

Appendix H:

Scientific Basis for Annual Livestock Use and Disturbance Indicator Guideline (GM-3G) in the Blue Mountains Forest Plans

PURPOSE

This paper describes the scientific basis for an Annual Livestock Use and Disturbance Indicator Guideline (GM-3G) included in the Proposed Action, which is to revise Forest Plans for the Blue Mountains National Forests. It also briefly describes the reasons for the guideline and its key characteristics.

INTRODUCTION

Guideline GM-3G contains numeric values for annual livestock use and disturbance indicators and a management framework for applying and adapting them based on local resource conditions and trends. These types of indicators and numeric values are not included within the standards and guidelines associated with the PACFISH and INFISH aquatic strategies (USDA and USDI 1995a, 1995b, 1995c, 1995d), which amended existing Forest plans throughout the Blue Mountains in the mid-1990s. Comparable indicators and numeric values are, however, included in inter-regional ‘implementation guidance’ for PACFISH, entitled *PACFISH Recommended Livestock Grazing Guidelines*¹ (USDA FS and USDI BLM 1995e).

This PACFISH implementation guidance is intended to facilitate consistent execution of PACFISH Standards and Guidelines by avoiding adverse grazing effects that retard attainment of aquatic and riparian desired conditions. Specifically, the guidance recommends ways to limit adverse grazing effects to those that do not carry through to the next year, thereby enabling stream and riparian areas to recover at ‘near natural’ rates. No comparable guidance has been developed for areas operating under the INFISH strategy. However, since that strategy is exceptionally similar to PACFISH, some Forests have used the PACFISH implementation guidelines to implement INFISH.

The GM-3G guideline was developed to: 1) provide more current, consistent, and objective grazing management direction across the entire Blue Mountains based on best available science; and 2) provide greater certainty of implementation to regulatory agencies and the public than provided by existing ‘implementation guidance’, given the current legal and regulatory context in which the Forest Service is managing grazing (e.g., large areas with threatened, endangered, and sensitive aquatic species, including ESA-listed fish; and large areas with waters listed as impaired under the Clean Water Act).

¹ These recommended guidelines were developed by an interdisciplinary team that included Ron Wiley, Wayne Elmore, and Don Nelson. Ron Wiley and Wayne Elmore went on to become Team Leaders of the National Riparian Service Team. Don Nelson went on to become a Rangeland Management Specialist in the Washington Office.

CHARACTERISTICS OF THE GUIDELINE

Key characteristics of the guideline include:

- flexibility, provided by the inherent nature of a guideline and the explicit language in GM-3G;
- a menu of indicators and default ranges of indicator values that are to be applied only when/where appropriate to maintain or move towards desired conditions;
- direction that indicators and values should be prescribed based on site-specific conditions to achieve longer-term goals and objectives;
- clarification that the indicators and values should be adjusted over time based on long-term monitoring;
- a management framework for applying the indicators and values based on assessments of local resource conditions and trends using information and data at multiple spatial and temporal scales, with particular emphasis on site-specific information;
- a purpose statement and specific language that allows use of alternative indicators and indicator values, provided the purpose of the guideline is met and best available science is used.

SUPPORTING SCIENCE

Some of the key science that supports the guideline includes the following:

- **Proper use of annual indicators and indicator values**

GM-3G includes four annual use indicators and default numeric ranges of values for these indicators in different situations. The selected indicators include 1) stubble height along the greenline, 2) utilization of deep-rooted herbaceous vegetation in the active floodplain and, as needed, other critical portions of riparian management areas, 3) streambank alteration, and 4) use of current year leaders of woody species along streambanks and, as needed, other critical portions of riparian management areas. This use of multiple indicators is supported by many authors, including Bryant et al. (2006), Burton et al. (2011), and Goss (2013).

These indicators were chosen because they generally: 1) have demonstrated or plausible relationships to grazing intensity, 2) are representative of cumulative impacts throughout the season, 3) have demonstrated or plausible relationships to long-term stream conditions, 4) are regularly used by field personnel, and 5) have readily implementable field protocols that are reasonably repeatable. Importantly, the guideline explicitly specifies that these annual livestock use and disturbance indicators should only be applied to help achieve, over longer timeframes, conditions at site and watershed scales that enable attainment and maintenance of aquatic and riparian desired conditions. They are not long-term management objectives, but a means to achieve them, when properly specified, applied and adapted over time (Bryant et al. 2006, Clary and Leininger 2000). Because rangelands, riparian areas, and streams are extremely diverse

(Sayre et al. 2012, Swanson et al. 2015), the guideline explicitly recognizes that not all indicators are appropriate to every situation (Bryant et al. 2006, Clary and Leininger 2000). GM-3G thus specifies that only indicators and indicator values appropriate to a particular site should be used. In addition, indicators and associated values are to be selected, prescribed and adjusted based on site-specific conditions (e.g., natural site potential, site sensitivity to grazing).

