Wildlife-Discipline Input into Proposed Utilization Limit and Basis of the Input — K-17 Allotment Management Planning Process —

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Introduction

The purpose of this report is to outline recommended changes to the Proposed Action or addition of a new alternative to build in long-term and short-term wildlife needs, as required for DFC 10 areas (51% of the K-17 project area). The standard for wildlife is higher for wildlife in DFC 12 areas (36% of the K-17 project area).

I identified two main shortcomings of the June 22, 2017 Proposed Action for K-17 alternatives, with respect to wildlife, in the January 17, 2018 interdisciplinary meeting: (1) the proposed desired plant species composition would result in less-than-suitable habitat conditions for wildlife, and (2) the proposed maximum utilization limit of 50% key forage was not designed to meet wildlife needs and would result in less-than-suitable habitat conditions for wildlife. I also expressed concerns about proposed desired conditions for ground cover in the meeting, and Aaron and I agreed to follow-up on this issue. Identification of the two issues, above, led to the recognition that the Proposed Action would either need to be modified or a new alternative developed.

It is noteworthy that the WGFD, on the first page of their scoping letter, stated that, "Because much of this area is recovering from documented historic impacts from the early to mid 1900s, we support a NEPA process that considers alternatives that evaluate management actions that may restore degraded habitat on important wildlife areas," emphasis added (WGFD 2017).

They also stated that "The vast scale of the project area elevates the importance of this analysis for the Department, since the resulting management plan could potentially affect a wide variety of wildlife species…" (WGFD 2017).

Negative effects of livestock grazing likely can be sufficiently mitigated by managing utilization levels and the distribution, timing and duration, and frequency of sheep grazing. Retaining and adequate amount of suitable. This report primarily deals with managing utilization levels. The Proposed Action of June 22, 2017……

I. Wildlife Issue Related to Retention & Utilization

> **Issue:** ***No desired conditions or objectives were defined for herbaceous retention for wildlife in the Proposed Action, and the Proposed Action's utilization limit of 50% — alone, without a desired condition statement or objective and without the use of key areas — is not sufficient to retain an adequate amount of suitable forage and cover for wildlife and a large number and wide variety of wildlife would be negatively affected. A utilization limit of 50% of key forage generally does not meet the requirements of the Forage Utilization Standard to prescribe utilization limits to meet Forest Plan objectives (Objectives 2.1(a), 3.3(a), and 4.7(d)) to prescribe utilization limits on key wildlife ranges, nor does it meet the Allotment Management Plan Standard and Fisheries and Wildlife Prescription.***
>
> ***Also, there is some question about the Proposed Action's utilization limit meeting the requirement of the Forage Utilization Standard to prescribe utilization limits to meet Forest Plan objectives (Objectives 4.7(a) and 4.7(b)) and Rangeland Vegetation Prescription as related to the provision of wildlife habitat over the long term. The degree to which this Forest Plan direction is met dictates the degree to which the capability to provide suitable habitat is sustained over the long term in rangeland, aspen, and riparian.***

The scope of this issue encompasses three related things: (1) the desired herbaceous retention level, (2.a) maximum utilization limit for sustaining/restoring long-term habitat conditions (rangeland and riparian health), and (2.b) maximum utilization limit for meeting desired herbaceous retention levels for wildlife. Maintaining, or restoring and then maintaining, rangeland and riparian health are central to the long-term sustainability of

wildlife habitat. Assuming a utilization limit is satisfactory for doing this, the next step is to adjust the utilization limit, if warranted, to ensure that an adequate amount of suitable forage and cover are retained for wildlife and that small wildlife are adequately protected from trampling. The management emphasis of DFC 10 areas (51% of the project area) captures this well: "…to provide long-term and short-term habitat to meet the needs of wildlife…" (and DFC 12 areas have a stronger emphasis on wildlife, 36% of the project area). This is also captured in the Range Vegetation Prescription: "Forage is provided on a sustained-yield basis that protects rangeland values, wildlife habitat…" This aspect of the issue statement is well recognized as an important issue for wildlife (Leopold 1923, Leopold 1924, Peek 1986:180-184, Robinson and Bolen 1989:297-302, Kie et al. 1994).

It is recognized that '2.a' is the purview of Rangeland Management Specialists, but because it is such a crucial part of the issue for wildlife, and because there is reason to question the basis of the proposed maximum 50% use limit based on the cited supporting authority on the subject (Dr. Jerry Holechek)[A], this was included in this wildlife issue. Based on their review of scientific information, Holechek et al. (2004, 2008, and 2011) concluded that a maximum 50% use of key forage in this ecological zone typically results in downward trends in range condition. There is a strong basis for developing and considering an alternative utilization limit, including for the long-term sustainability of wildlife habitat.

Two possible reasons for the Proposed Action's utilization limit not being sufficient to retain an adequate amount of forage and cover for wildlife or to protect sensitive species from being directly impacted (e.g., by trampling) are that (1) there does not appear to have been any effort to define suitable herbaceous-retention levels (as per Objective 4.7(d)) in a way that numerically-based utilization limits could be developed or adjusted; and (2) there does not appear to have been any effort to prescribe utilization limits that meet Forest Plan objectives for wildlife, as required by the Forage Utilization Standard.

I provided input on May 3, 2017 into the District Ranger's decision of whether to prepare an EA or EIS for K-17 allotments project. As part of this input, I stated:

> "There does not appear to be any scientific information demonstrating that 50% retention of key <u>forb</u> species (1) is sufficient to maintain desired conditions for range health, and (2) is sufficient to retain suitable habitat for wildlife. Also, available scientific information shows that this threshold would result in less-than-suitable habitat conditions for a range of wildlife species (e.g., see the 2011 wildlife reports). Retaining less-than-suitable habitat conditions would be compounded in communities in which plant species composition is altered and annual production levels are altered."

I had also expressed this in interdisciplinary meetings for the LaBarge Creek allotment management planning project in 2016. In her biological evaluation and wildlife report for K-17 allotments, Oles (2011a) concluded that a maximum 50% use of key forage species would provide less-than-suitable habitat conditions for native ungulates and sensitive amphibians, and other biologists on the BTNF have come to similar conclusions for these and other species. The lack of scientific support for a maximum 50% utilization of key forage, with respect to meeting the needs of wildlife and maintaining rangeland health, was brought up in public comments.

Sole reliance on a maximum 50% use of key forage species (without use of key areas and desired herbaceous retention for wildlife), the Forage Utilization Standard would not be met because (1) this standard requires forage utilization limits be prescribed, during the allotment planning process, to meet Forest Plan objectives, including Objectives 2.1(a), 3.3(a), and 4.7(d), which is especially pertinent in DFC 10 and 12 areas; and (2) no apparent effort has been put forth to date in the K-17 allotment planning process to adjust the utilization limit to meet these Forest Plan objectives. DeLong (2009), USFS (2009), DeLong (2012), DeLong (2015), and DeLong (2016) synthesize available scientific information and demonstrate that a maximum 50% use of key forage (Proposed Action) is not sufficient to meet these objectives.

[A] Holechek (2004) was cited in support of a maximum 50% utilization of key forage, and this was the only source cited.

Setting utilization limits too high would adversely affect many wildlife species, including those in the following categories:

- Mule deer, elk, and moose (subject of Objective 2.1(a) & of high interest to the WGFD and public)
- Great gray owls and northern goshawks (subject of Objectives 3.3(a))
- Boreal toads and Columbia spotted frogs (subject of Objective 3.3(a))
- A range of raptor, neotropical, and other migratory bird species (migratory bird requirements)
- Invertebrates, including pollinators (pollinators are an agency emphasis)

Making adjustments to the Proposed Action or adding a fourth alternative to address this wildlife issue would respond to Scoping Comments 3-24 (The proposed 50% utilization has no scientific basis on the basis of basic plant physiology or for retaining suitable forage and cover for wildlife); 3-32 (literature review of the implementation of Forest Plan Objective 4.7(d)); 3-33 (principles of Greys River RD wildlife-grazing reports need to be applied to this process, and the utilization rates don't implement the site-specific, interdisciplinary approach required in 2209. 21_30); and 9-17 (importance of the Wyoming Range mule deer herd).

See the "Basis of Suitable Herbaceous Retention Thresholds" for further discussion of the rationale for developing and considering an alternative to the Proposed Action's maximum 50% use of key forage.

II. Components of an Adjusted Proposed Action or Alternative 4

This part of the report provides the wildlife-discipline input into adjusting the Proposed Action and/or developing a new alternative (Alternative 4) for the K-17 sheep allotments. Part III of the report outline or summarize the basis of this input.

A. Desired Condition for Herbaceous Retention

While utilization limits are standards or annual indicators and are not treated as desired conditions in range management, minimum herbaceous retention is the subject of desired conditions (or objectives) in wildlife management on livestock allotments. This is discussed further in the "Treatment of Herbaceous Retention in Range Discipline versus in Wildlife Discipline" subsection (note that herbaceous retention is treated as a desired condition in Forest Plan Objective 4.7(d)), and this is consistent with wildlife conservation literature. Defining desired levels of post-grazing effective canopy cover and vegetation density is easier to envision as desired conditions, and herbaceous retention is just one other way to measure this vegetation height, density, structure, and diversity.

The following should be included as a project-level desired condition for wildlife. It steps down from Forest Plan Objectives 2.1(a), 3.3(a), and 4.7(d); Fisheries and Wildlife Prescription; Range Vegetation Prescription; Allotment Management Plan Standard; as well as migratory bird requirements.

> Desired Condition for Herbaceous Retention for Wildlife:
>
> 70-100% of the total herbaceous annual production is retained across ≥80% of each major vegetation type grouping (big sagebrush/mountain shrubland communities; aspen/open forestland communities; forbland communities; moist meadow/silver sagebrush/shrubby cinquefoil communities; wetland/wet meadow communities; and willow-herb communities) within each allotment. Mule ears, Louisiana sagewort, and tarweed communities are excluded from forbland communities for the purposes of assessing herbaceous retention across the forbland type.

70% of the annual production of key forage species is retained during the growing season and 60% of the annual production of key forage species is retained after the growing season across ≥80% of each major vegetation type grouping within each allotment.

Notes:

These objectives assume that ≥80% of herbaceous vegetation, by weight, is retained on a large proportion of each major vegetation type grouping, and they assume that herbaceous species composition is at or near desired conditions.

The ultimate aim of this desired condition is to retain, intact or relatively-intact, ≥50-60% of the pre-grazed herbaceous canopy cover and ≥50-60% of the pre-grazed visual obstruction (i.e., hiding cover as measured by modified-Robel pole) (see Figure 3). It is recognized this is a relatively-low bar for wildlife, but it allows for a meaningful amount of grazing, as compared to grazing that would result from higher levels of canopy cover and visual obstruction retained.

Trampled vegetation is <u>not</u> included as retained vegetation (as per *Wyoming Rangeland Monitoring Guide*, BLM et al. (2008), page 54).

This desired condition is based on DeLong (2009), USFS (2009a), DeLong (2012), and DeLong (2015), and is consistent with suitable retention levels defined in USFS (2009a), DeLong (2016), and Murphy (2016), and referenced in Oles (2011a), Oles (2011b), Roberts (2013), Roberts (2016), USFS (2016b).

It is estimated that 70% retention of total herbaceous vegetation equates to 50-70% retention of key forage (Appendix A), overall, with the expectation that it equates to 50-60% retention of key forage in many situations. It is not a safe assumption that 50% use of key forage equates to 70% retention of herbaceous vegetation. As one example, based on data he collected on the Upper Green cattle allotments, Pinedale District, Murphy (2016) stated that "Under maximum allowable use of key forage (50%), my estimated retention of total herbaceous vegetation in cattle-accessible moist meadows is 54%, a level well below the objective of 70%."

A minimum 70% herbaceous retention, as a suitable condition for wildlife is completely within the scope of key-forage use limits recommended by range experts (Figure 1). Table 1 shows how the different utilization limits under each alternative affect trends in plant species composition and ground cover, relative to the range expert that is relied upon.

B. ANNUAL BENCHMARK — MAXIMUM UTILIZATION LIMIT

On February 7, 2018, I was asked by Aaron to see if the maximum utilization limit of the Proposed Action (June 22, 2017), in combination with the "key area" concept, is workable from the standpoint of wildlife. I believe it is if it is clearly connected to the desired conditions that it supports (including for wildlife), and this is reflected in Option 1, below.

I see two viable options given that a maximum 50% use of key forage cannot be relied upon to retain suitable habitat for wildlife in most situations, that 50% use of key forage negatively impacts a range of wildlife species (see section E.4 of Part III of this report), that sheep graze large proportions of the vegetation types they graze, and that 87% of the project area is within DFC 10 and 12.

Both options depend on desired conditions for herbaceous retention for wildlife to be defined. Desired conditions play a critical role in livestock management (see Diagram 1 in the Proposed Action; and see section 92.1 of WO Amendment 2209.13-2005-10 and requirements of Forage Utilization Standard), and DFC management emphasis and themes dictate that providing suitable habitat for wildlife is of high importance.

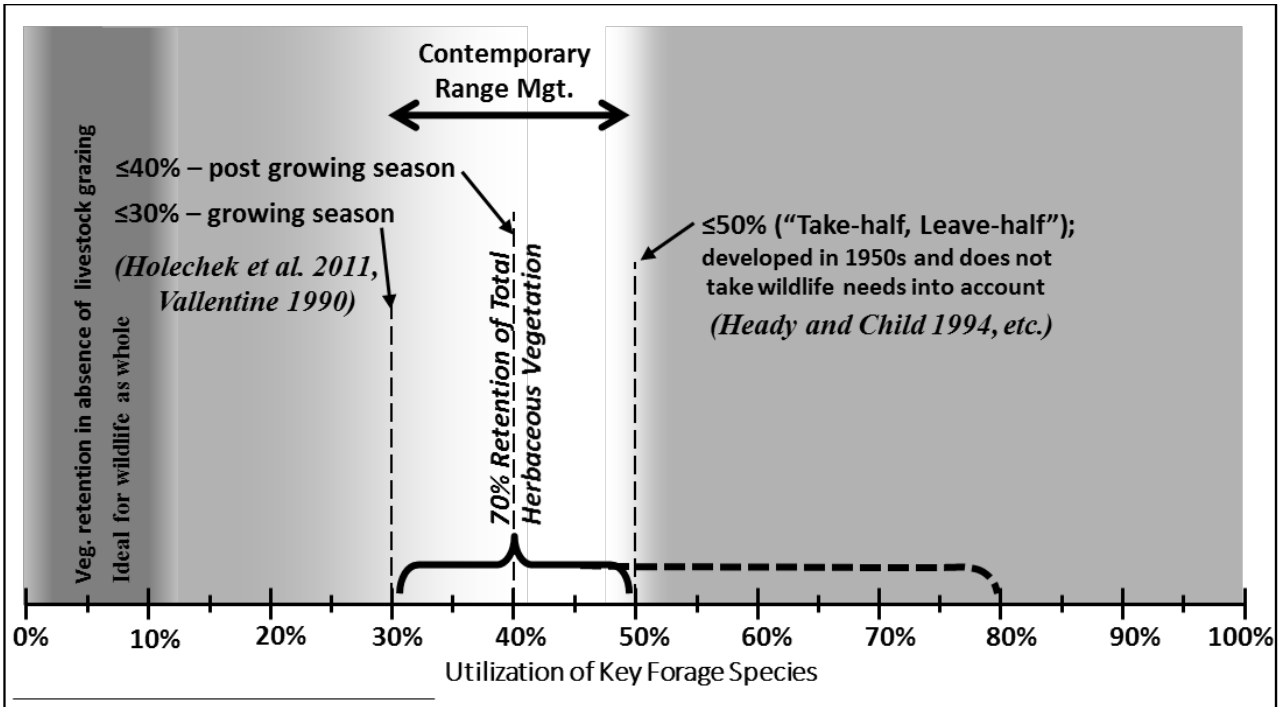


Figure 1. Conceptual illustration showing the relationship between 70% retention of total herbaceous vegetation and (1) exclusion of livestock grazing (i.e., near 0% utilization as measured in the fall) and (2) utilization limits being applied in contemporary range management. The dashed line extending from 50% to 80% use of key forage species indicates that 70% herbaceous retention can equate to as high as 80% use of key forage species, but these high use rates of key forage species are unlikely where use of total herbaceous vegetation is limited to 70%.

Table 1. Estimated trends in plant species composition and ground cover as a consequence of implementing different key-forage utilization limits, based on different range experts (published). Shaded cells designated utilization limits that are supported by the associated range text.

Source of Recommendation	**Maximum Use of Key Forage Species**				**Alternative**
	5-10%[A]	**30% / 40%**	**50%**	**60-65%**	
Unknown	n/a	n/a	n/a	(Not Supported)	Current Management
Heady and Child (1994)	Stable or Increase	Stable or Increase	Stable or Increase	Decline	Proposed Action
Holechek et al. (2011)[B]	Stable or Increase	Stable or Increase	Decline	Decline	Modified Proposed Action or Alternative 4 (new)
Unknown	Stable or Increase[C]	n/a	n/a	n/a	No Grazing Alternative

[A] This is an estimated based on pre-livestock-grazing measurements and estimates during July – September.

[B] Jerry Holechek was identified as the authority on utilization limits by the Range Program Manager for Kemmerer and Greys River Ranger Districts, as well as by Range Management Specialists on the Pinedale and Big Piney Ranger Districts. Holechek et al. (2011) is the textbook used at the University of Wyoming for range management courses.

[C] Using Holechek et al. (2011) as the supporting reference. Heady and Child (1994) also support this.

Option 1 — Adjustments to the Proposed Action

Three things will be needed under this option to meet wildlife-related Forest Plan direction (objectives, standards, prescriptions) and migratory bird requirements, in light of a large volume of scientific information: (1) a desired conditions statement for herbaceous retention for wildlife needs to be added to the Proposed Action, (2) the following changes to the key-forage utilization limit in the Proposed Action, and (3) it needs to be made clear in the Proposed Action that "in Satisfactory Condition" equates to meeting desired conditions as adjusted (i.e., desired conditions added to the LaBarge Creek Proposed Action, plus the addition of desired conditions for the forbland type). Needed changes are as follows:

- Rangelands or Plant Communities in Satisfactory Condition: Maximum forage utilization 50% of key species at key areas on uplands, aspen, and riparian areas away from the greenline in order to meet desired conditions for herbaceous retention (in short term) and desired conditions for vegetation and ground cover (over the long term). 50% use by key species equates to approximately ~~25-~~30-50% utilization of total ~~forage~~ herbaceous vegetation use (~~USDA, 1981~~ Appendix A).
- Rangelands or Plant Communities in Unsatisfactory Conditions: Maximum forage utilization 30% use at key areas on key species on uplands, aspen, and riparian areas away from the greenline in order to meet desired conditions for herbaceous retention (in short term) and desired conditions for vegetation and ground cover (over the long term). 30% use by key species equates to approximately ~~13-17~~15-30% utilization of total ~~forage~~ herbaceous vegetation use (~~USDA, 1981~~ Appendix A).
- Maximum forage utilization 30% use at key areas on key species on uplands, aspen, and riparian areas away from the greenline where ~~effective~~basal ground cover is <60% (or effective ground cover equivalent) as a result of burrowing rodent activity. 30% use by key species equates to approximately ~~13-17~~15-30% utilization of total ~~forage~~ herbaceous vegetation use (~~USDA, 1981~~ Appendix A).

The sentences supported by USDA (1981) need to either be adjusted, as outlined above, or the sentences need to be deleted. USDA (1981) is very limited in scope and is greatly outdated. I've put together two crosswalks between retention of key forage species and retention of total herbaceous vegetation (and visa versa), and these are supported by Smith et al. (2007).

Option 2 — Alternative 4

This option will be needed to meet wildlife-related Forest Plan direction (objectives, standards, prescriptions) and migratory bird requirements, in light of a large volume of scientific information, if (1) desired conditions for herbaceous-retention for wildlife is not added to the Proposed Action, and (2) the key-forage utilization limit is not adjusted as outlined above.

Replace the utilization limits of the Proposed Action (as modified 2-7-2018) to the following, in order to support the herbaceous-retention desired condition for wildlife:

- Rangelands or Plant Communities in Satisfactory Condition: Maximum 35% utilization of key forage across ≥80% of each major habitat grouping within each allotment in order to meet desired conditions for herbaceous retention (in short term) and desired conditions for vegetation and ground cover (over the long term).
- Rangelands or Plant Communities in Unsatisfactory Conditions: Maximum forage utilization 25% use at key areas on key species on uplands, aspen, and riparian areas away from the greenline in order to meet desired conditions for herbaceous retention (in short term) and desired conditions for vegetation and ground cover (over the long term).
- Maximum forage utilization 25% use at key areas on key species on uplands, aspen, and riparian areas away from the greenline where basal ground cover is <60% (or effective ground cover equivalent) as a result of burrowing rodent activity.

Vegetation type groupings are big sagebrush/mountain shrubland communities; aspen/open forestland communities; forbland communities; moist meadow/silver sagebrush/shrubby cinquefoil communities; wetland/wet meadow communities; and willow-herb communities. Mule ears, Louisiana sagewort, and tarweed communities are excluded from the forbland grouping.

III. Basis of Suitable Herbaceous Retention Thresholds and Maximum Utilization Limits

INTRODUCTION

The following sections outline the need and basis for three things: (1) the desired herbaceous retention level, (2.a) maximum utilization limit for sustaining/restoring long-term habitat conditions (rangeland and riparian health), and (2.b) maximum utilization limit for meeting desired herbaceous retention levels for wildlife.

