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Reversing the Effects of Livestock on Trout Habitats through Stream Restoration

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Introduction

As a result of the damage caused by grazing livestock on riparian zones, natural resource managers and biologists have studied and implemented streamside rehabilitation for improving trout habitat. This paper will examine stream restoration efforts to reverse the effects of grazing livestock on trout habitats through the revitalization of riparian zones. In the Midwestern U.S., two naturally reproducing species are found in designated trout streams: *Salmo trutta* (brown trout), an exotic species from Germany, and a native species, *Salvelinus fontinalis* (brook trout). Found in streams of the western United States, *Oncorhynchus mykiss aqua bonita* (golden trout) habitats are also examined in this paper as part of the relationship between grazing livestock and the trout streams they impact.

Grazing livestock directly affect three general components of stream and riparian ecosystems: water quality, stream channel morphology, and streamside vegetation (Knapp and Matthews, 1996). While the well being of each of these stream characteristics is important to the success of a complete restoration, this paper will focus on the link between riparian vegetation and grazing livestock because most of the effects on channel morphology, water quality, and trout habitats, stem from that initial interaction. The importance of this relationship on potential outcomes of restorations will be explored. In addition, I will present the restoration methods researchers have used on specific projects, and the degrees of success they have achieved. Finally, I will conclude with my comments and critiques for the restoration techniques used as a means of improving riparian areas.

Interaction between Livestock and Streamside Vegetation

Historically, livestock grazing across open landscapes from the Midwestern United States to the Pacific Coast were allowed almost unlimited access to watering areas within their range. After decades of unrestricted use, the results were wide expanses of exposed stream banks resulting from livestock continuously grazing and watering in the same sections of streams. According to Lea (1979), the U.S. Department of Interior's Bureau of Land Management (BLM) managed more than 200,000 hectares of riparian habitat bordering over 24,000 kilometers of fishable streams. Of those 200,000 hectares, more than 176,000 hectares were in need of improved management (Platts and Wagstaff, 1984). The difficulty in reversing the damage already incurred is that in many areas, particularly in the arid west, the vegetation found along the narrow riparian corridors is often the most lush. As a result, livestock will instinctively gather there (Platts and Wagstaff, 1984).

As the riparian grasses and forbs are stripped away, the morphology of the streams undergoes dramatic changes as well. In a study of the Golden Trout Wilderness (GTW) in California, biologists observed that streamside areas which were protected from grazing were generally narrower, deeper, and contained more riparian vegetation than reaches of the streams where livestock were allowed to graze (Knapp and Matthews, 1996). In other examples, conclusions have been drawn that the conversion of stream channels from narrow and deep to wide and shallow as a result of bank destabilization and erosion, “is one the most commonly reported effects of livestock grazing on meadow streams” (Platts, 1991 and Rosgen, 1994). The impact grazing livestock have on streamside vegetation affects the entire stream ecosystem. As briefly mentioned earlier, cattle seek out areas where food and water are in close proximity. However, as the livestock remove the vegetation in one reach of a stream, they migrate to new areas. Their instincts lead them along the stream to other riparian zones, thereby leaving the previous grazing area exposed and vulnerable to erosion by wind and rain. The dilemma then becomes that in the vast cattle ranges, access must be allowed to watering areas, despite the damage which is done to the riparian zone and the habitat of trout populations.

Impact of Livestock on Trout Habitat and the Riparian Zone

While the livestock using these streams likely saw no ill effects and probably preferred the easier access of lower banks and shallower water, the effects on trout populations were devastating. With their natural habitats undergoing rapid and dramatic changes, the trout were forced from their preferred habitats and into less suitable reaches where their populations declined in relation to less successful rates of reproduction. As the issues of overgrazing and streamside restorations began to be addressed by concerned parties, namely ecologists, fish and wildlife agencies, and private interest groups, the question became: can stream habitats for trout populations recover if the livestock were removed from riparian zones and the grazed vegetation was allowed to return?

At this point, it is important to also connect the livestock-vegetation relationship to the vegetation-trout habitat. Many salmonids, including golden trout, choose spawning sites based primarily on substrate size, water depth, and water velocity. In the ideal microsetting, substrate size is be 10-22mm, average water depth 4-18cm and water velocity of 15-64 cm/s (Bjornn and Reiser, 1991; Knapp and Vredenburg, 1996). In studies of brown trout habitat in general, research indicates they prefer pools with overhead bank cover, and 30%-50% of the stream run should contain riffle areas (Thorn, 1986). The ideal water temperature for brook and brown trout is between 13° and 18° C. However, following acclimation to water temperatures of 20° C, the critical temperature for brown trout increases to 27° C, and up to 28° C for brook trout (Blann and Nerbonne, 2002).