This approach of using default values from current applicable research and factoring in site-specific characteristics to arrive at a reasonable allowable value is consistent with the recommendations of Bryant et al. (2006). It is also consistent with the PACFISH implementation guidance, which states that 'Guidelines for developing allotment specific prescriptions can be identified at the programmatic level. However, in general, the prescriptions themselves must be developed to fit on-the-ground conditions within the context of those guidelines.'

- **Varying intensities of use depending on resource conditions and trends**

Consistent with the conclusions of Clary and Webster (1990), Swanson et al. (2015), and other researchers, the GM-3G guideline allows for higher levels of use and disturbance in areas where desired conditions have been attained than in areas where they have not. Furthermore, higher levels of use and disturbance are allowed for areas where desired conditions have not yet been attained but conditions are moving towards them, than in areas where recovery is not occurring. In addition, the degree of departure between existing and desired conditions, current and desired rate of improvement, the presence of special status species or water quality impairments and other factors are to be considered in prescribing specific indicators and indicator values. As such, the guideline properly incentivizes resource managers to implement the basic foundations of the Blues Aquatic and Riparian Conservation Strategy: maintaining conditions when desired conditions have been attained and improving them when desired conditions have not yet been attained.

As noted by Platts (1991) a short-term loss of forage for livestock may occur when overused and degraded riparian communities are put under proper management, but increased forage production should ultimately be a result of improved resources management.

- **Stubble height**

Stubble height is a measure of the height of residual herbaceous vegetation remaining after grazing (Bengeyfield and Svoboda 1998, Burton et al. 2011, Clary and Leininger 2000). GM-3G includes stubble height because it is a good indicator for limiting: 1) the effects of grazing on the physiological health of plants, 2) impacts to the ability of the vegetation to provide streambank protection and to filter out and trap sediments from overbank flows, 3) impacts on stream channel morphology and other effects associated with streambank trampling, and/or 4) browse of willows that provide fish with cover, modulate stream temperatures, and contribute leaf detritus and terrestrial insects that expand food sources (Bryant et al. 2006, Clary and Leininger 2000, Murphy and Meehan 1991). In addition, this annual indicator was chosen because Goss (2013), using the PACFISH/INFISH Biological Opinion (PIBO) monitoring

data from federal lands in the Columbia Basin, demonstrated a relationship between grazing intensity and stubble height and between stubble height and long-term stream habitat conditions (e.g., bank angle, % undercut banks, residual pool depth).

The GM-3G guideline specifies a minimum stubble height of 4" when desired conditions have been attained and riparian vegetation is in late seral conditions. When desired conditions have not been attained, but are moving towards them, 4-6" stubble height is prescribed. The guideline provides direction regarding location-specific factors that are to be considered in choosing a specific value within this 4-6" range (e.g., degree of departure between existing and desired conditions, current and desired rates of improvement, presence of special status species or water quality status). When desired conditions have not been attained and conditions are not improving, a minimum 6" stubble height is specified.

These values were informed by existing PACFISH implementation guidance (*PACFISH Recommended Livestock Grazing Guidelines*, USDA FS and USDI BLM 1995), which recommends:

- 4-6" stubble height where ecological status is 'late seral' and other conditions (e.g., limited bank alteration and woody vegetation utilization) are met.
- at least 6" stubble height where ecological status is 'mid seral' and other conditions (e.g., limited bank alteration and woody vegetation utilization) are met. Also use early season grazing in areas with sensitive, low to moderate gradient streams.
- at least 6" stubble height and early season grazing where ecological status is 'early seral' and channels are in 'good' or 'moderate' condition and are relatively insensitive, with moderate to high gradients. In areas with 'early seral' vegetation and 'poor' channel conditions, consider rest.

