Appendix 8

Greater Sage-Grouse Habitat Indicators and Benchmarks

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Appendix 8. Greater Sage-Grouse Habitat Indicators and Benchmarks

8.1 Incorporating the Best Available Science into the Habitat Assessment Framework Process

The Habitat Assessment Framework (HAF/ BLM TR 6710-1, as revised) provides a standardized, scientifically based methodology to assess sage-grouse habitat suitability at multiple scales (broad, mid, fine, and site-scales, Levels 1, 2, 3 and 4 respectively). Habitat suitability occurs along a gradient ranging from unsuitable to suitable and is rarely uniform within and across the scales. Using multi-scale evaluations is important for assessing GRSG habitat by considering the entire suite of conditions that contribute to high quality habitat, the success of past conservation actions, and prioritizing future land uses and conservation actions. Descriptions of the scales of habitat selection (broad-, mid-, fine-, and site-) and the associated indicators for habitat assessment at each scale are available in the HAF (BLM TR 6710-1, as revised).

8.2 Habitat Indicators and Benchmarks for Site-Scale HAF

The vegetation characteristics associated with site-scale habitat suitability vary across the range of GRSG. For example, characteristics (both indicators and benchmarks) in the grasslands of Montana are different than the characteristics in the sagebrush shrublands in the southern Great Basin of Utah and Nevada. The HAF technical reference includes general site-scale forms for the indicators and benchmark values for suitable site scale habitat ratings. The indicators and benchmark values used in these forms at the site scale should be updated to incorporate the best available research related to habitat suitability applicable to the regional and local variability.

The Habitat Indicators Tables (**Tables 8-1.A-G**) provide a list of indicators and benchmarks, derived from local and regional research on GRSG habitat selection, that collectively are used to inform habitat suitability. BLM offices will use the indicators and benchmarks in **the tables below** to assess each monitoring location within seasonal habitats for site-scale suitability, with data collected during the appropriate corresponding seasonal use period, as applicable to address phenological changes. Not all areas within a given habitat management area will be capable of meeting the identified seasonal habitat values in the Habitat Indicators Table due to inherent variation in vegetation communities and ecological potential. Habitat Indicators and Benchmarks are habitat conditions that are based on habitat selection that may not be achievable or applicable in all areas. Site-specific benchmarks must be based on the site's ecological potential informed by ecological site descriptions and associated state-and-transition models and the site's current ecological state.

When completing site-scale assessments, **it is *inappropriate* to use a single indicator** from any of the below **Tables 8-1.A-G** or the HAF habitat suitability form to determine overall habitat suitability of the plot (i.e., suitable, marginal, or unsuitable) unless sagebrush is absent or limiting. Instead, BLM staff must consider all the indicators using multiple lines of evidence, as described in the HAF and in the training materials, to determine the plot's overall habitat suitability. The measured habitat indicator values will vary seasonally, driven largely by use and environmental conditions (e.g., ecological site potential of the monitoring plot), including factors such as annual rainfall, drought, annual production, and natural disturbances, such as high intensity wildfires and flooding. In addition, a site may not meet the suitable rating if many indicators are impacted by annual climate variability (e.g., drought conditions), which is independent of management. Thus, it is critical to document environmental factors when completing the habitat suitability forms. This

information is essential to inform land health assessments and evaluations. Factors to inform assessments and evaluations could also include grouping portions of the landscape based on ecological characteristics that influence their impact to and recovery from changes on the landscape (e.g., fire, drought and other extreme weather events, insect outbreaks, soil disturbance, etc.). Use of such disturbance response groupings (considering disturbance in the ecological sense, not based on the RMP disturbance cap) may also be appropriate to scale ecological site descriptions for larger planning areas and provide context to HAF assessments (Stringham et al. 2016).

Indicators are assessed following the methods described in the Sage-grouse Habitat Assessment Framework. BLM will leverage the terrestrial Assessment, Inventory, & Monitoring (AIM) methods (Herrick et al. 2021), additional monitoring approaches for wetland & riparian habitats, credible partner data, and supplemental long-term monitoring data and guidelines developed by the BLM to collect data on site-scale habitat condition (**Tables 8-1.A-G**). Not all monitoring locations within a given seasonal habitat area will be able to achieve all suitable benchmark values in the Habitat Indicators Table due to the inherent variation in vegetation communities and ecological site potential. The intent is not to meet all habitat requirements at all monitoring locations, but to provide seasonal habitat requirements sufficiently across the landscape. Marginal or unsuitable ratings may still provide, or have the capacity to provide, one or more of the habitat components.

As research becomes available, new data could refine or clarify GRSG selection for vegetation structure and composition in seasonal habitats for certain populations. Because of this, the Habitat Indicators Table(s) (**see below in the remainder of Section 8.2**) will be periodically reviewed to incorporate the best available science in coordination with applicable federal, state, local, and tribal agencies. The addition or adjustment to indicators or benchmarks in the Habitat Indicators Table must include the reference or basis for which the changes are made. Edits should only be made if warranted by scientific evidence, in coordination with the applicable state agency.

8.2.1 Colorado GRSG Habitat Indicators Table

Table 8-1.A. Colorado GRSG Seasonal Habitat Indicators and Benchmarks

Attribute	Indicators	Benchmark	Reference
BREEDING AND NESTING [1,2] Seasonal Use Period for Arid sites: March 1-June 15 Seasonal Use Period for Mesic sites: March 15-June 30 Apply 4 miles from active leks. [12]			[1] Doherty 2008 [2] Holloran and Anderson 2005
Lek Security	Proximity of trees [3]	Trees or other tall structures are none to uncommon within line of site or 1.86 miles (3 km) of leks [4,5]	[3] Baruch-Mordo et al. 2013 [4] Stiver et al. 2015 [5] Connelly et al. 2000
	Proximity of sagebrush to leks [4]	Adjacent protective sagebrush cover within 328 feet (100 m) of lek [4]	[4] Stiver et al. 2015
Cover	Sagebrush canopy cover [4,5,6,14] Arid sites Mesic sites	15 to 30% [14,15] 20 to 30% [14,15]	[4] Stiver et al. 2015 [5] Connelly et al. 2000 [6] Connelly et al. 2003 [14] CO GRSG Steering Committee 2008
	Sagebrush height [5,14] Arid sites [4,5,7] Mesic sites [4,5,8]	 11.8 to 31.5 inches (30-80 cm) 15.7 to 31.5 inches (40-80 cm)	[4] Stiver et al. 2015 [5] Connelly et al. 2000
	Perennial grass canopy cover (such as native bunchgrasses) [4,5,14] Arid sites [5,7] Mesic sites [5,8,14]	 ≥10% ≥20% [14]	[4] Stiver et al. 2015 [5] Connelly et al. 2000 [14] CO GRSG Steering Committee 2008