Tight Connection between Utilization Limits and Objective / Desired Conditions

The purpose of defining and implementing utilization limits is to meet objectives and desired conditions, and the connection between the utilization limit and the objectives/desired conditions it supports needs to be clear. The Forage Utilization Standard requires that, during allotment management planning, utilization limits are prescribed to meet Forest Plan objectives. Similarly, Chapter 90 requires that proposed actions include "maximum amount of use in terms of allowable use levels," as basic elements of an allotment management plan, "…to achieve management objectives" (section 92.23.2 of WO Amendment 2209.13-2005-10).

Given this clear, required connection between utilization limits and objectives, it is important (1) to clearly articulate which objectives and desired conditions the utilization limit aims to meet or achieve, and (2) to show whether the utilization limit will meet or achieve them. To be able to demonstrate whether a given utilization limit constrains livestock grazing sufficiently to meet Forest Plan objectives — with respect to retaining an adequate amount of suitable forage and cover and protecting sensitive species from trampling — "adequate" and "suitable" must be defined numerically. Given the large breadth and depth of scientific information available to biologists (many hundreds of applicable scientific studies), there is no place for unsupported "professional" opinion. Note the key elements of sound professional judgement in relation to the wildlife discipline:

> "The term 'sound professional judgment' means a finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to… applicable laws" (16 USC 668dd, section 5, paragraph 3).
>
> Three key components = (1) consistent with principles of wildlife management, (2) consistent with available science, and (3) adherence to applicable laws. Note the distinctions between "consistent with" and "adherence to."

The foundation of desired conditions is Forest Plan direction, migratory bird requirements, and direction in applicable laws, regulation, and policy. Scientific information is used to describe desired conditions in more detail, and to quantify desired conditions wherever possible.

If project-level desired conditions or objectives are not defined numerically, it will be difficult to prescribe utilization limits to meet them:

- Utilization limits are defined numerically and it would be difficult to demonstrate that a given utilization limit would retain a suitable level of forage and cover for wildlife.

- If a biologist were to conclude that a given numeric utilization limit (e.g., max. 50% use of key forage) will retain suitable forage and cover for wildlife, the biologist will have just put a number to the objective or desired condition since retention is the direct inverse of utilization. In this example, the biologist will have effectively concluded that suitable conditions equates to a minimum 50% retention of key forage (or, a minimum of about 50-70% total-herbaceous retention). To do this — and meet the rigors of professional judgement — the biologist must be able to demonstrate this numeric retention level will, based on scientific information, provide suitable forage and cover for wildlife. If the biologist is unable to demonstrate that the preponderance of scientific information shows this herbaceous retention level retains suitable forage and cover for wildlife, they will not be able to conclude that a maximum 50% use of key forage will meet Forest Plan objectives for wildlife.

Status of Prescribing Utilization Limits to Meet Forest Plan Objectives for Wildlife

Up to this point in the K-17 allotment planning and NEPA process, no adjustments have been made to the proposed utilization limit to meet Forest Plan Objectives 2.1(a), 3.3(a), and 4.7(d) with regard to retaining an adequate amount of suitable forage and cover for wildlife and to protect sensitive species from trampling effects. No adjustments have been made to meet migratory bird requirements.

Forest Plan objectives call for suitable habitat to be provided for wildlife, including the retention of suitable forage and cover, and Oles (2011a) made the following assessments (which were also included in the Draft EIS):

- For mule deer and elk, Oles (2011a:11) wrote "Conditions that reduce or limit the availability of nutritious forage include… less than 60-70% of the annual production of key herbaceous forage species retained through the livestock grazing season" (Oles 2011a:11). (also on page 8 of Draft EIS)
- "Generally, retaining a minimum of 60-70% of the annual production of key forage species through the livestock grazing season in rangelands and meadows should be sufficient to provide for the forage needs of elk and mule deer (Wisdom and Thomas 1996, Holechek et al. 2004, Peek and Krausman 1996, WAFWA 2009)" (Oles 2011a:20). (also on page 26 of Draft EIS)
- "Because amphibians using meadowland depend on vegetation to provide protection from evaporative water loss, to thermoregulate, and to provide protection from predators, major reductions in vegetation height (e.g., lower than 4-6 inches along banks (Keinath and McGee 2005) or less than 60-70% vegetation retained in meadowlands) would render affected habitats LTS [less than suitable] for that season" (Oles 2011a:31). (also on page 30 of Draft EIS)

Options 1 and 2 in part II of this report would meet the requirements of the Forage Utilization Standard since the utilization limits would clearly be subject to desired conditions.

Treatment of Herbaceous Retention in Range Discipline versus in Wildlife Discipline

Herbaceous retention for wildlife is treated in the Forest Plan as a desired condition, which is different than it is treated in the Range Discipline. Herbaceous retention is treated differently in wildlife conservation than it is in range management for the following reasons:

- It is well established that forage utilization limits and minimum stubble heights (herbaceous retention) are used as management constraints implemented as a means to achieve long-term objectives for ground cover, plant species composition, and bank stability (Heitschmidt et al. 1998, BLM et al. 1999, University of Idaho 2004). They are discussed in terms of annual indicators. As assessed by Sanders (pg. 6 in Heitschmidt et al. 1998), "Allowable use levels make poor and inconclusive allotment and riparian objectives because they provide no information by themselves on whether desired long-term conditions are being met."

- In contrast, the height, structure, and retention of herbaceous vegetation are subjects of objectives and desired conditions when it comes to wildlife habitat (e.g., Wyo. Partners in Flight 2003, Adamcik et al. 2004, Laubhan et al. 2012, and Forest Plan Objective 4.7(d)). The height and structure of herbaceous vegetation retained through the summer and into the fall are key components of habitat for many species of wildlife, not just annual indicators of habitat being provided. For this reason, it is a key element of wildlife habitat objectives, which is reflected in Forest Plan Objective 4.7(d) of the Forest Plan. Therefore, Sanders' words (in Heitschmidt et al. 1998:6) can be modified somewhat to put it in the context of wildlife habitat management: *retention levels make good and conclusive wildlife habitat objectives because they provide information by themselves on whether desired short-term (annual and seasonal) conditions for wildlife are being provided.*

Adequate and Suitable versus Optimum

The Forest Plan does not require optimum conditions to be provided for wildlife. It calls for an "adequate amount" of "suitable" habitat to be provided, as discussed in more detail under the heading "Adequate and Suitable versus Optimum and Marginal" in DeLong (2009a:17).

A paragraph on page 71 of my migratory bird report for the Upper Green range management project captures it well:

> "Objective 4.7(d) of the Forest Plan and E.O. 13186 do not require optimum habitat conditions for wildlife (they call for "suitable" conditions), and they do not call for suitable habitat to be provided on every acre of wildlife habitat. Objective 4.7(d) calls for an "adequate" amount of suitable habitat to be provided and this is consistent with direction in E.O. 13186 and USFS and USFWS (2008). As such, ≥70% of herbaceous vegetation would need to be retained on a large majority of each major type of habitat (e.g., 70%, 80%; see DeLong 2009) to meet the "adequate amount" part of Objective 4.7(d) and to meet migratory bird requirements."

A. HERBACEOUS RETENTION IN THE CONTEXT OF RANGE MANAGEMENT

The following points are important in putting the identified suitable herbaceous retention level of 70% in perspective in regard to range management, and balancing between wildlife and livestock grazing:

1. A minimum 70% herbaceous retention, as a suitable condition for wildlife:
   a. Is completely within the scope of key-forage use limits recommended by range experts (Figure 1).

      Note: While limiting use of key forage to 30-40% (Holechek et al. 2011) would retain ≥70% herbaceous retention in most situations, limiting use of key forage to 50% (Heady and Child 1994) would retain ≥70% herbaceous retention in a relatively small number of situations (Appendix A).

   b. Cannot legitimately be characterized as protectionist, anti-livestock grazing, or a Muir approach.
2. ≥90-95% herbaceous retention (as measured in late summer / early fall) is probably ideal for wildlife in this area.
3. Sustained yield is a central tenet of Gifford Pinchot (and it is central to the Range Vegetation Prescription), and a maximum 30-40% use of key forage is clearly a viable option that should be seriously considered:
   a. Some range experts recommend limiting utilization of key forage to 50% to attain sustained yield of forage (Heady and Child 1994; see also Dietz 1989) (Figure 1). This "take half, leave half" philosophy originated in the 1950s (Smith 1998), and it is founded on studies on the effects of defoliation on root growth (Crider 1955, Dietz 1989, Smith 1998). These results were obtained on individual plants and not on communities of plants; when expanded to a plant community, their results do not necessarily support 50% use of key forage at this scale (see DeLong 2010).

b. Other range experts show that limiting utilization of key forage to 30-40% is needed to attain sustained yield of forage on rangelands in this part of the Intermountain West (Holechek et al. 2011; see also Vallentine 1989) (Figure 1); and science they summarize demonstrates that rangelands grazed at 50% use of key forage decline in condition[B].

c. While the recommendation of Heady and Child (1994) for a maximum 50% use of key forage also provides support for a maximum 30-40% use of key forage (i.e., if ≤50% use sufficiently limits impacts, ≤30-40% use must also sufficiently limit impacts), the science reviewed in Holechek et al. (2011) supporting a maximum 30-40% use of key forage does not lend support to a maximum 50% use of key forage. In fact, this science demonstrates that rangeland condition declines at 50% use of key forage.

d. Holechek et al. (2011) provides scientific information showing that a maximum 30-40% use of key forage is more beneficial to livestock operations than a maximum 50% use of key forage in the long term. It would be difficult to conclude that a maximum 30-40% use of key forage would not contribute satisfactorily toward Forest Plan Objective 1.1(h) for livestock grazing.

e. An increasing number national forests are reducing maximum utilization limits to 40% or less (e.g., Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, Inyo, and Humboldt-Toiyabe National Forests; Malheur, Umatilla, and Wallowa-Whitman National Forests; Beaverhead-Deerlodge National Forest).

4. While a maximum 50% use of key forage places emphasis on livestock grazing and places minimal if any attention on meeting wildlife needs, a maximum 30-40% use would provide for both livestock grazing and wildlife needs. In DFC 10 areas (51% of the project area), the management emphasis is "…to provide long-term and short-term habitat to meet the needs of wildlife managed in balance with… livestock grazing…." The management emphasis and theme of DFC 12 areas (36% of the project area) is more wildlife centric than DFC 10 areas.

B. NUMBER AND VARIETY OF AFFECTED WILDLIFE SPECIES, AND HABITAT AND SURVIVAL ELEMENTS

A key message of this section is that, despite the large number and variety of wildlife species affected by sheep grazing, one minimum herbaceous retention level — if properly defined based on Forest Plan and other direction as informed by science — probably can suffice to provide for and retain suitable conditions for a large majority of wildlife species. This was the thrust of my reports… to wade through and synthesize available scientific information, in the context of Forest Plan and other direction, and come up with a singular threshold.

The herbaceous retention thresholds for wildlife involve at least 13 habitat and survival elements, divided between elements directly tied to the amount and types of herbaceous vegetation that remains ("I" in Figure 2) and elements that are tied to livestock grazing intensity but not directly affected by or related to herbaceous vegetation ("II" in Figure 2). Herbaceous retention is not just about forage for big game. It's not just about wildlife cover. A large number and variety of wildlife depend on or are associated with herbaceous vegetation for numerous life-history functions.

[B] This applies to coniferous forest rangelands (16-50 inches annual precipitation), sagebrush grasslands (8-12 inches annual precipitation), and mountain shrublands (16-50 inches annual precipitation). Holechek et al. (2011) is the textbook being used in rangeland management courses at the University of Wyoming.

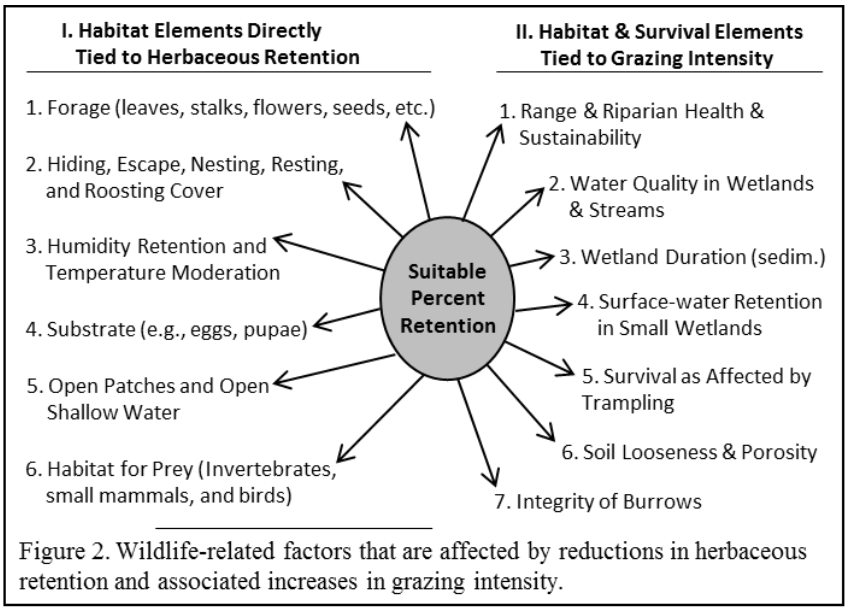


Figure 2. Wildlife-related factors that are affected by reductions in herbaceous retention and associated increases in grazing intensity.

Examples of wildlife that occur in the project area that can be affected by sheep grazing use, and specifically herbaceous retention levels. These are just examples; the full list is much longer.

Large Ungulates and Medium-size Herbivores

Mule deer	Moose	Porcupine	Mountain cottontail
Elk			

Small Herbivores

Montane vole	Long-tailed vole	Western harvest mouse	Pika
Meadow vole	Water vole	N. pocket gopher	

Vole-eating Predators		Generalists (that eat voles)	
Great gray owl	Northern harriers	Long-tailed weasel	Red-tailed hawks
Long-eared owl	American kestrel	Short-tailed weasel	Red foxes
Short-eared owl		Least weasel	Striped skunks

Insectivores

Preble's shrew	Silver-haired bat	Olive-sided flycatcher	Columbia spotted frog
Water shrew	Hoary bat	Willow flycatcher	Boreal toad
Masked shrew	Long-legged myotis	Tree swallows	Garter snake
Dwarf shrew	Big brown bat	Rough-winged swallow	
Vagrant shrew	Long-eared myotis		
Dusky shrew	Little brown myotis		
Pygmy shrew			

Seed Eaters and Nectar Eaters

White-crowned sparrow	Vesper sparrow	Cassin's finch	Br-tailed hummingbird
Chipping sparrow	Brewer's sparrow	American goldfinch	Calliope Hummingbird
Green-tailed towhee	Lazuli bunting	Pine siskin	

Pollinators and other Invertebrates

Numerous (many dozens to hundreds) species of pollinators
Numerous (many hundreds) other species of invertebrates

Increasing attention is being paid to food webs in conservation. As pointed out by Vander Zanden et al. (2006:165), "…food webs represent a way of thinking about an ecological system that considers trophic (consumer-resource) interactions among species or groups of similar species (trophic guilds or trophic levels)," thereby providing an established conceptual thought process for recognizing and building-in these indirect effects of herbaceous vegetation on wildlife. The importance of understanding food webs in the conservation of wildlife was recognized as far back as the 1930s, including the role insects play (e.g., Leopold 1939). Food webs are complex, and certainly are inherent in the need "To keep every cog and wheel" as "…the first precaution of intelligent tinkering" (Leopold 1938:213).

Increasing attention is being paid to the important roles that invertebrates prey in ecosystem functioning. Invertebrates are of fundamental importance to a wide range of ecological functions (e.g., pollination, decomposition and soil aeration, herbivory, a major food source) in riparian and rangeland systems. Most insects are either primary or secondary consumers and, therefore, are critical links in food webs (Krebs 1978, Brewer 1979, Ricklefs 1979, Evans 1984). Food-web and energy-pyramid illustrations demonstrate the pivotal role that invertebrates play in sustaining wildlife communities. Pollinators (e.g., moths, butterflies, bees, and some fly and beetle species) play a crucial role in sustaining healthy meadow plant communities (Samways 2005, National Research Council 2009), especially where forbs are a naturally predominant component of plant communities. Healthy and diverse invertebrate communities are central to sustaining numerous species of birds, bats, small mammals (e.g., shrews), reptiles, and amphibians.

C. MANAGEMENT DIRECTION

There are two Forest Plan requirements that are important in defining a suitable herbaceous retention level and prescribing maximum utilization limits:

1. Objective 4.7(d) qualitatively defines the desired condition for herbaceous retention, i.e., to retain an adequate amount of suitable forage and cover for wildlife. A major effort was put forth starting in 2008 to numerically define "suitable" forage and cover for wildlife.
2. The agency is required — during allotment management planning — to design utilization limits that will meet Forest Plan objectives, including objectives for wildlife. To meet wildlife objectives in the Forest Plan, the utilization limit must retain an adequate amount of suitable forage and cover for native ungulates, sensitive species, migratory birds, and other wildlife.

1. Upshot of Management Direction for Desired Herbaceous Retention for Wildlife

The upshot for desired herbaceous retention, at the level defined in the Forest Plan, Executive Order 13186, and the 2012 Planning Rule, is generally as follows:

> Retain an adequate amount of suitable forage and cover for native ungulates, sensitive species, migratory birds, small mammals, invertebrates, and other wildlife.

This is based on Forest Plan Objectives 2.1(a), 3.3(a), and 4.7(d); Fisheries and Wildlife Prescription; Range Vegetation Prescription; migratory bird requirements to "restore and enhance the habitat of migratory birds, as practicable" and to "Avoid or minimize the alteration of the environment and other adverse impacts on migratory birds" (Executive Order 13186, section 3); migratory bird conservation principles, measures, and practices; applicable Forest Service policy and guidance; and on direction in the 2012 Planning Rule. This management direction is outlined in more detail in sections 2.a, 2.c, 3.a-b, 4, and 5.a-b, below.

This general definition of desired herbaceous retention was stepped-down to a definition of desired herbaceous retention having greater specificity using a wealth of scientific information, as summarized in "E. Scientific Basis of Suitable Herbaceous Retention Levels," below.

2. Forest Plan

a. Forest Plan and Other Direction for Defining Desired Herbaceous Retention for Wildlife

The following Forest Plan direction heavily influenced the general characterization of desired herbaceous retention, above.

- Objective 4.7(d) calls for an adequate amount of suitable forage and cover to be *retained* for wildlife, as a desired condition. It addresses all wildlife, and fish and wildlife is defined as follows:

  > "Fish and Wildlife. Any nondomesticated member of the animal kingdom including, without limitation, any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, anthropod, or other invertebrate, and including any part, product, egg, or offspring, thereof, or the dead body or parts thereof" (WO Amendment 2600-2005-1, section 2670.5).

- Objective 2.1(a) calls for suitable habitat conditions to be provided for native ungulates, and retaining suitable forage is an important part of managing habitat for native ungulates (see page 242 of Forest Plan, and Wisdom and Thomas 1996, WAFWA 2009).

- Objective 3.3(a) calls for suitable habitat to be provided for suitable habitat for sensitive species and for sensitive species to be protected from activities (which includes protection from livestock trampling). For example: (1) retaining cover and protecting metamorphs and adults from trampling are important components of conserving sensitive amphibians (Loeffler et al. (2001, Hogrefe et al. 2005, Keinath and McGee 2005, Patla and Keinath 2005, Brown et al. 2015:74-75,49-50); and (2) retaining herbaceous cover for microtine voles in moist meadows and other openings associated with forests is central to conserving great gray owls (Winter 1986, Bull and Henjum 1990, Duncan and Hayward 1994:171, Greene 1995, Powers et al. 2011, Kalinowski et al. 2014).

- The Fisheries and Wildlife Prescription requires the provision of "…habitat adequate to meet the needs of dependent fish and wildlife populations, including those of threatened, endangered, and sensitive species." As outlined above, retaining herbaceous vegetation is an important part of providing habitat that is adequate to meet the needs of many wildlife species.

- The Vegetation: Range Prescription requires that forage be "…provided on a sustained-yield basis that protects rangeland values, wildlife habitat, and meets other resource needs and, for DFC 12 areas, particularly big game," emphasis added. As recognized by Objective 4.7(d), retaining forage and cover for wildlife is an important part of protecting wildlife habitat.

Where conflicts occur between efforts to meet different sets of Forest Plan objectives (e.g., objectives for wildlife and objectives for livestock grazing), "The conflicts are resolved by application of the different Desired Future Conditions to different areas of the National Forest" (USFS 1990:93,145). This means that if a DFC area emphasizes wildlife, as DFC 10 and 12 areas do, wildlife objectives apply.

- DFC 10 — The theme and management emphasis of DFC 10 (51% of the project area) are "An area managed to allow for some resource development and roads while having no adverse and some beneficial effects on wildlife" and "…to provide long-term and short-term habitat to meet the needs of wildlife managed in balance with… livestock grazing…"

  Applicable wildlife-related Forest Plan objectives are 2.1(a), 3.3(a), 4.7(a), 4.7(b), and 4.7(d).

- DFC 12 — The theme and management emphasis of DFC 12 (36% of the project area) are "An area managed for high-quality wildlife habitat and escape cover, big-game hunting, and dispersed

recreation" and "…providing such important habitat for big-game as winter ranges, feedgrounds, calving areas, and security areas…"

Applicable wildlife-related Forest Plan objectives are 2.1(a), 3.3(a), 4.7(a), 4.7(b), and 4.7(d).

b. Forest Plan and Other Direction for Prescribing Utilization Limits

Forest Plan direction for prescribing utilization limits to meet Forest Plan objectives is different than direction for defining desired herbaceous retention, but prescribing utilization limits is central to achieving desired herbaceous retention levels. One is the reciprocal of the other. In a given alternative, utilization limits must be coordinated with herbaceous retention.