GM-3G stubble height criteria were also informed by Clary and Leininger (2000), who concluded that: 1) a streamside stubble height of approximately 4" may be near optimal in many, but not all, situations when considering a number of riparian issues; 2) less than 4" stubble height may be adequate in some situations, whereas greater stubble heights may be needed in others; 3) in particular, 6-8" stubble heights may be needed to reduce willow browse and trampling of vulnerable streambanks and 8" may be needed to reduce willow consumption in late summer and fall in some vegetation communities. Pelster et al. (2004) came to similar conclusions about willow management. They found 25-50% of steer diets were comprised of willow during late-summer and fall grazing at utilization levels similar to those specified in GM-3G. As such, they suggested that stubble heights of about 8" were needed to reduce willow consumption in some vegetation communities during these critical periods. The recommendations of Clary and Webster (1990) were also considered. They suggested that 6" stubble height or perhaps removal of grazing may be warranted where critical fish habitats, especially for threatened, endangered or sensitive species, occur or where streambanks are erodible.

The work of Bengeyfield (2006) and Clary (1999) was also considered in development of GM-3G stubble height criteria. Specifically, Bengeyfield (2006) found, based on 7-9 years of

monitoring, a 4" stubble height did not initiate an upward trend in stream channel morphology at sites on the Beaverhead-Deerlodge National Forest (NF). In contrast, Clary (1999) found that stubble heights of 5" at the end of the growing season resulted in improvements in most, but not all, measured aquatic and riparian variables associated with an Idaho salmon stream after 10 years. Some important variables did not recover or recovered very slowly from initial degraded conditions at this level of use, but values of 6-7" at the end of the growing season improved virtually all measured habitat metrics. (Clary and Leininger, 2000).

The guideline stubble height values were further informed by a recent review focused on use of stubble height as a tool for maintaining or improving stream and riparian conditions for cold water biota, specifically salmon and trout (Roper 2016). He concluded a minimum 6" stubble height was an appropriate starting point for protecting most small to medium-size, cold-water salmon and trout streams. He also noted 4" may be more appropriate for some situations, while 8" may be more suitable for others.

The findings of Goss (2013) were also considered. She demonstrated, for example, that: 1) there is a general relationship between stubble height and streambank alteration, but there is significant variability in this relationship, suggesting that indicators may respond differently at different sites; 2) streambank alteration begins to increase substantially when stubble heights decrease below 10", as does the variability in the relationship between these indicators, highlighting the importance of site-specific conditions; and 3) that stubble height values of 4"-6" and 6"-8" generally correspond with streambank alteration values of 30-40% and 20-30%, respectively, using the methods of Burton et al. (2011)². These alteration values are somewhat higher than those specified in GM-3G (20-25% and 15-20%, depending on conditions and trends). However, they correspond with levels of streambank alteration that enabled recovery of stream channel morphology in two streams in Montana over the course of 7 years (Bengetyfield 2006, see Streambank Alteration section).

Lastly, monitoring and assessment data from the Blue Mountains informed the GM-3G stubble height values. For example, using PIBO monitoring data, Roper (2017) found that: 1) sites with stubble heights <4" are more often associated with poor stream conditions than sites with higher stubble heights; 2) sites with stubble heights of 4-6" are associated with better stream conditions than those with stubble heights <4" and are likely to reflect maintenance of existing conditions; and 3) sites with >6" stubble heights are associated with streams in the best condition, more frequently reflecting reference condition (i.e., minimal human disturbance). He

² While findings of Goss (2013) are based on stubble heights for all herbaceous vegetation rather than the select species used in some other research and monitoring protocols (e.g., Burton et al. 2011), the general patterns described here should apply and in many situations, the results should be reasonably comparable. Exceptions include areas where stream channels are degraded and are in the early phases of recovery (B. Roper, personal communication).

also found that of the three National Forests in the Blue Mountains, the greatest improvements in aquatic habitat conditions since the early 2000s have occurred on the Malheur NF, which has the lowest frequency of stubble heights less than 4". In contrast, the weakest trends in improvement have occurred on the Wallowa-Whitman NF, which has had the highest frequency of stubble heights less than 4". Importantly, of these three Forests, conditions on the Malheur NF were and continue to be the most-highly departed from desired and reference conditions.

- **Utilization of deep-rooted herbaceous vegetation**

Utilization measures the percentage of annual herbaceous production removed by grazing and browsing. This indicator is included in GM-3G because it can be used to 1) identify use patterns, 2) help establish cause-and-effect interpretations of range trend data, and 3) aid in adjusting stocking rates when combined with other monitoring data. Moreover, standardized methods are available to evaluate this indicator in a technically sound, reliable and economical manner (USDA and USDI 1999).