Attribute	Indicators	Benchmark	Reference
Cover *(cont.)*	Perennial grass and forb height (includes residual cover) [5,6,7]	>6 inches (15 cm) [5,13,14]	[5] Stiver et al. 2015 [14] CO GRSG Steering Committee 2008
	Perennial forb canopy cover [4,5,6] Arid sites [7] Mesic sites [8]	 ≥5% [4,5,14] ≥15% [4,5,14]	[4] Stiver et al. 2015 [5] Connelly et al. 2000 [6] Connelly et al. 2003 [14] CO GRSG Steering Committee 2008
	Invasive annual grass cover [16]	<2% cover [16]	[16] BLM synthesis of research
	Conifer [17]	0 (Absence of conifer) [17]	[17] BLM synthesis of research
BROOD-REARING/SUMMER Seasonal Use Period for Arid sites: June 16-October 31 Seasonal Use Period for Mesic sites: July 1-October 31			
Cover	Sagebrush canopy cover [4,5,6,14]	10 to 25%	[4] Stiver et al. 2015 [5] Connelly et al. 2000 [6] Connelly et al. 2003 [14] CO GRSG Steering Committee 2008
	Sagebrush height [5,6,14] Arid sites [7] Mesic sites [8]	11.8 to 31.5 inches (30-80 cm) 13.8 to 31.5 inches (35-80 cm)	[5] Connelly et al. 2000 [6] Connelly et al. 2003
	Perennial grass and forb cover [5,6,14] Arid sites [7] Mesic sites [8]	>15% [14] >25% [14]	[5] Connelly et al. 2000 [6] Connelly et al. 2003 [14] CO GRSG Steering Committee 2008
	Invasive annual grass cover [16]	<2% cover [16]	[16] BLM synthesis of research
	Conifer	0 (Absence of conifer)	[17] BLM synthesis of research
	Riparian areas (both lentic and lotic systems)	Proper Functioning Condition [10]	
	Upland and riparian perennial forb availability [4,5]	Preferred forbs are common with several preferred species present [9]	[4] Stiver et al. 2015 [5] Connelly et al. 2000
WINTER (Seasonal Use Period November 1-February 28) Seasonal Use Period for Arid sites: November 1-February 28 Seasonal Use Period for Mesic sites: November 1-March 14			
Cover and Food	Sagebrush canopy cover above snow [4,5,6] Arid sites [7] Mesic sites [8]	>20% [14] >25% [14]	[4] Stiver et al. 2015 [5] Connelly et al. 2000 [6] Connelly et al. 2003 [14] CO GRSG Steering Committee 2008
	Sagebrush height above snow [4,5,6]	>10 inches (25 cm) [11]	[4] Stiver et al. 2015 [5] Connelly et al. 2000 [6] Connelly et al. 2003
	Conifer	0 (Absence of conifer)	[17] BLM synthesis of research

Notes:
[1] Doherty 2008
[2] Holloran and Anderson 2005
[3] Baruch-Mordo et al. 2013
[4] Stiver et. al. 2015
[5] Connelly et al. 2000
[6] Connelly et al. 2003
[7] 10–12 inch precipitation zone; *Artemisia tridentata wyomingensis* is a common big sagebrush sub-species for this type site [4].
[8] >12 inch precipitation zone; *Artemisia tridentata vaseyana* is a common big sagebrush sub-species for this type site [4].
[9] Preferred forbs are listed in Habitat Assessment Framework Table III-2 [4]. Overall, total forb cover may be greater than that of preferred forb cover since not all forb species are listed as preferred in Table III-2.
[10] Existing land management plan desired conditions for riparian areas/wet meadows (spring seeps) may be used in place of properly functioning conditions, if appropriate for meeting GRSG habitat requirements.
[11] The height of sagebrush remaining above the snow depends upon snow depth in a particular year. The intent is to manage for a mosaic of sagebrush stands with tall, healthy, sagebrush present in swales or bottoms.
[12] Buffer distance may be changed only if 3 out of 5 years of telemetry studies indicate the 4 miles is not appropriate.
[13] Measured as "droop height"; the highest naturally growing portion of the plant.

[14] Colorado Greater Sage-grouse Steering Committee 2008
[15] If sagebrush cover exceeds 30%, this would not be cause to consider the site as less than suitable unless total shrub cover is above 40%[14]
[16] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[17] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

8.2.2 Idaho GRSG Habitat Indicators Table

Table 8-1.B. Idaho GRSG Seasonal Habitat Indicators and Benchmarks

Attribute	Indicator	Benchmarks	Reference
LEK HABITAT (Seasonal Use Period March 1 – May 15) [1]			
Lek Security	Proximity of trees	Trees (i.e., mainly juniper, conifers, and does not include old- growth juniper, pinyon pine and mountain mahogany) absent or uncommon on shrub/grassland ecological sites within 1.86 miles (3 km) of occupied leks.	Baruch-Mordo et al. 2013 Stiver et al. 2015
	Proximity of sagebrush to leks	Adjacent protective sagebrush cover within 328 ft. (100 m) of an occupied lek	Stiver et al. 2015
NESTING/EARLY BROOD REARING [1,5] (Seasonal Use Period May 1 – June 30) [1]			
Cover and Food	Sagebrush cover [2]	15-25%	Connelly et al. 2000 Connelly et al. 2003 Hagen et al. 2007 Stevens et al. 2023
	Sagebrush height Arid sites [3] Mesic sites [4]	 12-31 inches (30-80cm) 16-31 inches (40-80cm)	Connelly et al. 2000
	Predominant sagebrush shape	Predominantly spreading shape [5]	Stiver et al. 2015
	Perennial grass cover (such as native bunchgrasses) [2] Arid sites [3] Mesic sites [4]	 ≥10% ≥15%	Connelly et al. 2000 Stiver et al. 2015
	Perennial grass (and forb) height (includes residual grasses)	≥ 7 inches (18 cm)	Connelly et al. 2000 Connelly et al. 2003 Hagen et al. 2007 Stiver et al. 2015
	Perennial forb cover [2] Arid sites [3] Mesic sites [4]	 ≥5% ≥10%	Connelly et al. 2000
	Perennial forb availability	Preferred forbs are common with several species present [6]	Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [9]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [10]
LATE BROOD-REARING/SUMMER [1, 7] (July-October) [1] Late brood-rearing areas, such as riparian, meadows, springs, higher elevation mesic uplands, etc. may occur within other mapped seasonal habitat areas. Apply late brood rearing/summer habitat desired conditions locally as appropriate.			
Cover and Food	Sagebrush cover [2]	Uplands 10-25% Riparian/Meadow: Sagebrush cover within 100 m	Connelly et al. 2000
	Sagebrush height	16 to 32 inches (40-80cm)	Connelly et al. 2000
	Perennial grass and forb cover [2]	>15%	
	Upland and riparian perennial forb availability [2]	Preferred forbs are common with appropriate numbers of species present [6]	Stiver et al. 2015
	Riparian and/or meadow habitat condition	Proper Functioning Condition	Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [9]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [10]

Attribute	Indicator	Benchmarks	Reference
WINTER[1] November-March[1] (Apply to areas of known or likely winter-use)			
Cover and Food	Sagebrush cover and height above snow.	Sagebrush is at least 10 inches (25 cm) above snow and ≥10% cover [8]	Connelly et al. 2000 Stiver et al. 2015
	Conifer	0 (Absence of conifer)	BLM synthesis of research [10]

Notes:
[1] Seasonal dates can be adjusted by local unit according to geographic region.
[2] Since plant species and/or life forms may overlap, total vegetative cover, inclusive of shrubs, forbs and grasses may exceed 100%. Note that sagebrush cover objectives may exceed 25% in some areas, for example in areas with higher precipitation, and/or where local science is available demonstrating sage-grouse use of areas with sagebrush cover > 25%.
[3] Arid corresponds to the 10 – 12 inch precipitation zone; *Artemisia tridentata wyomingensis* is a common big sagebrush sub- species for this type site (Stiver et al. 2015).
[4] Mesic corresponds to the ≥12 inch precipitation zone; *Artemisia tridentata vaseyana* is a common big sagebrush sub-species for this type site (Stiver et al. 2015).
[5] Collectively the indicators for sagebrush (cover, height, and shape), perennial grass and perennial forb (cover, height and/or availability) represent the desired condition range for nesting/early brood rearing habitat characteristics, consistent with the breeding habitat suitability matrix identified in Stiver et al. *2015*. Sagebrush plants that are more tree or columnar-shaped provide less protective cover near the ground than sagebrush plants with a spreading shape (Stiver et al. 2015). Some sagebrush plants are naturally columnar (e.g., Great Basin big sagebrush), and a natural part of the plant community. However, a predominance of columnar shape arising from animal impacts may warrant management investigation or adjustments at site specific scales.
[6] Preferred forbs are listed in Stiver et al. 2015. Overall total forb cover may be greater than that of preferred forb cover since not all forb species are listed as preferred.
[7] Some late brood habitat occurs at higher elevations outside of mapped nesting habitat and some is embedded within nesting landscapes especially areas such as wet meadows, riparian areas, springs and seeps.
[8] Winter habitat metrics are a guideline but snow depths and habitat availability may vary widely depending on winter severity, topography and elevation.
[9] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[10] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