Two requirements of the Forage Utilization Standard are (1) to prescribe, during allotment management planning, site-specific utilization limits needed to meet Forest Plan objectives; and (2) establish site-specific utilization limits on key wildlife ranges. This direction is reinforced by the requirements of the National Forest Management Act, specifically that "project-level decisions, which authorize the use of specific National Forest System lands for a particular purpose like livestock grazing, must be consistent with the broad programmatic direction established in the LRMP" (Section 91.1 of WO Amendment 2209.13-2005-10). Section 91.1 continues by clarifying that "Consistency is determined by examining whether the project-level decision implements the goals, objectives, desired conditions, standards and guidelines, and monitoring requirements from the LRMP. Where necessary, grazing permits must be modified to ensure consistency with the LRMP."

Although other facets of livestock grazing management (e.g., timing, duration of livestock grazing) are important factors that must be carefully prescribed, the maximum allowable utilization level is likely the most important factor, and it is specifically addressed in several ways in the Forest Plan.

Based on direction in the Forage Utilization Standard, utilization limits must be purposely designed to meet the following Forest Plan objectives for wildlife, among other Forest Plan objectives, relative to DFC direction:

- Objective 2.1(a) — Provide suitable and adequate habitat to support WGFD game and fish population objectives.
- Objective 3.3(a) — Protect sensitive species and provide an adequate amount of suitable habitat to ensure activities do not cause: (1) long-term or further declines in populations or habitats supporting these populations; and, (2) trends toward federal listing."

The onus is on Biologists to be able to demonstrate that a maximum utilization limit would result in suitable forage and cover being retained for sensitive species, big game, migratory birds, and other affected wildlife; if the biologist cannot demonstrate this, a lower utilization limit needs to be considered.

Note: Utilization limits can be designed, to some degree, to reduce or minimize (i.e., "protect") metamorph and adult frogs and toads, and possibly other sensitive species from being trampled by livestock.

- Objective 4.7(d) — An adequate amount of suitable forage and cover are retained for wildlife and fish.

Note: Wildlife includes native ungulates, sensitive wildlife species, migratory birds, and all other wild animal species as defined in the Forest Service manual.

During allotment management planning, the Forage Utilization Standard does not allow deference to be given to current utilization levels until monitoring data shows that current utilization levels are inadequate to meet wildlife needs. The standard is stated deliberatively and in the affirmative, both in terms of its requirement to "prescribe" utilization limits and "to meet" objectives.

As explained in the ROD for the Bridger-Teton National Forest Land and Resource Management Plan (Forest Plan), "…the first and most important part of the [Forest] Plan is…. Goals and Objectives" (USFS 1990a:6-7). The purpose of standards in the Forest Plan is to support the attainment of Forest Plan goals and objectives,

with standards being subordinate to Forest Plan goals and objectives (Forest Plan 1990a:6). Again, Section 91.1 of WO Amendment 2209.13-2005-10 states that "Consistency [of project-level decisions on livestock grazing] is determined by examining whether the project-level decision implements the goals, objectives… from the LRMP."

Where conflicts occur between efforts to meet different sets of Forest Plan objectives (e.g., objectives for wildlife and objectives for livestock grazing), "The conflicts are resolved by application of the different Desired Future Conditions to different areas of the National Forest" (USFS 1990:93).

- DFC 10 — The theme and management emphasis of DFC 10 (51% of the project area) are "An area managed to allow for some resource development and roads while having no adverse and some beneficial effects on wildlife" and "…to provide long-term and short-term habitat to meet the needs of wildlife managed in balance with… livestock grazing…"

  Applicable wildlife-related Forest Plan objectives: 2.1(a), 3.3(a), 4.7(a), 4.7(b), and 4.7(d)

- DFC 12 — The theme and management emphasis of DFC 12 (36% of the project area) are "An area managed for high-quality wildlife habitat and escape cover, big-game hunting, and dispersed recreation" and "…providing such important habitat for big-game as winter ranges, feedgrounds, calving areas, and security areas…"

  Applicable wildlife-related Forest Plan objectives: 2.1(a), 3.3(a), 4.7(a), 4.7(b), and 4.7(d)

c. Forest Plan Direction Applicable to Both Suitable Herbaceous Retention and Utilization Limits

A full listing of Forest Plan objectives, standards, prescriptions, and guidelines that provide direction for defining suitable herbaceous retention levels and for prescribing utilization limits to allow suitable wildlife habitat to be retained is as follows:

- Objective 2.1(a) — Provide suitable and adequate habitat to support the game and fish population objectives established by the WGFD.
- Objective 3.3(a) — Protect [Region 4] sensitive plant and animal species and provide suitable and adequate amounts of habitat to ensure that activities do not cause: (1) long-term or further decline in population numbers or habitats supporting these populations; and, (2) trends toward federal listing.
- Objective 4.7(d) — Require that an adequate amount of suitable forage are retained for wildlife and fish.
- Forage Utilization Standard (BTNF-wide) — …During AMP revision, the ID Team and livestock permittees will prescribe site-specific utilization levels needed to meet Forest Plan objectives… Site-specific utilization levels on key wildlife ranges will be established by an ID Team. ID Teams will prescribe other proper-use standards to achieve site-specific objectives for the rangeland being managed…
- Fisheries and Wildlife Prescription (BTNF-wide) — The BTNF provides habitat adequate to meet the needs of dependent fish and wildlife populations, including those of threatened, endangered, and sensitive species.
- Sensitive Species Management Standard (BTNF-wide) — …Crucial habitats of priority I, II, and III species as listed by WGFD and R4's sensitive species list will be protected and maintained…
- Habitat Diversity Guideline (DFC 2A) — Diverse fish and wildlife habitat types should be maintained in each watershed to provide sufficient habitat to meet WGFD population objectives and distribution of native wildlife including non-game, small game, big game, fish, and threatened and endangered species.
- Vegetation: Range Prescription (BTNF-wide) — Forage is provided on a sustained-yield basis that protects rangeland values, wildlife habitat, and meets other resource needs and, for DFC 12 areas, particularly big game.
- Allotment Management Plan Standard (BTNF-wide) — Fisheries; riparian habitats; and threatened, endangered, and sensitive species' needs will be addressed in allotment management plans. Findings from big-game winter range evaluations will be incorporated into allotment management plans as wildlife habitat objectives and management procedures. Plans will identify the amount and kind of streamside vegetation needed to maintain or improve riparian areas.

3. FSH (Guidance)

a. 91.1 - Consistency with Land and Resource Management Plan

Section 91.1 of WO Amendment 2209.13-2005-10 (Chapter 90) states that "Consistency [in allotment management planning] is determined by examining whether the project-level decision implements the goals, objectives, desired conditions, standards and guidelines, and monitoring requirements from the LRMP. Where necessary, grazing permits must be modified to ensure consistency with the LRMP" (see also, Forage Utilization Standard, above).

b. 92.11 - Identification of Desired Conditions

Section 92.11 of WO Amendment 2209.13-2005-10 provides the following direction for defining desired conditions:

> A team, using an interdisciplinary approach, identifies the desired conditions for rangelands and other related resources within the analysis area. Desired conditions should be specific, quantifiable, and focused. Desired condition statements have two distinct scales.
>
> 1. At the landscape scale, desired conditions are generally taken directly from the LRMP.
> 2. At the broad scale, desired conditions are then further described on a site-specific scale for reference areas.
>
> Monitoring can then tie to these reference areas as a means of determining progress toward meeting the desired conditions.

The first scale is addressed in "a. Generally-stated Desired Conditions for Herb Retention for Wildlife in the Forest Plan" under the section, "1. Forest Plan," above.

Desired conditions at the second scale are outlined in "3. Herbaceous Retention for Wildlife" in part II.A near the beginning of the report.

c. 92.23 - Proposed Action

Section 92.23.2 of WO Amendment 2209.13-2005-10 states that:

> A proposed action that includes authorization of livestock grazing shall also include the basic elements of an allotment management plan… The pertinent parts of an AMP include:
>
> b. Required livestock management practices including maximum amount of use in terms of allowable use levels to achieve management objectives.

4. 2012 Planning Rule

In the near future, wildlife and livestock grazing on the BTNF will need to be managed consistent with the 2012 Planning Rule (USDA 2012). This direction applies both to defining suitable and desired herbaceous retention levels and prescribing utilization limits to meet objectives. A key premise of the 2012 Planning Rule is that approximating conditions under which native wildlife-communities formed is fundamental to sustaining all native wildlife species and keeping common native species common:

> "The Department's intent in providing the requirements in this section is to provide for diversity of plant and animal communities, and provide ecological conditions to keep common native species common, contribute to the recovery of threatened and endangered species, conserve candidate and proposed species, and maintain viable populations of species of conservation concern within the plan area.

> The premise behind the coarse-filter approach is that native species evolved and adapted within the limits established by natural landforms, vegetation, and disturbance patterns prior to extensive human alteration. Maintaining or restoring ecological conditions similar to those under which native species have evolved therefore offers the best assurance against losses of biological diversity and maintains habitats for the vast majority of species in an area, subject to factors outside of the Agency's control, such as climate change..." (USDA 2012:21212)

As noted in the 2012 Planning Rule (USDA 2012:21212), the coarse-filter/fine-filter approach is a "well-developed concept in the scientific literature and has broad support from the scientific community…" Iverson (2001), including references to published literature, described the concept as it pertains to the Forest Service. Some of the published support for the approach includes Applet et al. (1999), Haufler et al. (1999), and Hughes et al. (2000).

5. Migratory Bird Requirements

In summary, Executive Order 13186 and USFS and USFWS (2008) require the following things — to extent permitted by law, within administrative budgetary limits, and in harmony with agency missions — (letters correspond to those in the "Summary of Requirements, minus qualifiers" column of Table 2):

a. Design and integrate migratory bird habitat and population conservation principles, measures, and practices into agency planning processes, plans, actions, and activities (there are three individual requirements for this).

b. Avoid or minimize the alteration of the environment and other adverse impacts on migratory birds.

c. Restore and enhance migratory bird habitat.

d. Lesson the amount of identified unintentional take through the application of principles, standards, and practices.

The direction outlined in Table 2 applies both to defining suitable and desired herbaceous retention levels and prescribing utilization limits to meet objectives.

Executive Order 13186 (Federal Register, Vol. 66, No. 11, 2001) outlines responsibilities of federal agencies to protect migratory birds under the Migratory Bird Treaty Act. As explained in the "Purpose and Scope of the MOU between the Forest Service and U.S. Fish and Wildlife Service (2008), "The Executive Order directs agencies to take certain actions to further comply with the migratory bird conventions, the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act (BGEPA), and other pertinent statutes… The purpose of this MOU is to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds…"

Many requirements outlined in Executive Order 13186 are incorporated by reference into USFS and USFWS (2008). For example, the MOU requires both agencies to "Protect, restore, and conserve habitat of migratory birds, addressing the responsibilities in Executive Order 13186." The applicable responsibilities identified in E. O. 13186 are outlined in Table 2. Note that the first responsibility starts with "support the conservation intent of migratory bird conventions…," and other responsibilities similarly use terms like "promote." To reduce the amount of text under each habitat/survival element, requirements of Executive Order 13186 are summarized in a-d in Table 2. Summaries do not include qualifiers (e.g., to the extent permitted by law).

Agency plans and planning processes, in Table 2, include "…forest and rangeland planning, coastal management planning, watershed planning, etc." Note the specific reference to rangeland planning.

Principles, measures, and practices identified in bird conservation plans are central to meeting migratory bird requirements. (The requirement to design and integrate migratory bird habitat and population conservation

Table 2. Migratory bird requirements outlined in Executive Order 13186 that are applicable to defining suitable conditions on livestock allotments, and summaries of these requirements.

Executive Order 13186 requires that all federal agencies, in accordance with its MOU and to the extent to which it is permitted by law, within administrative budgetary limits, and in harmony with agency missions:	**Summary of Requirements, minus qualifiers**
1. support the conservation intent of migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities	a. Design and integrate migratory bird habitat and population conservation principles, measures, and practices into agency planning processes, plans, actions, and activities.
…and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions;	b. Avoid or minimize the alteration of the environment and other adverse impacts on migratory birds.
2. restore and enhance the habitat of migratory birds, as practicable;	c. Restore and enhance migratory bird habitat.
3. prevent or abate the… detrimental alteration of the environment for the benefit of migratory birds, as practicable;	see "b," above.
4. design migratory bird habitat and population conservation principles, measures, and practices into agency plans and planning processes (…including, but not limited to, forest and rangeland planning, coastal management planning, watershed planning, etc.) as practicable…;	see "a," above.
5. [several qualifiers]… ensure that agency plans and actions promote programs and recommendations of comprehensive migratory bird planning efforts such as Partners-in-Flight, U.S. National Shorebird Plan, North American Waterfowl Management Plan, North American Colonial Waterbird Plan, and other planning efforts, as well as guidance from other sources…" (e.g., see Objectives and Recommendations in Wyoming Partners in Flight (2003) and Goals and Objectives in Intermountain West Joint Venture (2005:15-20)).	see "a," above.
6. [addresses NEPA analysis]	n/a
7. [addresses permits for intentional take]	n/a
8. [addresses intentional take]	n/a
9. identify where unintentional take reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect on migratory bird populations, focusing first on species of concern, priority habitats, and key risk factors. With respect to those actions so identified, the agency shall develop and use principles, standards, and practices that will lessen the amount of unintentional take, developing any such conservation efforts in cooperation with the Service. These principles, standards, and practices shall be regularly evaluated and revised to ensure that they are effective in lessening the detrimental effect of agency actions on migratory bird populations. The agency also shall inventory and monitor bird habitat and populations within the agency's capabilities and authorities to the extent feasible to facilitate decisions about the need for, and effectiveness of, conservation efforts;	d. Lesson the amount of identified unintentional take through the application of principles, standards, and practices.
10 - 15. n/a to identification of suitable conditions.	n/a

principles, measures, and practices into agency planning processes, plans, actions, and activities is repeated in three of the 15 requirements of Section (e) of Executive Order 13186.) Pertinent principles, measures, and practices identified in pertinent bird conservation plans are listed in the "Management Direction" section of each of the 11 (I – XI) habitat / survival elements.

With respect to requirements items 1-5 (as summarized in a-c) in Table 2, the focus of habitat restoration and conservation is natural habitats and ecosystems (e.g., the Convention for the Conservation of Migratory Birds and Their Environment-Union of Soviet Socialist Republics 1978), which aligns well with the 2012 Planning Rule's focus on the same thing.

As pointed out by the Regional Office (USFS 2012:7), "Importantly, the MOU directs the agencies to, 'focus on habitat restoration and enhancement where actions can benefit specific ecosystems and the migratory birds dependent on them…'"

Paragraph 'f' of Section 3 of Executive Order 13186 states that, "Notwithstanding the requirement to finalize an MOU within 2 years, each agency is encouraged to immediately begin implementing the conservation measures set forth above in subparagraphs (1) through (15) of this section, as appropriate and practicable." This means that the conservation measures in subparagraphs (1) through (15) would need to be carried out even if the MOU expires without replacement.

D. Principles of Wildlife Ecology and Conservation

A principle of wildlife management, as defined in the *Principles of Wildlife Management* text by Bailey (1984:6), is "a widely accepted generalization based on abundant and diverse research and experience and having wide application for managing wildlife."

Executive Order 13186 and the 2008 MOU between the Forest Service and U.S. Fish and Wildlife Service emphasized that the importance of the Forest Service designing and integrating migratory bird habitat and population conservation principles, measures, and practices into agency planning processes, plans, actions, and activities, specifically including range management planning (see "5. Migratory Bird Requirements," above).

Being consistent with principles of wildlife management and ecology is important in making sound professional judgements (16 USC 668dd, section 5, paragraph 3).

1. General Principles of Wildlife Management and Conservation

The first four principles apply to the desired plant species composition and all five apply to the desired condition for herbaceous retention and the utilization limits. Many of the principles, measures, and practices in subsection '2', below, were incorporated into the following general principles.

> **Principle A.1. Wildlife need habitat in suitable condition** — A long-standing basic principle of wildlife management is that wildlife populations and communities require an adequate amount of suitable habitat to be sustained (Leopold 1933, Dasmann 1981, Burger 1979, Kie et al. 1994, WGFD Staff 1995, Peek 1986, Morrison et al. 1998), and this is recognized in range management (Holechek et al. 2011). Key elements of habitat are food, water, cover from predators and adverse weather, nesting or denning sites, and interspecific competition (Peek 1986, Kie et al. 1994, Morrison et al. 1998). In some cases, insufficient cover may contribute to increased predation and in other cases, behavior of wildlife may inhibit their use of the area with insufficient cover. In discussing basic concepts concerning wildlife habitat, Holechek et al. (2011:283) stated "Wildlife populations are regulated by the availability of food, water, and cover, the basic components of wildlife habitat." If basic habitat elements preferred or required by a particular wildlife species or group of species are absent or of insufficient quality in a given area, this species or group of species will not exist or will exist in lower

numbers, depending on the extent of unsuitability. Providing suitable habitat for wildlife is a fundamental underpinning of Forest Plan objectives for wildlife (USFS 1990a)

Principle A.2. Sustaining a full complement of wildlife species requires sustaining habitat that is suitable for native wildlife communities as a whole — The only realistic way to sustain the full complement of native wildlife species on a given landscape over the long term is to approximate, at a landscape scale, habitat conditions within the natural range of variability, which may involve actively managing habitat to mimic key elements of natural systems and allowing natural processes to shape and sustain other habitat elements (Reid and Miller 1989, Keystone 1991, Franklin 1993, Noss and Cooperider 1994, Hunter 1996, Applet et al. 1999, Haufler et al. 1999, Hughes et al. 2000, Iverson 2001, Cooperrider 2002, Samways 2005). There are far too many unknowns to attempt to manage for the needs of each individual species of group of species if the ultimate goal is to maintain viable populations of all native species. This is a major underlying premise of the 2012 Planning Rule.

Principle A.3. All changes to habitat have positive and negative effects on wildlife — Changes in habitat have positive effects on some wildlife species and negative effects on other species (Bailey 1984, Peek 1986, Severson 1990, Kie et al. 1994, Krausman 1996). This is a consequence in large part of the very wide range of habitat preferences and needs of wildlife. The same change that positively effects on one or more species will negatively affect other species, making it critical to evaluate these effects in the context of sustaining the full complement of wildlife species (see previous principle). Documented positive effects on a given aspect of a wildlife species' natural history does not necessarily mean that the effect is needed or that it translates into population level effects. Given the large number of effects of any change, this principle adds to the importance of Principle A.2 as a general guiding principle.

Principle B.1. Livestock grazing use has positive and negative effects on wildlife — Livestock grazing/browsing has been shown to positively affect some wildlife species during certain life-history stages in particular habitats and more holistically in other species (e.g., at the population level), and it has been shown to negatively affect other wildlife species during certain life-history stages in particular habitats and more holistically in other species (Leopold 1933, University of Idaho 1981, Severson 1990, Kie et al. 1994, Krausman 1996, Peek 1996, Holechek et al. 2011). Positive and negative effects need to be considered in the context of principles A.1, A.2, and A.3, as well as principle B.2. In particular, they need to be considered in the context of the conditions under which native wildlife-communities formed.

Whether livestock grazing/browsing positively or negatively affects a given wildlife species in a given area depends on wildlife habitat requirements, timing of these requirements, and tolerance to shorter/sparser vegetation relative to the forage utilization rate, use of particular features of herbaceous vegetation used by wildlife relative to the parts eaten by livestock, timing and duration of grazing, among other factors. Consistent with Principle A.3, virtually any level, timing, and duration of livestock grazing use will benefit some species and will negatively affect other species.

Whether livestock grazing/browsing positively or negatively affects a native wildlife community as a whole (i.e., wildlife community that formed or evolved in an area prior to Euro-American settlement) depends primarily on the extent to which the community was formed with grazing/browsing pressure, the timing and frequency of this pressure, the extent to which the existing native grazing guild exerts grazing/browsing pressure (relative to pre-Euro-American levels), and the extent to which livestock grazing use can effectively fill-in any of the unfilled gaps of native ungulates (Van Vuren 1981, Mack and Thompson 1982, Burkhardt 1996, Severson 1990, Miller et al. 1994, Noss and Cooperrider 1994, Hunter 1996, Lubinski 2000; see Principle A.2), regardless of positive and negative effects on individual species (see Principle A.3). As with Principle A.3, given the large number of effects of livestock grazing on wildlife and the many unknowns, this principle adds to the importance of Principle A.2 as a general guiding principle.

Principle B.2. The amount and quality of forage and cover for most wildlife species inhabiting riparian, wetland, and rangeland habitats on allotments is inversely related to the level of forage utilization by livestock — This principle involves one aspect of Principle B.1, above, and it addresses one specific element of Forest Plan direction:

> Context: Objective 4.7(d), applicable only to livestock allotments, focuses on the amount and quality of wildlife forage and cover retained during the livestock grazing season, and the Forest Plan focuses on addressing resource problems, including inconsistencies between livestock grazing use and achieving wildlife objectives. The opening sentence of the Forest Plan is to "solve or prevent serious problems associated with existing natural resources and people's continuing use of them," thereby emphasizing the resolution of resource problems while continuing sustainable use of resources. Under one of the four major problem categories, one of the "Forest Challenges" is to avoid unacceptable effects of livestock grazing use (USFS 1990a:82). "Overuse of the range by livestock, including pack and saddle stock, can cause unacceptable loss of other resources. The challenge is to manage the levels and locations of grazing livestock to maintain or enhance resource values… Livestock grazing is managed to limit effects on other resources." While most effects of livestock grazing use on habitat conditions on the allotments in the Greys River and Kemmerer Ranger District likely are the result of historic livestock grazing practices, current and future livestock grazing use has the potential to affect wildlife habitat.

