visited by the review team. The site amply demonstrated the recovery potential of low-gradient systems once grazing impacts are removed. Although the channel is still somewhat incised, there are important signs of geomorphic recovery. Channel sinuosity is increasing and becoming increasing irregular as recovering plants (primarily willow and alder) begin to exert a greater signature on hydrologic processes (e.g., bank formation, sediment transport, dissipation of hydraulic energy). Undercut banks (i.e., overhanging root masses in contact with the water even at low summer flow) are becoming common. Such banks indicate a healthy riparian system and are not to be confused with vertical cutbanks which indicate bank erosion is occurring at a rapid pace. Good sized pools were present at meander bends. Coarse gravel substrates occupied riffle sections; point bars contained finer gravels. Small point bars with abrupt features are becoming rapidly vegetated by a variety of willow species. Shifts in channel particle sizes over short distances demonstrates that sediment sorting is occurring during transport. Such sorting is uncommon in most degraded streams that were visited in the Grande Ronde and John Day Basins.

The extent of change occurring within the Sheep Creek exclosure is phenomenal compared to the downstream reach which continues to receive grazing impacts. Perhaps more than any other site visited, fundamental research and longterm monitoring should have been initiated prior to fencing. Without scientific analysis and monitoring, the remarkable changes occurring within the Sheep Creek exclosure will be insufficiently documented. Society should never be allowed to forget the effects of excessive livestock grazing upon valuable riverine/riparian ecosystems such as typified by Sheep Creek.

Although stream structures were added and are creating some channel diversity, the real improvement results from the overriding influence of reestablishing vegetation upon the hydrology and geomorphology of the system. Money spent on structural additions would have been better spent on monitoring or building additional corridor fencing. Furthermore, because such structures tend to lock-in vertical and horizontal channel elevations, they will continue to limit longterm recovery as the stream attempts to reestablish a new equilibrium. It would be fortunate, but probably unlikely, if these structures were naturally buried by the stream as recovery continues.

Several trees have fallen or have been placed in the channel. These large roughness elements (tree boles longer than the stream is wide with branches and root wads attached) provide increased hydraulic roughness, channel diversity, and fish cover. They also provide important niches for vegetation establishment and local bank protection.

Whenever the stream channel shifts towards a fence, the fence should be moved away from the stream. A concurrent movement of the fence toward the stream could be undertaken at some other location if the landowner will not accept the slight decreases in acreage associated with expanding the fenced corridor.

Big game animals appear to be utilizing shrubs within the exclosure. Small elk and deer exclosures within the corridor exclosure would provide an important perspective as to how significant such grazing/browsing pressure is on the rapidity of vegetative recovery.

Sheep Creek also experienced the high flows in mid-May of 1991. In contrast to other degraded streams in the Grande Ronde Basin, Sheep Creek, within the exclosure, appears to have suffered little environmental damage. In fact, the high flow event probably assisted ecosystem recovery now underway within the fenced corridor.

No additional structural or vegetation treatments should be undertaken in this reach. The large meadows of similar terrain downstream from the Sheep Creek exclosure offer excellent opportunities for improved grazing management. These types of lands and streams lend themselves to significant improvement and restoration of riverine/riparian ecosystems through simple changes in management.

LONG CREEK, MIDDLE FORK OF THE JOHN DAY BASIN (August 14, 1991)

Site Description

ODF&W installed a corridor fence in the fall of 1990. As part of this treatment, large rock and boulders were installed to create instream structure and riprap eroding banks. The stream is at an elevation of about 4,200 feet and normally has a winter snowpack of less than two feet.

The USFS is managing surrounding areas on a rest-rotation grazing strategy. Steelhead trout spawn in the stream annually and Chinook salmon use it occasionally. Juvenile Chinook salmon will migrate into the stream to rear.

Limiting factors

High summer temperature, lack of streamside vegetation, and numerous raw (eroding) banks are believed to be the factors limiting fish populations.

Observations/Interpretations/Comments

The riparian zone associated with Long Creek was typified as having a few residual cottonwoods and little additional establishment in the past 50-100 years. The construction of exclosures has facilitated establishment and growth of willows and cottonwoods in numerous areas. The shrub diversity in this area was high; eleven species of woody species were noted. Already established willows experienced significant release following the exclusion of grazing. Many plants were now higher than the browse level of big game species.