When overgrazing of riparian zones takes place, the habitat for trout species begin to deteriorate. In terms of overhead bank cover, the protection provided by stream bank grasses and forbs is as significant as an overhanging canopy of trees, and is a leading determinant to securing a stable trout environment (Thorn, 1986). As livestock remove the riparian vegetation, that cover is lost and a chain of events leading to the degradation of a site rapidly begins. The exposed stream banks are prone to erosion and decreased bank stabilization under the weight of the livestock. As the banks are broken down, the streams widen and become shallower. In addition, the increased loads of sediment slow the rate of flow in the stream, and the substrate size becomes finer, covering prime spawning areas. Finally, as a combination of slower flow rates, wider stream sections, and more exposed water surface to the suns rays by lack of shade, the water temperature rises above suitable levels for trout to inhabit those stream reaches (Kauffman and Krueger, 1984;

Thorn, 1986; Blann and Nerbonne, 2002).

In response to the visible damage caused by overgrazing in and around riparian zones, research was begun to study the effects of altering livestock grazing management practices on streamside vegetation. The goals of many studies was reversing the damage to the vegetation, improving livestock management practices, and restoring stream trout habitats to their pre-grazing levels.

Research Studies

Throughout the United States, numerous studies have been conducted regarding the restoration of the delicate relationship between riparian vegetation and grazing livestock. Research methods have included total exclusion of livestock from partial or entire portions of a stream restoration site, rotating grazing schedules, and partial or seasonal exclusion of livestock. The results have been generally positive for the revegetation of the streams and the restoration of trout habitats.

Total Exclusion of Livestock

In his study, Skovlin (1984) outlined ten options range managers could consider when restoring riparian zones and instream habitats. Included in that list were options to fence the entire riparian zone, fence the streamside corridor, implement specialized grazing seasons and strategies, and rest the entire grazing unit for five years or longer until recovery occurs. Coinciding with Skovlin's findings, Platts and Wagstaff (1984) studied the viability of simply fencing off livestock from riparian habitats as a means of restoring streams damaged by the effects of overgrazing. The conclusion drawn by the Platts and Wagstaff study was, at the time of publication, the best known management strategies for protecting and rehabilitating a riparian area, outside of eliminating grazing for the area, was some sort of fencing (Platts and Wagstaff, 1984). However, they also concluded that while this may be the most effective means of restoration, significant fencing had at least two limitations. First, the cost of fencing, in terms of dollars spent and grazing area lost, far outweighed the benefits to the riparian zone. Second, the livestock industry opposed any legal action of mandatory fencing and indicated that all fencing should be voluntary (Swan, 1979; Platts and Wagstaff, 1984).

Located in the foothills of the Sierra Nevada mountains of California, the Golden Trout Wilderness has been a study site comparing the effects cattle exclusion has had on the South Fork Kern River and Mulkey Creek with reaches of those streams where grazing has been allowed. Prior to the formation of the Golden Trout Wilderness, livestock had been using the area for grazing since at least 1860. At the time of one study in 1993-94, approximately 950 cow-calf pairs were grazing in the two meadows along the stream reaches (Knapp and Matthews, 1996). The meadows themselves were dominated by *Artemisia cana* (sagebrush), but riparian zones were dominated by *Carex rostrata*. (beaked sedge) and *Salix* spp. (willow). Along the two selected stream sites, a total of three livestock exclosures were set up for study purposes, with adjacent grazing areas (Knapp and Matthews, 1996).

The results of the study generally agreed with the predictions that areas inside the enclosures would establish better riparian habitat than the areas outside the exclosure. In previous studies using livestock exclosures, observations indicated that in areas outside the exclosures where overgrazing had occurred, the result was widespread meadow erosion (Albert, 1982). In this study of the GTW, similar observations were made regarding meadow erosion in the overgrazed sites. Additionally, in the four sections studied, the data indicated that on average ungrazed sections were deeper (60.3 cm vs. 56.8 cm), narrower (190 cm vs. 221 cm), and had higher bank full heights (21.0 cm vs. 15.0 cm) than the adjacent grazed sections (Knapp and Matthews, 1996). The most prominent disparity between the sites inside and outside of the exclosures was the size and numbers of willows. Outside the exclosure, the number of young willows (5-40 cm) was much lower than inside the exclosure (Knapp and Matthews, 1996).

Additional expected observations of a site recovering from grazing induced damage are improved canopy shading (bank and overhead), increased bank stability, and increased streamside vegetation. The GTW sites showed these same results, with increased vegetation displaying the quickest recovery, and restoration of stream banks and channel morphology proceeding at a much slower rate (Knapp and Matthews, 1996). These results were similar to an earlier study in which a site in the lower White Mountains of California showed significant recovery of vegetation, but no detectable recovery of channel morphology after 24 years with no grazing in comparison to the adjacent grazing site (Platts, 1991).