8.2.3 Montana/Dakotas GRSG Habitat Indicators Tables

MT-Dak did not amend RMPs in 2019 and Butte/UMRBNM were not included in the 2015 amendment process. Original 2015 Tables are provided in Appendix 2 for reference but have been modified/adjusted for the Proposed Plan to take into account ecological boundaries, experience implementing the HAF, BLM review of recent range wide and local research, and additional comments/information provided during the planning process. Montana/Dakotas BLM offices will utilize three sets of boundaries, mostly aligned with one or multiple mid-scale HAF boundaries. These areas and associated offices are:

Name	Boundary and Offices
Headwaters	SW Montana: Dillon and Butte (Headwaters HAF Midscale)
North-Central Prairies	HiLine, Lewistown, UMRBNM, and parts of Billings and Miles City FOs (Northern Border and Midrivers HAF Midscale)
Bighorn-Custer High Plains	North and South Dakota, Billings and Miles City south of Yellowstone River (Custer midscale with extension to WY border)

Table 8-1.C.1. Headwaters Habitat Indicators and Benchmarks

Attribute	Indicator	Benchmarks	Reference
LEK HABITAT (Seasonal Use Period March 1 – May 15) [1]			
Lek Security	Proximity of trees	Trees and tall structures (> 3m [10 ft.]) are absent within 0.65 km (.388 miles) of active leks (line of sight).	Stiver et al. 2015
	Tree Cover in the Landscape	Tree canopy cover is < 1% within 3 kilometers (1.86 miles) of occupied Sage-grouse leks	Baruch-Mordo et al. 2013 Stiver et al. 2015
	Proximity of sagebrush to leks	Adjacent protective sagebrush cover within 328 ft. (100 m) of an occupied lek	Stiver et al. 2015

Attribute	Indicator	Benchmarks	Reference
NESTING/EARLY BROOD REARING (Seasonal Use Period May 1 – June 30) [1]			
Cover and Food	Sagebrush cover [2]	15-25%	Connelly et al. 2000 Connelly et al. 2003 Hagen et al. 2007
	Sagebrush height Arid sites [3]	12-31 inch (30-80cm) with taller individual sagebrush available within stand (for nesting) and a variety of heights (including those <30 cm)	Connelly et al. 2000 Scroff 2016 Boccadori et al. 2023 Scroff et al. 2018
	Mesic sites [4]	16-31 inch (40-80cm) with taller individual sagebrush available within stand (for nesting) and a variety of heights (including those <40 cm)	
	Predominant sagebrush shape	Predominantly spreading shape [5]	Stiver et al. 2015
	Perennial grass cover [2, 5] Arid sites [3] Mesic sites [4]	 >10% >15%	Connelly et al. 2000 Stiver et al. 2015
	Perennial grass height (includes residual grasses) [5]	≥ 7 inches (18 cm)	Connelly et al. 2000 Connelly et al. 2003 Hagen et al. 2007 Stiver et al. 2015 Smith et al. 2018
	Perennial forb cover [2] Arid sites [3] Mesic sites [4]	 >5% >10%	Connelly et al. 2000
	Perennial forb availability	Preferred forbs are common with several species present [7]	Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [10]
	Trees (e.g. Conifer)	0 (Absence of conifer trees)	BLM synthesis of research [11]
LATE BROOD-REARING/SUMMER (Seasonal Use Period June 16th-October 31)[1] Late brood-rearing areas, such as riparian, meadows, springs, higher elevation mesic uplands, etc. may occur within other mapped seasonal habitat areas. Apply late brood rearing/summer habitat desired conditions locally as appropriate.[8]			
Cover and Food	Sagebrush cover [2]	Uplands 10-25% Riparian/Meadow: Sagebrush cover within 100 m	Connelly et al. 2000
	Sagebrush height	16 to 32 inches (40-80cm)	Connelly et al. 2000
	Perennial grass and forb cover [2]	>15%	Connelly et al. 2000 Hagen et al. 2007 Sant et al. 2014
	Upland and riparian perennial forb availability [2]	Preferred forbs are common with appropriate numbers of species present (e.g., > 5)[7]	Stiver et al. 2015
	Riparian and/or meadow habitat condition	Proper Functioning Condition	Stiver et al. 2015 BLM 1997 Prichard et al. 1999 Prichard 1998 Gonzalez and Smith 2020
	Invasive annual grass cover	<2% cover	BLM synthesis of research [11]
	Conifer	0 (Absence of conifer trees)	BLM synthesis of research [12]

Attribute	Indicator	Benchmarks	Reference
WINTER November-March [1] (Apply to areas of known or likely winter-use) [9, 10]			
Cover and Food	Sagebrush cover	≥15% cover	Connelly et al. 2000 Stiver et al. 2015 Dusek et al. 2002
	Sagebrush height	>16 inch (40cm) with multiple tall sagebrush available within stand	Connelly et al. 2000 Stiver et al. 2015 Dusek et al. 2002
	Invasive Annual Grass Cover	<2%	BLM synthesis of research [11]
	Conifer	0 (Absence of conifer trees)	BLM synthesis of research [12]

Notes:
[1] Seasonal dates can be adjusted by local unit according to geographic region.
[2] Since plant species and/or life forms may overlap, total vegetative cover, inclusive of shrubs, forbs and grasses may exceed 100%.
[3] Arid corresponds to the 10 – 12 inch precipitation zone; *Artemisia tridentata wyoming*ensis is a common big sagebrush subspecies for this type site (Stiver et al. 2015).
[4] Mesic corresponds to the >12 inch precipitation zone; *Artemisia tridentata vaseyana* is a common big sagebrush sub-species for this type site (Stiver et al. 2015).
[5] Adequate nesting cover may be provided by a mix of shrub and herbaceous. For sites with sagebrush canopy cover and/or heights at the low end or below the benchmark values, higher herbaceous cover may provide suitable conditions for nesting. Conversely, for sites with preferred nesting shrubs (height, width, branch distribution, etc.) grass cover may not be predictive of suitable nesting locations.
[6] Collectively the indicators for sagebrush (cover, height, and shape), perennial grass and perennial forb (cover, height and/or availability) represent the desired condition range for nesting/early brood rearing habitat characteristics, consistent with the breeding habitat suitability matrix identified in Stiver et al. 2015. Sagebrush plants that are more tree or columnar-shaped provide less protective cover near the ground than sagebrush plants with a spreading shape (Stiver et al. 2015). Some sagebrush plants are naturally columnar (e.g., Great Basin big sagebrush), and a natural part of the plant community. However, a predominance of columnar shape arising from animal impacts may warrant management investigation or adjustments at site specific scales.
[7] Preferred forbs are listed in Stiver et al. 2015. Overall total forb cover may be greater than that of preferred forb cover since not all forb species are listed as preferred.
[8] Some late brood-rearing habitat occurs at higher elevations outside of mapped nesting habitat and some is embedded within nesting landscapes especially areas such as wet meadows, riparian areas, springs and seeps.
[9] Winter habitat metrics are a guideline but snow depths and habitat availability may vary widely depending on winter severity, topography and elevation.
[10] Winter habitat generally taller and denser stands relative to availability
[11] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[12] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

Table 8-1.C.2. North-Central Prairies Habitat Indicators and Benchmarks

Attribute	Indicator	Benchmarks	Reference
Lek Habitat (Seasonal Use Period March 1 – May 15) [1]			
Lek Security	Proximity of trees	Trees and tall structures (> 3m [10 ft.]) are absent within 0.65 km (.388 miles) of active leks (line of sight).	Stiver et al. 2015
	Tree Cover in the Landscape	Tree canopy cover is < 1% within 3 kilometers (1.86 miles) of occupied Sage-grouse leks	Baruch-Mordo et al. 2013 Stiver et al. 2015
	Proximity of sagebrush to leks	Adjacent protective sagebrush cover within 328 ft. (100 m) of an occupied lek	Stiver et al. 2015

