



Using Stubble Height to Monitor Livestock Disturbance Near Streams: How a Recent Critique is Relevant to the Protection of Cold-water Salmonids

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On the Ground

- The measurement of utilization and residual vegetation (stubble height) is a valuable tool in managing livestock disturbance but it is often improperly measured, and results misinterpreted. A common situation for these concerns is when stubble height protocols and rationales used for terrestrial areas are applied to riparian zones and the protection of fish habitat.
- Protocols used to assess stubble height near streams and serve as a surrogate for fish habitat may differ from approaches used to protect upland plant vigor. Measurements of stubble height designed to protect fish habitat can include the measurement of all herbaceous vegetation along the greenline and should be evaluated following the removal of livestock and after the growing season ends.
- In allotments with threatened salmonids or other at-risk aquatic species, stubble heights necessary to protect fish habitat may exceed what is necessary to maintain forage production for livestock. Properly determined and applied near stream stubble height standards can protect important fish habitats while providing accountability for grazing management. Consistent livestock management above standards will improve salmonid habitats and undermine arguments used by organizations that would like to limit livestock grazing on public lands.
- If range conservationists and fisheries biologists work together to develop monitoring protocols for stubble height or other metrics that can be used to improve fish habitat, the application of proper standards to manage livestock disturbance near streams should benefit the fish, the land management agencies, and the ranchers that rely on grazing public lands.

Keywords: Stubble Height, Monitoring, Livestock Disturbance, Streams, Riparian, Fish

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Introduction

A recent paper in *Rangelands* found a consensus of range management professionals thought evaluating utilization and residual vegetation heights was a valuable tool in managing livestock.¹ It has been suggested that in some situations this indicator of livestock disturbance can be improperly measured and misinterpreted.^{1,2} These are valid concerns and often apply when the goal of residual vegetation measurements are used to evaluate riparian conditions. Transcribing general concerns associated with the measurement of utilization and residual vegetation (hereafter call stubble height) to riparian areas can fail to recognize that rangeland health based on sustainable ungulate forage production is not the only management objective for grazing near streams on public lands. Within riparian zones, proper stubble heights can help achieve multiple objectives dependent on the vegetative community, ensure vegetative vigor, and maintain stream habitat for salmon, trout, and char (*Oncorhynchus* spp. and *Salvelinus confluentus*). In allotments where protection of cold water salmonid habitat is a key management goal, sampling protocols must reflect this objective and stubble height standards that protect streambanks and riparian vegetation may be required if other strategies for restoring and maintaining needed vegetation are not employed.³⁻⁵

Use of Stubble Height to Protect Cold-water Salmonid Habitat

Protocols used for stubble height assessments in terrestrial situations may not be adequate if the use of this metric is to assess the conditions of coldwater salmonid habitat. When evaluating stubble height to estimate stream habitat conditions, the protocol should evaluate the height of herbaceous vegetation that is the first to form linearly along the stream water's edge (greenline⁶) rather than key species across the riparian area. Although stubble height may be correlated with plant vigor in riparian areas,⁷ its primary value in the assessment of salmonid habitat is in providing estimates of above ground vegetation available to limit erosion⁸ and leaf area to photosynthesize carbohydrates, which grow roots that bind soils and maintain streambanks.⁹ These relationships suggest stubble height can inform our understanding of how the stream channels may be directly and indirectly altered by herbivory.¹⁰ Evaluations of stubble heights should occur along both streambanks and are most useful in smaller streams (e.g. <15 m wide) and with lower gradients (e.g. <6%), as streambank conditions along bigger or steeper streams will be primarily driven by stream energy rather than management disturbance.¹¹

