6/1/2009

An ecological assessment of Oregon's CREP cumulative impact incentive program

Anne M. Bartuszevige[1], Ken Diebel[2], and Patricia L. Kennedy[1]
[1]Eastern Oregon Agricultural Research Center – Union and [2]Oregon Department of Agriculture

Introduction

Riparian buffer strips perform important ecological services. For example, they absorb floodwaters during high flows, filter sediment and nutrient runoff from upland areas, regulate river water temperatures, and provide allochthonous nutrient inputs to rivers. In agricultural areas, riparian buffers are often highly degraded, if not absent entirely, and incapable of providing these important ecological services. The result is degraded streams that are eutrophic, have high sediment loads with wide channels and have high water temperatures that are unsuitable for fish and macroinvertebrates. The Pacific Northwest struggles with riparian management and it is especially important here because of the many species of endemic anadromous fish that are listed as threatened or endangered on the endangered species list.

Unbuffered riparian reaches have high sediment loads that change the substrate of the riverbed, making it unsuitable for salmonid fish to nest. In addition, in riparian areas without a vegetated buffer, stream temperatures are often too high for successful development of eggs and fry. Large woody debris (LWD) is also important in stream systems for creating small pools for fish to spawn in and to protect the young fry. Several methods for riparian restoration have been proposed (e.g. adding LWD, nutrient addition) but fencing riparian areas from agricultural disturbance seems to have the highest success rate for restoration. Riparian fencing can be coupled with native vegetation plantings or the vegetation can be allowed to restore naturally. Results from riparian fencing projects include decreased sediment loads in the stream, water temperatures, channel width, and increased LWD. All these results are thought to increase habitat suitability for anadromous fish. One limitation for many studies on riparian fencing is that the area fenced is small in size which limits inference about the success of riparian fencing for stream vertebrates and macroinvertebrates.

The Conservation Reserve Enhancement Program (CREP) is a federal program that pays rental fees to farmers on land along riparian areas that the farmer removes from production. The resulting area is fenced for restoration and conservation purposes. Despite the fact that CREP is a federal program, it is the responsibility of the individual states to see that the program is implemented and the money distributed. Oregon's CREP program is unique due to its cumulative impact incentive payment. This is a program in which a landowner (or group of landowners) can fence >50% of a 5 mile stream segment and receive a one time payment of four times the annual rental rate. This cumulative impact incentive program has generated controversy because of the lack of data to support paying such a large monetary incentive for restoration of longer stream sections.

Despite the enormous efforts of private, state and federal agencies to encourage riparian restoration, very little data exists that illustrates the effectiveness of such measures. Many of the studies conducted to date are on small fenced areas that were fenced many years ago. Evidence exists that these small riparian fencing projects are not large enough to effect any change on the stream reach in question. Parkyn et al. (2003) suggest that the width and length of riparian buffers need to be created in proportion to the size of river segment that is to be restored. For example, wider rivers need wider and longer buffers to effect any change on the river ecosystem. Wooster and DeBano (2006) concluded that wooded buffer length has a greater impact on stream macroinvertebrates than width of wooded buffers. Although, (Kondolf 1993) concluded that riparian buffers along one section of the stream will have little effect on overall stream recovery if cattle are allowed access to the stream in other sections.

The purpose of this study is to determine the effectiveness of Oregon's CREP program. Specifically we will select areas of cumulative impact buffers for an in depth assessment and determine their effectiveness compared to control (unbuffered) reaches and a series of shorter buffered areas whose total buffer area is equal to the total length of cumulative impact buffer. This comparison will allow us to assess whether cumulative impact buffered areas have a higher impact than shorter buffers.

We hypothesize that cumulative impact CREP buffers will have higher values for stream quality measures when compared to control or short CREP buffers. Specifically, cumulative impact buffers will have higher bank stability (Parkyn et al. 2003), water clarity (Parkyn et al. 2003), wetted width (Wooster and DeBano 2006), and lower sediments (Wooster and DeBano 2006). We also hypothesize that the macroinvertebrate community in cumulative impact buffers will reflect the lower sediment loads and have higher representation of "shredder" insects (Parkyn et al. 2003, Wooster and DeBano 2006). We hypothesize that older buffers will have higher values stream quality values than newer buffers demonstrating that stream quality improves over time in the buffer (Parkyn et al. 2003).