Attribute	Indicator	Benchmarks	Reference
NESTING/EARLY BROOD REARING (Seasonal Use Period May 1 – June 30) [1]			
Cover and Food	Sagebrush cover [2] WY Big Sage [3] Silver Sage [4]	10-25% ≥5% (≥10)% [6]	Berkeley et al. 2013 Connelly et al. 2000 Doherty et al. 2010 Lane 2005 Hagen et al. 2007 Sant et al. 2014 Tack 2010
	Sagebrush height [2] WY Big Sage [3] Silver Sage [4]	 6-31 inch (15-80cm) with taller individual sagebrush available within stand (nesting shrubs) and a variety of heights (i.e., adequate nest cover based on ecological site potential) [2] 16-31 inch (40-80cm) with taller individual sagebrush available within stand (for nesting) and a variety of heights (including those <40 cm) [2]	Connelly et al. 2000 Lane 2005 Foster et al. 2014 Tack 2010
	Predominant sagebrush shape	Predominantly spreading shape [5]	Stiver et al. 2015
	Perennial grass cover	≥10%	Connelly et al. 2000 Lane 2005 Sant et al. 2014
	Perennial grass height (includes residual grasses)[2]	≥18 cm (≥7.1 inches) - i.e., adequate nest cover based on ecological site potential and seasonal precipitation	Berkeley et al. 2013 Connelly et al. 2000 Doherty et al. 2014 Hagen et al. 2007 Taylor et al. 2012 Smith et al. 2018
	Perennial forb cover	≥5%	Connelly et al. 2000 Sant et al. 2014
	Perennial forb availability	Preferred forbs are common with several species present (≥5) [7]	Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [10]
	Trees (i.e., Conifer)	0 (Absence of conifer)	BLM synthesis of research [11]

Attribute	Indicator	Benchmarks	Reference
LATE BROOD-REARING/SUMMER (Seasonal Use Period June 16th-October 31)[1]			
Cover and Food	Sagebrush cover WY Big Sage [4] Silver Sage [5] Saline/Acid Shale/Clay [6]	 10-25% 2-25% 5-25% Riparian/Meadow: Sagebrush cover within 100m	Connelly et al. 2000 Lane 2005 Hagen et al. 2007 Sant et al. 2014 Foster et al. 2014
	Sagebrush height WY Big Sage [4] Silver Sage [5] Saline/Acid Shale/Clay [6]	 12 to 31 inch (30-80cm) 12 to 31 inch (30-80cm) > 6 inches (15cm)	Connelly et al. 2000 Lane 2005
	Perennial grass cover WY Big Sage [4] Silver Sage [5] Saline/Acid Shale/Clay [6]	>15% >15% >10%	Connelly et al. 2000 Hagen et al. 2007 Sant et al. 2014
	Perennial forb cover WY Big Sage [4] Silver Sage [5] Saline/Acid Shale/Clay [6]	>5% >10% >3%	Prichard et al. 1999 Schroeder et al. 2020 BLM 1997
	Upland and riparian perennial forb availability WY/Silver Sage [4,5] Saline/Acid Shale/Clay [6]	 Preferred forbs are common with several species present (≥5) [7] Preferred forbs are common with several species present (≥2) [7]	Connelly et al. 2000 Stiver et al. 2015
	Riparian and/or meadow habitat condition	Majority of sites are in Proper Functioning Condition	BLM 1997 Prichard et al. 1999 Prichard 1998 Gonzalez and Smith 2020
	Invasive annual grass cover	<2% cover	BLM synthesis of research [10]
	Conifer presence	0 (Absence of conifer)	BLM synthesis of research [11]
WINTER (Seasonal Use Period: November 1 to February 28) [8, 9]			
Cover and Food	Sagebrush cover	≥15% cover, or cover supported based on ecological site potential	Connelly et al. 2000 Stiver et al. 2015 Dusek et al. 2002
	Sagebrush height	Multiple tall sagebrush available (>12 inch, 30cm) within stand [7,8]	Connelly et al. 2000 Stiver et al. 2015 Dusek et al. 2002
	Invasive Annual Grass Cover	<2%	BLM synthesis of research [10]
	Trees (i.e., Conifer)	0 (Absence of conifer trees)	BLM synthesis of research [11]

Notes:
[1] Seasonal dates can be adjusted by local unit according to geographic region.
[2] Adequate nesting cover may be provided by a mix of shrub and herbaceous. For sites with sagebrush canopy cover and/or heights at the low end or below the benchmark values, higher herbaceous cover may provide suitable conditions for nesting. Conversely, for sites with preferred nesting shrubs (height, width, branch distribution, etc.) grass cover may be less important towards providing suitable nesting locations. Overall cover and height may be lower based on ecological site potential but still provide important components of suitable GRSG habitat as part of the heterogeneous landscape.
[3] WY Big Sage - Unglaciated, semiarid (10-14 inches annual precipitation) plains where the dominant, most common, shrub is Wyoming Big Sage. Characterized by frigid soil temperature regime and the overlap of Great Plains rhizomatous grasslands and sagebrush ecosystems
[4] Silver sage – Predominantly areas north of the Milk River in Montana. Characterized by mixed grass prairie habitat containing silver sage (most common shrub, species of sagebrush)
[5] Saline/Acid Shale/Clay – Low productivity sites due to site limitations, soils. However, provide brood rearing and foraging habitat for sage-grouse as part of the heterogeneous landscape.

[6] In silver sage communities, both sagebrush and total shrub cover should be considered. Studies of nesting GRSG indicate that up to half of shrub cover may be of other species in silver sage habitats.
[7] Preferred forbs are listed in Stiver et al. 2015. Overall total forb cover may be greater than that of preferred forb cover since not all forb species are listed as preferred.
[8] Winter habitat metrics are a guideline but snow depths and habitat availability may vary widely depending on winter severity, topography and elevation.
[9] Winter habitat generally taller and denser stands relative to availability
[10] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[11] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

Table 8-1.C.3. Bighorn-Custer High Plains Habitat Indicators and Benchmarks

Attribute	Indicator	Benchmarks	References
Lek Habitat (Seasonal Use Period March 1 – May 15) [1]			
Lek Security	Proximity of trees	Trees and tall structures (> 3m [10 ft.]) are absent within 0.65 km (.388 miles) of active leks (line of sight).	Stiver et al. 2015
	Tree Cover in the Landscape	Tree canopy cover is < 1% within 3 kilometers (1.86 miles) of occupied Sage-grouse leks	Baruch-Mordo et al. 2013 Stiver et al. 2015
	Proximity of sagebrush to leks	Adjacent protective sagebrush cover within 328 ft. (100 m) of an occupied lek	Stiver et al. 2015
NESTING/EARLY BROOD REARING (Seasonal Use Period May 1 – June 30) [1]			
Cover and Food	Sagebrush cover [2] High Plains [3] Transitional Prairie [4]	 10-25% 2-25%	Herman–Brunson 2007 Swanson 2009 Doherty et al. 2010 Hagen et al. 2007 Doherty et al. 2011 Foster et al. 2014 Wright and Wegner 2008
	Sagebrush height [2] High Plains [3] Transitional Prairie [4]	 12-31 inch (30-80cm) with taller individual sagebrush available within stand (for nesting) and a variety of heights (including those <30 cm) [2] 7-31 inch (18-80cm) with taller individual sagebrush available within stand (for nesting) and a variety of heights (including those <30 cm) [2]	Swanson 2009 Doherty et al. 2011 Schroeder et al. 2020 Holloran et al. 2005
	Predominant sagebrush shape	Predominantly spreading shape [5]	Stiver et al. 2015
	Perennial grass cover [2] High Plains [3] Transitional Prairie [4]	 ≥10% ≥15%	Doherty et al. 2010 Hagen et al. 2007 Doherty et al. 2011 Holloran et al. 2005
	Perennial grass height (includes residual grasses) [2]	≥18 cm (≥7.1 inches) - i.e., adequate nest cover based on ecological site potential and seasonal precipitation	Doherty et al. 2014 Smith et al. 2018 Foster et al. 2014
	Perennial forb canopy cover	≥5%	Doherty et al. 2010 Hagen et al. 2007 Doherty et al. 2011 Holloran et al. 2005
	Perennial forb availability	Preferred forbs are common with several species present (≥5) [5]	Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [6]
	Trees (i.e., Conifer)_	0 (Absence of conifer trees)	BLM synthesis of research [7]

