The Effects of Livestock Grazing on Riparian and Stream Ecosystems

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The following draft position paper was approved by the Executive Committee of the American Fisheries Society on 25 August 1990. AFS members are encouraged to comment on this draft. Comments, data, or supporting information should be sent c/o Editor, Fisheries, *5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814.*

A. Issue Definition

The U.S. federal government owns approximately 316 million acres of land in the 11 contiguous western states, representing 48% of the total acreage. Domestic livestock grazing is permitted on 150 million acres of this federal land administered by the Bureau of Land Management (BLM) and 138 million acres administered by the Forest Service (FS). Grazing also occurs on 212 million acres of privately-owned land in the western states. The majority of the BLM rangeland (58%) is in fair or poor condition. Fifty-two million acres of big game habitat, 100 million acres of small game and nongame habitat, and 19,000 miles of sport fishing streams have declined in quality as a result of land management practices, including overgrazing. These degraded habitat conditions also have negative implications for endangered and threatened species. Similar loss of fish and wildlife habitat quality has likely occurred on 41 million acres of FS land and 134 million acres of private rangeland. Figures such as "58% of rangeland in fair or poor condition" do not truly represent riparian habitat conditions but can be an indicator as to their current condition. It is well known that livestock often spend a disproportionate amount of time in riparian areas, especially on rangeland in the arid and semi-arid West. Unfortunately, overuse has resulted in considerable damage to riparian zones with degradation of aquatic and wildlife habitats.

Streamside vegetation is most affected by grazing because riparian-aquatic zones are usually grazed more heavily than are upland-terrestrial zones. The riparian problem is further complicated because today's range management guidelines do not call for different management strategies for upland and riparian vegetative types. Because riparian environments are lumped into broad terrestrial environmental classifications, they become unidentifiable for land-management purposes. Often what is good for timber or range management, particularly in the short term, is not good for riparian or stream management.

Livestock grazing can affect the riparian environment by changing and reducing vegetation or by actual elimination of riparian areas by channel widening, channel aggradation, or lowering of the water table. The most apparent effects on fish habitat are the reduction of shade, cover, and terrestrial food supply, resultant increases in stream temperature, changes in water quality and stream morphology, and the addition of sediment through bank degradation and off-site soil erosion.

Stream-channel sedimentation caused by soil erosion on millions of acres of rangelands has long been recognized as a major watershed-fisheries problem. The elimination of streambank riparian vegetation is due to extreme overuse by livestock. Streambanks erode because livestock congregate along streams for shade and the more succulent riparian vegetation and drinking water. The collapse of overhanging banks due to livestock grazing is one of the principal factors contributing to the decline of native trout in the West.

Rangeland grazing practices can affect the water quality characteristics of runoff in a watershed, especially by increasing a stream's turbidity and sediment. Photosynthesis is decreased by stream turbidity and primary productivity is reduced. Aquatic insect food production for native salmonid species is also reduced by streambank vegetation removal and bank erosion causing streambed gravel sedimentation.

Damaged western rangelands (public and private) may total as high as 327 million acres. It is our belief that the most pronounced damage is to riparian zones and other wetland habitats. It would be naive to assume that issues associated with grazing are simple and that removing livestock from private or public rangelands is the only viable solution for the problems. Resolution of grazing conflicts does not necessarily mean total elimination of grazing, but rather managing livestock in conformance with other recognized uses of riparian areas. When livestock management plans for federal lands are formulated, an array of implications must be considered. Ecological interrelationships that must be evaluated are extremely complex. The outlook for solving range problems on federal lands is favorable only if interdisciplinary efforts and interagency cooperation occurs. Through such efforts, reasonable approaches can be developed and implemented to provide forage for domestic livestock while improving and maintaining habitat for fish and wildlife. It is our strong contention that when properly implemented and supervised, grazing could become an important management tool benefiting fish and wildlife riparian habitats. In some cases, grazing systems could be used without intractable damage to riparian eco-

systems if key riparian plant species are monitored as indicators of forage production and use. Such use of indicator species could allow plant vigor and density to be maintained. In turn, wildlife, fish, and habitat abundance could be sustained, and unstable streambanks and poor soils would be able to recover. There also must be willingness to implement changes in livestock season of use and animal numbers to assist in this vegetative rehabilitation process. However, even riparian areas in good condition are susceptible to damage by concentrations of livestock at the wrong time, in too great a number, for too long, or any combination of these factors (EPA 1990).

