

# PROCEEDINGS

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# Developing Management Strategies for Riparian Areas

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## Abstract

This talk outlines four principles that are critical to successful management of a riparian area. First, given problems both with defining historic conditions and with returning to them, attaining management goals based on restoration of ecological processes and functions will be far more successful. Second, the management goals for any stream reach must be placed in a watershed context. Ecological and hydrologic processes that occur above a target stream reach can determine whether many stream reach-specific goals can be met. Third, riparian systems are dynamic, and disturbance is normal and expected. Microsite conditions are highly variable. Management plans should utilize or accommodate, not fight, these dynamics. Fourth, riparian areas are generally fully occupied by plants and so can be very difficult places for new or desired plants to get a start. Thus, a hands-off approach may not achieve the desired long-term goals.

Most plans for riparian zone management call for some change in plant species composition; getting new plants started in riparian areas is often a big challenge. We will review some of the factors that contribute to this challenge and offer some strategies to address these factors. We have organized these strategies into four principles.

*Principle 1.* If restoration is among your goals, define restoration in terms of the ecological processes and functions you want to restore, rather than in terms of specific historic species composition or structures.

We know very little about historic conditions anywhere. We do know that Native Americans were living in the West long before the current vegetation assemblages came in to being and that the nature of these assemblages was strongly influenced by them through fire and agricultural practices. We strongly suspect that upwards of 90% of the native human population died within 150 years of European landing in the Americas in 1492 (Diamond 1997). Thus, the role of the native Americans and their riparian landscape legacies are likely to differ depending on the time frame in which the historical observations were recorded. We know that most of the beaver population in Western streams were trapped before most of the settlers' observations of ecological conditions were made (Jenkins and Busher 1979). Thus, the early observations of riparian (or general forest) vegetation conditions were looking at an overlay of the vegetation patterns created in the pre-European environment with 25 to 200 years of patterns generated under post-European conditions.

We do get some historic information from study of the older components of riparian systems. We also get some historic information from pollen patterns in sediment cores (Whitlock 1992). But the precision and resolution of this information is low although it is helpful in

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defining some of the coarse-grain patterns. To complicate our interpretation of this historic information is good information that the climate regime that existed at the time that our current oldest forests began is quite different from the climate of the last century (Wagner et al. 2000).

Many of the factors that help determine what is in riparian areas have changed. On larger rivers, flood control dams have changed flood behavior. Floods now do not get as deep but they last longer. This increased duration of flooding has removed some species from riparian areas and created the opportunity for new ones to come in.

Stream cleaning for navigation on larger streams and general channelization of most low-gradient streams has caused the stream to down cut the stream bed (e.g., Benner and Sedell 1997). The stream bed is now lower than it used to be. As the larger streams down-cut, the streams that feed into these larger channels begin to down cut also. For example, stream cleaning of logs and channelization of the Willamette River in western Oregon has caused feeder rivers like the Luckiamute River to incise more than 20 feet. The Lukiamute used to be a shallow river with surrounding wetlands - now dry - that flooded frequently. Recently down-cut streams have limited flood plains, higher water velocity, less stream structure, and more erosion.

Another factor that has changed is the plant community. We now have many non-native plant species that are very happy in riparian areas. Control of their population size may be possible; elimination would be difficult and expensive. Also, changed ecological conditions caused by factors like flood control and down-cutting can mean that the historic plant community is no longer appropriate for the site.

There are often social constraints on the literal restoration of historic conditions. Take the Luckiamute River example above. With the improved drainage and cessation of flooding that followed down-cutting, houses have been built along the stream. Return of the historic hydrologic regime would likely make these home owners a bit unhappy.

So, given the difficulties of both knowing historic conditions and of returning strictly to them, one is forced to ask what are the essential ecological processes and functions that are wanted in the riparian area and seek approaches to managing the riparian vegetation and hydrology to achieve these processes and functions. Our rough knowledge of historic conditions can help define some of these processes and functions. So can our understanding of the ecology of critical species in the riparian system. For example, a lot is known about what ecological processes and functions contribute to good salmon habitat.

*Principle 2.* Set your management goals in the context of your specific watershed as well as watershed processes in general.