A large number and variety of wildlife species depend on different parts of herbaceous plants for forage (directly or indirectly, e.g., some wildlife depend on insects, some of which rely on particular plant parts), and an equally large number and variety of wildlife species depend on tall, dense herbaceous vegetation or moderately dense herbaceous vegetation. This is based on a large volume of published literature, some of which is cited in this report. For many species that depend on plant parts preferred by livestock and for those that depend on tall, dense herbaceous vegetation, forage/cover begins to decline with the first bites and steps taken by livestock in a given area, although the effects are negligible and immeasurable at the early stage of grazing in a given area. As assessed by Holechek et al. (2011), "Livestock affect wildlife habitat directly by removing and/or trampling vegetation that could otherwise be used for food and cover." However, in the early stages of livestock grazing in tall, dense herbaceous vegetation, small microsite openings are created, which may benefit some wildlife species (e.g., spotted frogs, white-crowned sparrow) until the tall, dense characteristics of the vegetation begins to decline (Kie and Loft 1990, Severson 1990, Chilton et al. 1995, Watson et al. 2003, Holechek et al. 2011). At some point along the continuum of grazing utilization, which spans from 0% to 100% utilization, the amount of forage and cover begins to decline more rapidly as grazing progresses. The rate of decline then slows at some point along the continuum as insufficient forage and cover are left.

In considering this principle, one must also consider Principles A.3 and B.1, specifically that some wildlife species and groups of species benefit from higher levels of grazing up to and including heavy and severe grazing pressure. These species, however, are not addressed in Objective 4.7(d) with its emphasis on *retaining* forage and cover for wildlife during the livestock grazing process.

2. Migratory Bird Conservation Principles, Measures, and Practices

Some of the principles and practices in the Wyoming Partners in Flight Plan (2003) that apply to defining suitable herbaceous retention levels for migratory birds in riparian areas are as follows. The generally-defined desired condition for herbaceous retention is based in part on these principles and practices.

- "Ensure adequate residual vegetation cover is left after grazing; this is essential for maintaining wetland ecosystem health" (pg. 96).

- "Defer livestock grazing until after the breeding season in pastures that contain wetlands important to breeding birds. Idle grasslands near wetlands and previously grazed areas provide habitat for nesting, but areas with cattle present during the breeding season are less suitable" (pg. 97).
- "Relatively few bird species breed in meadows, yet they are important foraging areas for members of adjoining avian communities, particularly those in forest and riparian habitats. In the fall, montane meadows become important to both resident and migratory birds because of the abundant populations of insects, which peak late in the season" (pg. 136).
- "Identify and protect those habitats that still have a thriving community of native grasses and forbs. Management should focus on restoring natural disturbance processes, such as fire, and removing invasive nonnative plants" (pg. 137).
- "Maintain small mammal and insect populations as prey for many bird species" (pg. 137).
- "Manage for a variety of locally native plants. Different plant species host different insect populations, which provide food for a variety of bird species" (pg. 137).
- "Ensure adequate residual vegetation cover is left after grazing; this is essential for maintaining meadow health" (pg. 139).
- "Identify and protect those habitats that still have a thriving community of native understory and sagebrush plants" (pg. 277).
- "…maintain small mammal populations as prey for many bird and mammal predators" (pg. 278).
- "Perennial bunchgrasses and native forbs provide food and cover for many sagebrush birds" (pg. 282).
- "Maintain native forb diversity. Forbs are extremely important to the diets of Greater Sage-Grouse broods, pronghorn antelope, and other wildlife" (pg. 282).

  This includes *functional* diversity; i.e., the diversity of plant material after being grazed.
- "Allow herbaceous cover to conceal nests through the first incubation period for birds that nest on the ground or low in shrubs. Maintain the current season's growth through mid-July, and manage for 50% cover or more of the annual vegetative growth to remain through the following nesting season" (pg. 283).
- "Maintain herbaceous cover for nest concealment by protecting the current season's growth through the nesting season [e.g., through July 20] and by managing for at least 50% of annual vegetative growth to remain through the following nesting season" (pg. 372, 475; Brewer's sparrows, vesper sparrows).
- "Within shrublands where Vesper Sparrows nest, maintain grass height of 6 to 12 inches (15 to 30 cm), 6 to 24% bare ground, 10 to 20% shrub canopy cover, and territory size of about 5 acres (2 ha) per pair" (pg. 475).
- "Maintain vole and other small mammal populations as a food source for Northern Harriers" (pg. 503).
- "Protect undisturbed habitat in which annual vegetation and successional plants can grow and dead vegetation is not removed" (pg. 503).
- "Manage grazing in wet meadows and wetland pastures at low levels, especially during dry years, to maintain nesting cover for Northern Harriers" (pg. 503).
- "Implement wetland and grassland management techniques that provide extensive areas [at least 250 acres (100 ha)] of tall, dense grasses and emergent vegetation in areas where Northern Harriers occur. Nests have been found in areas where the vegetation ranges in height from 1 to 7 feet (30 cm to 2 m)" (pg. 503).

E. SCIENTIFIC BASIS OF SUITABLE HERBACEOUS RETENTION LEVELS

This section applies first-and-foremost to defining suitable herbaceous retention levels, but also applies to prescribing utilization limits since utilization is the flip-side of retention. The focus is on herbaceous retention since this is what provides habitat for wildlife and because this is the focus of Objective 4.7(d).

1. Introduction

In general terms, the purposes of establishing desired retention levels on livestock allotments, from the standpoint of wildlife, are to (1) maintain the capability to annually produce the vegetation that is needed to provide for the needs of wildlife, (2) retain an adequate amount of suitable forage and cover for wildlife, and (3) provide some level of protection to sensitive amphibians, bird nests, and other small wildlife from direct effects of livestock grazing (e.g., trampling). The scientific basis of the first is outlined in the section on plant species composition (see "Basis of Recommended Changes to Desired Plant Species Composition and Ground Cover"). The scientific basis of the second and third are outlined below.

A large amount of scientific information has been reviewed over the last ten years in the process of determining a low-end herbaceous-retention threshold for wildlife (i.e., a minimum low-end threshold for meeting Objectives 4.7(d), 2.1(a), and 3.3(a) with respect to herbaceous retention and protecting sensitive species from direct effects of activities). An attempt was made to minimize references to specific scientific papers and texts in this report. Many of the assessments in this report are based on reviews of scientific information in four BTNF-specific reports: DeLong (2009a), DeLong (2012), DeLong (2015), and DeLong (2016). These reports go well beyond any published scientific literature reviews on this topic.

a. Crosswalk

A crosswalk between retention/use of key forage species and retention/use of total herbaceous vegetation is needed (Appendix A). While utilization limits based on key forage species is useful for ensuring that favored forage species are not over-used, it has no more than limited usefulness for wildlife since most wildlife species dependent on or associated with herbaceous vegetation key in on other aspects of the vegetation. Retention is most useful for wildlife issues because wildlife use what remains, not what is removed.

Converting percent retention of key forage species (KFS) to percent retention of total herbaceous vegetation (THV) and visa versa are matters of simple mathematics. Going in either direction, there are three variables:

From Ret'n of KFS to Ret'n of THV:	From Ret'n of THV to Ret'n of KFS:
1. Percent retention of KFS	1. Percent retention of THV
2. Percent retention of non-KFS	2. Percent retention of non-KFS
3. Composition of key forage species in the plant community (by weight)	3. Composition of key forage species in the plant community (by weight)

While Smith et al. (2007) used slightly different terms and took a slightly different approach, their report provides a published report by range professionals that describes the basic approach used in the crosswalks provided at the end of this report. The graph provided in USDA (1981) (see Figure A.1 in Appendix A) is outdated and only provides a crosswalk for plant communities that have the same composition of key forage species as was used to build the graph, and it likely did not account for any use of non-key-forage species.

2. Basis of 70% Herbaceous Retention Threshold for Suitable Habitat for Wildlife

The basis summarized below is outlined in more detail in several reports (DeLong 2009a, DeLong 2012, DeLong 2015, and DeLong 2016). The reports provide a more in-depth examination of applicable management direction, and several hundred scientific papers and books were reviewed and synthesized. No attempt was made to reference the large number and wide range of scientific papers and books in this summary.

At its most basic level, the process of determining a minimum herbaceous-retention threshold involved starting at near-100% retention and incrementally working downward in retention levels (see downward-pointed arrow in Figure 3) as scientific information demonstrated that (1) suitable herbaceous habitat would be retained, (2) impacts to other related factors (e.g., water quality, surface water retention, survival as influence by trampling) would remain within acceptable limits, and ultimately (3) Forest Plan Objectives 2.1(a), 3.3(a), and 4.7(d), Fisheries and Wildlife Prescription, migratory bird requirements, and 2012 Planning Rule would still be met. At the retention level where it could no longer be demonstrated that these criteria would be met at least to a moderate degree of confidence, the process was stopped and the next higher herbaceous retention level was identified as the minimum suitable herbaceous retention level.

A minimum 70% retention of herbaceous vegetation and max. 60-70% retention of key forage species is needed to meet Forest Plan Objectives 2.1(a), 3.3(a), and 4.7(d); Fisheries and Wildlife Prescription; migratory bird requirements (including principles and practices); and 2012 Planning Rule, based on available scientific information. This is based on a-f, below:

a. An impetus behind defining a minimum herbaceous retention was to define a retention level that met wildlife-related Forest Plan objectives and migratory bird requirements while providing forage for livestock.

   If it were not for grazing of vegetation by livestock, there would be no need to have identified a minimum herbaceous retention threshold. And, if a threshold were identified that did not need to accommodate livestock grazing, it likely would have been set in the neighborhood of 85-95%, as measured in July – September.

   The minimum 70% herbaceous retention and minimum 60-70% retention of key forage species reflects somewhat of a balance between no livestock grazing (best scenario for wildlife) and the highest possible level of grazing that can be sustained over the long term (Figure 1), except that, if a maximum 30-40% use of key forage is needed for sustainable livestock grazing (Holechek et al. 2011), then the minimum 70% herbaceous retention and 30-40% maximum use for livestock are one-in-the-same. "Somewhat" is used because 70% retention is skewed more toward range management than toward ideal wildlife habitat. Furthermore, for some wildlife species and groups of species, 80% herbaceous retention is the most defensible minimum threshold for suitable habitat (DeLong 2009a, DeLong 2012, DeLong 2015; and see Figure 3).

b. Some studies and scientists directly address suitable herbaceous retention or utilization, and these generally support a minimum 70% herbaceous retention and minimum 60-70% retention of key forage species, although some studies show that a higher retention level is needed to support some natural-history functions of some groups of species.

   The following are recommendations and results of studies for a range of retention levels, starting with 50% retention of herbaceous vegetation:

   Direct support of a minimum 50% herbaceous retention:

   - "Maintain herbaceous cover for nest concealment by protecting the current season's growth through the nesting season [e.g., through July 20] and by managing for at least 50% of annual

vegetative growth to remain through the following nesting season" (Wyoming Partners for Flight 2003:372 and 475, for Brewer's sparrows and vesper sparrows). The conservation plan also recommended that "Within shrublands where Vesper Sparrows nest, maintain grass height of 6 to 12 inches…"

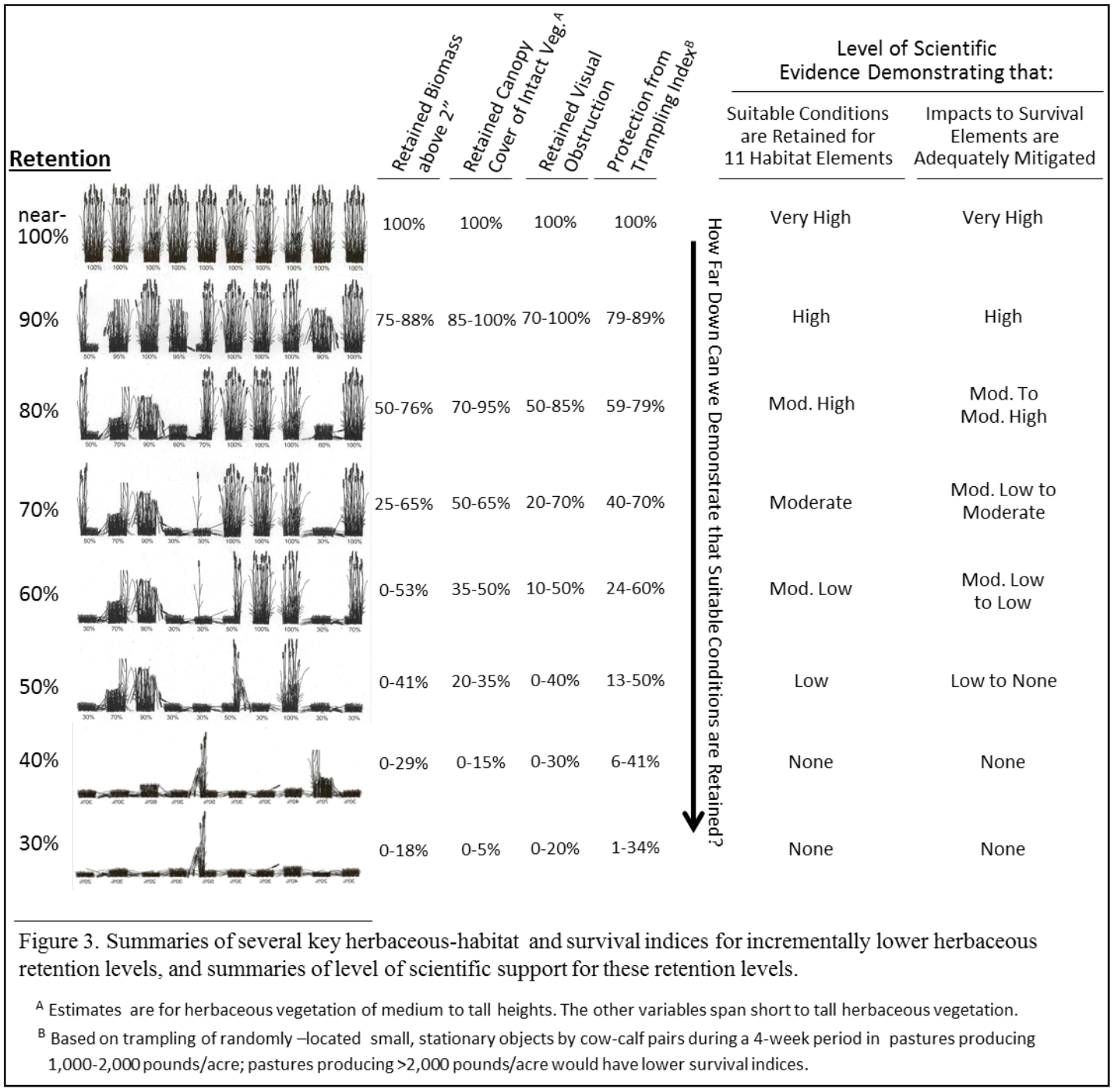


Figure 3. Summaries of several key herbaceous-habitat and survival indices for incrementally lower herbaceous retention levels, and summaries of level of scientific support for these retention levels.

[A] Estimates are for herbaceous vegetation of medium to tall heights. The other variables span short to tall herbaceous vegetation.

[B] Based on trampling of randomly –located small, stationary objects by cow-calf pairs during a 4-week period in pastures producing 1,000-2,000 pounds/acre; pastures producing >2,000 pounds/acre would have lower survival indices.

- Johnson et al. (2012) did not detect changes in depredation rates of horned lark and savannah sparrow nests where grazing use was measured at 28% and 54% use of herbaceous vegetation (72% and 46% herbaceous retention). However, there is only weak evidence because Johnson et al. (2011) did not find evidence of any grazing effects on visual obstruction at their nest sites (i.e., little actual grazing at nest sites), and Johnson et al. (2012) left out species for which Johnson et al. (2011) found evidence that grazing did reduced visual obstruction at the nest site (vesper sparrows and western meadowlarks). Also, horned larks select nest sites with short vegetation and high percent bare ground.

Direct support of a minimum 60-70% retention of key forage:

- WAFWA (2009) recommended limiting use of key forage to 30-40% to retain suitable forage for mule deer. The Western Association of Wildlife Agencies document was authored by 14 biologists representing 7 western states.
- Wisdom and Thomas (1996) recommended limiting use of key forage species to 40% to retain forage for elk.

Direct support of a minimum 70% or 80% herbaceous retention:

- Several studies consistently show that microtine vole densities declined when herbaceous retention levels dropped to roughly 60% ±10% (Birney et al. 1976, Edge et al. 1995, Batzli et al. 1999) (Figure 4), when herbaceous height excluding seedheads dropped below about 12 inches (Kie and Loft 1990, Greene 1995, Kalinowski et al. 2014), and when herbaceous vegetation dropped below about 3,500 pounds/acre (Birney et al. 1976). Although retention or utilization limits were not specifically examined in the first set of studies, sufficient information (e.g., changes in vegetation height) was provided to estimate percent herbaceous retention relative to height-weight relationships in Kinney and Clary 1994 and BLM et al. 1999:118). In grazed areas studied by Greene (1995), sites occupied by voles averaged about 13.2 inches and sites unoccupied by voles averaged 9.2 inches. See DeLong (2012) for more discussion. (see also Figure 5)
- Microtine voles are central to sustaining several species of raptors, and Johnson and Horn (2008) and Wheeler (2008) found that livestock grazing reduced herbaceous height, which reduced vole densities, which in turn reduced vole-dependent raptor densities (one of these involved sheep grazing) (Figure 5). Reductions in herbaceous height translated to herbaceous retention of an estimated 55-75% and 70-85%, respectively. Similar results were found with herbaceous height, voles, and red fox which is a generalist predator (Villar et al. 2013).
- In managing meadow habitat for great gray owls, Kalinowski et al. (2014:555) stated that, "If cattle grazing takes place in meadows managed for vole habitat, we recommend maintaining sward heights of at least 290mm [12 inches] on sites that are not dominated by corn lily."
- To provide habitat needs of goshawk prey, Reynolds et al. (1992) recommended that utilization of grasses and forbs average no higher than 20% and not exceed 40% in any given area.
- Munger (1994:4) found that "Sites with adult spotted frogs had a significantly lower rating for evidence of grazing (an average of 0.769 on a scale of 3) than did sites without adults (average rating 1.262)," and the rating of 1.262 appears to translate to an average herbaceous retention level in the vicinity of 80% (DeLong 2015:A-103). They inventoried a total of 204 wetland/stream sites in southwest Idaho and observed adults or tadpole Columbia spotted frogs at 44 of these sites.
- Roche et al. (2012a), Roche et al. (2012b), and McIlroly et al. (2013) found no detectable effects of a maximum 40% use by cattle on Yosemite toad breeding pool habitat, adult toad occupancy, and tadpole densities. However, all response variables were measured at breeding pools, except that adult toads were surveyed away from breeding pools; however (1) utilization near breeding

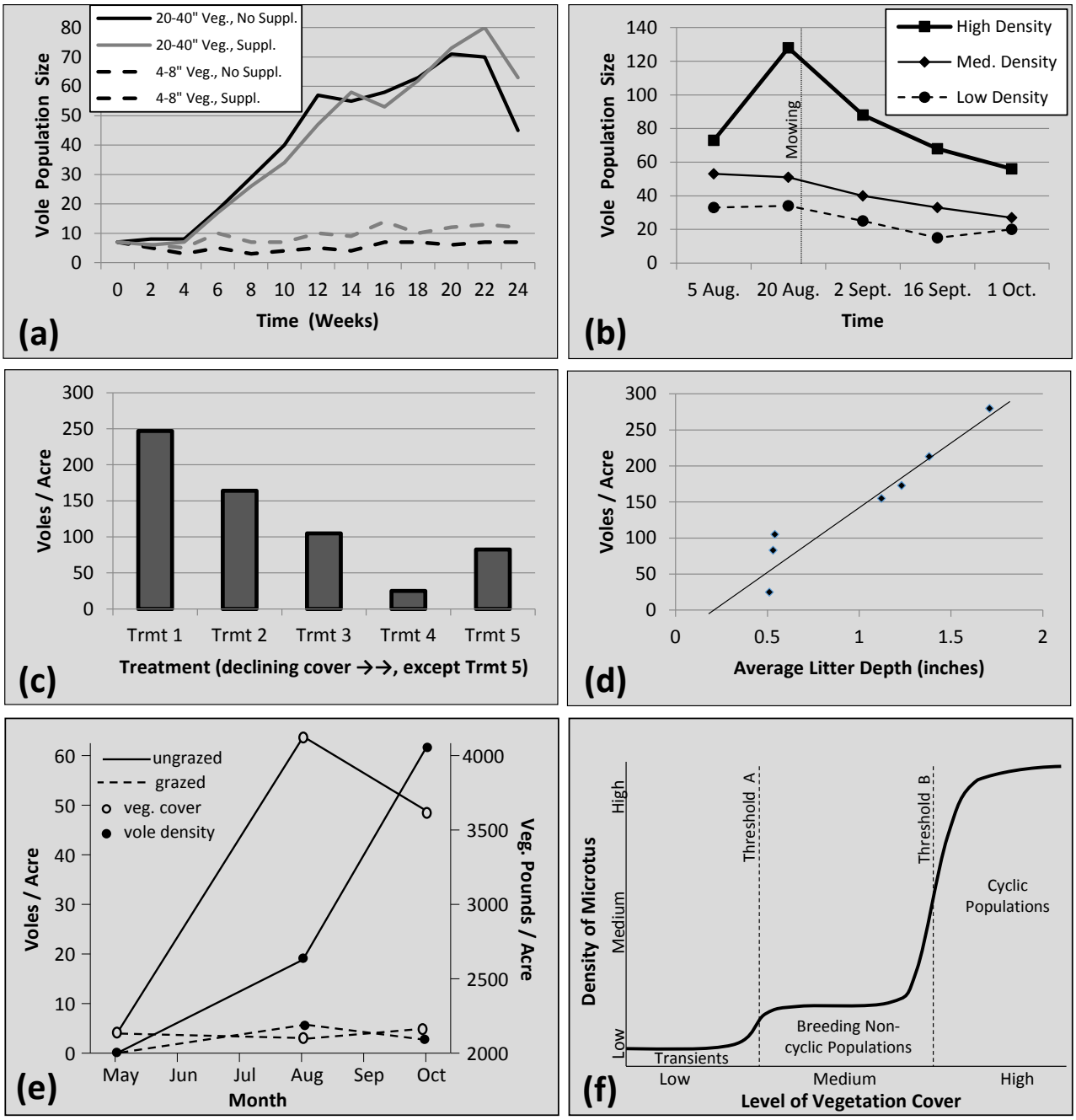


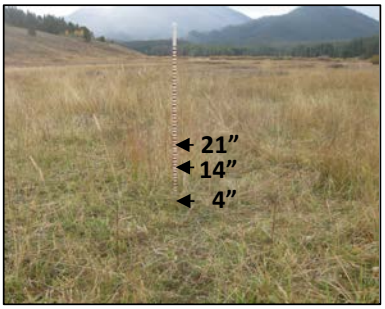
Figure 4. Results of studies on (a) meadow voles by Batzli et al. (1999); (b) gray-tailed voles by Edge et al. (1995); (c,d) meadow, montane, and pine voles by McAninch (1978); and (e) prairie voles by Birney et al. (1976). The last graph (f) is a schematic representation of the "cover level hypothesis" by Birney et al. (1976). Meadow and montane voles occur on the Bridger-Teton National Forest, but gray-tailed, pine, and prairie voles do not. In the study by Batlzi et al. (1999), 4-8 inch stubble height (an estimated 50-80% retention compared to un-mowed heights of 20-40 inches). In the study by Edge et al. (1995), alfalfa was mowed to less than 3.15 inches tall (an estimated 45-70% retention), but residue was not removed. In the study by Birney et al. (1976), approximately 50-55% of herbaceous vegetation was retained in the grazed area (graph e).