A recent General Accounting Office (GAO) report (1988) concluded that neither BLM nor the FS has a current data base of range conditions. The report states that in the last 20 years carrying capacities have not been assessed for 30% of BLM and 14% of FS allotments. Eleven percent of the grazing allotments had been assessed on both BLM and FS range within the last 10 to 29 years. Fifty-five percent of BLM and 49% of FS rangelands had been evaluated within the last 10 years.

There is an urgent need to conduct filed surveys of the condition of rangeland currently being grazed and the carrying capacity of that land. Further, one out of five grazing allotments may be threatened with further deterioration because more livestock are supported. There are no plans to reduce grazing density on current range conditions. The GAO survey of range managers also revealed grazing levels were not reduced on some allotments due to permittee/political pressure.

GAO also found that 66% of the BLM and 27% of the FS grazing allotments did not have allotment management plans (AMP). Many of the AMPs were more than 10 years old and "may not have been sufficiently current to properly manage the allotments."

The 1988 GAO report also addresses the cost of cattle grazing on federal land (16 western states). In fiscal year 1986, the BLM cost to manage grazing was about $39 million or about $3.37 per animal unit month. Total grazing revenue was about $14.6 million or about 37% of the program's cost. In fiscal year 1986, the FS grazing program cost about $24 million or about $3.40 per animal unit month. Total grazing receipts were about $7.3 million or about 30% of the cost of the program. Large livestock operators are the primary users of public land. Fifteen percent of grazing permittees on BLM rangeland have herd sizes of 500 or more animals and account for 58% of the grazing. Over 85% of the permittees using FS rangeland have herds of 500 animals or more.

The current grazing fee structure gives unfair economic advantage to permittees and is inconsistent with the need to improve the productive capacity of the public rangeland. It's time to end this government welfare program for a very limited group of individuals. Current grazing fees impede efforts to improve range conditions and achieve legally mandated balanced multiple-use management goals.

The grazing fee formula established by the Public Rangeland Policy Act amendments should be repealed. Congress should instruct the secretaries to lease publicly owned forage by first setting a fair market value through an independent appraisal at the minimum return the public should receive for the use of its land and resources. Fees could then be raised through open competitive bidding with the current permittees having the right of first refusal. They should pay the going price, and the federal government should not allow grazing to occur on the land unless they can better protect the resources.

The crux of the issue is improved management of grazing on degraded streams for public benefit. The American Fisheries Society does not advocate discontinuance of grazing on the public lands. We recognize that production of livestock forage is a legitimate and valuable use of public lands if wise management can be applied simultaneously to protect and improve habitat for fisheries resources.

B. Impacts on Aquatic Ecosystems

Considerable documentation shows conclusively that grazing problems have contributed to extensive damage of streams in the West. Essentially, the immediate effects of overgrazing are loss of streamside vegetation and trampling of streambanks. This damage eventually results in reduced populations or, worse yet, elimination of trout.

Trampling causes physical bank damage in the form of caving and sloughing that contributes to erosion and sedimentation. Also, damage to banks lessens the availability of protective cover in undercut areas. Erosion can also lower water tables to reduce stream flows during critical base flow periods.

Aquatic habitat degradation from adverse livestock management practices has occurred throughout areas where public lands exist. The principal reason for the degradation is that adequate consideration of special management requirements of stream zones and application of practices to meet clearly stated habitat objectives to protect and improve the zones have not occurred. Consequently, stream zones that are outstanding forage producers have been considered sacrifice areas, and the heavy use by livestock has been accompanied by aquatic habitat degradation (Leopold 1974).

Aquatic habitat degradation is a major concern to the fisheries profession because the effect is impaired capability of streams to produce and maintain populations of important fish species. Overgrazing is considered one of the principal factors contributing to the decline of native salmonids in the West. Ungrazed stream zones generally have better fish habitat, and fish are typically more successful and more numerous than in heavily grazed zones with degraded habitat.

One of the principal impacts of damaged streams is that they support fewer public recreational opportunities than would be possible if the streams were in optimum condition (USFWS 1980). Decreased opportunities and degraded streams result in heavier pressure on streams that are fished. As human populations increase, the problem will become increasingly acute with more demand for correction of improper grazing practices to improve fish habitat (USFS 1988). Another factor contributing to fewer fishing opportunities is the access problem caused by private landowners who surround the public lands. Many of these owners with public land grazing permits refuse to allow the public to cross their private lands to gain access to streams on public lands that support a fishery. In essence these landowners control the public lands for their exclusive use (USFWS 1980).