When stubble height of herbaceous vegetation is evaluated along the greenline, increasing vegetation heights may relate to stream habitat conditions favored by cold-water fish species. Clary¹² found early season grazing (late June), which maintained 12.9 cm (5.1 inches) of stubble height near the stream's edge and measured at the end-of the growing season protected most stream conditions (e.g., stream width, fine sediment, willow growth) favored by fish. Similarly, Goss and Roper¹³ found nonlinear relationships between increasing stubble heights of all herbaceous material along greenline and the following year's improvement in stream conditions important to fish, such as undercut streambanks, streambank stability, the presence and depth of pools, wood frequencies, and streambank angles. Saunders and Fausch¹⁴ found short-term high intensity grazing fostered conditions where graminoids and forbs were tall enough to provide overhead cover for small streams, which promoted fish growth. Pelester et al.³ demonstrated that in the fall cattle shifted to feeding on willow, an important predictor of fish habitat in some streams,⁴ when near stream stubble heights were <20 cm (7.9 inches). These studies demonstrate the measurement of stubble heights of all grasses and forbs along the greenline is not only an annual indicator of livestock use but may be linked over longer timeframes to the formation of stream habitats favored by salmonids.

Several review papers suggest that selected key species be used for the evaluation of stubble height in riparian areas.^{6,7} Previous field studies, however, found stubble height of all herbaceous species along the greenline are valuable in protecting the channel parameters important to fish growth and fish habitat.¹²⁻¹⁴ Measuring the height and utilization of key species could focus managers attention on hydric stabilizers⁷ or species commonly overused by cattle¹ which may

provide added insight into the specific mechanisms that lead to changes in stream conditions.⁶ In contrast, measuring the stubble heights of all herbaceous species is a simpler protocol to teach and has been shown to be related to stream conditions important to fish.¹³ It is likely either protocol, if properly implemented, could be used to measure ungulate disturbance in a manner that helps managers maintain or improve streambanks subject to cattle grazing.

The level of livestock disturbance allowed in publicly managed riparian areas is often limited by requirements intended to maintain or improve fish habitat. Livestock, however, can and should still utilize riparian areas as these zones are often the most productive areas within an allotment.¹⁵ To properly manage livestock disturbance in these zones, managers will benefit from having specific standards for end-of-growing season greenline stubble height to monitor the implementation of management strategies. As cattle congregate in numbers where their foraging activities could impact riparian functions or fish habitat conditions,¹⁶ ranchers will need to implement management strategies to limit their impacts. Actions may include reducing the pasture stocking rate, providing periods of rest during the growing season, reducing the amount of time cattle are allowed in riparian pastures, using riders to move cattle out of riparian reaches, providing off-stream water sources, and using different breeds of cattle.¹⁷

There are other near stream metrics, such as streambank alteration,¹⁸ the percent of reach that is willow,⁴ or the amount of bare ground¹⁹ for which appropriate standards could be developed to determine the effectiveness of livestock management strategies in riparian areas. Each of these metrics may facilitate a better understanding of the relationship between ungulate disturbance and stream channel conditions. The advantage of using stubble height for standards is that it has already been shown to be both a useful end-of-season indicator of livestock disturbance² as well as being related to many long-term habitat conditions important to fish.^{3,5,13}

An increasing number of studies demonstrate that stream conditions important to fish can improve rapidly following the cessation of livestock grazing.⁵ These studies force federal land management agencies with multiple use mandates (i.e., the USDA Forest Service and Bureau of Land Management) to provide criteria for evaluating when or how much livestock disturbance should be allowed near streams. Personnel working for these agencies recognize that not all stream reaches respond similarly to grazing but rarely have sufficient data to defend unique site-specific standards. In many situations, they must work in an interdisciplinary manner with the data they have to consider management strategies and monitoring approaches that will achieve agency objectives for a given stream reach. Range specialists and fisheries biologists must then make the choice to implement generalized standards for stubble height that protect stream habitat conditions on average^{12,13} or develop the rationale for another approach to insure that the implemented grazing strategy will protect stream conditions important to fish. Given the shortage of range specialists and fisheries biologists in public

land management agencies, the choice is often made to implement a generalized standard. This should not prevent managers from choosing other management strategies or collecting additional data with the intent of making more informed decisions in the future.