Streamside conifers outside the corridor fence were selectively harvested in the past. The remaining conifers are currently providing some shade and litter to the stream. They also represent a future source of whole tree recruitment. When corridor fences are installed, large trees in the riparian zone (even though they be located outside the fences) should be retained to benefit riparian and aquatic resources.

A large amount of rock was added to the channel to riprap the outsides of stream bends and to create pools. The amount of material added appeared excessive in comparison to the size of the stream. Because high stream power will be necessary to move the added rock, this treatment represents a permanent change in the channel morphology of Long Creek. The geomorphic context of the channel has been changed by the extensive addition of rock materials. The stream will largely function as a cobble/boulder channel and fish species adapted to those types of conditions will be favored. The ability of vegetation to interact with channel forming processes, even though a corridor fence has been installed to prevent livestock grazing, has been largely eliminated by the large amount of rock.

In relation to the limiting factors, rock riprap does little to alleviate temperature problems or encourage vegetation changes typical of alluvial channels. Although riprap can be effective in the shortterm for reducing bank erosion, the longterm consequences cannot be predicted. Such structures do little for initiating the development of vegetated streambanks on the outside of meanders and greatly reduce the capability of a channel to store fine sediments for bank-building processes.

Should a comparable stream reach become available for corridor fencing by ODFCW, the widespread use of rock to riprap channel banks and beds should not be part of the treatment. If a rancher insists on extensive rock riprap as part of the treatment, the corridor fencing project should not be undertaken. A compromise position on riprapping would be to use juniper trees or limby conifers to protect banks and initiate revegetation of the lower banks. Rock riprapping is to be avoided as a means of reconstructing streams for fish.

FOX CREEK,
NORTH FORK OF JOHN DAY BASIN
(August 14, 1991)

Site Description

Eleven miles of Fox Creek were fenced by ODF&W in 1985. Grasses and sedges responded immediately, but according to ODF&W representatives, vegetative conditions have not changed much after the first couple of years of exclosure. Juniper riprap was placed on several large bends two years ago. ODF&W observations indicate the channel may be flowing more water in the summer than before fencing. An Forest Service grazing allotment which affects seven miles of stream immediately upstream of private lands is in poor shape and influencing Fox Creek.

Limiting factors

High summer stream temperatures and low summer flows are believed to be the major limiting factors controlling fish populations.

Observations/Interpretations/Comments

Fox Creek is an extremely low gradient system. Prior to establishment of the corridor fence, Fox Creek was characterized by an entrenched channel with high sinuosity and long sweeping meanders. Sedges and grasses have largely stabilized streambanks. The stream is developing small floodplains within previously incised channels several feet below the pre-incision floodplain surface. Although sedges and grasses are abundant, only a few willows have begun to establish. The general paucity of willows may be primarily a result of the high clay soils characteristic of the banks. Established willows were generally no higher than surrounding grasses and showed signs of being grazed by elk or deer. Nevertheless, the extent of ecosystem recovery from livestock grazing exclusion is impressive.

The juniper tree riprap effectively prevented continued bank erosion. However, because of the close spacing of junipers, significant amounts of floatable organic debris are being trapped at higher flows. Hence, sedges and grasses have a difficult time becoming established. Because the channel is deeply incised, there is heavy topographic shading of many streambank soils. A less dense application of junipers along the outer banks may be more effective in encouraging revegetation. Because sedges and grasses responded quickly following grazing exclusion, the addition of juniper to selected meander bends was probably not necessary.

Exclusion of livestock grazing since 1985 has created the appropriate environmental conditions for habitat recovery. The channel is definitely narrowing as sedges and grasses cause sediment deposition along the lower banks. Long, sweeping meanders are becoming more irregular as streambank vegetation increasingly exerts an effect on flow conditions and channel geometry. This channel shows every indication of undergoing hydrologic/geomorphic/vegetative restoration. However, ecosystem processes and plant succession require time.