Attribute	Indicator	Benchmarks	References
BROOD-REARING/SUMMER (Seasonal Use Period June 16-October 31)[1]			
Cover and Food	Sagebrush cover High Plains [3] Transitional Prairie [4]	 10-25% 2-25%	Herman–Brunson 2007 Swanson 2009 Doherty et al. 2010 Hagen et al. 2007 Doherty et al. 2011 Foster et al. 2014
	Sagebrush height High Plains [3] Transitional Prairie [4]	 12 to 31 inch (30-80cm) > 6 inches (15cm)	Doherty et al. 2011 Foster et al. 2014 Schroeder et al. 2020 Holloran et al. 2005
	Perennial grass cover High Plains [3] Transitional Prairie [4]	 ≥10% ≥15%	Doherty et al. 2010 Hagen et al. 2007 Doherty et al. 2011 Holloran et al. 2005
	Perennial forb cover	≥10%	Prichard et al. 1999 Schroeder et al. 2020 BLM 1997
	Upland and riparian perennial forb availability	Preferred forbs are common with several species present (≥5)	Stiver et al. 2015 Doherty et al. 2011
	Riparian and/or meadow habitat condition	Majority of sites are in Proper Functioning Condition	BLM 1997 Prichard et al. 1999 Prichard 1998 Gonzalez and Smith 2020
	Invasive annual grass cover	<2% cover	BLM synthesis of research [6]
	Trees (i.e., Conifer)	0 (Absence of conifer trees)	BLM synthesis of research [7]
WINTER (Seasonal Use Period November 1-February 28) [8,9]			
Cover and Food	Sagebrush cover	≥10% cover, or cover supported based on ecological site potential	Swanson 2009 Foster et al. 2014 Schroeder et al. 2020 Dusek et al 2002
	Sagebrush height	Multiple tall sagebrush available (>12 inch, 30cm) within stand [8,9]	Doherty et al. 2011 Schroeder et al. 2020
	Invasive Annual Grass Cover	<2%	BLM synthesis of research [6]
	Trees (i.e., Conifer)	0 (Absence of conifer trees)	BLM synthesis of research [7]

Notes:
[1] Seasonal dates can be adjusted by local unit according to geographic region.
[2] Adequate nesting cover may be provided by a mix of shrub and herbaceous. For sites with sagebrush canopy cover and/or heights at the low end or below the benchmark values, higher herbaceous cover may provide suitable conditions for nesting. Conversely, for sites with preferred nesting shrubs (height, width, branch distribution, etc.) grass cover may be less important towards providing suitable nesting locations. Ecological site, including site potential and state, and additional GRSG information may inform suitability and benchmarks for individual sites.
[3] High Plains - Unglaciated, rolling, semiarid (10-14 inches annual precipitation) plains. Characterized by frigid soil temperature regime and the overlap of Great Plains rhizomatous grasslands and sagebrush ecosystems
[4] Transitional Prairie - Fringe areas on the edge of sagebrush range (far east Montana into the Dakotas) and Desertic Basins (more arid areas)
[5] Preferred forbs are listed in Stiver et al. 2015. Overall total forb cover may be greater than that of preferred forb cover since not all forb species are listed as preferred.
[6] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[7] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)
[8] Winter habitat metrics are a guideline but snow depths and habitat availability may vary widely depending on winter severity, topography and elevation.
[9] Winter habitat generally taller and denser stands relative to availability

8.2.4 Nevada/California GRSG Habitat Indicators Table(s)

Table 8-1.D. Nevada/California GRSG Habitat Indicators Table

Attribute	Indicators	Benchmarks	Reference
GENERAL/LANDSCAPE-LEVEL [1]			
All life stages	Rangeland health assessments	Meeting all standards[2]	
Cover (nesting)	Seasonal habitat needed	>65% of the landscape in sagebrush cover	Aldridge and Boyce 2007
	Annual grasses	<%5	Blomberg et al. 2012
Security (nesting)	Conifer encroachment	<3% phase I (>0 to <25% cover) No phase II (25 to 50% cover) No phase III (>50% cover)	Casazza et al. 2011 Coates et al. 2016
Cover and food (winter)	Conifer encroachment	<5% phase I (>0 to <25% cover) No phase II (25 to 50% cover) No phase III (>50%)	Coates et al. 2016
	Sagebrush extent	>85% sagebrush land cover	Doherty et al. 2008
LEK (Seasonal Use Period: March 1 to May 15) [1]			
Cover	Availability of sagebrush cover	Adjacent sagebrush provides escape cover	Blomberg et al. 2012 Connelly et al. 2000 Stiver et al. 2015
Security [3]	Pinyon or juniper cover	<2% landscape cover within .6 mile of leks	Connelly et al. 2000 (modified) Stiver et al. 2015 Baruch-Mordo et al. 2013 Coates et al. 2017b
	Proximity of Linear Features	>3.1 miles	Manier et al. 2014
	Proximity of Surface Disturbance	>3.1 miles	Manier et al. 2014
	Proximity of Tall Structures	>2 miles	Coates et al. 2013 Manier et al. 2014
	Proximity of Low Structures	>1.2 miles	Manier et al. 2014
NESTING (Seasonal Use Period: April 1 to June 30) [1]			
Cover [6]	Sagebrush cover	Arid [8]: ≥20% Mesic [8]: ≥20%	Kolada et al. 2009a, 2009b Coates et al. 2017a
	Residual and live perennial grass cover (such as native bunchgrasses)	Arid [8]: ≥7% if shrub cover is >20% [5] Mesic [8]: ≥13% if shrub cover is >20% [5]	Coates et al. 2013; 2017a Coates and Delehanty 2010 Kolada et al. 2009a, 2009b
	Annual grass cover	Arid [8]: <3% Mesic [8]: <3%	Coates et al. 2017a
	Total shrub cover	Arid [8]: >28% Mesic [8]: >26%	Coates and Delehanty 2010 Kolada et al. 2009a Coates et al. 2017a
	Perennial grass height (includes residual grasses)	Arid [8]: 12 cm Mesic [8]: 18 cm	Connelly et al. 2000, 2003 Hagen et al. 2007 Stiver et. al. 2015 Coates et al. 2017a
Security [2]	Proximity of tall structures [4] (3 feet [1 meter] above shrub height)	Use Manier et al. 2014, Conservation Buffer Distance Estimates for GRSG-A Review; preference is 3 miles	Coates et al. 2013 Gibson et al. 2013 Manier et al. 2014
	Pinyon or juniper cover	<3% within 800 meters	Severson et al. 2017
	Invasive annual grass cover	<2% cover	BLM synthesis of research [9]
	Conifer	0 (Absence of conifer at site)	BLM synthesis of research [10]

Attribute	Indicators	Benchmarks	Reference
BROOD-REARING/SUMMER (Seasonal Use Period: May 15 to September 15; Early: May 15 to June 15; Late: June 15 to September 15) [1]			
UPLAND HABITATS			
Cover [6]	Sagebrush cover	Arid [8]: ≥20% Mesic [8]: ≥15%	Connelly et al. 2000 Coates et al. 2017a
	Perennial grass and forb cover	Arid [8]: >19% Mesic [8]: >25%	Connelly et al. 2000 Hagen et al. 2007 Coates et al. 2017a
	Deep rooted perennial bunchgrass (within 522 feet [200 meters] of riparian areas and wet meadows)	Arid [8]: 12 cm [7] Mesic [8]: 14 cm [7]	Hagen et al. 2007 Casazza et al. 2011 Coates et al. 2017a
Cover and food [6]	Perennial forb cover	Arid [8]: >5% Mesic [8]: >9%	Casazza et al. 2011 Lockyer et al. 2015 Coates et al. 2017a
	Invasive annual grass cover	<2% cover	BLM synthesis of research [9]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [10]
RIPARIAN/MEADOW HABITATS [1]			
Cover and food [6]	Riparian areas/meadows	PFC	Dickard et al. 2015 Gonzalez and Smith 2020 Prichard 1998 Prichard 1999 Stiver et al. 2015
Security [6]	Upland and riparian perennial forb availability and understory species richness	Preferred forbs are common with several species present and high species richness (all plants)	Stiver et al. 2015
	Riparian area/meadow interspersion with adjacent sagebrush	Has adjacent sagebrush cover within 200 meters	Casazza et al. 2011 Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [9]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [10]
WINTER (Seasonal Use Period: November 1 to February 28)[1]			
Cover and Food	Sagebrush cover	≥10%	Connelly et al. 2000 Stiver et al. 2015
	Sagebrush height	> 25 cm above snow depth	Connelly et al. 2000 Stiver et al. 2015
	Conifer	0 (Absence of conifer)	BLM synthesis of research [10]