In the study by McAninch (1978), Trmt 1 = fields mowed in 1976 but not in 1977, Trmt 2 = fields mowed in May 1977, Tmt 3 = field mowed in early June and mid July 1977, Trmt 4 = field mowed and bailed in early June and mid July 1977, and Trmt 5 = field unmowed, but substantially different plant community (relatively sparse, 0.5" litter depth); all other fields were of the same plant community type. Voles were trapped in all fields in August 1977. Unmowed vegetation heights were about 20-24 inches, and mowed heights were likely approximately 4 inches, which translates to about 40-60% retention of herbaceous vegetation, except that cut material remained where it was cut except for Trmt 4 which was bailed.

A.1

High-producing meadows produce an estimated 3,000-5,000 lbs/acre, and many moist meadows dominated by native species typically produce vegetation cover >12 inches tall and >3,500 lbs./acre *(Mueggler and Stewart 1980, Youngblood et al. 1985, Padgett et al. 1989, Kovalchik 1987)*.

A.2



Livestock grazing in moist meadows and similar habitats reduces vegetation height and functional canopy cover. Visual obstruction starts to drop rapidly when herbaceous retention drops below about 80%, and declines by 60-100% by the time herbaceous retention drops to 50%.

B.1

Microtine voles play a disproportionately large role as an abundant food source *(Bailey 1924, Andersson and Erlinge 1977, Pearson 1985, Rose and Birney 1985, Baker and Brooks 1991, Grant et al. 1991, Korpimäki 1994, Sundell et al. 2004)*.

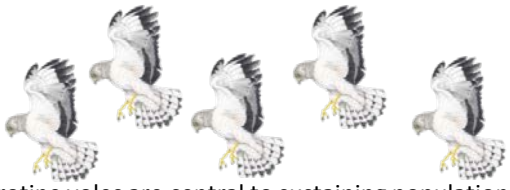
Microtine voles depend on relatively-tall, dense herbaceous vegetation *(Brown 1967, Grant et al. 1982, Winter 1986, Belk et al. 1988, Medin and Clary 1990, Duncan 1997, and Giuliano and Homyack 2004)*. Vegetation ≥12 inches and ≥3,500 lbs/acre is needed for high densities (*Birney et al. 1976, Key and Loft 1990, Greene 1995, Kalinowski et al. 2014*).

B.2

Microtine vole densities decline as grazing increases *(Winter 1986, Medin and Clary 1990, Fagerstone and Ramey 1996, Duncan 1997, Torre et al. 2007, Johnson and Horn 2008, Rickel 2008).*

Microtine vole densities begin dropping rapidly in the vicinity of about 80% herbaceous retention (and below a height of about 12 inches), and by the time herbaceous retention drops to about 50%, vole densities are low *(Birney et al. 1976, McAninch et al. 1978, Edge et al. 1995, Greene 1995, Batzli et al. 1999, Johnson and Horn 2008, Kalinowski et al. 2014, Evans et al. 2015).*

C.1



Microtine voles are central to sustaining populations of long-eared owls, short-eared owls, and northern harriers, and, in some areas, great gray owls *(Lockie 1955, Wijnandts 1984, Pearson 1985, Village 1987, Holt and Leasure 1993, Duncan and Hayward 1994, Marks et al. 1994, MacWhirter and Bildstein 1996, Sulkava and Huhtala 1997, Wiggins 2004a, Slater 2005, Wheeler 2008)*. Some species require high vole densities for successful nesting.

C.2

It is well established that reductions in the prey base causes reductions in raptor abundance and reproductive success *(Village 1982, Newton et al. 1986, Village 1987, Redpath et al. 2002, Newton 2003, Thirgood et al. 2003, Sundell et al. 2004)*.

Declines in microtine vole densities reduce raptor reproductive success and abundance *(Lockie 1955, Village 1982, Wijnandts 1984, Village 1987, Dunk and Cooper 1994, Redpath et al. 2002, Newton 2003, Sears 2006, Hipkiss et al. 2008, Johnson and Horn 2008, Beemster and Vulink 2013).*

Figure 5. The above cited studies, in combination, show how owls and raptor populations are affected through changes in microtine vole densities caused by reductions in herbaceous vegetation.

Three landscape-scale studies demonstrate cause-and-effect through all of these trophic levels (food-web links) simultaneously. Johnson and Horn (2008) and Wheeler (2008) showed that microtine vole densities declined due to 25-45% and 15-30% use of total herbaceous vegetation, respectively (i.e., 55-75% and 70-85% retention) in grazed areas, and that vole-specialist raptor densities declined in response to reductions in microtine vole densities. Villar et al. (2013) found the same relationships between vegetation, microtine voles, and red foxes (a generalist predator). Also, Amar et al. (2011) and Beemster and Vulink (2013) found that vole-eating raptors declined over the long term in response to livestock grazing that maintained vegetation too short to sustain high densities of microtine voles.

wetlands was probably less than 15%, (2) adults were only surveyed in meadow habitat through July and actual use by cattle was only measured in September in the corresponding study, and (3) utilization by cattle at the end of July was likely ≤25% across meadows in this study based on the other studies in the study area (see DeLong 2015 for more detail).

- Several studies on spotted frogs and other frog species showed that even relatively-low use rates of herbaceous vegetation (as low as 15-25%) can adversely affect various aspects of their ecology (Shovlain 2006, Schmutzer et al. 2008, Burton et al. 2009), except possibly for some species of toads (Burton et al. 2009).

Direct support of a minimum 85-95% herbaceous retention (i.e., no grazing use by livestock):

- All of the many dozens of studies on effects of livestock grazing on waterfowl nesting, except for a one or two, have demonstrated that livestock grazing adversely affects nest densities and nest success, with negative effects beginning at relatively low levels of grazing (Braun et al. 1978, Kirsch et al. 1978, Gilbert et al. 1996, Bloom et al. 2013). Even small reductions in nest success can substantively impact duck populations. Several large studies have shown that nest densities and nest success incrementally declines with declining herbaceous cover (Kirsch et al. 1978, Bloom et al. 2013) (Figures 6.a – 6.d).
- The most common recommendation on livestock grazing in/near amphibian breeding wetlands is to exclude livestock from them, and some authors recommend excluding livestock from larger areas (Bartelt 2000, Maxell 2000, Engle 2001, Patla 2001, Keinath and McGee 2005, Patla and Keinath 2005, Shovlain et al. 2006, Schmutzer et al. 2008). Note that a minimum retention level (e.g., 70%) allows for grazing to take place while also attempting to protect amphibians.

Note that, although there are few studies directly showing that 70% herbaceous retention maintains suitable forage and cover for wildlife, there are virtually no studies directly supporting a minimum 60% and 50% herbaceous retention threshold.

No recommendations or findings were found supporting a maximum 50% use of key forage species for mule deer, elk, goshawks, microtine voles, great gray owls, other raptors, waterfowl, Columbia spotted frogs, or boreal toads (of the species specifically addressed above), or any other wildlife species, except for post-nesting habitat for Brewer's sparrows and vesper sparrows. It is noteworthy that the same conservation plan that recommended a post-nesting season limit of 50% use of annual vegetation production, also recommended maintaining 6-12 inches of grass height, which would not be possible with 50% use of herbaceous vegetation.

c. At 70% herbaceous retention in medium-height to tall herbaceous communities, there is an estimated 50-65% similarity to pre-grazed vegetation structural conditions; the degree of similarity in shorter herbaceous communities can be as low as 25% (optimum is 75-100%).

This is low, but see 'a', above.

The following provides a little more detail. This is useful for visualizing the quality of remaining herbaceous habitat at 70% herbaceous retention. It shows that remaining habitat is minimally suitable for dependent wildlife (see Figure 3).

- 50-65% of the canopy cover of relatively intact herbaceous vegetation in medium-height to tall herbaceous communities, based on DeLong (2009a), and <50% in short communities.
- 25-65% of the biomass of herbaceous vegetation above a 2-inch height, based on height-weight relationships in Kinney and Clary (1994) and BLM et al. (1999:118) including the exclusion of the weight of the bottom 2 inches of plants based on their information.

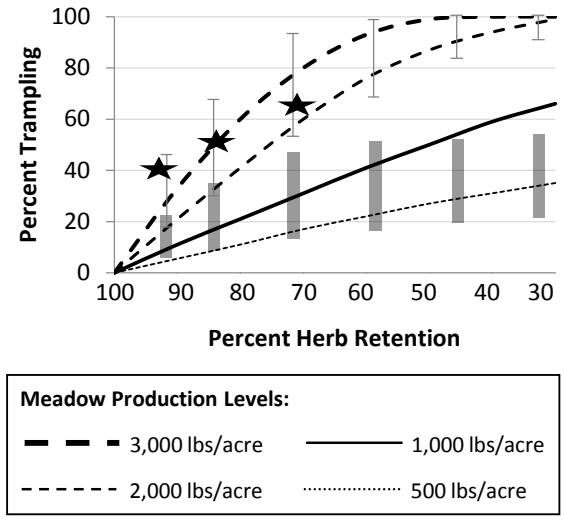


Figure 6.a. Estimates of the percent of small stationary objects (as simulated ground nests) trampled at different levels of total herbaceous utilization in meadows of different production levels during a 4-week period. See text for more detail. (see DeLong 2016 for development)

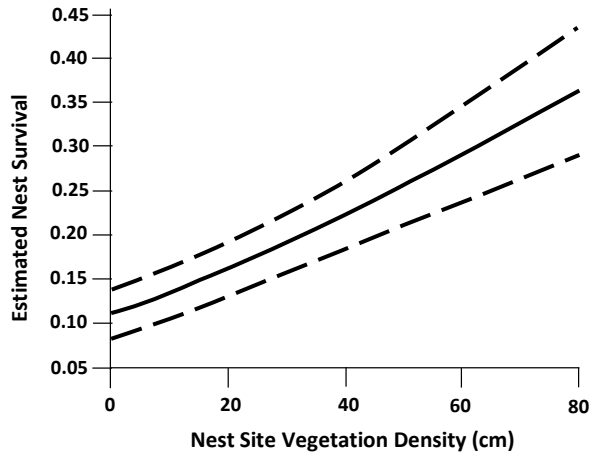


Figure 6.b. Adapted from Bloom et al. (2013:Figure 2e). Relationship between estimated waterfowl nest survival (±85% CIs) and nest-site vegetation density in the Canadian Prairie Pothole Region, 2002-2009.

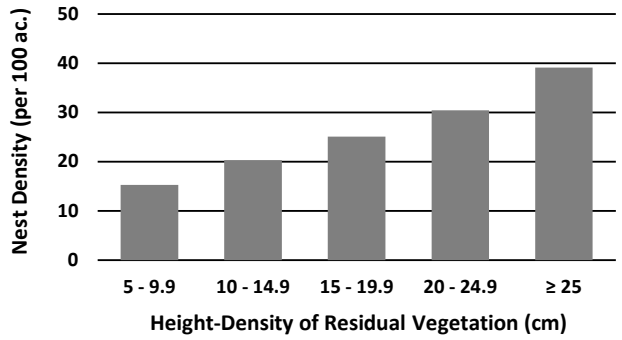


Figure 6.c. Adapted from Kirsch et al. (1978:Table 1). Relationship between height-density of residual vegetation and the number of duck nests per 100 acres (of a total of 697 nests). Height-density was determined with a Robel pole.

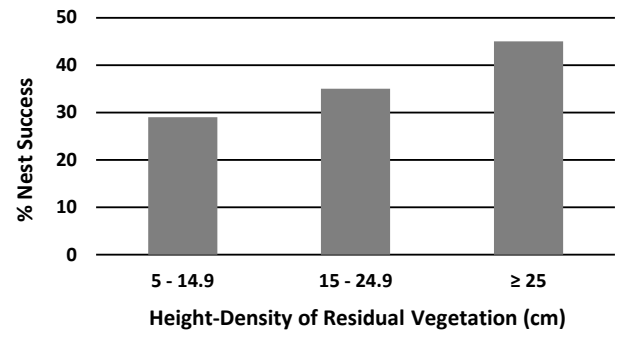


Figure 6.d. Adapted from Kirsch et al. (1978:Table 2). Relationship between height-density of residual vegetation and nest success of 573 duck nests. Height-density was determined with a Robel pole.

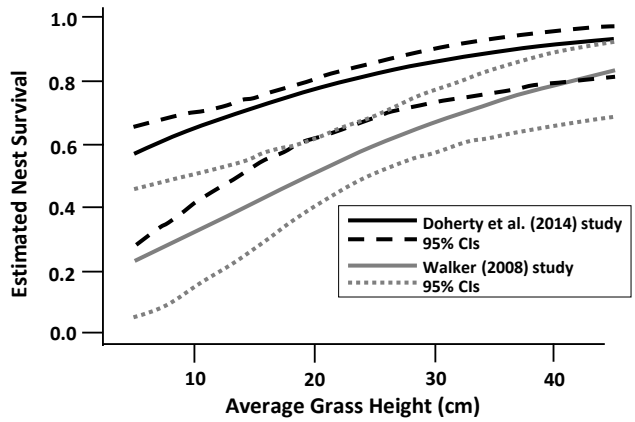


Table 6.e. Adapted from Doherty et al. (2014:Figure 2). Relationship between sage grouse nest survival (±95% CIs) and average grass height in the Powder River Basin, Montana and Wyoming, 2004-2006.

- 20-70% of visual obstruction (Robel pole readings), based on DeLong (2009b). Robel pole readings decline relatively sharply from about 90% retention down to about 60% or 70% retention.
- Retention of leaves, flowers, and seedheads (as forage) generally follows the patterns outlined above.
- 0-65% of the canopy cover and biomass of key forage plants above about 2 inches, which provides an indication of the proportion of leaves, flowers, and seedheads of key forage plants that remain available as forage. As examples, there could be near-0% retention of flowers of some plant species (e.g., single-flower sunflower) and low (e.g., up to 25%) retention of some flower (e.g., silvery lupine, tall larkspur, cow parsnip) even when overall herbaceous retention is at or above 70%.
- 41-50% of plant height if vegetation is grazed at an even height (e.g., sedge communities), based on height-weight relationship information in Kinney and Clary (1994) and BLM et al. (1999:118).
- 40-70% of protection from trampling (index).

d. In addition to recommendations and direct study results on herbaceous retention levels (iii, above), a moderate proportion of the large volume of pertinent "indirect" scientific and ecological information demonstrates that a minimum 70% herbaceous retention would retain suitable habitat conditions and provide sufficient protection from direct impacts of livestock use. "Indirect" scientific and ecological information refers to studies

Detailed examinations and syntheses of hundreds of scientific studies, papers, and textbooks from a wide range of disciplines demonstrated that 70% herbaceous retention has a reasonable likelihood of (1) retaining enough herbaceous vegetation to provide suitable conditions for seven habitat elements for many dependent wildlife species, and (2) providing sufficient protection from direct impacts of livestock use (Figure 3), recognizing however, that 80% retention is needed for some species (DeLong 2009a, DeLong 2012, DeLong 2015, and DeLong 2016). There is a moderate level of scientific information supporting these conclusions.

Findings from this approach are consistent with findings in 'b', above, and more detail can be found in Appendix B. These findings and findings from 'b', above, are summarized in Figure 7.

However, given limited direct evidence ('b', above), drawing scientific information from a wide range of disciplines and geographic locations was needed to be able to better ascertain the threshold between suitable herbaceous retention and less-than-suitable herbaceous retention. The above conclusions are based in part on recognizing effects of grazing on habitat elements (as summarized in 'c', above) and then assessing effects of these changes in habitat, and effects of trampling, on wildlife species and groups of species.

Having only moderate support for a low-end threshold of 70% should not be surprising given the relatively large reductions in herbaceous habitat attributes and elevated potential for impacts to survival elements (as summarized in 'c', above). It is important to recognize that there is only a low amount of scientific information demonstrating that 60% retention retains suitable forage and cover for wildlife and protects sensitive wildlife from trampling, and virtually no scientific information for 50% retention.

This approach, for which hundreds of scientific papers were reviewed, yielded the following:

- There is moderate evidence demonstrating that a minimum 70% herbaceous retention would provide — for native wildlife-communities in general — forage (including leaves, flowers, and seeds), suitable hiding and escape cover, suitable microclimatic conditions, habitat for small prey species, and adequate protection from trampling of nests by livestock (DeLong 2009a).

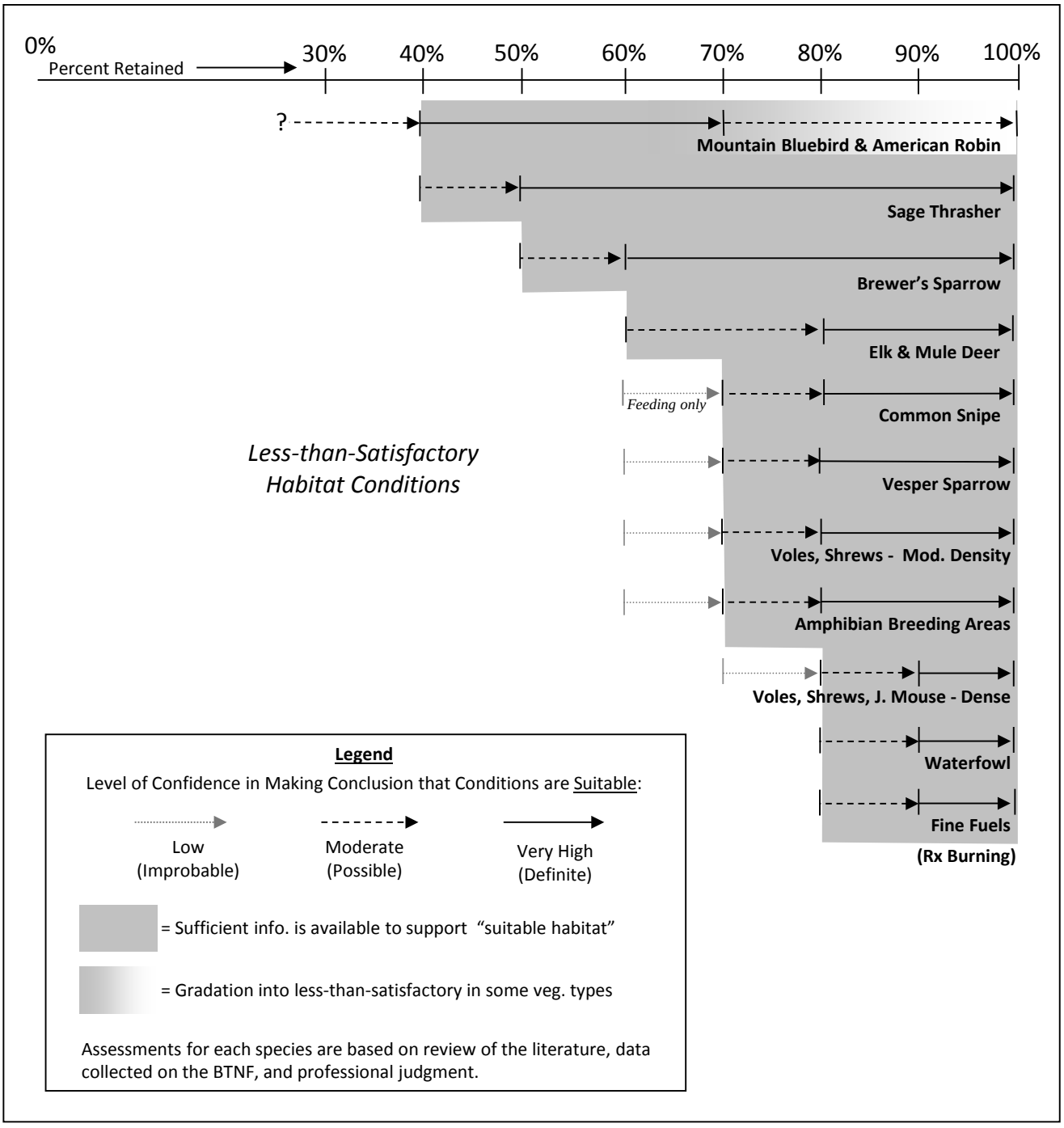


Figure 7. Suitable habitat conditions as related to different retention levels of total-herbaceous vegetation during the livestock grazing season (assuming healthy, properly functioning conditions). If conditions are less than properly functioning, the amount of herbaceous vegetation retained would need to be higher, proportional to the extent to which conditions deviate from healthy, functioning conditions. Based on assessments in DeLong (2009a), DeLong (2012), DeLong (2015), and DeLong (2016).