Anecdotal information on increased summertime low flows (where previously the channel went dry) following corridor fencing, while of interest, does not provide a reliable scientific basis for proving low flows have increased. Observations cannot replace the need for accurate pretreatment and posttreatment measurements of streamflow in comparison to a control reach or control watershed. Collection of streamflow data for paired reaches/watersheds is expensive. However, if changes in low flow hydroperiods or discharges remain an important issue associated with the potential benefits of corridor fencing, such studies should be initiated.

No additional structures (either soft or hard architecture) should be considered for this reach. If the landowner reinitiates past grazing practices in this reach after the 15-year lease, most vegetative recovery benefits would be rapidly undone.

CANYON CREEK, JOHN DAY BASIN (August 15, 1991)

Site Description

A 3.5 mile reach of Canyon Creek was fenced by ODF&W in the fall of 1990. Some boulders and low rock check dams were installed previously. ODF&W plans on installing 40 wood/boulder structures in 1991. The stream had been channelized in the 1960's prior to the 1964/65 floods. The channelized section has shown little improvement over the past 30 years. High streamflows are normally generated by snowmelt; much of the upper basin is in wilderness. The lower portion of the fenced reach is covered by tall shrubs. At a second stop, farther upstream, little shrub overstory was present.

Limiting factors

The lack of adult holding pools and high water temperatures are believed to be the major limiting factors affecting fish populations. Although spring Chinook survive summer conditions, additional holding pools would reduce stress.

Observations/Interpretations/Comments

The channelized stream will limit recovery potential of vegetation. Along the downstream end of this exclosure a good cover of alder, whiplash willow, Mackenzie willow, cottonwood, and aspen were present. Some narrowing of the channel was apparent. Creeping spikerush (*Eloecharis palustris*) was the first plant to establish along stream banks and was influencing sediment retention and structure. Numerous small willows were establishing in the upstream end of the exclosure.

This upstream site is in the preliminary stages of recovery from recent fencing. Although some perceived shortterm benefits to channel morphology favorable to fish may occur from the addition of structures, structures may slow longterm recovery of this stream. (See previous discussions for other sites).

Although beaver do not presently occupy this reach, ODF&W personnel stated that it was common for beaver to move into a recovering reach after several years. Significant channel changes often occur as beavers begin to influence flows and sediment transport. This situation may become more common as additional reaches become corridor fenced. There is a need to identify alternative grazing strategies that promote riparian recovery without the need for fences, to identify situations where the trapping and relocating beavers are necessary, and to transfer information to landowners regarding the ecosystem values associated with beavers so that potential conflicts with landowners can be minimized.

It is usually always desirable to allow natural vegetative recovery to proceed for five years or more before considering the possibility of instream structures.

EAST FORK OF CANYON CREEK, JOHN DAY BASIN (August 15, 1991)

Site Description

A riparian corridor fence was constructed by ODF&W in 1990. The addition of significant amounts of rock riprap and low rock check dams to stop eroding cutbanks was a significant part of the treatment. Cutbank erosion was occurring and if left unchecked was expected to affect fence location within the next year or two. Cutbanks in some places were eroding 5 feet per year. Although the channel has occupied its present position for the last 30 years, the stream had previously flowed across other portions of the alluvial bottom.

Limiting factors

High sediment rates and low cover diversity were believed to be the factors limiting fish populations.

Observations/Interpretations/Comments

The lower reach within the corridor fence had a good shrub cover and will respond rapidly and favorably to livestock exclusion. Farther upstream the riparian vegetation was in very poor condition resulting from past winter livestock feeding. A few residual large willows, cottonwood, and aspen were present and will provide germplasm for establishment of new stands of vegetation.

The pros and cons of riprapping have been discussed previously (see comments associated with other sites). If riprapping a particular bank with rock is deemed necessary, it still is not justification for the more extensive application of rock riprapping associated with some reaches of the East Fork of Canyon Creek. Much less rock should have been placed in this creek. If a landowner identifies extensive riprapping as a necessary component of a corridor fencing project, alternative stream reaches should be considered. Riprapping is expensive, has questionable ecosystem value, and should not be supported by funds directed at fish habitat improvement.