Notes:
[1] Any one single habitat indicator does not define whether the habitat objective is or is not met. Instead, the preponderance of evidence from all indicators within that seasonal habitat period must be considered when assessing GRSG habitat objectives.
[2] Upland standards are based on indicators for cover, including litter, live vegetation, and rock, appropriate to the ecological potential of the site in context of the site's current ecological state and using the associated state and transition model/disturbance response group.
[3] Applicable to Phase I and Phase II pinyon and/or juniper.
[4] Does not include fences.
[5] In addition, if upland rangeland health standards are being met.
[6] Ecological site potential to meet habitat objectives should be considered when determining if objectives are feasible for the site. .
[7] In drought years, 4-inch perennial bunchgrass height with greater than 20 percent measurements exceeding 5 inches in dry years.
[8] Arid is defined as areas that received >35.0 cm of average annual precipitation.
Mesic is defined as areas that received ≤35.0 cm of average annual precipitation.
[9] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[10] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

8.2.5 Oregon GRSG Habitat Indicators Table

Table 8-1.E. Oregon GRSG Habitat Indicators Table

Attribute	Indicators	Benchmarks	Reference
Breeding Including Lekking, Pre-nesting, Nesting, and Early Brood Rearing (Seasonal Use Period March 1 – June 30)			
Lek Security	Proximity of trees or other tall structures	No conifers or tall structures[1] within 1.0 mile of lek center and conifer cover ≤4% within 4.0 miles of lek, excluding pre-settlement trees	Connelly et al. 2000 Fresse 2009 Baruch-Mordo et al. 2013 Knick et al. 2013
	Proximity of sagebrush to leks	Lek has adjacent sagebrush cover	Connelly et al. 2000
Cover	Sagebrush cover (%)	10 to 25	Doescher et al. 1986 Gregg et al. 1994 Hanf et al. 1994 Coggins 1998 Crawford and Carver 2000 Bates and Davies 2014 BLM 2015a
	Sagebrush height (inches) Arid sites (warm-dry) Mesic sites (cool-moist)	 11 to 31 15 to 31	Gregg et al. 1994 Hanf et al. 1994 Coggins 1998 Crawford and Carver 2000 Freese 2009
	Predominant sagebrush shape	Spreading	Connelly et al. 2000
	Perennial grass cover (such as bunchgrass) (%) Arid sites Warm-dry Shallow-dry Mesic sites Cool-moist Warm-moist	 ≥10 ≥10 ≥20 ≥20	Gregg at al. 1994 Coggins 1998 Crawford and Carver 2000 Freese 2009 NRCS 2015 Bates and Davies 2014 Jon Bates, USDA ARS, pers. comm. 2/10/2015 BLM 2015a BLM 2015b
	Perennial grass and forb height (inches, including residual grasses) – most important in nest areas; excludes shallow-dry sites[2] Arid sites (warm-dry) Mesic sites (cool-moist)	 ≥7 ≥9	Gregg et al. 1994 Hanf et al. 1994 Crawford and Carver 2000 Hagen et al. 2007 Jon Bates, USDA ARS, pers. comm. 2/10/2015
	Perennial forb cover (%)[3] Arid sagebrush Warm-dry Shallow-dry Mesic sagebrush Cool-moist Warm-moist	 ≥2 ≥2 ≥6 ≥5	Drut 1992 Drut et al. 1994 Crawford and Carver 2000 Freese 2009 NRCS 2015 Bates and Davies 2014 BLM 2015a Jon Bates, USDA ARS, pers. comm. 2/10/2015 BLM 2015b
	Invasive annual grass cover	<2% cover	BLM synthesis of research[7]
	Conifer	0 (Absence of conifer)	BLM synthesis of research[8]

Attribute	Indicators	Benchmarks	Reference
Food	forb diversity and availability [3]	Palatable forbs are common (≥6 individual plants) with ≥5 species present[4] and ≥2% forb cover	Hanf et al. 1994 Crawford and Carver 2000 Freese 2009 Bates and Davies 2014 BLM 2015a Jon Bates, USDA ARS, pers. comm. 2/10/2015
Brood-rearing/Summer Including Late-brood Rearing, Summering, and Early Autumn (Seasonal Use Period July 1- October 31)			
Cover	Sagebrush cover (%)	10 to 25	Doescher et al. 1986 Drut et al. 1994 Connelly et al. 2000 Crawford and Carver 2000 Bates and Davies 2014 Jon Bates, USDA ARS, pers. comm. 2/10/2015
	Sagebrush height (inches)	15 to 31	Gregg et al. 1994 Hanf et al. 1994 Crawford and Carver 2000 Freese 2009
	Perennial herbaceous (grass and forbs) cover (%) Arid sagebrush Warm-dry Shallow-dry Mesic sagebrush Cool-moist Warm-moist Riparian [5]	 ≥15 ≥10 ≥20 ≥30 ≥50	Drut et al. 1994 Bates and Davies 2014 NRCS 2015 BLM 2015b Jon Bates, USDA ARS, pers. comm. 2/10/2015
	Riparian areas/mesic meadows	Majority of areas are in PFC	Stiver et al. 2015, or as updated
	Invasive annual grass cover	<2% cover	BLM synthesis of research[7]
	Conifer	0 (Absence of conifer)	BLM synthesis of research[8]
Food	Upland and riparian perennial forb availability [3]	Palatable forbs are common (≥6 individuals present) with ≥5 species present [4] and ≥2% forb cover in upland habitat and ≥4% forb cover in riparian habitat [5]	Hanf et al. 1994 Freese 2009 Bates and Davies 2014 BLM 2015b Jon Bates, USDA ARS, pers. comm. 2/10/2015
Winter Including Late Autumn and Winter (Seasonal Use Period November 1 – February 28)			
Cover and Food	Sagebrush cover (%)	≥10	Willis 1990 (in Hagen 2011) Bruce 2011
	Sagebrush height above snow (inches) [6]	≥10	Willis 1990 (in Hagen 2011) Bruce et al. 2011
	Conifer	0 (Absence of conifer)	BLM synthesis of research [8]

Notes:

[1] Tall structures are any man-made structure that has the potential to disrupt lekking or nesting birds by creating perching and nesting opportunities for predators (e.g., raptors and ravens) or that decrease use of an area by sage-grouse, including communication towers, meteorological towers, electrical transmission or distribution towers, power poles, wind turbines, and associated structures.

[2] Perennial grass and forb minimum height may not be achievable in years with below normal precipitation. Other indicators of desired condition may still render the site suitable, however.

[3] In drought years, forb cover and availability may not be at the desired condition. In certain plant associations, such as Wyoming big sagebrush/Needle and Thread, these indicators may rarely be achieved even in years with normal precipitation.

[4] Native plant species important for sage-grouse in Oregon are listed in Appendix I of the 2015 Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment. This partial list may be revised and expanded with additional plant species as new information becomes available.

[5] Riparian includes swales, wet meadows, and intermittent/ephemeral streams.

[6] Low sagebrush vegetation types (average sagebrush height <12 inches) found along slopes that are cleared of snow by prevailing winds are potentially important winter foraging areas.