While a riparian project will take place at a specific location along a stream, both the appropriateness of the goals (the ecological process and functions to be supported) and the ability to achieve them successfully will vary with where that location is within the whole watershed. Along the length of a stream from its headwaters to its end at the sea, many of its botanical, climatic and hydrologic characteristics change. Because of the strong interest in

large conifer wood for fish habitat, we will briefly look, as an example, at the changes in large conifer wood processes over the length of a typical stream.

Our stream starts pretty high in the forested mountains. This is where the stream gradient is the steepest. Some of these head water areas are so steep that they periodically let go in an avalanche of water, soil, rocks, and trees. These debris flows travel until either the gradient drops too low or the stream turns at a sharp angle. When these debris flows carry wood as well as soil into a fish-bearing stream, they are generally regarded as a net positive (Reeves et al. 1995).

At its start, our stream sits in a small V-shaped valley and conifers grow on the bank, Hardwood occurrence is spotty. Traveling down the stream, the stream gradient drops gradually, water flow increases, the stream meanders across a widening flood plain and the amount of near-stream conifers decreases. With these changes, the ability of large conifers to grow near the stream is decreased and the ability of the stream to move logs is increased. These two factors lead to a situation where large wood in the smallest streams stays put unless moved in a debris flow. Trees grown near mid-sized streams are moved down stream and, because of the limited production of large conifers on large streams, these mid-sized streams serve as the source area for most down-stream reaches. With this understanding, the importance of managing for large trees (especially conifers) along mid-sized streams is clear.

Precipitation also decreases along this stream, from the headwaters to the sea. This changes greatly the nature of competition and the amount of natural regeneration that is found. Generally, natural regeneration is greater at lower elevations. At higher elevations where moisture is abundant, shrub competition is the concern and light is usually what limits tree regeneration. At lower elevation, herbaceous competition for the limited moisture can limit tree regeneration. There is a notable exception to the generalities of this paragraph in the lower elevations of the central and north Oregon Coast Range. Here, precipitation is very high and so regeneration of trees is less frequent and competition for light is most often the limiting factor.

Precipitation decreases from north to south in our region. This is overlaid on the elevation pattern to create a huge range of moisture conditions within the region. At the wet end of this range, there is so little difference in soil moisture between the near-stream riparian soils and the upslope soils that similar vegetation can be found from the stream edge to the ridge top. At the dry end of the range, even the stream bank is surprisingly dry. It is often too dry to allow true water-demanding species to grow (Figure 1, Sarr and Hibbs, unpublished data). And only a meter or two away, the upland plant community starts.

What happens at one place along a stream can affect down-stream processes. Most resource managers have run into the concerns over cumulative effect, especially with respect to water temperature. The concern is that warming the water in one place will increase stream temperature down stream as well and, if there are a number of locations that each make the water a little warmer, the stream temperature will eventually become too high. While the process is not quite as simple as this - there are also cold water sources coming into streams that cool them - there are numerous examples of very warm streams because of increased exposure to the sun.

The cumulative effects concept can also be applied to other stream characteristics besides temperature. Two other common concerns are sediment and nitrogen. In small amounts, these may be beneficial; in large amounts, they can create big problems for fish and other stream-dependent organisms. In all discussions of cumulative effects, it is important to remember that effects to streams of an action can be limited by careful management to just a short period of time.

In summary, there are two reasons to consider goals for a particular stream reach in the context of the whole watershed. First, different portions of a stream system are better able to support particular goals. Second, while the impact of any individual management activity may be small, it may interact with other small impacts over a watershed to create a big impact.

Hydrologic patterns and growing conditions can be altered by culvert placement and road construction. Small riparian communities can be eliminated when flows are diverted or consolidated. Road banks and cuts favor pioneer species. We have seen efforts to vegetate boulder and gravel road banks along streams with very limited rewards at great expense. Such efforts need to be considered within the context of watershed functions and processes.

*Principle 3.* Management goals should explicitly incorporate the normal dynamics and disturbances of riparian areas.

Principle 2 says that you must consider the spatial context of a stream reach. Principle 3 says that you must consider the temporal context as well. We all know that plant communities change with time (succession) yet most riparian management plans still manage to forget it. It is pretty common to hear something like, we've got Douglas-fir now so we don't need to think about this place. This 'place' may not be an immediate priority, but it certainly needs to be part of a plan. Depending on where you are, Douglas-fir is succeeded by Douglas-fir, by more shade-tolerant conifers, by hardwoods, or by shrubs.