Methods

Site selection will take place in June – August 2007. Data from the Farm Services Agency indicates that the majority of CREP buffers are located in Sherman and Wasco counties; therefore, site selection will focus on these counties in north central Oregon. We have obtained GIS data layers of soils, geologic substrate and land use and land cover for Sherman and Wasco counties.

To select sites, we will determine, which stream reaches have been enrolled in the CREP program, when the restoration was initiated, and the length of the stream segment included. A subset of CREP areas will be selected that span a variety of ages since restoration. We will attempt to make sure stream buffers are as similar as possible (e.g. equal lengths and widths) and have similar land uses adjacent to the buffer and similar geology. At the selected streams we will attempt to obtain pre-restoration data from landowners, project managers, and aerial photos.

Objective: Evaluate cumulative impact program
The purpose of this objective is to collect data to provide a quantitative description of how stream quality differs among cumulative impact buffers, unbuffered areas, and smaller CREP buffers and to determine if cumulative impact buffers are meeting the criteria for the program. We will ask the question: Do cumulative impact buffers increase stream quality compared to 1) unbuffered controls and 2) smaller buffered areas? We will select 3 sets of sites, one set will be a

recent addition (1-2 years old) to the CREP program, the second site will have buffers 4-5 years old and a third set will have buffers >7 years old. A set of sites includes 1) cumulative impact buffer, 2) series of smaller CREP buffers whose length sum to the length of the cumulative impact buffer and 3) an unbuffered control equal to the length of the cumulative impact buffer. We will sample the following measures at 5 evenly spaced locations in a 100 m length of stream located at the downstream end of the buffers and control: vegetation, width-to-depth ratio, channel cross section, bank stability, stream temperature, macroinvertebrates, sediment, Water clarity, nutrients (nitrogen and phosphorous) and bacterial content (Parkyn et al. 2003, Wooster and DeBano 2006). We will measure these variables using standard techniques described in the scientific literature and the water quality monitoring technical guidebook (1999) so that results from this study can be compared to other investigations on riparian buffers. Data collection will occur from April – August 2008. We will not measure shade because of the young age of the buffers and the planted trees. We do not expect the trees to be large enough to cast a shadow over the streams we measure.

Vegetation: We will measure density and survival of CREP plants. In addition, we will measure percent cover of invasive plants with special focus on those plants on the noxious weed list.

We will collect soil cores from each of the sites at three distances from the stream edge: 0, 10 m, and 20 m. We will remove the top 2 cm of sol from the soil core and spread this soil over vermiculite in a greenhouse pot. The remainder of the soil from the soil core will be spread over vermiculite in a separate pot. Both samples will be allowed to germinate and seedlings identified. Separating the soil core in this way will allow us to determine recent deposition of seeds (in the top 2 cm) from long term seed bank deposition.

To determine potential for water dispersal of native and exotic plants, we will collect seeds from the stream and germinate them in the greenhouse. A variety of techniques for sampling water deposition of seeds will be tested during June – August 2007 with the assistance of a work study student from Eastern Oregon University. Data will be collected during the 2008 field season using the best technique tested during the 2007 field season.

With-to-depth ratio and Channel cross section: At equally spaced points along the streams, we will measure stream width and depth using measuring tapes (Bauer and Burton 1993). We will also measure bankful height and measure the depth of undercut banks (Bauer and Burton 1993).

Bank stability: We will survey stream bank erosion and measure the length of any area of unstable or damaged stream bank (Pfankuch 1975, Bauer and Burton 1993). We will collaborate with the U.S. Forest Service on bank stability techniques as appropriate.

Stream temperature: We will install temperature data loggers at equally spaced locations along the stream reach being investigated. We will set the temperature loggers to record water temperatures hourly. Before data analysis, we will “smooth” temperature by using a moving window average of water temperatures (e.g. 7 or 10 day moving window average).

Macroinvertebrates: Macroinvertebrate community composition can be used as an indicator of stream health. High densities of worms and Chironomid larvae indicate streams that are heavily impacted by humans and indicate high levels of pollution (Parkyn et al. 2003, Sovell et al. 2004, Wooster and DeBano 2006). High densities of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) (the EPT taxa) indicate streams that are not heavily impacted by humans and have low levels of pollution. Shifts in community composition from worms and chironomids to the EPT taxa will indicate improved stream condition. We will collect macroinvertebrates at all streams to document changes in macroinvertebrate community related to buffer length and age. We will sample macroinvertebrates using a D-net which is placed on the stream bottom and the upstream portion of the stream bed in front of the net is disturbed (Water Quality Monitoring Handbook 1999). Invertebrates that are disturbed from the substrate then flow into the net and are preserved in an alcohol solution until processing, identification and analysis. To reduce the variation in the macroinvertebrates collected due to habitat differences we will collect only in the riffles in the thalweg (Water Quality Monitoring Handbook 1999, Wooster and DeBano 2006).