Partial Exclusion of Livestock

Hay Creek is a tributary of the Mississippi river located in southeast Minnesota. Prior to a restoration effort in the early 1980s of a section where overgrazing had taken place, stream banks were "nonvegetated and severely eroded" (Thorn, 1986). The plan of restoration for the riparian zone of Hay Creek was for cattle to be fenced off for the months of June, July, and August as an initial attempt to bring back riparian vegetation. The result was a narrowing and deepening of the stream and the development of undercut banks in some reaches, although in other areas, channel morphology remained largely unchanged (Thorn, 1986). As evidence of streamside improvements rehabilitating trout habitats, in spring surveys taken each year, the average biomass of trout populations in the study zones increased from 26.7 kg/ha for the five years preceding the improvements to 114.9 kg/ha for the five years after improvements were completed . In addition to the initial removal of cattle from the riparian zone, an instream overhead bank structure was also added as a means of restoration and undoubtedly contributed to increased biomass results (Thorn, 1986).

West Indian Creek, southeast Minnesota

Beginning in 1981, a habitat improvement project was begun on the first of four sections of West Indian Creek, in southeastern Minnesota. West Indian Creek is a tributary of the Zumbro River, one of the major east-west watersheds of the region. The sections of the restoration include grazing pastures, corn fields and wooded areas. The project was divided into four sections. Sections A and C were control sites. Section B was the only section with artificial overhead bank covers. Section D of the project was formerly a pasteurized wood lot. After the purchase of the land, the cattle were removed, and nothing else was done to this section with the exception of fencing it off. After sections A, B, and C had been improved through the addition of riprap, removal of brush within 10 meters of the bank, and resloping and reseeding of the bank were complete, the pool quality on section D was better than sections A and C, but less than section B (Thorn, 1986). Trout sampling done in the fall before and after the project was completed showed biomass increased in all four sections. In section D, where livestock removal was the only means of improving the riparian zone, biomass for the resident trout in that reach increased from 35.9 kg/ha for the two years prior to the project, to 77.1 kg/ha for the four years after the habitat improvement was completed (Thorn, 1986).

Recommendations

To most people who have walked miles of streams, the damage cattle can do to riparian zones and the benefits of restoration efforts are usually visible without a multitude of scientific research. In conjunction with the observable effects, most of the research literature indicates that successful restoration of overgrazed stream banks begins with removal of the cattle to some degree. Although most effective with total exclusion from stream reaches, rehabilitation can be successful with short seasonal grazing or rotational grazing as well (Claire and Storch, In Press). Currently, research is being conducted to quantify the effect different range management practices have on the overall health of the riparian zone. For example, instead of simply fencing off entire stretches of a stream, a possible solution may include decreasing the length of time the herd is grazing in one spot as well as increasing the rest periods for each riparian zone between grazing times. In addition, the practice of herding the cattle to prevent them from spending all their time in the riparian zone may also assist in the overall improvement of the riparian reaches (Skovlin, 1984). For managers in the Midwest, another consideration is research which concludes that concepts for range management in the arid west should be considered in general terms, such as using rotational grazing or simply fencing off areas along streams. This is because differences in climate, geomorphology, and precise management practices do not allow specific concepts to be easily transferable (Sovell, 1997).

In privately held stream reaches, for issues of practicality and enforcement, the issue is whether changes in livestock management in the riparian zone should be mandatory or entirely voluntary. Because total exclusion can be a delicate solution when a family's well-being is dependent on the success of their livestock herd, other options need to be explored. Therefore, feasible recommendations may take into account that the best method of restoring the riparian zone and managing a livestock herd effectively involves a variety of practices used in conjunction with each other. As outlined above, I believe a rotational grazing schedule, in addition to new management practices such as herding the cattle, is the best alternative. Using new methods of management means the livestock still have access to water and prime vegetation, yet minimizes the damage inflicted to the stream banks. Taking into consideration all of the above recommendations, the damage done when a herd of livestock passes through an area can still be significant, especially if the riparian zone is already in some state of degradation or climatic conditions coinciding with the grazing in a particular area are dramatic (excessive rainfall or drought conditions). In contrast to previous research, Duff (1979) came to the conclusion that after four years of rest, a riparian zone reintroduced to heavy grazing will rapidly return to a degraded state. Where landowners voluntarily agree to any measures of restoring riparian zones, my recommendation is that the best option possible for improving the entire stream habitat is total exclusion of livestock . This can best be accomplished with fenced riparian corridors providing an easement or buffer strip, or by completely removing the livestock from the reaches where that option is realistic.

In areas where state or federal agencies have made land purchases in severely deteriorated areas, I believe exclusion through permanent removal of the livestock is the best alternative. The results of many studies indicate the positive impact on a riparian zone is dramatic once cattle have been removed, particularly in terms of revegetation of the entire riparian zone. Although changes in stream morphology may be slower or non existent without the addition of some structure, most projects I have seen in recent years include this as a standard part of restoration. However, new research (within the last two years) is necessary and recommended to support further support these observations.

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