Where desired conditions have been attained and riparian vegetation is in late seral conditions or where conditions are trending towards desired conditions, GM-3G specifies maximum utilization rates of 30-45% in the active floodplain and, as needed, in other critical portions of the riparian management area. These values generally correspond with 'moderate' grazing intensity (Clary and Leininger 2000, Holechek et al. 1999). Values of 30-35% are specified for situations where desired conditions have not yet been achieved and conditions are not moving towards them. These ranges of utilization are considered 'conservative' or somewhere between 'moderate' to 'light' grazing intensity, respectively (Clary and Leininger 2000, Holechek et al. 1999). They are comparable to guidelines from some other Regions (e.g., <30-40% on Forests in the Sierra Nevada, depending on seral status).

These ranges of values were informed by the work of multiple researchers. Clary (1995), for example, found utilization rates >30% in riparian meadows can reduce herbage production significantly, while Crider (1955) found root growth stops when 50% of aboveground biomass is removed. In addition, Holechek et al. (1999) concluded 'moderate' utilization rates of 40-45% may maintain range conditions, while use <30-35% may be needed to improve rangeland vegetation. These values were further informed by the findings of Freitas et al. (2014) and Kauffman et al. (2004). Freitas et al. (2014), for example, concluded that riparian herbaceous utilization rates of 35%, when combined with other use limitations (e.g., streambank alteration, willow browse), neither degraded nor hampered recovery of meadow plant communities on the Inyo NF. In contrast, Kauffman et al. (2004), found at a site in the John Day River Basin, that utilization rates on the order of (and likely less than) 64% in dry meadows and 42% in wet meadows may affect or hinder recovery of stream channel structure, water quality, and aquatic biota by substantially altering below ground biomass, soil porosity, infiltration rates, and other key ecological processes.

- **Streambank Alteration**

Streambank alteration is the presence of shearing, trampling, and trailing of streambanks as a direct result from current year ungulate use (Burton et al. 2011, Heike et al. 2008). This indicator is included in GM-3G because limiting this type of disturbance by livestock is critical to maintaining and restoring riparian areas (Bengeyfield 2006, Goss 2013). Despite some limitations, of all the indicators, it has the closest connection to the effects of grazing on aquatic habitats and species (Interagency Coordinating Subgroup, 2009). Goss (2013) found this indicator to be moderately repeatable. She also found a relationship between grazing intensity and streambank alteration and between streambank alteration and long-term stream conditions (e.g., width-to-depth ratio, bank angle).

The GM-3G guideline specifies a maximum streambank alteration of 20-25% when desired conditions have been attained and riparian vegetation is in late seral conditions or when conditions are moving towards desired conditions. Streambank alteration levels of 15-20% are prescribed when desired conditions have not been attained and conditions are not moving towards them.

These guideline values were informed by recent ESA consultations in some areas of the Pacific Northwest Region (e.g., 15% endpoint indicators for pastures with the most sensitive riparian areas and 20% endpoint indicators for other pastures on the Malheur NF) and guidelines from other Regions (e.g., <10-20% on Forests in the Sierra Nevada, 10-25% on Caribou-Targhee NF). They are substantially greater than the 5% 'new bank alteration' criterion included in the PACFISH implementation guidance, but that value refers only to bank shearing and is therefore a subset of the disturbance included in the bank alteration component of GM-3G.

GM-3G streambank alteration criteria were further informed by Bengeyfield (2006), who found two degraded streams on the Beaverhead-Deerlodge NF in southwest Montana were recovering and beginning to resemble the shape (narrower and deeper) of an undisturbed 'reference reach' when bank alteration was reduced over the course of 7 years and had ultimately reached levels of 15-17%, as measured using a line intercept method. Importantly, Goss (2013) found that those values correspond to about 30-40% streambank alteration using the monitoring methods specified in GM-3G (i.e., Burton et al. 2011).

These values were further informed by the findings of Goss (2013). She found streambank alteration and stubble height were correlated and the stubble height values in GM-3G were attained much more frequently when alteration values were <30-40%. The guideline criteria were also informed by the findings of the Montana Monitoring Working Group (1998), which concluded that streambanks are more likely to slough or erode during peak stream discharge when streambank disturbance exceeds 25%. Lastly, Freitas et al. (2014) found that streambank alteration rates of <10%, when combined with other use limitations (e.g., herbaceous and willow utilization), enabled recovery of meadow plant species richness and diversity on the Inyo NF.