Normal winter flooding does not often create opportunities for tree regeneration. Normal winter flooding sets limits on what plant species can be present, by limiting the communities to species with some level of flood tolerance. But winter floods that deposit deep sediment layers, debris flows, and beaver are all disturbance agents with a profound and rapid effect on species composition. Sediment deposits and debris flows are disturbances that create smaller and larger patches of bare ground with distinct site characteristics for plant regeneration. Both act to create a patchy pattern of vegetation. Generally, because both kinds of events are small, seed sources are very close and regeneration is rapid.

Beaver present a different challenge. Beaver selectively remove trees and some shrub species, converting a riparian area to a low shrub or herb community. Beaver damage can be controlled by trapping or fencing. However, because beaver impoundments do provide some benefits to fish (Leidholt-Brunner et al. 1992, Naiman et al. 1988), most stream ecologists do not recommend their removal. Rather, it is probably a more efficient use of resources to 1) recognize that beaver focus most of their activity on low-gradient streams (<3% gradient, Suzuki and McComb 1998) on mid-sized streams and 2) let the beaver use these areas, focusing tree regeneration efforts elsewhere in the watershed.

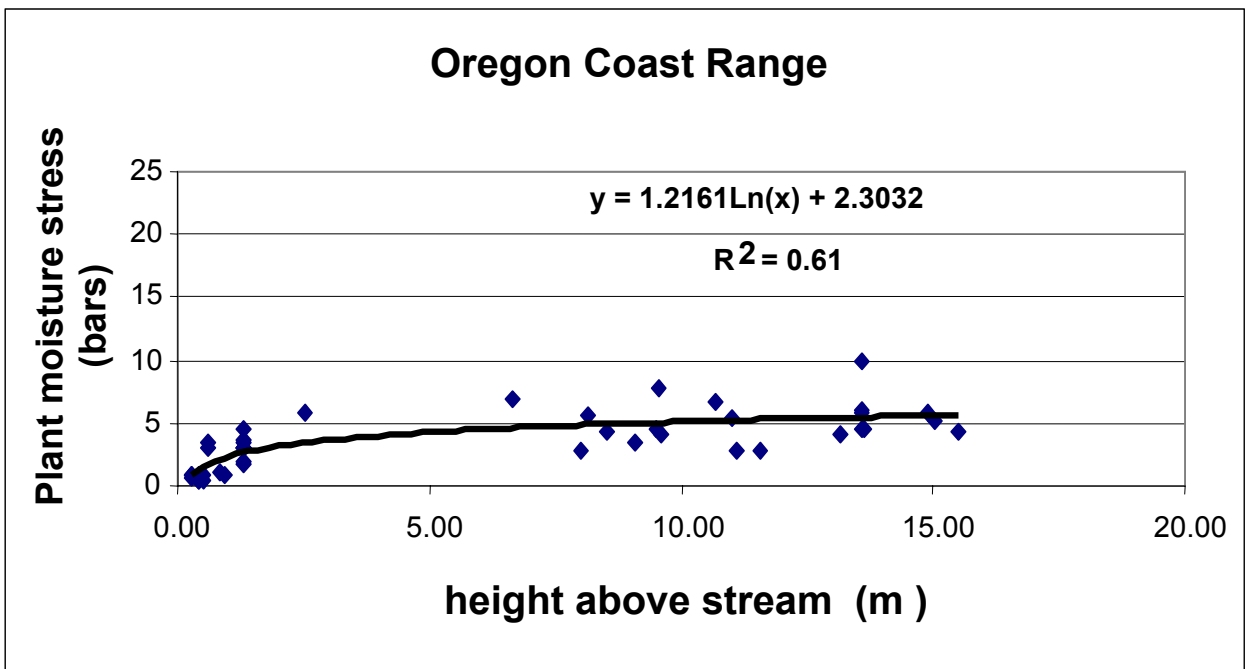
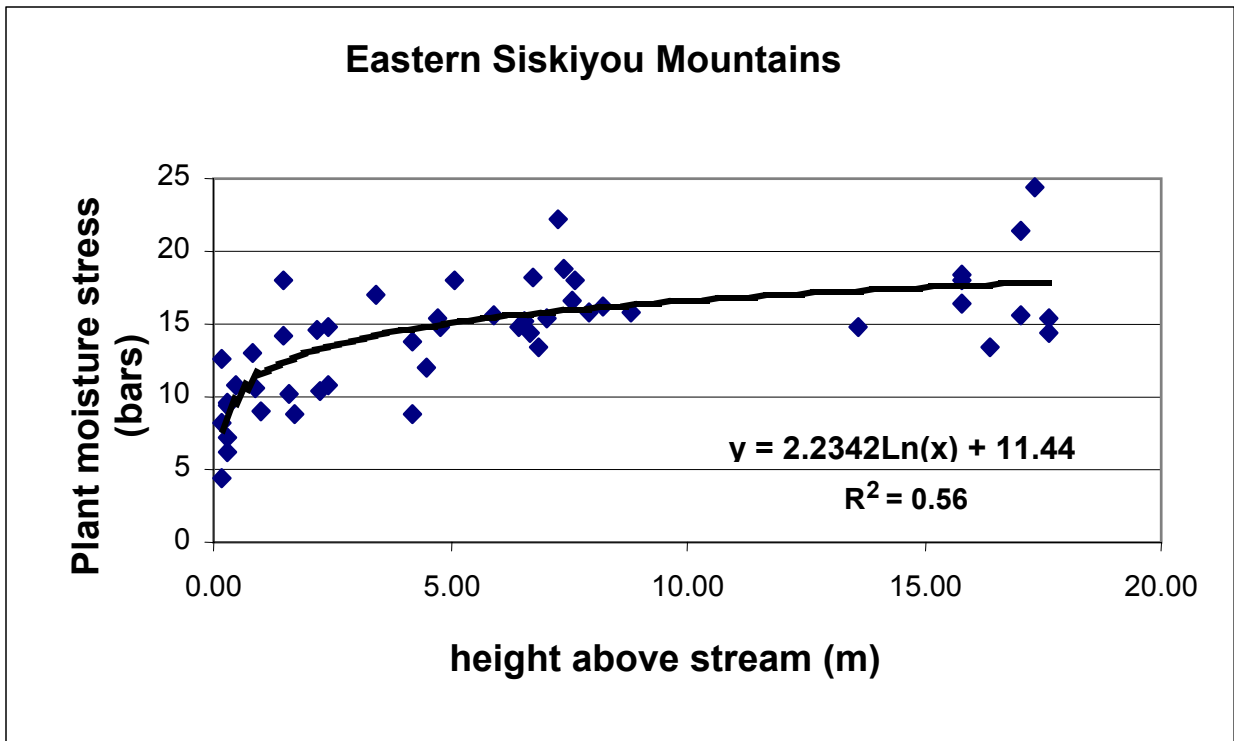