Federal land management agencies must deal with sub-standard grazing livestock management in riparian areas not only to improve salmonid habitats but to reduce the chances these allotments end up in court. Failures in a few allotments makes it more difficult for federal management agencies to tell the broader story that most ranchers are properly managing cattle in riparian areas on public lands and that the conditions of these ecosystems are improving across the arid west.^{4,13}

My intent is not to argue what specific value a standard for riparian stubble height should be or how it should be determined, but to suggest that in most situations having a standard for stubble height (or a number of other metrics such as streambank alteration¹⁸ or woody browse⁴) near streams on public lands will serve to protect the fish, the permittee, the land management agency, and the ranching industry. Laws such as the Endangered Species Act and National Forest Management Act require goals, objectives, guidelines, and standards to achieve desired conditions in an allotment. In streams with native salmon, trout, or char, the measurement of stubble height can serve as a surrogate for stream habitat conditions. Setting standards for stubble height rather than fish habitat is something the permittee knows how to manage for and will provide a level of legal certainty when the standard is met. When standards are met, the ranching industry can maintain a proactive stance against the portion of the public that would like to eliminate grazing on public lands.²⁰

While stream habitat conditions will benefit from consistently being managed above a standard, there are reasons an occasional annual measurement below a stubble height standard by a few centimeters should not be a concern.¹ A sporadic low value may reflect measurement error,²¹ unusual weather, environmental variation,¹³ or slightly greater livestock disturbance. Maintaining or improving grazing practices when stream reaches are near standard values, in most

allotments, will maintain habitat conditions important to fish (Fig. 1). In contrast, a large departure (>5 cm) below the standard in a single year could have long-term consequences on riparian function.²² It may be necessary in these situations to mitigate damages the following year by implementing grazing strategies that improve the vigor of woody material and herbaceous vegetation. How federal management agencies deal with these departures must be described in management plans so responses are transparent to the public. While having stubble height or other monitored metrics are an important step in maintaining or improving riparian and stream conditions, consistently exceeding this standard does not guarantee that livestock disturbance no longer poses a risk to fish. Depending upon the situation it may be necessary to include standards for other riparian characteristics such as the amount of bare ground¹⁹ or percent of the riparian zone in willows⁴ to sustain good fish habitat.

For the evaluation of stubble height to meaningfully influence riparian and near stream management of livestock, outcomes must be based on a welldeveloped monitoring program. Key components of such a program include consistent training²¹ and a quality assessment quality control systems for data collection and storage.²³ There is a benefit of evaluations occurring following the removal of cattle and after the growing season has ended as these are the site conditions which will be subject to erosion during high streamflows.¹³ Even with these constraints, previous efforts suggest an average variation among observer's results of 2–4 cm (0.8–1.6 inches) when stubble heights are in the 10–15 cm (3.9–5.9 inches) range.^{6,24} As this amount of variation is relatively high for an monitored attribute²³ it will be beneficial to collect auxiliary information on the status and trend of streambank conditions. The simplest to collect and often most compelling supporting data are photographs of the surveyed reach²⁵ (Fig. 2). Photographs can also help determine if falling below a standard for stubble height will have consequences to fish habitat or if the vegetative conditions are sufficiently resilient to maintain stream habitat conditions.