SUMMIT MEADOW, MALHEUR NATIONAL FOREST, MIDDLE FORK OF JOHN DAY BASIN (August 15, 1991)

Site Description

Combination log and rock check dams were constructed in 1990 by the USFS in eroded gullies of a small (formerly wet) meadow at the head of Summit Creek. The meadow continues to receive annual summer grazing (cows were present in mid-August). A livestock exclusion fence was mentioned as possibly being considered by the USFS.

The meadow and tributaries have been extremely damaged by livestock grazing. Stream channels are deeply entrenched and dish shaped. Meadow vegetation has reverted to large stands of tarweed in some areas.

Limiting factors

Year around fish producing streams are not present in the meadow. However, this meadow is important because it is a wetland and it affects flow and sediment transport into downstream fish producing reaches of Summit Creek.

Observations/Interpretations/Comments

This was one of the more degraded sites we visited. Current levels of grazing are excessive and causing losses in site productivity of this riparian ecosystem. Wind erosion is ongoing; we observed dust clouds (i.e., top soil and nutrients) being carried from bare ground on this site. Dry portions of this meadow are dominated by Kentucky bluegrass (*Poa pratensis*) and the unpalatable plant tarweed (*Madia* spp.). Wet areas, of decreasing size, are dominated by baltic rush (*Juncus balticus*) and Nebraska sedge (*Carex nebraskensis*).

Overgrazing has caused the hydrologic failure of a formerly wet meadow system. Gullying and channel incision are occurring in clay textured soils and wet meadow soils are being drained. Although the upper several inches of soil have been compacted by livestock, good soil structure is still evident two inches below the soil surface. Present grazing is exacerbating an already deteriorating condition and the hydrology of the wet meadow is rapidly being shifted to that typical of a xeric site. This meadow no longer functions as a depositional landform. Instead, it is an active source of fine sediment movement into lower Summit Creek during periods of high streamflow and a source of aeolian dust during the summer.

The installed structures will not improve the hydrologic processes occurring in this meadow unless grazing is stopped. With continued grazing the structures will only result in additional soil loss and gullying.

Although the current condition is severely degraded, exclusion from livestock grazing may be the only change in management needed. These sites are often resilient following cessation of grazing. Reseeding with exotic grass species is not recommended. Ten years of rest from grazing is recommended. Furthermore, it is recommended that grazing of meadows in similar condition on the Malheur National Forest should be terminated immediately.

Forest Service personnel indicated that ripping of meadow surfaces was used as a restoration technique for at least three degraded meadow systems on the Malheur National Forest. We recommend that such restoration practices be also terminated.

SUMMIT CREEK, MALHEUR NATIONAL FOREST,
MIDDLE FORK OF JOHN DAY BASIN
(August 15, 1991)

Site Description

Summit Creek flows through a coniferous forest. In 1989, the USFS installed ten rock and wood structures along less than two miles of stream. These structures were intended to help spawning steelhead. This is the first year 45% vegetation utilization on terraces adjacent to the stream, but outside any floodplain, have been in force.

Present use includes about three weeks of grazing; previous use was substantially heavier.

Photographs taken in 1966 from established photopoints show extensive raw banks and a stream with severe erosion problems.

Limiting factors

A stream inventory showed few pools were available for holding adult salmonids.

Observations/Interpretations/Comments

In comparison to the 1966 photographs, considerable channel improvement had occurred along this reach. Many eroding banks had been stabilized by vegetation growing along the waters edge. However, there were few shrubs along the stream and those present were heavily grazed. Sedges along the waters edge were also heavily grazed.

Mountain alder was the only riparian shrub present along the stream and may represent the most common species for these sites; the riparian vegetation should be managed for alder dominance, Although utilization of the allotment was targeted at 45%, almost all of the current years' growth of small alders had been utilized by grazing animals. We observed photopoints with pictures from the mid-1960s. Although riparian condition has improved since 1966, an equivalent level of recovery was noted in areas managed under nonuse for as little as one to two years. Such a slow rate of recovery during almost three decades is inadequate for these sites.

Monitoring of grazing utilization was based on herbaceous plants growing on benches or terraces away from the stream. Furthermore, current monitoring of grazing utilization includes no measurements of shrubs. If the objective is to restore plants that are dependent upon the hydroperiod of the stream, grazing utilization standards must also be applied to plant species along the stream.