The pollen found in sediment cores records the vegetation history of a location. Since sediment cores are always collected from wet areas, they are particularly useful for describing change in riparian areas. These cores show that many species are present all the time and that the relative abundance of any species changes greatly over time periods of 100 to 300 years. In the Oregon Coast Range, pollen cores show that the species we see present today have been there for about 7,000 years. They also show that the abundance of red alder pollen varies by almost 150% over any 200-year period. When alder pollen is abundant, some other species are less common. As alder pollen decreases in abundance, the pollen of other species increases. Above, we talked about some of the processes that cause short-term changes in vegetation. Pollen cores show that these changes have been going on for a very long time and that quite an assortment of vegetation communities is normal for any one location.

*Principle 4.* If you do not have the resources or ability to manage competing vegetation effectively, wait until you do.

Competition from competing vegetation is the most common limit to tree regeneration. Established vegetation often reduces light and soil moisture (even in the riparian zone) below critical thresholds for new trees. I saw one well intentioned project which planted willow cuttings along a stream and up the bank about 30 feet. In three years, this was a dense thicket of willow over 20 feet high. The people who planted the willow thought they had followed the directions about stabilizing the bank - they did - and now did not understand why trees were not regenerating under the willow. It was, of course, quite dark there as well as being great hiding cover for animals that eat seeds and seedlings.