In spite of the damage that has occurred, affected streams have the potential to respond dramatically to improved management. For example, Otter Creek (Van Velson 1979) in western Nebraska was severely degraded by overgrazing. By the mid-1950s, the rainbow trout population had been virtually eliminated. Problems included sediment deposition on spawning areas, bank erosion, and poor pool quality. The headwater area of the creek was leased in 1969 by the Nebraska Game and Parks Commission and improved management was applied. Within 3 years, the average width of the stream decreased and the stream banks stabilized. Furthermore, conditions for spawning improved because less sand was deposited on the gravel bottoms. Also, pools became established and water temperatures were improved to benefit the fish. The net result was that in 1975 it was estimated that in approximately two miles of the leased zone with 3.34 surface acres, 20,419 young fish were produced.

As another example of stream recovery, Sheep Creek (Stuber 1985) in Colorado is one of several that could be cited. The creek was fenced to protect it from heavy streamside use by humans and grazing by domestic livestock. Following fencing, the vegetation recovered, the stream became narrower and deeper, and the estimated trout standing crop was twice the standing crop in the unfenced areas. Additionally, it was estimated that fishing opportunities were double those for a comparable stretch of unfenced stream.

The removal of streamside vegetation has serious consequences. The vegetation in hot, arid areas of the West where many of the streams are located is essential for shading and maintaining temperature regimes suitable for trout and salmon. When the vegetation is removed, summer water temperatures can elevate to 85°F or higher. This is intolerable to the fish because they usually cannot survive for prolonged periods if temperatures exceed 65°F. High temperatures can be acutely lethal, promote disease because of induced stress, adversely impact spawning and reproductive success, and they can impede growth and migrations.

When streamside vegetation is cropped too severely, erosion and sedimentation increase. Sediments settle into spaces between gravel in which salmonid eggs are incubated. As a result, besides hindering emergence of hatched fish, water flow in gravel is impaired and developing embryos do not receive sufficient dissolved oxygen. Also, metabolic wastes of the embryos are not flushed, which contributes to higher mortality rates. Mortality for rainbow trout can exceed 75% (Peters 1962) when sediments elevate to 200 parts per million, which can be a common occurrence in streams damaged by improperly managed grazing. For steelhead trout, when sediment approximates 30% of the substrate, less than 25% of the eggs develop to the emergent fry stage compared to an excess of 75% emergence when sediments are less than 20% (Bjornn 1973).

In studies on streamside vegetation and fisheries, Binns (Wyoming Game and Fish Department, unpublished data) found streamside cover to be highly significant in determining fish biomass in Wyoming streams. Boussu (1954) increased trout biomass over 200% by stimulating cover in a South Dakota stream. Upon elimination of this cover, trout biomass decreased. Other authors (Cummins 1974) have shown the importance of this vegetation in providing fish food organisms. Holscher and Woolford (1953), Gunderson (1968), Armour (1977), Claire and Storch (1983), and Duff (1983) found riparian vegetation declined when grazed by livestock. Lorz (1974), however, found little influence of grazing on fish populations when there was dense willow cover on one or both banks.

Platts (1981) found stream channels were four times as wide in areas heavily grazed by sheep than in adjacent lightly grazed areas. Moore (1976) estimated that in the West grazed rangelands were second only to cropland in sediment production. Studies have shown that livestock grazing on the vegetative cover causes caving in of overhanging streambanks, probably affecting fish population. Behnke and Zarn (1976), Winget and Reichert (1976), Platts (1981), and Duff (1983), all found that livestock grazing reduced streambank stability.

Besides maintaining favorable temperature regimes and controlling erosion and sedimentation of streams, vegetation provides protective cover for salmonids. It has been demonstrated that in streams where streamside vegetation was eliminated there can be an increase of salmonid poundage exceeding 200% when the vegetation is restored.

Claire and Storch (1983) noted that the average stream temperature dropped 12°F in an enclosure that was ungrazed for 10 years. Kunkle (1970), Darling and Coltharp (1973), and Skinner et al. (1974) attribute high coli count in streams to livestock. Elmore and Beschta (1987) reported that vegetation influences hydrologic conditions within a watershed. Any activity, including overgrazing, that de-

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creases vegetation can result in adverse hydrological conditions including lowering of summer flows in streams. Grazing produces definite changes in the riparian environment and may bring about decreases in fish productivity under grazed conditions. Armour (1977), Behnke (1977), Kennedy (1977), Marcuson (1977), Van Velson (1979), Duff (1979, 1983), and Claire and Storch (1983) all reported decreased fish populations under grazed conditions.