Summertime stream temperatures are generally high along this reach because of inadequate cover. Algae growth was common.

Forest Service personnel indicated that twenty four Allotment Management Plans are scheduled to be redone in the next three years, however the process appears to have become bogged down. This is an important goal and needs to be accomplished.

THREE-WAY EXCLOSURE ALONG SUMMIT CREEK, MALHEUR NATIONAL FOREST, MIDDLE FORK OF JOHN DAY BASIN (August 15, 1991)

Site Description

One reach of Summit Creek was fenced to exclude big game , another was fenced to exclude livestock, and the third reach retained ongoing grazing management. The three-way exclosure is located in a coniferous forest setting.

Observations/Interpretations/Comments

This site provides an excellent demonstration of the ecosystem response to three treatments: (1) cattle grazing with the addition of several instream structures, (2) exclusion of cattle only, and (3) complete exclusion of large herbivores. In the cattle-grazed and instream structure treatment, a riparian ecosystem exists that is dramatically different in comparison to treatments (2) and (3) . Shrub cover was largely lacking, water temperatures were warmer than inside the exclosures, channel banks were vegetated but not to the extent that was seen within the exclosure, and channels tended to have large width-to-depth ratios. Where log weirs had been placed, deposition of sediments had occurred upstream from the log weirs and pools formed downstream. However, the vertical drop over these structures would limit upstream migration of fish during low flow periods. In general, pools were absent throughout most of the stream. Large woody debris was also largely absent (except for the log weirs) and algal growth generally dominated the water column.

The exclosure treatments (particularly the elk and deer exclosure) showed remarkable contrast to grazed areas outside the exclosures. Excellent shrub cover and age classes were present and the stream was well shaded by vegetation. Stream temperatures were cooler in the enclosure than in grazed areas. Channel banks were well vegetated, the stream had small width-to-depth ratios, and deep pools contained numerous fish. In some reaches, the entire flow went subsurface and was apparently interchanging with cooler groundwater. Fine sediments were accumulating along stream margins and building streambanks. The presence of algae, which was a dominant feature of the stream in grazed areas, was nearly entirely absent within the ungrazed exclosure. Although much floatable woody debris (e.g., branches) occurred in the channel, it has remained in place, thus demonstrating the general stability of this stream reach. Large woody debris, consisting of large trees with branches and root wads intact, provided important hydraulic roughness to the channel. Vegetation in both exclosures was more mesic indicating greater interaction with the subsurface water. These vegetation/water interactions include high inputs of energy and organic matter to the water while decreasing dissolved nutrients such as nitrates and phosphates. This vegetation/stream interaction further prevents the eutrophication that was apparent in the algal-based grazed area. Because of the changes in vegetation cover, water quality, and channel morphology, it is apparent that grazing exclusion alone is far superior to the use of instream structures and the current grazing system. There was a functioning, healthy, and diverse aquatic and riparian ecosystem within the exclosures; outside of the exclosures the stream and riparian systems were significantly degraded.

The contrast between conditions inside and outside the exclosures was extraordinary. It is recommended that District Rangers and Forest Supervisors spend time understanding the process occurring inside and outside of the exclosures. These functioning ecosystems provide a template of what National Forest streams and riparian areas might look like should the USFS decide to accept the challenge of good stewardship. It is also recommended that the USFS begin building effective cattle exclosures. Poorly constructed allotment fences are not effective at excluding livestock and are defeating their ability to assess grazing effects throughout the western United States.

CAMP CREEK, MALHEUR NATIONAL FOREST,
MIDDLE FORK OF JOHN DAY BASIN
(August 16, 1991)

Site Description

Two hundred eighty three structures were installed along approximately 12 miles of Camp Creek. The structures were installed with the main purpose of reducing stream temperatures. Camp Creek drains a forested watershed.

Limiting factors

Lack of pools and high stream temperatures are believed to be limiting fish populations.

