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Streamway Corridors: The Importance of Riparian Buffer Zones

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Introduction

In general, riparian buffer zones can be defined as green zones along streams, rivers, and lakes. When these areas are wet for a significant part of the year, then they are also considered wetlands (9). Also known as streamside forests, these riparian buffer zones have a very diverse selection of vegetation that provide numerous benefits to the streams they border, as well as to the selection of wildlife that find shelter in their unique environment. Since the onset of agriculture, these riparian zones have been continually degraded. In the continental U.S. today, over half of the wetland and riparian zones have been destroyed. (11) The destruction of these zones has created numerous problems, resulting in the partial or complete destruction of the immediate stream habitat, as well as destruction of the vitality of areas further downstream. (6) This paper focuses on the positive qualities of riparian zones, including the prevention of nutrient and sediment pollution, the stabilization of fish habitat, the perpetuation of the microbial food loop, and the control of flooding. In addition, the effects of river modification through dams and agriculture are discussed in relation to these issues, with case studies used to reinforce the importance of restoring the riparian buffer zones.

Erosion and Sedimentation

Perhaps one of the most important qualities of the riparian buffer zone is its ability to control erosion, and thus, to prevent sediment pollution. While we often think of pollution in terms of toxic chemicals and waste, sediment pollution is a very large and very significant problem. Erosion is a natural process, yet it is often sped up through human activities either directly or indirectly. Sedimentation and siltation will effect the geomorphology of the stream banks in the immediate area, as well as the water chemistry and ecology downstream.

In a stream surrounded by a riparian zone, sediment pollution is controlled. Riparian zones are densely populated, and thus have an intricate root system that helps to stabilize the bank and prevent erosion. In addition, the woody stems and grasses help to physically trap sediment by slowing down the water runoff from the surrounding area, allowing the sediment to settle out. A stream with these characteristics will tend to be deeper and narrower because the banks are stable and sediment is not filling the stream bottom. This type of environment allows fish and insect populations to thrive. (5)

In contrast, a stream in which the riparian zone has been cleared, also known as a meadow stream, erodes easily as the vegetation by the stream, if any, has shallow and weak root systems. These systems do not trap the sediment, nor do they hold together the stream banks. Thus, these streams are characterized by wide, shallow streams resulting from the erosion of the banks and the sedimentation of the streambed. In addition, the combination of a lack of vegetation for shade cover and a shallower stream leads to a dramatic increase in water temperature that neither the fish nor the microbes can survive. While these qualities alone are not suitable for fish populations, the increased sediment in the stream water also clogs fishes' gills, covers their food on the stream floor, buries their eggs, and clouds the water, depriving the aquatic plants of light. (7) In addition to the direct impacts on fish, the sediment carries other problems. As the larger pebbles settle out, the finer sediment is carried further downstream, where it can build up and create similar problems in the fish habitat. In addition, because the sediment is often clay, and because clay particles are often charged, pollutants can bind to these particles and thus are spread downstream with the sediment. (3)

Nitrogen and Phosphorous Pollution

Nitrogen and phosphorous are usually the limiting factors in primary production for stream bank vegetation. However, too much nitrogen and phosphorous can have deleterious effects on the health of the stream. In high quantities, they are toxic. It is essential, then, that a balance be maintained, allowing for amounts of nitrogen and phosphorous that help keep the stream healthy.

A stream with a riparian buffer zone is able to maintain more natural inputs of nitrogen and phosphorous into the stream. Riparian zone plants do this by having denitrifying bacteria on the rhizomes of their roots. The products of this denitrification process are generally innocuous, thus allowing the excess nitrogen to enter the atmosphere or be used by the vegetation of the riparian zone rather than enter the stream. This is especially important when large quantities of unwanted nitrogen travel in the run-off of agricultural fields. In the case of phosphorous, the riparian vegetation sequesters the nutrient in their roots or vascular tissue, thus controlling its entrance to the stream water. (1)

Meadow streams are poor controllers on nitrogen and phosphorous. Instead of breaking down the nitrogen through denitrification, and or sequestering the phosphorous in plant materials, most of these nutrients will flow into the stream as part of overland flow during storms and run-off events. This influx of nutrients, including nitrogen and phosphorous, serves to promote algal blooms and eutrophication. The result of these two occurrences is a decreased amount of dissolved oxygen available to fish, microbial, and macro-invertebrate species within the stream. These three groups of organisms will effectively die off, leaving the stream unproductive and barren. (4)

Habitat and Food Web

The fauna that live in the stream and in the riparian zone itself are very dependent on the zone for their food and habitat requirements. In addition to preventing pollution and sedimentation, the diverse vegetation of the riparian zones provide an environment in which a large variety of fauna is sustained. (6)