- **Use of current year leaders of woody species**

GM-3G includes estimated use of current year branch growth of trees and shrubs, known as 'woody browse', as an annual use indicator (Heady 1949; Burton et al. 2011). It was included because: 1) it is indicative of grazing intensity, and 2) healthy woody vegetation, together with herbaceous vegetation, contributes nutrients to streams, provides shade, and includes strong root systems that stabilize banks, filter sediment, and slow water during high stream flows (Micheli and Kirchner 2002, Burton et al. 2011).

GM-3G specifies maximum woody browse rates <30-40% along streambanks when desired conditions have been attained and riparian vegetation is in late seral conditions or when conditions are moving towards desired conditions. Browse rates of 20-30% are specified when desired conditions have not been met and conditions are not improving. These values were informed by the PACFISH implementation guidance (*PACFISH Recommended Livestock Grazing Guidelines*, USDA FS and USDI BLM 1995), Forest Service vegetation monitoring protocols (Winward 2000), and Recovery and Implementation Plans for Bull Trout in the Blue Mountains (USFWS 2015a-c). Existing PACFISH implementation guidance (USDA and USDI 1995), for example, recommends <30%. In addition, Winward (2000) characterized utilization values of 20-40% as 'light' grazing that should avoid reductions in seed production that can occur at 'moderate' (41-60%) use levels as well as reductions in root size and strength that can occur under 'heavy' (61-80%) and 'severe' (81-100%) use rates. Lastly, USFWS (2015a-c) specifies 0-20% and 21-40% woody browse, depending on habitat type.

Guidelines from other Regions were also considered in development of the allowable woody browse criteria (e.g., <20% for National Forests in the Sierra Nevada, 30-50% on Caribou-Targhee NF). On the Inyo NF in the Sierra Nevada, Freitas et al. (2014) found the <20% browse rates, when combined with other use limitations (e.g., streambank alteration, herbaceous utilization), neither degraded nor hampered recovery of meadow plant communities.

Woody browse is the least reliable indicator included in GM-3G. Hall and Max (1999), for example, found high variability in measurements of livestock use to riparian woody plants. Goss (2013) found similar problems with the repeatability of this indicator, which led to weak relations with other disturbance indicators and insignificant relations to grazing intensity. As such, this indicator should generally be used in combination with other indicators (e.g., stubble height) to achieve aquatic and riparian resource objectives.

REFERENCES

- Bengeyfield, P. 2006. Managing cows with streams in mind. *Rangelands* 26:3-6.
- Bengeyfield, P., and D. Svoboda. 1998. Determining allowable use levels for livestock movement in riparian areas. Proceedings of the specialty conference on rangeland management and water resources. Vol. 27. 1998.
- Bryant, I., W. Burkhardt, T. Burton, W. Clary, R. Henderson, D. Nelson, W. Ririe, K. Saunders, and R. Wiley. 2006. Using stubble height to monitor riparian vegetation. *Rangelands* 28(1): 23-28.
- Burton, T.A., S.J. Smith, and E.R. Cowley. 2011. Riparian area management: Multiple indicator monitoring (MIM) of stream channels and streamside vegetation. Denver, CO, USU: US Department of the Interior, Bureau of Land Management. Technical Reference BLM/OC/ST-10/003+ 1737.
- Clary, W. P. 1995. Vegetation and soil responses to grazing simulation on riparian meadows. *Journal of Range Management* 48: 18-25.
- Clary, W.P. 1999. Stream channel and vegetation responses to late spring cattle grazing. *Journal of Range Management* 52:218-227.
- Clary, W.P., and W.C. Leininger. 2000. Stubble height as a tool for management of riparian areas. *J. Range Management*. 53: 562-573.
- Clary, W. P., and B.F. Webster. 1990. Riparian grazing guidelines for the Intermountain Region. *Rangelands*, 12: 209-212.
- Crider, F. J. 1955. Root growth stoppage resulting from defoliation of grass. U. S. Dept. Agr. Tech. Bull. 1102, 23 p.
- Freitas, M. R., L.M. Roche, D. Weixelman, and K.W. Tate. 2014. Montane meadow plant community response to livestock grazing. *Environmental management*, 54(2), 301-308.
- Goss, L.M. 2013. Understanding the relationship between livestock disturbance, the protocols used to measure that disturbance, and stream conditions. Masters Thesis, Utah State University. 107pp.
- Hall, F. C., and T. Max. 1999. Test of observer variability in measuring riparian shrub twig length. *Journal of Range Management* 52:633-636.
- Heady, H. F. 1949. Methods of determining utilization of range forage. *Journal of Range Management* 2:53-63.