Observations/Interpretations/Comments

Only one stop was made along Camp Creek to observe specific stream'conditions. This section contained numerous log weirs filled with sediment on the upstream side and unable to scour pools on the downstream side. Thus, instead of a step-pool morphology in longitudinal profile, the channel was essentially a series of log controlled flats. The channel was generally widest and shallowest where log weirs were placed. This caused decreased vegetation interaction with the creek. Structural inputs decreased the effectiveness of vegetation to function as shade or as sources of nutrient inputs (litter). Once the stream was away from the influence of these structures, it deepened and narrowed. The lack of pools and the widening of the channel caused by the log structures are in direct conflict with the identified limiting factors. The structures should be removed even though such an activity would severely disrupt the channel. Logging has removed large trees bordering the channel that would have contributed large wood to stream over time; thus the recruitment of naturally occurring LOD has been prevented.

Pieces of geotextile fabric and woven wire scoured from structures were lying on the streambed; the presence of such materials in natural stream channels is totally undesirable. Crews should walk Camp Creek annually and remove these materials whenever they become exposed. Such materials should not be use in National Forest streams.

Scarce numbers of seedlings and sprouts of cottonwood, Mackenzie willow, whiplash willow, alder, and red-oshier dogwood were present. However, current grazing levels are retarding succession to arboreal or shrub-like sizes. Although there is a potential for a functioning ecosystem to exist, hard structures, and grazing management are limiting fish habitat recovery.

DUNSTON CREEK, MALHEUR NATIONAL FOREST, MIDDLE FORK OF THE JOHN DAY BASIN (August 16, 1991)

Site Description

The intermittent channel of Dunston Creek runs through a ten-acre, north facing, moderately sloped, forested area that was harvested in 1990. The area was essentially clearcut and cable yarded; however several overstory and understory trees were left at scattered locations in the harvest unit. Concern was expressed by the USFS that the creek had not been adequately protected because trees had been harvested along the intermittent channel.

Observations/Interpretations/Comments

Logging occurred last year but slash burning had not yet occurred. From an erosion and water quality perspective, it did not appear that the harvesting had significantly affected the channel. The site should again be inspected after completion of burning and site preparation.

MIDDLE FORK OF TEE JOHN DAY RIVER,
MALHEUR NATIONAL FOREST
(August 16, 1991)

Site Description

Major reaches of USFS streambanks along the Middle Fork of the John Day River have received extensive boulder treatments. The site visited had boulder structures and the riparian area was in a grazing allotment. Current management consists of early season grazing.

The existing stream has been channelized. An old channel occurs at the downstream end of the reach and a project is being considered to reconnect the river to this old channel.

Limitina factors

High stream temperatures and lack of high quality pools are believed to be the factors limiting fish populations.

Observations/Interpretations/Comments

A pasture occurs on a wide terrace (above the active floodplain of the river) and is dominated by exotic pasture grasses. The tamed pasture is of little ecological value and should be managed separately from the riparian area between the pasture and the river.

Livestock grazing management of the riparian area should emphasize recovery of shrub species. Although only 40% utilization of herbaceous species is occurring on the terrace, shrubs and other riparian species close to the stream are being overgrazed. Woody plants have not established along the channel because of past grazing practices and the channelized nature of the stream. Accelerated riparian recovery could be obtained by fencing the riparian area to totally exclude livestock grazing. This would allow increased utilization of vegetation on the terrace by grazing animals.

Tremendous amounts of money have been spent structuring the Middle Fork of the John Day River for fish habitat improvement. This money may well have been wasted. No systematically collected data or monitoring information was presented which indicated that the hoped for benefits to fisheries had been realized. Again, the geomorphic template of this river, like so many in eastern Oregon, has been irreversibly altered by the massive amounts of rock that have been added to the system.