[7] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)

[8] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

8.2.6 Utah GRSG Habitat Indicators Table

Table 8-1.F. Utah GRSG Habitat Indicators Table

Attribute	Indicators	Benchmarks	Reference
Breeding and Nesting (February 15-June 15)			
Lek Security	Proximity to conifers	Conifers are absent or uncommon on shrub/grassland ecological sites within 1.8 miles (approx. 3 kilometers) of occupied leks.	Stiver et al. 2015 Baruch-Mordo et al. 2013 Connelly et al. 2000
	Proximity of sagebrush to leks	Has adjacent sagebrush cover.	Stiver et al. 2015
Cover	Sagebrush cover	Low [2]: ≥ 7% Mid [3]: ≥ 18% High [4]: ≥ 14%	Dahlgren et al. 2019
	Total shrub cover	Low [2]: ≥ 17% Mid [3]: ≥ 22% High [4]: ≥ 19%	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Sagebrush Composition	Low [2]: ≥ 36% Mid [3]: ≥ 71% High [4]: ≥ 83%	Dahlgren et al. 2019
	Shrub height	Low [2]: ≥ 12 inches (30 cm) Mid [3]: ≥ 5.9 inches (15 cm) High [4]: ≥ 9 inches (23 cm)	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Perennial grass cover (such as native bunchgrasses, rhizomatous grasses called for on applicable ecological site descriptions, or other perennial grasses that provide similar functionality)	Low [2]: ≥ 5% Mid [3]: ≥ 4% High [4]: ≥ 8%	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Perennial grass and forb height (includes residual grasses)	Provide overhead and lateral concealment from predators.[5]	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Perennial forb canopy cover	Low [2]: ≥ 2% Mid [3]: ≥ 1% High [4]: ≥ 4%	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Invasive annual grass cover	<2% cover	BLM synthesis of research [7]
	Conifer	0 (Absence of conifer)	BLM synthesis of research[8]
Brood-Rearing/Summer (April 15-August 15) [1]			
Cover	Sagebrush cover	Low [2]: ≥ 4% Mid [3]: ≥ 16% High [4]: ≥ 15%	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Total shrub cover	Low [2]: ≥ 10% Mid [3]: ≥ 19% High [4]: ≥ 17%	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Sagebrush Composition	Low [2]: ≥ 28% Mid [3]: ≥ 77% High: ≥ 77%	Dahlgren et al. 2019
	Shrub height	Low [2]: ≥ 10.25 inches (26 cm) Mid [3]: ≥ 4.3 inches (11 cm) High [4]: ≥ 8 inches (20 cm)	Stiver et al. 2015 Connelly et al. 2000 Dahlgren et al. 2019
	Perennial grass cover	Low [2]: ≥ 5% Mid [3]: ≥ 6% High: ≥ 8%	Dahlgren et al. 2019
	Perennial forb cover	Low [2]: ≥ 2% Mid [3]: ≥ 2% High [4]: ≥ 6%	Dahlgren et al. 2019
	Riparian areas/mesic meadows	Proper Functioning Condition	
	Upland and riparian perennial forb availability	Preferred forbs are common with several preferred species present [6]	Stiver et al. 2015

Attribute	Indicators	Benchmarks	Reference
Cover *(cont.)*	Invasive annual grass cover	<2% cover	BLM synthesis of research[7]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [8]
Winter (November 15-March 15) [1]			
Cover and Food	Sagebrush cover above snow	≥10%	Stiver et al. 2015 Connelly et al. 2000
	Shrub height	Low [2]: ≥ 12 inches (30 cm) Mid [3]: ≥ 5.9 inches (15 cm) High [4]: ≥ 9 inches (23 cm)	Connelly et al. 2000
	Conifer	0 (Absence of conifer)	BLM synthesis of research [8]

Notes:
[1] Specific dates will be based on site-specific conditions and may be modified due to documented local variations (e.g., higher/lower elevations) or annual climactic fluctuations (e.g., early/late spring, and long and/or heavy winter), in coordination with the appropriate State of Utah agency.
[2] Low is equivalent to the *Low* cluster from Dahlgren et al. 2019. It covers lower elevation areas (~1,200–2,200 m) in Utah, consisting primarily of Wyoming big sagebrush communities, with some basin big sagebrush included.
[3] Mid is equivalent to the *Parker* cluster from Dahlgren et al. 2019. It occurs primarily on the plateau of Parker Mountain (~2,300–2,800 m) in south-central Utah, dominated by black sagebrush communities.[4] High is equivalent to the *Wasatch* cluster from Dahlgren et al. 2019. It covers mid- to high-elevation areas (~2,200–3,000 m) in Utah, consisting primarily of basin (mid-elevation) and mountain big sagebrush (high elevation), as well as other mesic and higher elevation vegetation communities.
[5] Specific height requirements needed to meet the objective will be set at the time of watershed assessments.
[6] Preferred forbs are listed in Stiver et al. 2015. Overall total forb cover may be greater than that of preferred forb cover, since not all forb species are listed as preferred.
[7] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)
[8] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

8.2.7 Wyoming GRSG Habitat Indicators Table

Table 8-1.G. Wyoming GRSG Habitat Indicators Table

Attribute	Indicators [1]	Benchmarks [2]	Reference
Breeding (Seasonal Use Period March 1 – June 15; Doherty 2008, Holloran and Anderson 2005) [3]			
Lek Security	Proximity of trees	Conifer cover in shrub/grassland ecological sites <4% in each 125-acre (50.6-ha) segment within 3.1 miles (5 km) of occupied leks [4]	Baruch-Mordo et al. 2013 Stiver et al. 2015 Beers and Frey 2022 Severson et al. 2017
	Proximity of sagebrush to leks	Protective sagebrush cover within 330 ft. (approx. 100 m) of occupied leks	Stiver et al. 2015
Cover	Sagebrush cover [5]	5 to 25%	Connelly et al. 2000 Hagen et al 2007 Hanser et al. 2018
	Sagebrush height	12 to 31 in (30 to 80 cm) Arid sites [6] 16 to 31 in (40 to 80 cm) Mesic sites [7]	Connelly et al. 2000
	Sagebrush shape	Predominantly spreading shape [8]	Stiver et al. 2015
	Perennial grass cover [5,9]	>10% Arid sites [6] >15% Mesic sites [7]	Connelly et al. 2000 Stiver et al. 2015 Cagney et al. 2010
	Perennial grass and forb height (including residual grasses)	Reference state as determined by ecological site potential in consideration of annual variability; robust cool-season bunchgrass understory necessary for adequate herbaceous height [9]	Connelly et al. 2000 Coates et al. 2017 Doherty et al. 2014 Hagen et al. 2007 Stiver et al. 2015 Cagney et al. 2010
	Forb cover [5]	>5% Arid sites [6] >10% Mesic sites [7] Preferred species [10] present in upland nesting/early brood-rearing areas	Connelly et al. 2000 Stiver et al. 2015 Hagen et al. 2007
	Invasive annual grass cover	<2% cover	BLM synthesis of research [13]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [14]

Attribute	Indicators [1]	Benchmarks [2]	Reference
Late Brood-Rearing/Summer (Seasonal Use Period June 16 – October 31) [3]			
Cover and Food	Sagebrush cover [5]	5 to 25% in adjacent sagebrush stands within 200 ft. (approx. 60 m) of late brood-rearing/summer feeding sites [11]	Connelly et al. 2000 Slater 2003
	Sagebrush height	16 to 31 in (40 to 80 cm) in adjacent sagebrush stands within 200 ft. (approx. 60 m) of late brood-rearing/summer feeding sites [11]	Connelly et al. 2000 Slater 2003
	Perennial grass and forb cover [5]	>25% in late brood-rearing/summer feeding sites [11]	Connelly et al. 2000 Coates et al. 2017
	Riparian areas; Mesic meadows	Proper functioning condition	Stiver et al. 2015
	Forb availability	Preferred species [10] present in late brood-rearing/summer feeding sites [12]	Stiver et al. 2015
	Invasive annual grass cover	<2% cover	BLM synthesis of research [13]
	Conifer	0 (Absence of conifer)	BLM synthesis of research [14]
Winter (Seasonal Use Period November 1 – February 28) [3]			
Cover and Food	Sagebrush cover above snow [5, 12]	>5%	Connelly et al. 2000 Stiver et al. 2015
	Sagebrush height above snow [12]	>10 in (>25 cm)	Connelly et al. 2000
	Conifer	0 (Absence of conifer)	BLM synthesis of research [14]

Notes:

[1] The indicators included represent the minimum habitat requirements that should be considered. When assessing the suitability of a seasonal use area (e.g., HAF site-scale polygon), practitioners are encouraged to use a multiple lines of evidence approach that references all relevant data, expertise, and locally-relevant habitat indicators (BLM Technical Note 453; Kachergis et al. 2020).