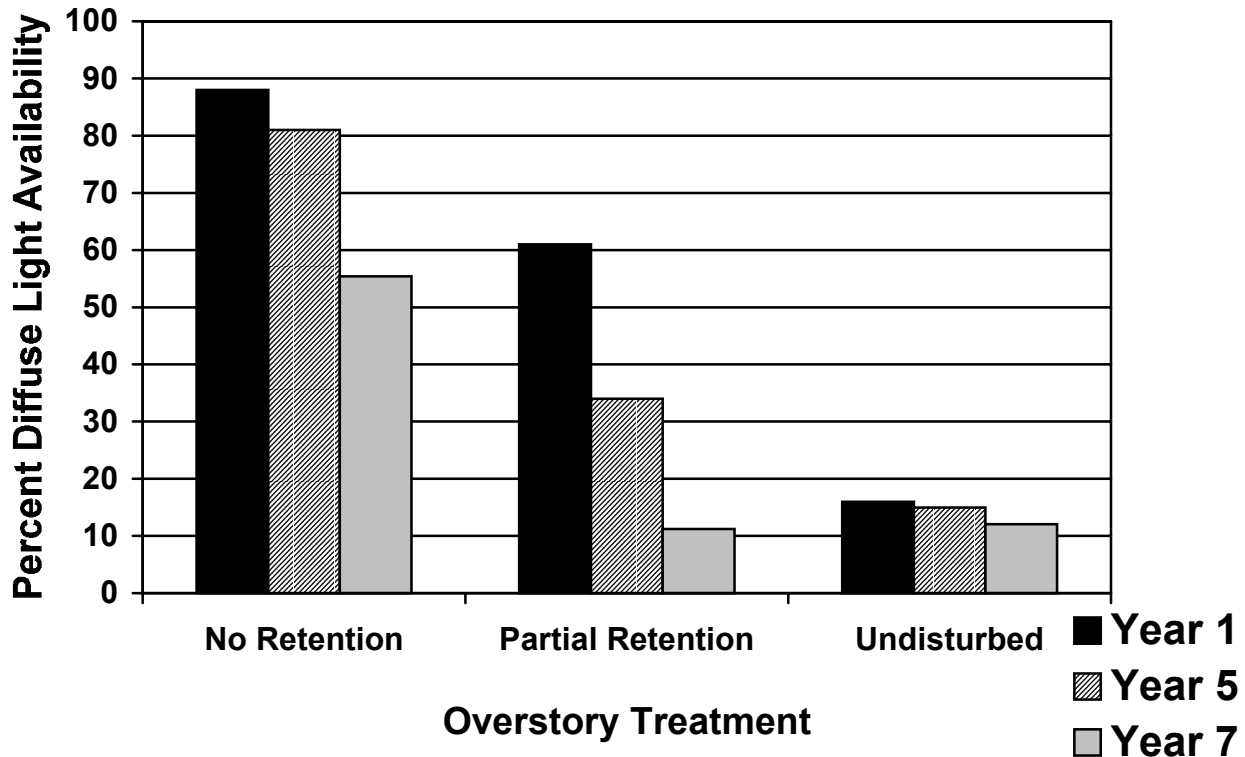
We have worked a lot in the Oregon Coast Range because tree regeneration there is quite a challenge. This is a moist environment with rapidly growing trees as well as the shrub, salmonberry, with an amazing vegetative reproductive ability. Many miles of hardwood and shrub-dominated stream banks in the Oregon Coast Range have been underplanted with conifers. All of these failed miles demonstrate the importance of controlling competing vegetation. We will review here a little of a project we did to demonstrate the challenge of adequate competition control.

First, in this riparian area dominated by red alder and salmonberry, we wanted to thin the overstory enough that it let through light equivalent to 60% of open conditions. To do this required cutting 90% of the trees. It took only 8 years for light to return to prethinning levels (Figure 2, Chan and Hibbs, unpublished data). Second, we found that if we clearcut the overstory and let the salmonberry grow, seedling-level light was only 4% of open - too dark for trees to grow. We found that we needed to thin the overstory every 4-6 years and cut the understory every year for the first 3 years to successfully regenerate conifers in this riparian setting.



**Figure 1.** Pre-dawn plant moisture potential in late summer (Sarr and Hibbs, unpublished data). In the moist ecosystem (Eckman Creek, Coast Range), riparian moisture conditions are not too different from up-slope conditions. In the low precipitation system (Mule Creek), even the stream edge is relatively dry.

**Figure 2.** Regrowth of overstory cover after complete and partial removal of a 24 year old alder canopy (Chan and Hibbs, unpublished data). No Retention was a ½ acre gap. Partial Retention removed 90% of the overstory tree stems to achieve 60% of open light conditions on the ground.



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