Heike, J.D., R.C. Henderson, B.B. Roper, and E.K. Archer. 2008. Evaluating livestock grazing use with streambank alteration protocols: challenges and solutions. *Rangeland Ecol Manage* 61: 647-655.

Holechek, J. L., H. Gomez, F. Molinar, and D. Galt. 1999. Grazing studies: what we've learned. *Rangelands*, 12-16.

Interagency Coordinating Subgroup. 2009. Blue Mountains Consultation Streamlining Level 2 Elevation of Unresolved Issues.

Kauffman, J.B., A. S. Thorpe, and E. N. Brookshire. 2004. Livestock exclusion and belowground ecosystem responses in riparian meadows of eastern Oregon. *Ecological Applications* 14.6: 1671-1679.

Micheli, E.R., and J.W. Kirchner. 2002. Effects of wet meadow riparian vegetation on streambank erosion. 2. Measurements of vegetation bank strength and consequences for failure mechanics. *Earth Surface Processes and Landforms* 27: 687-697.

Montana Monitoring Working Group. 1998. Monitoring for success, ranch planning, upland monitoring, stream channel and riparian area monitoring. State of Montana, Department of Natural Resources and Conservation. Helena, MT.

Murphy, M.L. and W.R. Meehan. 1991. Stream ecosystems. Pages 17-46. *In*: Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19, Bethesda, MD.

Platts, W. 1991. Livestock grazing. Pages 389-423. *In* W. R. Meehan, editor. Influences of forest and rangeland management on salmonids and their habitats. American Fisheries Society Special Publication 19, Bethesda, MD.

Pelster, A. J., S. Evans, W.C. Leininger, M.J. Trlica, and W.P. Clary. 2004. Steer diets in a montane riparian community. *Journal of Range Management*. 57: 546-552.

Roper, B.B. 2016. Setting stubble height standards for riparian areas grazed by cattle in areas with Endangered Species Act listed or sensitive salmon and trout species. National Stream and Aquatic Center, USDA Forest Service. 7pp.

Roper, B. B. 2017. Providing for livestock grazing and the conservation of aquatic resources. Presentation at Baker City, October 31, 2017. Copy on file with Brett Roper (contact broper @fs.fed.us).

Sayre, N.F., B.T. Bestelmeyer, and K.M. Havstad. 'The Range Problem' after a century of rangeland science: new research themes for altered landscapes. *Rangeland Ecology & Management* 65.6 (2012): 545-552.

Swanson, S.R., S. Wyman, and C. Evans. 2015. Practical grazing management to meet riparian objectives. *Journal of Rangeland Applications* 2 (2015): 1-28.

USDA Forest Service and USDI Bureau of Land Management (USDA and USDI). 1995a. Environmental assessment for the interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California (PACFISH). Washington, DC.

USDA Forest Service and USDI Bureau of Land Management (USDA and USDI). 1995b. Decision Notice/Decision Record and Finding of No Significant Impact for the interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California (PACFISH). Washington, DC.

USDA Forest Service and USDI Bureau of Land Management (USDA and USDI). 1995c. Environmental assessment for the interim strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana and portions of Nevada (INFISH).

USDA Forest Service and USDI Bureau of Land Management (USDA and USDI). 1995d. Decision Notice and Finding of No Significant Impact for the interim strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana and portions of Nevada (INFISH).

USDA Forest Service and USDI Bureau of Land Management (USDA and USDI). 1995e. PACFISH Recommended livestock grazing guidelines.

USDA and USDI. 1999. Utilization studies and residual measurements: Interagency technical reference. BLM/RS/ST-96/004+1730.

United States Fish and Wildlife Service. 2015a. Recovery Plan for the Coterminous United States Population of Bull Trout (*Salvelinus confluentus*).

United States Fish and Wildlife Service. 2015b. Mid-Columbia Recovery Unit Implementation Plan for Bull Trout (*Salvelinus confluentus*).

United States Fish and Wildlife Service. 2015c. Upper Snake Recovery Unit Implementation Plan for Bull Trout (*Salvelinus confluentus*).

Winward, Alma H. 2000. Monitoring the vegetation resources in riparian areas. General Technical Report RMRS GTR-47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 p.