The reconnection of the structurally modified "new river" to the channel of the "old river" is being proposed in an effort to reintroduce sinuosity to the river. The length of channel could potentially be doubled. Furthermore, the old channel has a high shrub density which would, in theory, provide cover to the stream. (The existing river is almost entirely lacking in shrub cover.) To reconnect the river will require the construction of a diversion structure and channel to move water from the new to the old. How this will be accomplished is not known at this time. Apparently the willows that are currently occupying the old channel would have to be cleaned out if the conveyance capacity of the old channel is to be adequate to handle high flows; how this would be accomplished was not specified. The doubling of the channel length will decrease channel slope by at least 50%. Furthermore, the highly vegetated channel will have a much higher roughness than the existing river. What this all means is that the diversion of the river into a lower gradient and hydraulically rough channel is likely to cause substantial sediment deposition and instability at the head of the diversion. The engineering solution to such a problem is often to add more riprap. Reestablishing old channels seems, at least on the surface, like a desirable and worthy objective. However, given the general lack of successful attempts to improve and enhance fisheries with structural approaches, this project would have little likelihood of success. It may represent another attempt at trying to make channels behave the way we think they should, only at a much grander scale. Instead of focusing on such a technically complicated and potentially disastrous project, USFS technical staff should concentrate on the more important task of restoration and improvement of riparian vegetation throughout the forest.

THE NATURE CONSERVANCY, MIDDLE FORK *OF* TEE JOHN DAY RIVER (August 16, 1991)

Site Description

The Nature Conservancy (TNC) recently purchased four miles of valley bottom along the Middle Fork of the John Day River. Several management options were discussed regarding the TNC property.

The general objective of TNC is to manage the property so that natural ecosystem processes can occur.

Observations/Interpretations/Comments

This large reach of the Middle Fork of the John Day has a tremendous potential for recovery. Two years of nonuse have resulted in the establishment or release of willows and cottonwoods on numerous gravel bars. Wet meadows are diverse and recovering. Through vegetation succession and changes in hydrology, this ecosystem will likely become more hydric and biologically diverse in the future. These changes will increase bank storage of water and exert some influence on base flows, particularly within secondary channels. Currently the cottonwood and willow dominated communities consist of mature or decadent age classes only. Past management has resulted in an under-representation of young and middle-aged stands. The present management strategy utilized by the Nature Conservancy will allow for establishment of young cottonwood and willow communities.

Instream structures (riprap, and secondary channel plugs) are influencing natural plant succession and ground water processes within the riparian zone. Establishment of cottonwood gallery forests is related to natural fluvial processes of channel meandering which are limited in areas due to structural control. It is suggested that the secondary channel plugs be removed so that the river is more directly connected to its original floodplain and side channels. Railroad fills which cross side channels and other depressions should be removed to allow increased connectivity of surface and subsurface water systems. The instream boulder treatments, with the possible exception of the heavy riprap treatment near the diversion headgate at the lower end of the TNC property, should be removed. These boulders are effectively maintaining a straight, high gradient channel and preventing natural meandering from occurring.

Two major options were discussed related to the TNC property: (a) allow natural recovery processes to modify channel and floodplain systems and (b) utilize water diversions from Big Boulder Creek to create side channel rearing habitat .

Current management is resulting in dramatic improvements in riparian recovery. If the TNC decides to utilize natural processes on their property, the existing water right from Big Boulder Creek should not be used for irrigating meadows nor for maintaining flows in side channels for fisheries production. Managerial activities (other than those identified above) which influence the natural recovery of hydrological or ecological processes should be discouraged. Sustainable fish habitat may best be accomplished through natural recovery of a complex riparian/stream ecosystem. Additional ditch construction and stream diversions may retard this recovery and potentially influence the inherent biological diversity of the site. Because water rights are generally valuable, perhaps TNC's water could be used somehow to augment side channel flows or to initiate improved riparian management on lands outside the TNC property.

If improved young-of-the-year rearing habitat is desired on the TNC, water from Big Boulder Creek might be diverted into old floodplain channels and wet meadows in an attempt to provide increased habitat quantity and quality. The use of diverted waters, while appealing from a fisheries perspective, may be in contradiction to the overall goals of TNC. If increased salmonid production through active management becomes a desired management goal, the diversion of Big Boulder Creek onto TNC property requires further evaluation. Prior to implementation of any water diversion, potential ecosystem implications and impacts need to be considered. These include: (a) the potential effects on plant community recovery and successional dynamics, (b) the effects of implementation/construction, (c) the effects of decreasing the cold water plume from Big Boulder Creek into the Middle Fork, and (d) the feasibility of this practice providing a significant improvement for rearing fish in the John Day Basin.