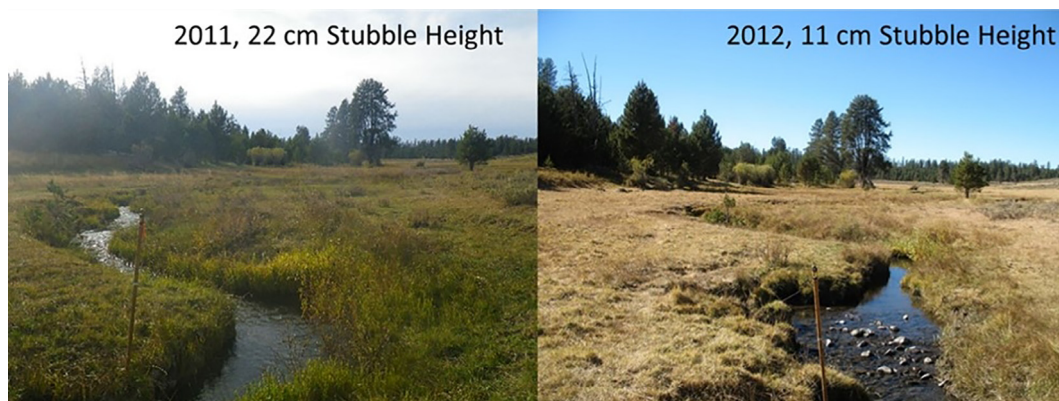


Figure 1. Grazing outcomes near the same spot in a stream reach in two different years (taken 10/3/2011 and 9/30/2012). In both cases, stubble height seems to be protecting streambanks sufficiently to maintain fish habitat. Although there is evidence of historic streambank failures, undercut streambanks are forming under the recent grazing regime. More damage (bare ground) is evident in 2012 when stubble heights are shorter. The greenness shows an environmental effect (differences in late summer precipitation) that likely played a role in shorter stubble heights in 2012.



Stubble Height 6 cm

Figure 2. An example that demonstrates the concern of having a stubble height outcome that is low. Vegetation along the streambanks is denuded at this level of livestock disturbance. While willow exists, in this situation their presence may exacerbate streambank damage as it funnels cattle to fewer areas. This year's stubble height outcome (6 cm, as shown in picture) follows the previous year's outcome (11 cm, not shown) and suggests a different management strategy may be needed to improve fish habitat. Determining the specific management actions that needs to be implemented should be the product of an interdisciplinary team working with the permittee.

Implications

General guidance for utilization and residual vegetation measurements¹ in terrestrial rangeland settings may not be sufficient to manage livestock disturbance in riparian areas in a manner that protects habitat conditions for cold-water salmonids. In some near stream environments, the protocols used to measure and set standards for stubble height (or other ungulate disturbance metrics) should be chosen with the goal of maintaining or improving fish habitat. This recommendation is not new^{25,26} but is intended to more clearly reflect an increasing number of studies that have shown the value of stubble height as a metric related to stream conditions important to cold-water salmonids.

Improvements in stream habitat conditions were shown in the Interior Columbia River Basin following changes in federal land management standards made in the 1990s.²⁷ These changes included the protection of stream habitat by limiting timber harvest within a standard distance of the stream. This change, in combination with improved road management, likely explained an increase in wood frequencies and improved streambed substrate characteristics.²⁷ New guidelines controlling riparian grazing were also implemented in the 1990s, but this study²⁷ did not incorporate a sufficient number of arid stream reaches grazed by livestock to evaluate those changes. As such, there remains a need for federal managers to show they are consistently implementing livestock management strategies, monitoring the implementation of those strategies,²⁸ and the strategies are having their intended effects.

There is increasing evidence that stubble height is a rapidly assessed near-stream metric that can integrate how livestock

disturbance affects stream habitat conditions important to fish within and across years. While general guidance to livestock use of riparian zones are helpful, the implementation of near stream standards will provide for greater accountability and a quantifiable approach to judge the effectiveness of different livestock management strategies. Strengthening our understanding of how changes in stubble height alters stream habitat important to salmonids will simplify the planning and consultation efforts related to livestock grazing on public lands. In moving towards this goal, there remains many opportunities for range conservationists, hydrologists, riparian ecologists, and fisheries biologists to work together to improve approaches to monitor the implementation and effectiveness of livestock disturbance metrics in a manner that best describes changes in stream channel characteristics that are important to fish and riparian function.

Declaration of Interest

No conflict of interest.

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