- There is moderate evidence demonstrating that a minimum 70% herbaceous retention would provide — for migratory birds — suitable nesting cover, hiding and resting cover, forage (including flowers and seeds), habitat for invertebrates and small mammals like microtine voles, and adequate protection from trampling of nests by livestock (DeLong 2009a, DeLong 2106).
- There is moderate evidence demonstrating that a minimum 70% herbaceous retention would provide — for sensitive amphibians — suitable hiding cover, humidity retention, substrate for tadpole forage, invertebrate habitat, and adequate protection from livestock trampling and declines in water quality, while also providing openings for basking in the sun (DeLong 2009a, DeLong 2105).
- Even though 70% retention would not maintain high abundance of microtine voles (the cornerstone of small mammal prey for raptors, owls, and small predatory mammals) in most herbaceous communities, it would likely allow vole populations to be maintained at moderate densities, although densities could dip to low levels (DeLong 2009a, DeLong 2102).
- Even though 70% retention would likely not maintain invertebrate diversity at a high level for the full range of insectivores (e.g., migratory birds, bats, shrews, and amphibians), the altered invertebrate communities at this retention level likely are sufficient to provide for the needs of most insectivores and to provide for ecosystem services like pollination (DeLong 2009a, DeLong 2105, DeLong 2016).

e. Wildlife Population Trends.

This topic is included in this discussion because lack of any known downward population trends continues to be brought up as a reason for not needing to implement a minimum 70% herbaceous retention threshold. More specifically, the argument is that, if biologists have not identified any downward trends in wildlife populations that can be attributed to livestock grazing on the allotments being planned, there is no reason to change the utilization limit.

There are several reasons this is not a valid argument. There is no population trend data available for any wildlife species on the allotment, except for native ungulates, and the absence of information cannot be used as support for deciding to not make changes to current management ("absence of evidence is not evidence of absence," Carl Sagan, Astronomer). There are no requirements for the agency to prove that current management is causing population declines or having some other substantive negative impacts on a species before defining suitable conditions that do not encompass existing conditions.

Also, the 2012 Planning Rule "…does not require monitoring species population trends. Species population trend monitoring is costly, time intensive, and may not provide conclusive or relevant information. In addition, traditional monitoring of species population size and trend is not reliable for many species because of wide variations in population size" (USDA 2012:21233). Instead, "The final rule requires monitoring the status of select ecological conditions," including a number of habitat elements (USDA 2012:21234).

f. The thresholds are minimally consistent with fundamental principles of wildlife management.

A minimum 70% retention of herbaceous vegetation and 60-70% use of key forage species are at least minimally consistent with fundamental principles of wildlife management and ecology involving hiding and escape cover, nesting cover, forage retention for wildlife (including leaves, seeds, flowers), habitat for prey (e.g., invertebrates, small mammals) since half to two-thirds of cover attributes would be retained in medium-height to tall herbaceous communities and understories. The practice of adjusting utilization limits to ensure that habitat needs of wildlife are met on livestock allotments — as

is required by the Forage Utilization Standard — is well recognized in the wildlife conservation literature, but in practice it remains somewhat illusive in many places.

In herbaceous plant communities (e.g., wet meadow, moist meadow, grassland, forbland), herbaceous vegetation *IS* wildlife habitat and, in shrub-herb communities (e.g., shrubby cinquefoil, silver sagebrush, willow-herb communities), herbaceous vegetation is a major component of wildlife habitat. Because livestock eat herbaceous vegetation, the intensity of livestock grazing use has major ramifications on the ability to provide suitable wildlife habitat in herbaceous-dominated plant communities.

3. Adequate Amount of Suitable Forage and Cover

Wildlife do not require 100% of the habitat within their range to provide suitable forage and cover, the Forest Plan does not require this, nor is it possible to retain 100% of habitat in suitable condition in a commercial livestock grazing program. In Objective 4.7(d), the Forest Plan does not require suitable forage and cover to be retained for wildlife on 100% of an allotment. Rather, the objective calls for an "adequate amount" of suitable forage and cover to be retained.

Holechek et al. (2004) and WAFWA (2009) recognized that over-use of vegetation is an inherent part of livestock grazing on public lands. On rangelands in general, Holechek et al. (2004:248) felt that it would be reasonable for public land ranchers to over-use as much as 30% of key areas. Similarly, WAFWA (2009) suggested there may be some tolerance of heavy use on as much as 30% of grazable lands. This applies to all lands in general where livestock grazing occurs, regardless of management emphasis; e.g., no specified emphasis on wildlife.

A higher percentage (≥80%) is warranted in the K-17 project area for several reasons:

a. The management emphasis in DFC 10 areas (51% of the project area) is "…to provide long-term and short-term habitat to meet the needs of wildlife managed in balance with… livestock grazing…" and wildlife has an even higher emphasis in DFC 12 areas (36% of the project area); for example, "Livestock grazing is permitted on other big-game ranges [other than crucial winter range] if it does not conflict with wildlife needs" (USFS 1990:242).

b. "≥80%" is used for greater sage grouse. The Forest Service is required to meet desired vegetation composition and structural attributes on ≥80% of breeding habitat and seasonal habitat (Table 1, page 96 of USFS 2015).

The "key area" component of the proposed utilization limit fit very well with the "adequate amount" part of retaining an adequate amount of suitable forage and cover for wildlife. Adhering to a maximum 50% of key forage species in conjunction with the key area concept can conceivably work if key areas are delineated that truly are "most preferred by livestock and are typically grazed first and receive the most concentrated use." This could allow utilization on at least 80% of each major vegetation type grouping to remain at 30-40% or less, which would retain ≥70% of the herbaceous vegetation in these areas.

4. Why Sole Reliance on a Maximum 50% Use of Key Forage is Insufficient

With the "key area" component of the proposed utilization limit (see definition in text box, from the Proposed Action) and with the utilization limit clearly articulating that it is being implemented to meet the desired condition statement for herbaceous retention, and ultimately, wildlife-related Forest Plan objectives, this qualified maximum 50% use of key forage can work for wildlife (i.e., Forest Plan objectives for wildlife and migratory bird requirements can be met).

However, the rest of this section explains why retained forage and cover is mostly less-than-suitable for wildlife where sites are grazed at or near 50% use of key forage species. Where actual use of key forage species approaches or reaches 50% across extensive areas, an adequate amount of suitable forage and cover for wildlife will not have been retained to meet Forest Plan objectives for wildlife and migratory bird requirements.

Key Area (as defined in the Proposed Action) – A relatively small portion of a range selected because of its location, use or grazing value as a monitoring point for grazing use. It is assumed that key areas, if properly selected, will reflect the overall acceptability of current grazing management over the range. (SRM, 2005). For purposes of the proposed project, they are also those areas within the allotment most preferred by livestock and are typically grazed first and receive the most concentrated use.

The following discussion applies only to areas that are grazed at 50% use of key forage or nearly so. This part of the assessment is important because, if the utilization limit specified in the Proposed Action (maximum 50% use of key forage) is sufficient to meet the Forage Utilization Standard's requirement to prescribe utilization limits to meet Forest Plan objectives (e.g., Objectives 2.1(a), 3.3(a), and 4.7(d)), there would be no reason ― from the standpoint of wildlife ― to adjust the Proposed Action or develop an alternative utilization limit.

Key forage utilization of 50% does not translate to an estimated 70-75% retention of herbaceous vegetation, contrary to what is shown in the Proposed Action (based on R4 FSH 12/81 Amendment 11 (USFS 1981)). The cited information is from 37 years ago, and graphed line in R4 FSH 12/81 Amendment 11 represents a very specific set of conditions (specific plant species composition and specific use level of non-key forage species). This graphed line cannot be used for any situation where the composition of key forage species exceeds about 30-40% of the total herbaceous vegetation. Appendix A includes two crosswalks from percent retention of key forage species to percent retention of total herbaceous vegetation and visa versa. These crosswalks are consistent with Smith et al. (2007).

Using a procedure consistent with Smith et al. (2007), it is estimated that 50% use of key forage species translates into an estimated 50-70% retention of total herbaceous vegetation in most situations (Appendix A). While as much as 70% of total herbaceous vegetation would be retained at 50% use of key forage species, an estimated 50-60% of total herbaceous vegetation would be retained at 50% use of key forage species.

Reasons why a maximum 50% retention of key forage is insufficient for meeting Forest Plan objectives for wildlife and migratory bird requirements are outlined below.

a. There is little indication that a maximum 50% use of key forage species meets the Forage Utilization Standard requirement to prescribe utilization limits to meet Forest Plan objectives with respect to Objectives 2.1(a), 3.3(a), and 4.7(d) since:

The above statement is based on i-v, below, relative to direction in the standard, which is summarized in the next few paragraphs.

Two requirements of the Forage Utilization Standard are (1) to prescribe, during allotment management planning, site-specific utilization limits needed to meet Forest Plan objectives; and (2) establish site-specific utilization limits on key wildlife ranges. As such, utilization limits must be purposely designed to meet the following Forest Plan objectives for wildlife, among other Forest Plan objectives, relative to DFC direction:

- Objective 2.1(a) — Provide suitable and adequate habitat to support game and fish population objectives established by the WGFD.
- Objective 3.3(a) — Protect sensitive species and provide an adequate amount of suitable habitat to ensure activities do not cause: (1) long-term or further declines in populations or habitats supporting these populations; and, (2) trends toward federal listing."

- Objective 4.7(d) — An adequate amount of suitable forage and cover are retained for wildlife and fish.

Three related requirements were outlined out in Section 91.1 of WO Amendment 2209.13-2005-10: (1) "project-level decisions, which authorize the use of specific National Forest System lands for… livestock grazing, must be consistent with the broad programmatic direction established in the LRMP;. (2) "Consistency is determined by examining whether the project-level decision implements the goals, objectives, desired conditions, standards and guidelines, and monitoring requirements from the LRMP;" and (3) "Where necessary, grazing permits must be modified to ensure consistency with the LRMP."

During allotment management planning, the Forage Utilization Standard does not allow deference to be given to current utilization levels until monitoring data shows they are inadequate to meet wildlife needs. The standard is stated in the affirmative, both in terms of direction to "prescribe" utilization limits and "to meet" objectives. This means the onus is on Biologists to be able to demonstrate that a maximum utilization limit would result in suitable forage and cover being retained for sensitive species, big game, migratory birds, and other affected wildlife; if this cannot be done, a lower utilization limit needs to be considered.

This has not been done for a maximum 50% use of key forage species. There is no documentation demonstrating that a maximum 50% use of key forage species will allow Objectives 2.1(a), 3.3(a), and 4.7(d) to be met.

i. Retaining suitable forage and cover for wildlife was not a consideration when this threshold was introduced in the 1950s.

   As noted by Smith (1998:9), Crider's classic study (1955) and numerous other studies of defoliation effects on carbohydrate reserves, root growth, and biomass production resulted in the general 'take half, leave half' rule of thumb still prevalent in range management." There is no indication that retaining forage or cover for wildlife was considered (Heady and Child 1994, Smith 1998, Holechek et al. 2011).

ii. There is no more than a minor amount of scientific information demonstrating a maximum 50% use of key forage species would retain suitable forage and cover for wildlife and satisfactorily protect sensitive and other wildlife species from direct impacts of livestock use (e.g., trampling).

   There are very few studies directly showing that 50-60% herbaceous retention is sufficient to maintain suitable habitat for particular wildlife species. One recommendation and results of one study are as follows. These are the only two that I am aware of.

   - "Maintain herbaceous cover for nest concealment by protecting the current season's growth through the nesting season [e.g., through July 20] and by managing for at least 50% of annual vegetative growth to remain through the following nesting season" (Wyoming Partners for Flight 2003:372 and 475, for Brewer's sparrows and vesper sparrows). The conservation plan also recommended that "Within shrublands where Vesper Sparrows nest, maintain grass height of 6 to 12 inches…"
   - Johnson et al. (2012) did not detect changes in depredation rates of horned lark and savannah sparrow nests where grazing use was measured at 28% and 54% use of herbaceous vegetation (72% and 46% herbaceous retention). However, there is only weak evidence because Johnson et al. (2011) did not find evidence of any grazing effects on visual obstruction at their nest sites (i.e., little actual grazing at nest sites), and Johnson et al. (2012) left out species for which Johnson et al. (2011) found evidence that grazing did reduced visual obstruction at the nest site (vesper sparrows and western meadowlarks). Also, horned larks select nest sites with short vegetation and high percent bare ground.

There are no known studies showing that 60% or 50% herbaceous retention maintains suitable habitat for native wildlife-communities as a whole, or for a range of wildlife species. The large pool of scientific information reviewed for my four BTNF-specific reports, when looked at comprehensively, provides no more than minimal support for 60% or 50% herbaceous retention as low-end thresholds and shows there to be substantive negative impacts (see DeLong 2009a, 2012, 2015, and 2016 for discussions of this). This should not be surprising since only a minor proportion of pre-grazed vegetation is retained above about 2 inches (Figure 3), meaning that only a minor proportion of the pre-grazed habitat attributes are retained. Attributes of pre-grazed herbaceous habitat are nearly gone by about 50% herbaceous retention and are essentially gone by about 40% herbaceous retention (Figure 3).

iii. There is a large amount of scientific information showing that a maximum 50% use of key forage species is not sufficient to retain suitable habitat conditions or to provide sufficient protection from direct impacts of livestock use.

Numerous studies have demonstrated a decline in the diversity and abundance of invertebrates, small mammals, migratory birds, and amphibians where herbaceous height and structure had declined substantially as a result of livestock grazing (as discussed in DeLong 2009a, 2012, 2015, and 2016). This is consistent with fundamental principles of wildlife management and ecology; e.g., dependent wildlife decline as food resources decline, predation increases as nesting/hiding cover declines (Principles B.1 and B.2).

Reduction in herbaceous vegetation that approach or reach 40-50% utilization (i.e., 50-60% herbaceous retention) have been shown — through direct study — to:

- Substantively reduce microtine vole abundance, based on seven intensive studies (Birney et al. 1976, McAninch et al. 1978, Edge et al. 1995, Greene 1995, Batzli et al. 1999, Johnson and Horn 2008, Evans et al. 2015). Voles are the cornerstone of small mammal prey for raptors, owls, and small predatory mammals.
- Substantively reduce invertebrate species richness and abundance rate diversity, based on dozens of studies some of which were reviewed by East and Pottinger (1983) van Klink et al. (2015), and others. Invertebrates are of great importance to migratory birds, bats, shrews, and amphibians.
- Since only an estimated 0-50% of visual obstruction is retained at 50-60% herbaceous retention (Figure 3, page 24), success of ground nests in herbaceous vegetation can be expected to be substantively impacted. “Numerous studies, some with sample sizes of nests in the thousands, have shown that nest depredation rates generally increase with incremental reductions in concealment cover” (DeLong 2016:29). Many of these studies are cited in DeLong (2016)
- Kauffman et al. (1982) found that herbivorous/granivorous guilds declined in representation in riparian communities grazed by cattle from late August to mid September, and they attributed this to the reduction in seeds and flowers following cattle grazing; prior to cattle grazing, herbivorous/granivorous guilds comprised 51% and 44% of bird populations in grazed and ungrazed riparian habitats, and comprised 11% and 61%, respectively, after late-August to mid-September grazing. Herbaceous retention levels were as low as 30% in this study.
- Of 19 bird species for which population trends were graphed and evaluated in DeLong (2016), 14 were addressed in Bock et al. (1993); the 19 species were identified as species in the Upper Green area that can be affected by livestock grazing. Of the 14 species, Bock et al. (1993) assessed that 10 have responded negatively to moderate to heavy livestock grazing, 3 have shown mixed results or were apparently unresponsive to livestock grazing at these levels, and 1 had responded positively. Of the 10 species that responded negatively, 9 show downward trends

in Wyoming. Of the 3 species in the mixed results category, two have "stable" trends in Wyoming and one has a downward trend. The one species showing a positive response to livestock grazing has an upward trend in Wyoming.

- Substantively reduce waterfowl nest densities and nest success, based on a large study by Bloom et al. (2013) and on several dozen studies that were reviewed by Kirsch et al. (1978) and Braun et al. (1978). Nest success in waterfowl may indicate nest success of other ground-nesting birds that require nesting cover.
- Fondell and Ball (2004) reported that nest loss of short-eared owls due to predation in ungrazed grasslands was 10% and that predation in grazed grassslands was 60%. Visual obstruction was 50% and 67% lower in grazed areas than in ungrazed areas (50% and 37% retention), which translates to an estimated 60% ±10% herbaceous retention (Figure 3, page 24); this retention level spans the range for 50% use of key forage species (i.e., 50-70%).

Retention of 60% herbaceous vegetation represents a substantial decline in vegetation structure, vegetation height, and protection-from-trampling index since it would only retain an estimated:

- 10-50% of pre-grazed vegetation structure above about 2 inches and visual obstruction.
- 35-50% of intact and relatively-intact herbaceous canopies in medium-height to tall communities.
- 29-38% of sedge height above 2 inches (10-40% of herbaceous plant height above 2 inches).
- 24-60% of protection from trampling (index).

Retention of 50% herbaceous vegetation represent even greater declines in vegetation structure, vegetation height, and protection-from-trampling index since it would only retain an estimated:

- 0-40% of pre-grazed vegetation structure above about 2 inches and visual obstruction.
- 20-35% of intact and relatively-intact herbaceous canopies in medium-height to tall communities.
- 21-30% of sedge height above 2 inches (5-30% of herbaceous plant height above 2 inches).
- 13-50% of protection from trampling (index).

The pattern shown by these percentages (i.e., low similarity to pre-grazed conditions) is reinforced by illustrations (e.g., middle illustration vs. top illustration in Figure 8). There just isn't much vegetation left that contributes to wildlife habitat. And remarkably, each of the above measures were derived in much different ways, yet the percentages are very close (note: if short plant communities were included in the second bullet, above, the low-end threshold would be closer to 0%).

A large volume of scientific information from a range of disciplines was examined to assess the mechanisms by which livestock grazing effects take place relative to the vegetation conditions produced by livestock grazing at different levels (as summarized above), and the assessments reinforced the above conclusions for specific species and groups of species. Hundreds of scientific papers and books were reviewed.

There is low (50% herb retention) to moderately-low (60% herb retention) evidence demonstrating that a minimum 50-60% herbaceous retention would provide ― for native ungulates, microtine voles and western harvest mice, raptors and many species of other migratory birds, and amphibians ― suitable forage (leaves, flowers, and seeds of particular plant species and range of plant species), hiding and nesting cover, humidity retention, substrate for tadpole forage, prey (small mammal, bird, and invertebrate) habitat, and adequate protection from livestock trampling and declines in water quality. A large volume of scientific information supports this assessment (DeLong 2009a, 2012, 2015, and 2016).