Vegetation also contributes to the capability of a stream to produce food for salmonids. This occurs in two ways, i.e., vegetation that is washed into a stream is a food base for aquatic invertebrates that are normally the predominant food item. Also, when harmful sedimentation occurs, the material can cause abrasion and interfere with functions of respiratory systems of invertebrates. Additionally, when sediment settles over the most productive invertebrate substrate such as rubble, the result is diminished food for salmonids. Another important role of streamside vegetation is trapping of sediment before it enters a stream.

C. Needed Actions

The American Fisheries Society advocates actions that will contribute to improved livestock management to improve and maintain habitat of streams on the public lands. Objectives for this advocacy include restoring damaged streams to a productive fisheries status and protecting undamaged streams to prevent them from being lost as fisheries. Specific, advocated actions include the following:

1. Encourage agencies to conduct complete and accurate inventories of streams and riparian areas on public lands to determine their location, condition, and potential for recovery if improved livestock management were to be applied.

2. Encourage Congress to increase grazing fees to (a) improve the management and administration of federal grazing systems, (b) restore stream-riparian resources already damaged by past grazing, (c) remove the incentive for overgrazing that current low fees provide, and (d) provide a fairness to taxpayers who have provided subsidy to a privileged few.

3. Promote awareness to land managers of the ecology of aquatic-riparian ecosystems and processes that regulate these ecosystems. Managers should give management priority to riparian-dependent resources such as wildlife, fisheries, and vegetation, and they must recognize that needs of riparian areas may be different than other areas. Encourage managers to practice and maintain a land stewardship ethic to emphasize all resources.

4. Promote development and implementation of land use plans and allotment management plans that will provide the amount of vegetation necessary to ensure adequate watershed protection under grazing use to perpetuate vegetation, maintain and enhance plant vigor, and assure soil stability.

5. Encourage Congress and agencies to provide for a monitoring program to arrest the current decline in stream riparian ecosystems damaged by livestock grazing and to improve and restore areas that are in current, unsatisfactory condition. Promote standardization of monitoring programs to enable results of management for riparian and stream zones to be evaluated meaningfully. This would contribute to documentation of management that is successful as well as unsuccessful to benefit state-of-the-art management knowledge and practices. After information is acquired, promote its dissemination to benefit management applications elsewhere.

6. Acquire rights-of-way across private lands owned by permittees to obtain public access to streams to which access is presently denied. One way to achieve access would be through legislation to require permittees who benefit from the public lands to allow access as a condition of granting grazing permits.

7. Promote an awareness in academic institutions with range science programs to teach students to design livestock management plans under an ecosystem approach (holistic), to protect and improve the vegetative conditions along streams, and to install sensitivity to the value of these areas and their dependent resources.

8. Encourage the documentation of economic values and benefits of restoring damaged streams and protecting ones that are in good condition. An example would be studies of economic benefits of restoring streams to provide sport fishing opportunities that would result in less need for expensive put-and-take fisheries. This information would be useful in contributing to decisions concerning improved management of damaged streams.

9. Promote research designed to (a) develop predictive capabilities for evaluating stream zone responses to various management alternatives to meet objectives for fisheries resources; (b) aid accurate description of benefits from good stream habitat in benefiting other resources, including wildlife and in contributing to water conservation and establishing and maintaining improved stream flows; and (c) provide innovative and integrated management techniques that can be applied to achieve recovery and protection of damaged stream habitat.

10. Recognize individuals and institutions that make important contributions in advancing improved management to specifically benefit grazed streams. Form an adopt-a-stream program for citizen groups to restore and maintain aquatic and riparian habitat in specific streams.

11. Promote public awareness programs to stimulate interest and support for improved management of grazed streams. Encourage citizen groups to volunteer labor and/

or financial support in stream restoration efforts.

12. Promote the capability of land management agencies to properly manage grazing adjacent to streams and correct existing damage. Agencies should tailor grazing management systems to meet conditions, problems, site potential, objectives, and livestock considerations on a site-specific basis. Also, encourage institutional sensitivity to the need for improved management of stream zones.

13. Encourage land management agencies to provide career advancement opportunities for fisheries biologists to advance to both line and administrative management positions that will enable them to contribute expertise to the decision-making process and to enhance emphasis on fisheries resources associated with public lands in the West.

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