The riparian zone provides food for all trophic levels of the food web, starting with microbes and continuing to top consumers. The microbes feed on the leaf litter that falls into the stream from the vegetation, which provides organic matter for their production. The macro-invertebrates will also feed on this leaf litter, and the food web continues up with small fish eating these invertebrates, and larger fish eating those fish. In addition, the fauna that finds shelter in the riparian zone itself are also dependent on this food web, both for the vegetation and the invertebrates and fish. At the same time, a riparian zone also provides the components of this food web with shelter. The strong root systems, for example, allow for overhangs along the banks into which fish take shelter. The densely packed vegetation is also home to numerous birds and mammals. In a meadow stream, these webs and habitats are destroyed. A clear-cut land looses most if not all of its ability to provide habitat. The fauna either die or move away. In the stream, as mentioned earlier, not only are the fish habitats destroyed but the increase in temperature that results from a lack of shade is detrimental. The food web, in this way, is destroyed before it begins. With little leaf litter or organic matter of any kind, the microbes and macro-invertebrates cannot find food. As they die, the rest of the fauna dies with them. (10)

Flooding

Riparian zones, and wetlands in general, act as a buffer against floods. Besides slowing down run-off that enters the stream, decreasing the flow velocity of the stream, the zones also serve to soak up excess water through their root systems, thus controlling floods.

Although floods are necessary for the diversity of life in the flood plain and riparian zone, a stream with a mature riparian zone controls flooding, keeping it at the moderate levels which help to stimulate growth. Conversely, in a meadow stream, the flood peaks are higher, and the droughts lower, leading to an unstable system with less diversity in vegetation. Like the dams and the agricultural effects on riparian zones discussed next, the flooding control factor is important in relation to human activity. Especially in developed areas, where there tends to be increased velocity from storm run-off to begin with, the increased danger of flood could cause large amounts of property damage and possibly lead to human death. (2)

The Effects of Dams and Agriculture-two case studies

The effects of dams and other impoundments to the ecology of the stream deal mostly with the issue of sedimentation. The dams cause a change in the structure of a stream or river that varies depending on the type of dam and whether the area in question is upstream or downstream from the dam. In general, however, one could expect such results as modification of flow, increased temperature regimes, and unusual water clarity or cloudiness. (9)

In the early 1900s, a dam was built for the purpose of hydropower in Elwa River, Washington that had severe effects on the ecology of the stream. The dam had no fish passage facilities, and therefore did not allow for fish spawning in the shallower tributaries to the river. In addition, the dam modified the river to such a large extent that vast amounts of sediment built up in the area above the dam. The government finally decided that the dam had to be completely removed in order to restore the area, and the effort paid off. After getting rid of much of the sediment build up, the dam was demolished and many of the riparian zones and wetlands around the area restored. Though the project recently went underway, positive ecological results are already showing. In addition, the fish population is expected to begin increasing rapidly as their habitat becomes healed, thus providing the area once again with a fishing industry. (11)

Agriculture, although not quite as direct or apparent as a dam, is one of the largest caused of riparian zone loss in the country. Agriculture has caused numerous wetlands and riparian zones to be clear-cut, making use of the land instead for cattle grazing or cropland. The result is doubly negative, since the fertilizers used in agriculture increase the phosphorous and nitrogen in the run-off, while the clearing of the trees prevents this run-off from being stopped before it enters the stream ecosystem. (9)

In Blue Water Creek, New Mexico, extensive logging, mining, recreation, and cattle grazing caused the stream's natural riparian zone to become completely destroyed. As a result, flooding increased along the river, killing off even more flora and fauna. All the disastrous effects of clearing, from sedimentation and erosion to habitat destruction, were experienced. Finally, in recent years the government has begun to restore the natural ecosystem by reintroducing riparian zones as well as beaver management to the area. As a result, flooding has decreased, along with soil loss, and the ecosystem is now thriving, full of natural vegetation and fauna. In addition, because of such positive results, the area can now be reopened for recreation, although with a much stricter and more conscientious policy for use. (11)

Conclusion

Throughout this paper, I have discussed issues important to riparian buffer zones, including in this discussion a comparison between the forested streams and the meadow streams. These comparisons show beyond a doubt that riparian zones are extremely beneficial to the health of a stream. Within this discussion, I have also included several incidents in which human activities have lead to unfavorable stream conditions. These incidents again show the ecological stability created by riparian zones, as well as the importance of their restoration. (8)The two case studies compliment this, showing that restoration is not only possible but also beneficial to both the natural and recreational environments of an area. In conclusion, because these natural buffer zones are so important, the widespread use of these systems for controlling pollutants and maintaining diversity of life could lead to large benefits for all, and thus, should be implemented whenever possible in stream restoration projects.

WWW Sources

5. 5) Riparian Buffer Systems-The Basics , This site talks about the basic functions of Riparian Zones

7. 7) Minimizing Accelerated Soil Erosion and Preventing Sediment Pollution , Discusses Sedimentation

8. 8) Principles for the Ecological Restoration of Aquatic Resources , Lists Necessities of Restoration

9. 9) Riparian Recovery Initiative , From the Bureau of Land Management

11. 11) Stream Corridor Restoration , Case Studies

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2) Bayley, Peter B., "Understanding Large River-Floodplain Ecosystems," BioScience, Vol. 45, No. 3, pg 153-158, 1995

3) Calow, Peter, and Geoffrey E, Petts, The Rivers Handbook, Blackwell Scientific Publications, Boston, Ma, 1992