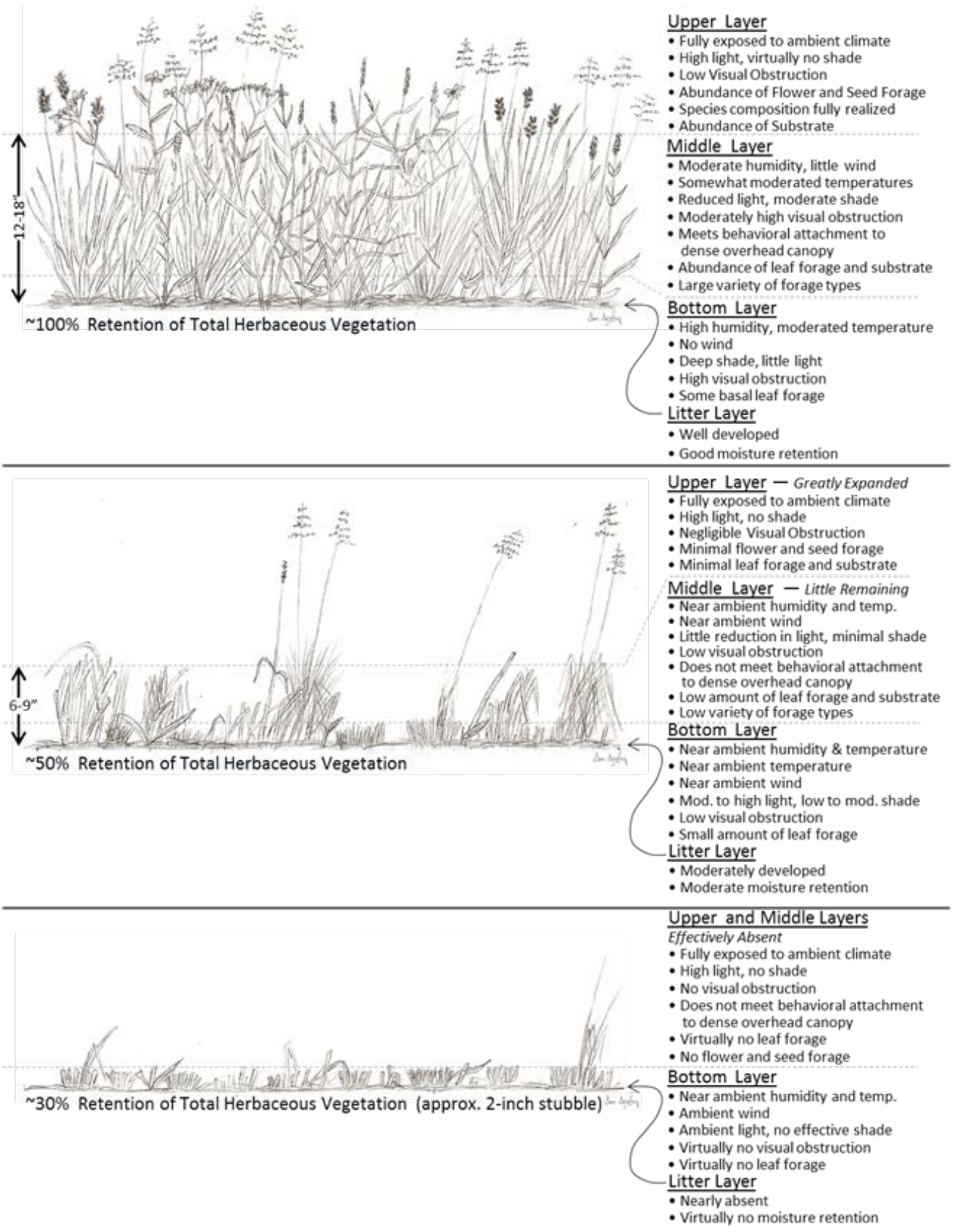


Figure 8. Contributions of meadow vegetation to wildlife habitat and changes relative to retention levels.

While the above reductions in the amount, structure, height, and visual obstruction of herbaceous vegetation negatively affects native wildlife-communities as a whole and most dependent wildlife species, there are several species that benefit from these reductions in herbaceous retention. They include Uinta ground squirrels, mountain bluebirds, and robins, all of which prefer short herbaceous vegetation.

It is difficult to fathom how one could pass the "straight-face test" in concluding that 50-60% herbaceous retention is sufficient to provide suitable forage, cover, and substrate for wildlife when considering (1) the large to major reductions in herbaceous structure and height (e.g., 50-80% reduction in canopy cover of relatively-intact and intact vegetation, and 60-80% reductions in height), and (2) the large volume of scientific information clearly showing links between cover and species diversity and abundance, and between livestock grazing intensity and the level of direct impacts (e.g., trampling, reductions in water levels in small pools).

iv. Six wildlife biologists on the BTNF have concluded that 50% use of key forage species would contribute to less-than-suitable habitat conditions for several groups of wildlife species:

- Native ungulates (DeLong 2009, USFS 2009, Oles 2011a).
- Microtine voles, pocket gophers, and great gray owls (DeLong 2012, Roberts 2016, USFS 2016b[C]).
- Northern goshawks (DeLong 2012).
- Trumpeter Swans (Roberts 2016).
- Sage grouse (A. DeLong 2016b[D]), partially.
- Migratory birds (DeLong 2009a, DeLong 2016).
- Amphibians (USFS 2009a, Oles 2011a,b, Roberts 2013, DeLong 2015, Murphy 2016).
- Invertebrates, as used by migratory birds and amphibians (DeLong 2015, DeLong 2016).
- Native wildlife-communities as a whole general (DeLong 2009).

Additionally, the previous Forest Biologist (G. Hanvey) supported assessments in these reports, and the Regional Aquatic Ecologist (C. Tate) supported Murphy's (2016) assessment and expressed support for the alternative having a maximum 35% use of key forage over the alternative having 50% as the maximum.

v. There are no local documented population trends of any wildlife species demonstrating that wildlife would not be negatively impacted by a threshold of 50% use of key forage species, nor are there local population trends showing that wildlife would be negatively affected.

The only trend data available for wildlife is for elk, mule deer, moose, and pronghorn. However, population data for these species is collected at large geographic scales, which makes it difficult to assess cause-and-effect at local scales; (2) all species are hunted which further compounds assessments of cause-and-effect of other activities; (3) elk are artificially fed, which further compounds any such assessment; and (4) data is not collected on other factors that affect their population trends, which makes assessments of cause-and-effect difficult. Also few pronghorn spend time on the LaBarge Creek allotment. Aside from mule deer population trends, population trends of native ungulates contributes little to our understanding of the compatibility of past and current utilization limits, and an assessment involving mule deer trends would be difficult.

[C] Authored by Randy Griebel, Forest Biologist, BTNF, Jackson.
[D] Authored by Anita DeLong.

Also, there is insufficient data on actual use levels across a large enough area to be able to assess the effects of forage utilization levels on wildlife. It is also doubtful that actual use of key forage species was consistently close to but lower than 50% in more than just limited areas.

Even though there is no wildlife trend data showing that wildlife is negatively affected by a maximum 50% use of key forage species, this in no way provides evidence that this utilization threshold is adequate from the standpoint of wildlife.

The 2012 Planning Rule "…does not require monitoring species population trends. Species population trend monitoring is costly, time intensive, and may not provide conclusive or relevant information."

b. There is little indication that migratory bird requirements would be met by implementing this threshold.

Solely relying on a maximum 50% use of key forage species would be insufficient to meet applicable provisions of Executive Order 13186 and USFS and USFWS (2008), recognizing that federal agencies are only required to carry-out these provisions to the extent they are permitted by law, are within administrative budgetary limits, are in harmony with agency missions, and to the extent they can practicably be carried out.

Migratory bird requirements applicable to utilization limits would not be met because (1) herbaceous retention could be 50-60% in many situations, depending on composition of key forage species and use of non-key species, and there is little to no evidence that 50-60% herbaceous retention provides suitable nesting and hiding cover, forage (seeds, leaves, nectar), and habitat for prey (e.g., invertebrates, small mammals, birds, amphibians); and (2) livestock grazing intensity at 40-50% use of total herbaceous vegetation brings with it a fairly high potential for nest trampling and trampling of sensitive amphibians at breeding wetlands (DeLong 2015 and DeLong 2016).

E.O. 13186 and the MOU between the USFS and USFWS call for the agency to restore and enhance migratory bird habitat; to incorporate or design principles, measures, and practices of bird conservation plans (e.g. *Wyoming Partners in Flight Bird Conservation Plan*) into agency actions and plans like allotment management plans; and minimize the potential for unintentional take; to the extent permitted by law and agency missions. A best management practice in this plan is to avoid grazing livestock in nesting habitat during the breeding season, and the Region 4 guidance document recommended avoiding the breeding season when planning activities (e.g., mechanical treatment) that can directly impact migratory birds. Most sheep grazing takes place after the breeding season because the onset of sheep grazing is July 1 or later.

c. The thresholds are not consistent with fundamental principles of wildlife management.

A maximum 50% use of key forage species is not consistent with fundamental principles of wildlife management and ecology involving hiding and escape cover, and nesting cover, since only 20% to half of cover attributes would be retained in many situations, and as little.as 0% and as much as two-thirds in other situations.

d. A maximum 50% use of key forage species falls at the uppermost end of the range of utilization limits recommended by range experts, meaning it allows the largest possible amount of livestock grazing.

Sustaining rangeland health is crucial to sustaining the capability of the land to produce the vegetation necessary to meet the needs of wildlife, and utilization limits play an important role in making sure that livestock grazing use does not result in the deterioration of rangelands and wildlife habitat.

Recommendations in range management texts for maximum utilization of key forage species span from 30-40% (Vallentine 1990, Holechek et al. 2011) to 50% (Heady and Child 1994), and 50% falls at the uppermost end of this range.

e. Sustained yield is a central tenet of Gifford Pinchot. While some range experts recommend limiting utilization of key forage species to 50% to attain sustained yield of forage, other range experts provide evidence this is not sufficient to maintain range health in this part of the Intermountain West and instead recommend limiting utilization of key forage species to 30-40%. This means there is at least some question whether a maximum 50% use of key forage species is sufficient to sustain healthy wildlife habitat over the long term.

Sustained-yield forestry is one of Gifford Pinchot's lasting legacies, and it is a cornerstone for sustained-yield livestock grazing (Vallentine 1990, Heady and Child 1994, Holechek et al. 2011).

The intent of this section is to show that a maximum key-forage utilization limit of 30-40% (or, 35%) is a viable alternative from the standpoint of long-term sustainability of wildlife habitat. The intent of this section is not to show that 50% use is not viable. A more thorough examination of the available information would be needed for this.

There is question about the ability of a maximum 50% use of key forage species to maintain rangeland and riparian health, and this question is of great importance to the wildlife resource, given the crucial role that long-term rangeland and riparian health play in providing an adequate amount of suitable wildlife habitat.

i. Dietz (1989) and Heady and Child (1994) recommend limiting utilization of key forage species to 50% to attain sustained yield of forage (Figure 1).

This "take half, leave half" philosophy originated in the 1950s, and apparently was founded in studies on the effects of defoliation on root growth (Crider 1955, Dietz 1989, Smith 1998); results of these studies apply to individual plants, not communities of plants.

ii. Holechek et al. (2011) recommend limiting utilization of key forage species to 30-40% to attain sustained yield of forage on rangelands in this part of the Intermountain West (Figure 1), except in alpine areas where they recommended 20% and 30%, respectively.

- Holechek et al. (2011) summarized scientific studies and found that rangelands grazed at or just under 50% use of key forage species decline in condition.
- Jerry Holechek is considered an authority on livestock utilization limits by Rangeland Management Specialists on the Kemmerer, Greys River, Pinedale, and Big Piney Ranger Districts. Several Rangeland Management Specialists have cited his work in support of utilization limits on the BTNF.

  In particular for the Kemmerer Ranger District, Aaron cited Holechek (2004)[E] as the sole supporting source for a maximum 50% use of key forage.

[E] Holechek (2004) is an unpublished report, and it only gives "part of the picture" that was published in his 2004 range textbook (Holechek et al. 2004) and at least as far back as Holechek et al. (1995). The unpublished report references 25 utilization studies, but Holechek et al. (2004) explained that "Conventional wisdom has been that moderate stocking involves 50 percent use of forage (Table 8.2). This guideline applies well in the southern pine forest, humid grasslands, and annual grasslands but results in rangeland deterioration in the semiarid grasslands, desert, and coniferous forest rangelands." Based on their review of the science, they recommended a maximum 30-40% use of key forage in coniferous forest rangelands (16-50 inches annual precipitation), sagebrush grasslands (8-12 inches annual precipitation), and mountain shrubland (16-50 inches annual precipitation), and they recommended 20-30% use of key forage in alpine areas (16-50 inches annual precipitation). These recommendations have been in their textbook at least as far back as 1995 (Holechek et al. 1995:195-196), was in their 2004 textbook and remains in Holechek et al. (2011:153).

- Holechek et al. (2011) is the textbook being used in rangeland management courses at the University of Wyoming.
- An increasing number national forests are reducing maximum utilization limits to 40% or less (e.g., Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sequoia, Sierra, Inyo, and Humboldt-Toiyabe National Forests; Malheur, Umatilla, and Wallowa-Whitman National Forests; Beaverhead-Deerlodge National Forest).

iii. While authoritative references can be cited in support of both ≤30-40% and ≤50% use of key forage species, as shown above in 'a' and 'b':

- The assessment of scientific information by Holechek et al. (2011) shows that 50% use of key forage in coniferous forest rangelands (16-50 inches annual precipitation) typically results in rangeland deterioration.
- Holechek et al. (2011) also provides scientific information showing that a maximum 30-40% use of key forage is more beneficial to livestock operations than a maximum 50% use of key forage in the long term. As such, it would be difficult to argue that a maximum 30-40% use of key forage would <u>not</u> contribute satisfactorily toward Forest Plan Objective 1.1(h) for livestock grazing.
- In DFC 10 areas (51% of the project area), the management emphasis is "…to provide long-term and short-term habitat to meet the needs of wildlife managed in balance with… livestock grazing…." This means that, where there is a question about the ability of a utilization limit to provide for rangeland sustainability (i.e., long-term habitat) and the ability to retain an adequate amount of suitable forage and cover for wildlife (i.e., short-term habitat), a maximum 30-40% use of key forage should at least be considered as an alternative for DFC 10 areas.

  DFC 12 areas (36% of the project area) emphasis wildlife over livestock grazing. For example, crucial winter range in DFC 12 areas can be closed to livestock grazing, and "Livestock grazing is permitted on other big-game ranges if it does not conflict with wildlife needs."

iv. Using Holechek's 2004 Unpublished Report to Support a Maximum 50% Use of Key Forage

Holechek (2004), an unpublished report, is being used to support the Proposed Action's maximum 50% use of key forage species, but it only gives "part of the story" that was published in his 2004 range textbook (Holechek et al. 2004) and at least as far back as Holechek et al. (1995), and that remains in the latest edition of their textbook (Holechek et al. 2011). Applicable details are as follows:

- Holechek et al. (2004:217) explained that, "Conventional wisdom has been that moderate stocking involves 50 percent use of forage (Table 8.2). This guideline applies well in the southern pine forest, humid grasslands, and annual grasslands but results in rangeland deterioration in the semiarid grasslands, desert, and coniferous forest rangelands."
- While the unpublished report stated that moderate grazing involved about 45% use of forage, the published textbook included the same sentence, but used "35 percent to 45 percent" instead of 45 percent. This range (35-45%) applies to all geographic areas addressed in their discussion, including southern pine forests, humid grasslands, and annual grasslands, and this is where the high end of the range probably applies.
- In a paragraph not included in the unpublished report, Holechek et al. (2004:218) pointed out that several researchers had recommended conservative grazing (≤35% use of key forage species) in their summaries.
- Based on their review of scientific information, Holechek et al. (2004:234) recommended a maximum 30-40% use of key forage in coniferous forest rangelands (16-50 inches annual precipitation), sagebrush grasslands (8-12 inches annual precipitation), and mountain shrubland (16-50 inches annual precipitation), and they recommended 20-30% use of key forage in alpine areas

(16-50 inches annual precipitation). These recommendations have been in their textbook at least as far back as 1995 (Holechek et al. 1995:195-196), was in their 2004 textbook and remains in Holechek et al. (2011:153). Vallentine (1990) recommended the same 30-40% maximum use levels and cited an earlier version of Holechek's textbook.

v. Other information showing that a maximum 30-40% use of key forage should be considered as an alternative.

- A review done by Leffert (2005) for the Caribou-Targhee National Forest summarized research supporting utilization levels of 30-40% in sagebrush-grass communities, other range types, and riparian areas. For example, Ratlif et al. (1987) was cited as suggesting "utilization rates for site protection should be 35-45 percent on excellent condition meadows, down to 20-30 percent on poor condition meadows" (Leffert 2005:19).
- While Clary and Webster (1989) recommended maximum utilization rates of 40-50 percent in summer months and 30 percent in the fall for maintaining healthy conditions in riparian meadows in good to high ecological status, several years later, Clary (1995:22) assessed, for riparian habitat in central Oregon, that "Defoliation treatments that removed greater than 30% of the annual biomass production reduced the following year's biomass production below that of the control."
- While available science is fairly clear that as much as 50% of individual plants of many grass species can be defoliated without lasting adverse impacts to those individual plants (Crider 1955, Dietz 1989, Briske et al. 1991), this scientific information does not demonstrate that 50% of the annual production of key forage species on a given site can be harvested year-to-year without lasting impacts to plant species composition and other elements of rangeland and riparian health.
    - Smith (1998) stressed the importance of understanding the difference between percent utilization of individual plants and percent utilization of the total annual production of all plant on a given site; he recognized that utilization of individual plants "…has no necessary relation to proper stocking rate or carrying capacity." This in part is due to the reliance on an "average" use level across a population of plants when there is large variability in use of individual plants; as noted by Smith (1998): "…an average utilization of 50% on a key species may result in widely varying amounts of utilization on each individual plant due to the way many animals graze."
    - DeLong (2010) showed that an average of 50% use of key forage species on a given site could result in ≥50-60% of individual plants of key forage species being defoliated beyond 50% (i.e., beyond what is sustainable for individual plants), and >70% of individual plants of highly-preferred forage species being defoliated beyond 50% use.
    - This may at least partially explain why individual grass plants can tolerate as much as 50% defoliation without considerable root loss, but why Clary et al. (1995) and studies summarized in Holechek et al. (2011) and Leffert (2005) found that an average 50% use of key forage species on a given site was not sufficient to maintain desired plant species composition and/or annual production on that site.

F. Other Allotments on the BTNF and Elsewhere

In many parts of the BTNF, sheep have been limited to once-over light grazing and, in some allotments, a maximum of 30-40% use of key forage. For example:

Once-over light grazing:

- Three Forks, Corral Creek, and Mink Creek Allotments (2007 decision)
- Bear Creek, Virginia Peak, North Salt, and South Salt Sheep & Goat Allotments (2009 decision)

30-40% use of key forage species:

- Wyoming Range Allotment Complex, 7 sheep allotments on 3 districts (2005 decision)

  The following table is on page 31 of USFS (2005)

Vegetation Communities	Utilization limits
Upland vegetation communities with ground cover of less than 60 percent.	Only incidental grazing utilization would be allowed up to 5% or less. These areas are essentially closed to grazing and the 5% utilization is only to facilitate trailing of livestock through these areas.
Upland vegetation communities with ground cover of 60 to 79 percent.	Up to 30% utilization of current year's growth.
Upland vegetation communities with a current ground cover of 80% or greater and with an upward or stable trend.	Up to 40% of current year's growth.

In a series of email notes on August 20, 2009, Richard Zobell wrote the following in a conversation with Faith Ryan (Range Management Program Manager, BTNF). Faith had asked Richard for an example of an AOI for a sheep allotment. Richard sent her the Meadow Creek and Red Castle allotment AOIs (which has tall forb communities and alpine communities, respectively). The maximum use of key "grasses and grass likes" was and still is at 50% in the AOIs (USFS 2017a, USFS 2017b). In part of the discussion in the 2009 emails, Richard made the following statements:

> "I have measured utilization on sheep allotments, but only where the primary use was on gramminoids; the only place where I could find anything approaching 50% use is across salting areas as a worse case scenario… I went out and measured some key gramminoids across some allotments; utilization rarely exceeded 30%..."
>
> "I believe the important thing about sheep grazing is not to force graze an allotment..this creates excessive trailing and salting and bedding impacts long before 50% utilization is achieved."

According to Richard Zobell's last statement, above, we can anticipate excessive trailing and salting and bedding impacts where forage utilization approaches 50%. Given this potential for impacts and if utilization of key graminoids rarely exceeds 30%, it is unclear why a maximum 50% use would be permitted.

In a report about management indicator species on livestock allotments on the BTNF, the following statement is made:

> "*Sheep Allotments* — Competition likely occurs on sheep allotments in important seasonal ranges of elk and mule deer where grazing pressure is more than once-over, low-intensity and where forblands, herblands, and sagebrush-forb communities are in LTS [less than suitable] condition, with respect to ground cover and plant species composition, and particularly where the density of nutritious forb species is depleted…"

In the 2011 Terrestrial Wildlife MIS report for the K-16 project, the wildlife biologist at the time wrote:

> "Conditions that reduce or limit the availability of nutritious forage [for elk and mule deer] include… less than 60-70% of the annual production of key herbaceous forage species retained through the livestock grazing season."
>
> "Generally, retaining a minimum of 60-70% of the annual production of key forage species through the livestock grazing season in rangelands and meadows should be sufficient to provide for the forage needs of elk and mule deer (Wisdom and Thomas 1996, Holechek et al. 2004, Peek and Krausman 1996, WAFWA 2009)" (Oles 2011a:20).

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Appendix A: Crosswalks

Table A.1. Crosswalk from percent retention of key forage species to percent retention of total herbaceous vegetation. Prepared by D. DeLong, Greys River RD, 10-29-2010.