We will analyze data using a variety of methods. First, we will work closely with the Department of Environmental Quality (DEQ) to use their previously established models to determine community composition shifts in species abundance in different buffer types and ages. Second, we will use indices commonly used in the scientific literature (such as the quantitative macroinvertebrate community index) and appropriate parametric statistical analyses to determine community composition shifts (Parkyn et al. 2003).

Sediment: We will measure the percent of fine particles using the grid method. We will place a 20 X 30 cm grid over the stream sediment and count the number of grid intersections that have fine sediment (< 6 mm) beneath them (Wooster and DeBano 2006).

Water clarity: We will measure water clarity using a turbidity meter (Water Quality Monitoring Handbook 1999).

Bacteria and nutrients: We will collect water samples at the downstream end of the study reaches. These samples will be analyzed for total dissolved reactive phosphorous, total nitrogen, nitrate nitrogen and bacterial content. We will send these samples to an accredited lab to perform the analysis.

Impact

A number of studies have investigated the impacts of riparian buffers. However, most studies focus on one issue related to buffered areas (e.g. nutrient run-off, sediment filtering, water temperature, etc.). Few studies have investigated a number of effects of riparian buffers on the streams. This will be among the first to do so. This study will allow us to draw conclusions about the community effects of buffers on streams, something that other studies cannot do due to their narrow focus. In addition, we will publish our findings in the scientific literature so that impacts of riparian buffers are disseminated to those studying them in other areas of the globe. It is important that impacts of stream buffers be investigated and the results published in the scientific literature so that we can learn about what methods work and which don’t in order to improve stream buffers (Kondolf 1995).

The principle investigators on this grant have experience writing reports to agencies and scientific papers. The design of the proposal is such that it would be written up as a journal article for a peer-reviewed scientific journal. In addition, AMB and PLK have experience and success working with private landowners.

Literature Cited

Bauer, S.B. and T.A. Burton. 1993. Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams. U.S. Environmental Protection Agency, Washington, D.C.

Davies-Colley, R.J. 1988. Measuring water clarity with a black disk. Limnology and Oceanography 33:616-623.

Kondolf, G.M. 1993. Lag in stream channel adjustment to livestock exclosure, White Mountains, California. Restoration Ecology 1:226-230.

Kondolf, G.M. 1995. Five elements for evaluation of stream restoration. Restoration Ecology 3:133-136.

Parkyn, S.M., R.J. Davies-Colley, N.J.Halliday, K.J.Costley, G.F. Crocker. 2003. Planted riparian buffer zones in New Zealand: do they live up to expectations? Restoration ecology 11:436-447.

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. USDA Forest Service Report, Region 1, Missoula Montana, U.S.A.

Water Quality Monitoring: Technical Guidebook. 1999.

Wooster, D.E. and S.J. DeBano. 2006. Effect of woody riparian patches in croplands on stream macroinvertebrates. Archiv für Hydrobiologie 165:241-268.

Budget justification

This budget includes money used for site selection on CREP buffers in Wasco and Sherman counties. Initial site selection will use GIS layers of aerial photos of Wasco and Sherman counties, FSA data of locations of CREP buffers in Oregon, and land use and land cover maps. Final selection of sites will require field visits to assess the site for suitability and to obtain landowner permission. Money for an Oregon State University motor pool vehicle and money for food and lodging are requested for travel to potential field sites. Food per diem is requested at a lower rate because I anticipate shopping for low-cost food items that can be prepared easily instead of eating at restaurants. Shopping for food will be a lower cost than restaurant eating, so I will need only $25/day for food.

Time Table

Dates	Activities
July 2007 – April 2008	Site selection in the office with GIS databases Site visits to complete site selection Contact landowners and obtain permission for access
July 2007 – September 2007	Experiments with various seed collection techniques
May 2008 – July 2008	Stream physical and chemical data collection Macroinvertebrate sampling Vegetation sampling
July 2008 – September 2008	Macroinvertebrate identification
September 2008 – December 2008	Write final report Write and submit manuscript for publication