(Figures in shaded cells refer to percent retention of Total Herbaceous Vegetation)

Retention Rate of Key Forage Species	Retention Rate of Non-Key Plant Species	Composition of Key Forage Species (% of Total Herbaceous Vegetation)				
		10%	25%	50%	75%	90%
90%	100%	99%	97.50%	95%	92.50%	91%
80%	100%	98%	95%	90%	85%	92%
	90%	89%	87.50%	85%	82.50%	81%
70%	100%	97%	92.50%	85%	77.50%	73%
	90%	88%	85%	80%	75%	72%
	80%	79%	77.50%	75%	72.50%	71%
60%	100%	96%	90%	80%	70%	64%
	90%	87%	82.50%	75%	67.50%	63%
	80%	78%	75%	70%	65%	62%
	70%	69%	67.50%	65%	62.50%	61%
50%	90%	86%	80%	70%	60%	54%
	80%	77%	72.50%	65%	57.50%	53%
	70%	68%	65%	60%	55%	52%
	60%	59%	57.50%	55%	52.50%	51%
40%	80%	76%	70%	60%	50%	44%
	70%	67%	62.50%	55%	47.50%	43%
	60%	58%	55%	50%	45%	42%
	50%	49%	47.50%	45%	42.50%	41%
30%	70%	66%	60%	50%	40%	34%
	60%	57%	52.50%	45%	37.50%	33%
	50%	48%	45%	40%	35%	32%
	40%	39%	37.50%	35%	32.50%	31%
20%	60%	56%	50%	40%	30%	24%
	50%	47%	42.50%	35%	27.50%	23%
	40%	38%	35%	30%	25%	22%
	30%	29%	27.50%	25%	22.50%	21%

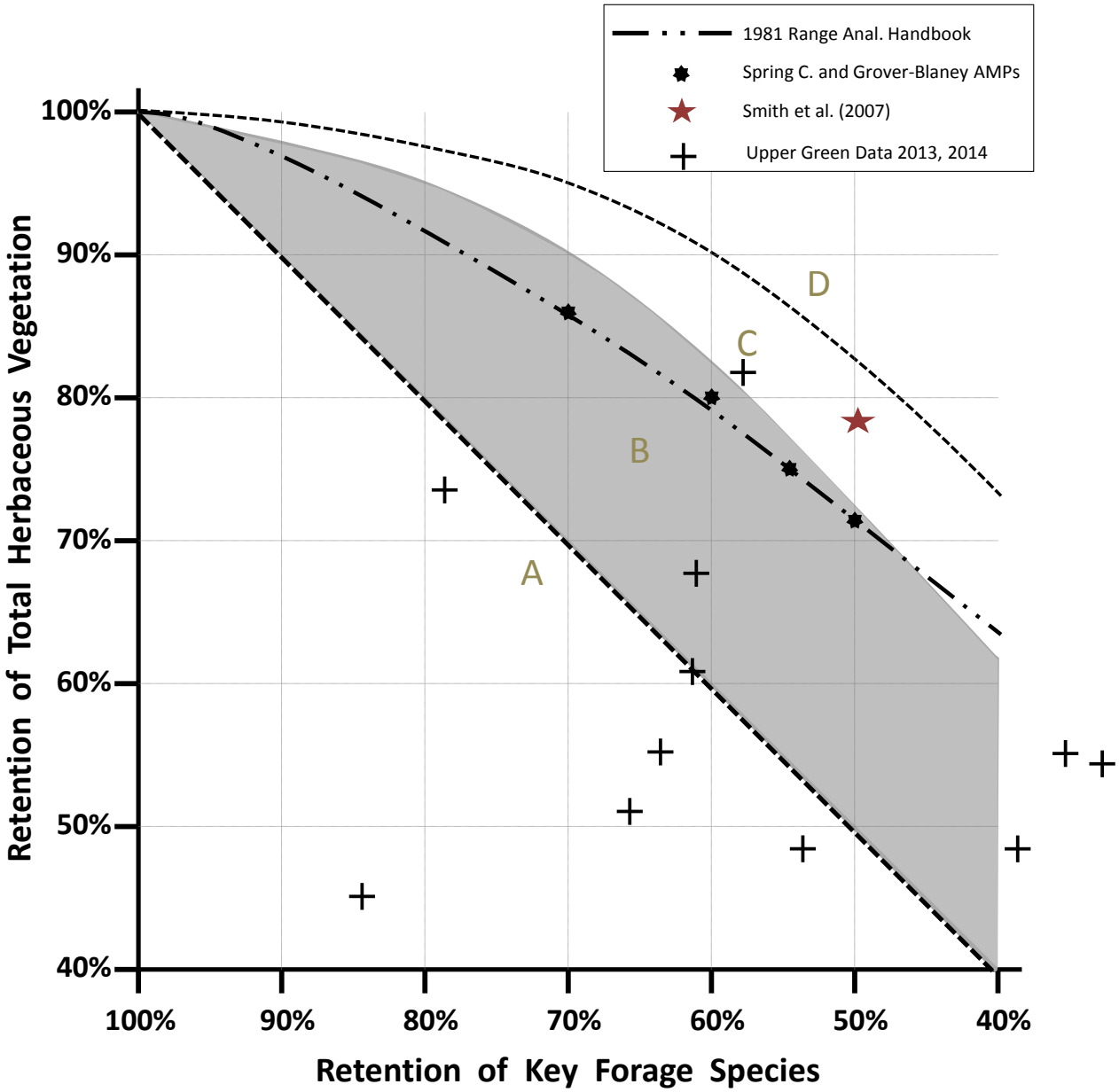

Figure A.1. Percent retention of total herbaceous vegetation at different levels of percent retention of key forage species. (A) it is not biologically possible for percent total herbaceous vegetation to be below the bottom dashed line if identified key forage species are preferentially eaten over non-key plant species (the only possible way for this to occur is if identified key forage species are eaten at a lower rate than the average for all herbaceous vegetation, i.e., if key forage species are mis-designated or other key forage species were not designated); (B) most total herbaceous vegetation retention readings likely fall within the gray portion of the graph, with only sedge communities falling near the lower dashed line (e.g., where beaked/water sedge makes up 95% of the weight of a community and beaked and water sedge are the key forage species; (C) total herbaceous vegetation retention levels can fall above the gray area where the composition of key forage species is low (e.g., <25% and utilization of non-key forage species is substantially lower than utilization of key forage species; and (D) it would be very unlikely for percent retention of herbaceous vegetation to fall above the upper dashed line. If actual-use monitoring reveals that total herbaceous retention falls below the bottom dashed line, this would be one indication that key forage species have been improperly identified.

Appendix B: Characterizations of Retained Vegetation Attributes and Survival Elements

A. Minimum 70% Retention of Herb Vegetation (as a Desired Condition)

The following can be used to visualize the quality of remaining herbaceous habitat at 70% herbaceous retention and, more specifically, to show that remaining habitat would be minimally suitable for dependent wildlife. In herbaceous communities and understories that are in healthy condition, 70% retention of total herbaceous vegetation would retain a moderate to moderately-high proportion of the plant material that contributes to wildlife forage and cover (see Figures 5 and 6). More specifically, 70% retention of total herbaceous vegetation would retain an estimated:

- 50-65% of the canopy cover of relatively intact herbaceous vegetation in medium-height to tall herbaceous communities, based on DeLong (2009a).
- 25-65% of the biomass of herbaceous vegetation above a 2-inch height, based on height-weight relationships in Kinney and Clary (1994) and BLM et al. (1999:118) including the exclusion of the weight of the bottom 2 inches of plants based on their information.
- 20-70% of visual obstruction (Robel pole readings), based on DeLong (2009b). Robel pole readings decline relatively sharply from about 90% retention down to about 60% or 70% retention.
- 41-50% of plant height if vegetation is grazed at an even height (e.g., sedge communities), based on height-weight relationship information in Kinney and Clary (1994) and BLM et al. (1999:118).

Percentages at the high end of the above ranges only apply to relatively tall herbaceous communities (e.g., those with the predominant cover-providing vegetation at heights above about 16-18 inches. Conversely, percentages at the low end of the above ranges (except the first bullet) apply to short herbaceous communities (e.g., those with predominant cover-providing vegetation at heights less than about 6-9 inches).

Also, reductions in herbaceous vegetation and direct effects of livestock use (e.g., trampling, removal of water through drinking) would have the following effects on habitat and survival elements:

- *Forage (leaves, stems, flowers, seeds)* — A large proportion of non-key forage plant material would remain available as forage for wildlife, but only a small to moderate amount of key forage plant material would remain available for species that favor or depend on these plant species. More so, for vertebrate and invertebrate wildlife that depend on or favor plant parts that are higher up on the key forage plants, little may remain for their use.

  For elk, one recommendation was found in the literature to limit use of key forage species to 40%, but this may be a mute point since many of the elk in the allotment are likely fed at nearby winter feedgrounds. Because 70% herbaceous retention roughly translates into 30-50% use of key forage species, a minimum 70% retention of herbaceous vegetation would be consistent with the recommendation published by the Western Association of Fish and Game Agencies (2009), except where key forage composition is substantially higher than 50% of the weight of the plant community.
- *Hiding Cover* — In medium-height to relatively-tall herbaceous communities and understories, a moderate to moderately-large proportion of hiding cover qualities would remain, but in short herbaceous communities or understories, only a moderately-small proportion would remain.
- *Humidity Retention and Temperature Moderation* — There is moderately-low to moderate support for the assessment that (1) retaining a 1/2 to 2/3 of the functional canopy cover in medium-height to relatively-tall moist-meadow type vegetation, and (2) retaining 15-45% of sedge height above 2 inches

(46-57% of total height) in sedge communities would maintain enough humidity retention and temperature moderation attributes to contribute to suitable habitat for dependent wildlife.

- *Open Patches* — There is moderate support for the assessment that 30% utilization of herbaceous vegetation would create small openings in large, extensive stands of herbaceous vegetation. It is moderate instead of strong because 30% use of herbaceous vegetation would "overshoot" the creation of small openings in some situations by reducing canopy cover by 35-50% in medium-height to tall herbaceous communities.
- *Prey (Invertebrates)* — There is moderately-low to moderate support for the assessment that (1) retaining a minimum of approximately half to 2/3 of the canopy cover of relatively-intact herbaceous vegetation and herbaceous biomass above 2 inches in moderate height to tall, dense moist-meadow type communities, and (2) retaining 41-50% of sedge height above 2 inches (46-57% of total height) in sedge communities would retain enough of the vegetation qualities in to provide for the habitat needs of native invertebrate-communities of moist and wet meadow, silver sagebrush, shrubby cinquefoil, and meadow-willow communities. (Canopy cover and biomass would be in the middle to upper end of these ranges in moderate height to tall, dense herbaceous communities.)

  A large number of studies on the effects of livestock grazing on invertebrates, and they demonstrate that this level of grazing has substantial negative impacts on many aspects of invertebrate communities. Impacts appear to stem from the large reduction or elimination of useable living space and cover, and large reduction in capability to retain humidity and moderate temperatures.

  Healthy and diverse invertebrate communities are very important to the very large insectivore guild — comprised of migratory birds, bats, shrews, and amphibians. Increasing recognition is being given to the importance of integrating food-web concepts into resource management planning.
- *Prey (Small Mammals)* — For some small mammal species like ground squirrels that favor short herbaceous vegetation, 30% use of herbaceous vegetation would not be beneficial, meaning that this retention level would not benefit predators that prefer these small mammal species. For microtine voles, 30% use of herbaceous vegetation in grass-dominated communities, would lower the capability of the site to provide for moderate to large populations of microtine voles (several directly-applicable studies demonstrate this), but it would be possible for moderately-low populations to be sustained. Microtine voles are arguably the most important prey for a range of raptors and mammalian predators.
- *Survival as Affected by Trampling* — The potential for ground nests and amphibians (especially metamorphs) being trampled is relatively high at this level of grazing use. The nest trampling-rate index (i.e., potential for ground nests to be trampled) for 30% use of herbaceous vegetation in herbaceous communities is an estimated 15-30% (DeLong 2016). The unaltered potential for trampling small, stationary objects at this grazing level is an estimated 30-75%. While the potential for trampling more than a small number of adult boreal toads and spotted frogs is low in most situations, this level of trampling potential of small, stationary objects means the potential exists for trampling low numbers adults in at least some situations (e.g., when cattle are being herded through a herbaceous communities inhabited by toads or frogs). At 30% utilization of herbaceous vegetation at breeding sites, there would be a high potential of trampling metamorphs in at least some years when and where livestock access wetlands during the metamorphosis period, and the level of impact could range from low to high depending on the situation.
- *Soil Looseness and Integrity of Near-Surface Burrows* — There is high support for the assessment that limiting utilization of herbaceous vegetation in summering and migration habitat to no more than 30% would protect soil looseness and porosity. Greater than equal to 70% retention of total herbaceous vegetation would likely limit soil compaction to acceptable levels.
- *Water Quality in Small Pools* — While there is low support for the assessment that 70% retention of herbaceous vegetation would protect against negative impacts to water quality for spotted frogs and

boreal toads in all breeding wetlands grazed to this level of retention, there is at least moderate support for the assessment that 70% retention of herbaceous vegetation would protect against negative impacts to water quality for these species in a majority of breeding wetlands grazed to this level of retention. Support is somewhat higher (e.g., moderately-high support) where willows comprise a relatively large proportion of the vegetation canopy cover and herbaceous production is relatively low, but support would still be moderate where herbaceous production is relatively high in willow-herb communities (e.g., 2,000-3,000 pounds/acre). Variability from wetland to wetland would exist in effects of livestock use on water quality, and the degree of effect would be difficult to predict in the absence of wetland-specific data collection or monitoring.

- *Water Retention in Small Pools* — For most medium-size and large breeding wetlands on the BTNF, there likely is a high probability of drinking by livestock having no discernible effect on water level reductions when retention of herbaceous vegetation is ≥70% in and immediately around the wetland. For small breeding wetlands (e.g., <2,000 ft^2), limiting livestock grazing use such that ≥70% of total herbaceous vegetation is retained in and immediately around wetlands would be low enough that it should not substantively elevate the rate of decline in surface-water levels in many situations. However, small wetlands have a higher probability than larger wetlands of losing water more quickly to livestock at any given grazing use intensity due to shallower water and lower water volumes, especially where subsurface water inflows are limited or non-existent. Lower water volume in small wetlands is partially a function of shallower depths that occur associated with smaller surface area. As with water quality, the range in variability of effects on the rate of surface-water declines is higher at livestock use levels associated with 70% retention than associated with 80% retention, but lower than at livestock use levels associated with 60% retention.

B. Minimum 50-60% Retention of Herb Vegetation (subset of 50% use of key forage species)

Where it is determined that the composition of key forage species and utilization of non-key-forage species are adequate for a maximum of 50% use of key forage species to translate to a maximum of 30% use of total herbaceous vegetation, then the assessment summarized above, under the heading, "Minimum 70% Retention of Herb Vegetation (as a Desired Condition)" should be consulted.

Where site-specific information does not demonstrate that a maximum of 50% use of key forage species to translate to a maximum of 30% use of total herbaceous vegetation, then we must assume about 40-50% use of total herbaceous vegetation, or 50-60% retention of total herbaceous vegetation. Wildlife habitat conditions produced and maintained by 50-60% herbaceous retention are outlined below.

The following can be used to visualize the quality of remaining herbaceous habitat at 50-60% herbaceous retention and, more specifically, to show that remaining habitat would be less-than-suitable for dependent wildlife. In herbaceous communities and understories that are in healthy condition, 60% and 50% retention of total herbaceous vegetation would retain a minority of the plant material that contributes to wildlife forage and cover (see also Figures 5 and 6). More specifically, 60% and 50% retention of total herbaceous vegetation would retain an estimated:

- 35-50% and 20-35%, respectively, of the canopy cover of relatively intact herbaceous vegetation in medium-height to tall herbaceous communities, based on DeLong (2009aTable 11).
- 0-53% and 0-41%, respectively, of the biomass of herbaceous vegetation above a 2-inch height, based on height-weight relationships in Kinney and Clary (1994) and BLM et al. (1999:118) including the exclusion of the weight of the bottom 2 inches of plants based on their information.
- 10-50% and 0-40% of visual obstruction (Robel pole readings), based on DeLong (2009b). Robel pole readings decline relatively sharply from about 90% retention down to about 60% or 70% retention.

- 29-38% and 21-30%, respectively, of plant height if vegetation is grazed at an even height (e.g., sedge communities), based on height-weight relationship information in Kinney and Clary (1994) and BLM et al. (1999:118).

Percentages at the high end of the above ranges only apply to relatively tall herbaceous communities (e.g., those with the predominant cover-providing vegetation at heights above about 16-18 inches. Conversely, percentages at the low end of the above ranges (except the first bullet) apply to short herbaceous communities (e.g., those with predominant cover-providing vegetation at heights less than about 6-9 inches). Short herbaceous communities are not included in the first bullet.

Also, reductions in herbaceous vegetation and direct effects of livestock use (e.g., trampling, removal of water through drinking) would have the following effects on habitat and survival elements:

- *Forage (leaves, stems, flowers, seeds)* — A moderately-large to large proportion of non-key forage plants would remain available as forage for wildlife, but only a small to moderate amount of key forage plants would remain available for species that favor or depend on these plant species. More so, for vertebrate and invertebrate wildlife that depend on or favor plant parts that are higher up on the key forage plants, little may remain for their use.

  For elk, one recommendation was found in the literature to limit use of key forage species to 40%, but this may be a mute point since many of the elk in the allotment are likely fed at nearby winter feedgrounds. A maximum 50% use of key forage species exceeds the recommendation published by the Western Association of Fish and Game Agencies (2009).

- *Hiding Cover* — In relatively-tall herbaceous communities and understories, a moderately-low to moderate proportion of hiding cover would remain, but in moderate-height or short communities or understories, only a small proportion would remain… or virtually none would remain.

- *Humidity Retention and Temperature Moderation* — There is low to moderately-low support (≥60% retention) and no support (≥50% retention) for the assessment that (1) retaining a 1/3 to 1/2 (≥60% retention) 1/5 and 1/3 (≥50% retention) functional canopy cover, respectively, in moist-meadow type vegetation, and (2) retaining 29-38% and 21-30%, respectively, of sedge height above 2 inches (35-43% and 28-36% of total height) in sedge communities would maintain enough humidity retention and temperature moderation attributes to contribute to suitable habitat for dependent wildlife.

- *Open Patches* — There is very little or no support for the assessment that 40% and 50% utilization of herbaceous vegetation would create small openings in large, extensive stands of herbaceous vegetation. This is because 40% and 50% use of herbaceous vegetation would substantially "overshoot" the creation of small openings.

- *Prey (Invertebrates)* — There is low support for the assessment that (1) retaining a 1/3 to 1/2 (≥60% retention) 1/5 and 1/3 (≥50% retention) functional canopy cover, respectively, in moist-meadow type vegetation, and (2) retaining 29-38% and 21-30%, respectively, of sedge height above 2 inches (35-43% and 28-36% of total height) in sedge communities would maintain enough of the vegetation qualities in large enough patches to provide for the habitat needs of native invertebrate-communities of moist and wet meadow, silver sagebrush, shrubby cinquefoil, and meadow-willow communities.

  A large number of studies on the effects of livestock grazing on invertebrates, and they demonstrate that this level of grazing has substantial negative impacts on many aspects of invertebrate communities. Impacts appear to stem from the large reduction or elimination of useable living space and cover, and large reduction in capability to retain humidity and moderate temperatures.

  Healthy and diverse invertebrate communities are very important to the very large insectivore guild — comprised of migratory birds, bats, shrews, and amphibians.

- *Prey (Small Mammals)* ― For some small mammal species (e.g., ground squirrels), 40-50% use of herbaceous vegetation would be beneficial, which would also benefit predators that favor these small mammal species. However, for microtine voles, 40-50% use of herbaceous vegetation in grass-dominated communities, would result in a major reduction in the capability of the site to provide for moderate to large populations of microtine voles (several directly-applicable studies demonstrate this). Microtine voles are arguably the most important prey for a range of raptors and mammalian predators.
- *Survival as Affected by Trampling* ― The potential for ground nests and amphibians (especially metamorphs) being trampled is relatively high at this level of grazing use. The nest trampling-rate index (i.e., potential for ground nests to be trampled) for 40-50% use of herbaceous vegetation in herbaceous communities is an estimated 20-43% (DeLong 2016). The unaltered potential for trampling small, stationary objects at this grazing level is an estimated 40-100%. While the potential for trampling more than a small number of adult boreal toads and spotted frogs is low in most situations, this level of trampling potential of small, stationary objects means there is a relatively high potential of trampling low numbers of adults in at least some situations (e.g., when cattle are being herded through a herbaceous communities inhabited by toads or frogs). At 40% or 50% utilization of herbaceous vegetation at breeding sites, there would be a moderate to high potential of trampling metamorphs in any given year when and where livestock access wetlands during the metamorphosis period, and the level of impact could range from low to high depending on the situation.
- *Soil Looseness and Integrity of Near-Surface Burrows* ― At 50-60% retention of total herbaceous vegetation, soil compaction would likely be limited to acceptable levels, but possibly near the low end of acceptability (i.e., a moderate level of support).
- *Water Quality in Small Pools* ― There is low support for the assessment that limiting grazing of herbaceous vegetation to 40-50% use would protect against negative impacts to water quality for spotted frogs and boreal toads in all breeding wetlands grazed to these levels of retention. Some studies have shown that water quality likely remains suitable for breeding amphibians at use levels in and around breeding wetlands as high as 40%, but most information shows there to be negative effects at this level of grazing use.
- *Water Retention in Small Pools* ― With the increasing intensity of use at small pools under livestock grazing use levels of 50% and 60%, and given the potential for disproportionately high use even at 70% retention, there is little support for the assessment that 60% or 50% retention of total herbaceous vegetation would adequately limit use of susceptible small pools. Use by livestock would be 1/3 to 2/3 higher than at wetlands where retention levels are at 70%. As the level of livestock use increases in a wetland, there may be a greater potential for the use of the wetland while not having retention levels accurately reflect this (i.e., more drinking than foraging, trailing into and out of wetlands).