[2] Collectively the indicators for sagebrush (cover, height, and shape), perennial grasses, and forbs (cover, height and/or availability) represent the desired condition for the seasonal habitats described. Connected habitats allowing for GRSG dispersal and migration among the seasonal ranges is needed to meet habitat objectives. GRSG habitats in northeastern Wyoming are ecologically limited in terms of sagebrush production and the ability to support dense stands of sagebrush (i.e., sagebrush canopy cover rarely exceeds 15%) and require additional consideration of local conditions, ecological site potential, and GRSG seasonal habitat selection (State of Wyoming Executive Order 2019-3).

[3] Where credible data support different seasonal dates than those identified, dates may be shifted but the amount of days cannot be shortened or lengthened by the local unit.

[4] Conifer reduction treatments should consider and limit potential impacts of those activities on populations of other sensitive species (e.g., pinon jay). Treatments where the likely impacts to habitats important for other sensitive species are not clearly outweighed by the likely benefits to GRSG habitat suitability should be reconsidered.

[5] Absolute cover is the actual recorded cover and can exceed 100% when recorded across all species and all layers. It is not relative cover, which is the proportion of each species and equals 100%. Note that cover is reported for only those species (e.g., sagebrush, preferred forbs) of interest to determine suitability of habitat for sage-grouse. Overall cover at the site may be greater than that sampled for sage-grouse habitat due to the presence of other species.

[6] Arid corresponds to the 10 – 12-inch precipitation zone; Wyoming big sagebrush (*A. t. wyomingensis*) is a common big sagebrush subspecies for this type site (Stiver et al. 2015).

[7] Mesic corresponds to the ≥12-inch precipitation zone; Mountain big sagebrush (*A. t. vaseyana*) is a common big sagebrush sub-species for this type site (Stiver et al. 2015).

[8] Sagebrush plants that are more tree or columnar-shaped provide less protective cover near the ground than sagebrush plants with a spreading shape (Stiver et al. 2015). Some sagebrush plants are naturally columnar (e.g., Basin big sagebrush; *A. t. tridentata*), and a natural part of the plant community. However, a predominance of columnar shape arising from animal impacts may warrant habitat management investigation or adjustments at site-specific scales.

[9] The intent is to manage for the long-term maintenance of sagebrush habitats in or restoration of sagebrush habitats to the reference state in combination with annually maintaining sufficient standing crop (i.e., current year's herbaceous growth) to provide residual hiding cover for the following nesting season (reference Cagney et al. 2010). A robust cool-season bunchgrass understory is necessary to achieve adequate herbaceous heights for suitable GRSG breeding habitats.

[10] Forb availability and diversity in sagebrush upland habitats used by GRSG during pre-laying (Barnett and Crawford 1994), nesting, and early brood-rearing (Hagen et al. 2007) is important for nesting success and chick survival; preferred forbs as established in the Habitat Assessment Framework (Stiver et al. 2015) as updated with state-specific information.

[11] Sage-grouse feed in habitats that maintain moist soils and high forb and insect availability throughout the summer (e.g., wet meadows, riparian areas, irrigated hay meadows, springs/seeps) that are closely associated with protective sagebrush cover (Connelly et al. 2011).

[12] Sage-grouse habitat availability and selection during winter is influenced by snow conditions (e.g., depth, hardness) and topography (elevation, aspect) in addition to sagebrush height and cover and can vary widely depending on winter severity (Connelly et al. 2011). The intent is to manage habitats for a mosaic of sagebrush stands across a variety of topographic conditions as windswept ridges with low-stature sagebrush and/or draws with tall sagebrush can provide access to sagebrush above snow for sage-grouse during any given winter.

[13] BLM synthesis of research on the impacts invasive annual grasses have on sage-grouse habitat suitability (**Attachment 8-1**)

[14] BLM synthesis of research on the impact conifer have on sage-grouse habitat suitability (**Attachment 8-2**)

8.3 USING THE HABITAT INDICATORS TABLE(S)

The Habitat Indicators Tables are to be used as follows:

- To inform habitat suitability at one point in time, as defined by the processes described in the Habitat Assessment Framework and BLM HAF Implementation Guidelines.
- To inform measurable project objectives during implementation-level planning for BLM-permitted and BLM-initiated actions in HMAs, as applicable.
- To inform agency decision-makers regarding consideration of whether a project or proposal should be approved, denied, or modified based on how it would affect an area's existing habitat suitability status.

Additional guidance on the use of the Habitat Indicators Table and the associated products is available in the Habitat Assessment Framework (Stiver et al. 2015, BLM TR 6710-1, as revised) and BLM Sage-grouse HAF Implementation Guidelines.

When assessing seasonal habitat suitability, the BLM will summarize and report the number of monitoring locations, or amount of seasonal habitat in the analysis area, that are suitable, marginal, or unsuitable. Based on the monitoring locations rated as suitable, marginal, or unsuitable and the documentation of conditions across the entire analysis area such as ecological site potential (using appropriate ecological site descriptions, State and Transition Models, reference sheets, etc.), weather, and land ownership patterns, the BLM will determine if a given seasonal habitat is a limiting factor for sage-grouse. All rationale will be documented in a HAF summary report.

Relationship of the Habitat Indicators Table to other assessment and planning tools

The indicators and benchmarks in the Habitat Indicators Table are meant to inform the wildlife and/or sensitive species component of the Land Health Standards evaluation process (LHS, 43 CFR 4180.2; **Figure 8-1**). The Habitat Indicators are not land health standards and do not replace land health assessments. The indicators relating to vegetative cover are assessed using AIM methodology (Herrick et al. 2021). The HAF, GRSG Monitoring Framework (see **Appendix 7**), and land health assessments all incorporate AIM data to monitor existing conditions and track changes over time. The Land Use Plan (LUP) indicators use AIM methods to measure several of the GRSG habitat indicators.

Table 8-2. Relationships of LUP, HAF, LHS, and MF relative to the GRSG Habitat Objectives

Land Health Standards (LHS) Evaluation	Land Use Plan (LUP)	GRSG Habitat Assessment Framework (HAF)	GRSG Monitoring Framework (MF)
Evaluates if the sage-grouse portion of the Special Status Species Land Health Standard is achieved or significant progress towards achievement is made. These evaluations utilize HAF results along with other data.	Sets GRSG habitat objective(s) and Identifies the GRSG habitat indicators (see **Tables 8-1.A-G** above) and benchmarks from best available science for evaluating progress toward meeting the objective	Provides methods to assess GRSG habitats using the LUP indicators and benchmarks from this appendix (see **Tables 8-1.A-G** above)	Provides framework for reporting progress toward achieving the objective(s) of the LUP

8.4 INAPPROPRIATE USES OF THE HABITAT INDICATORS TABLE

- Using the indicator value(s) as default desired conditions to inform LUP effectiveness without considering the current state compared to ecological potential of the site and relevant local information where measurements were taken.
- Using a single measured indicator value to determine sage-grouse habitat suitability.
- Using a single indicator as a criterion to modify grazing management or any other use.
- Adjusting use authorizations based on measured indicator values without adequate monitoring data.
- Adjusting use authorizations before determining whether the change will help move towards suitable habitat.

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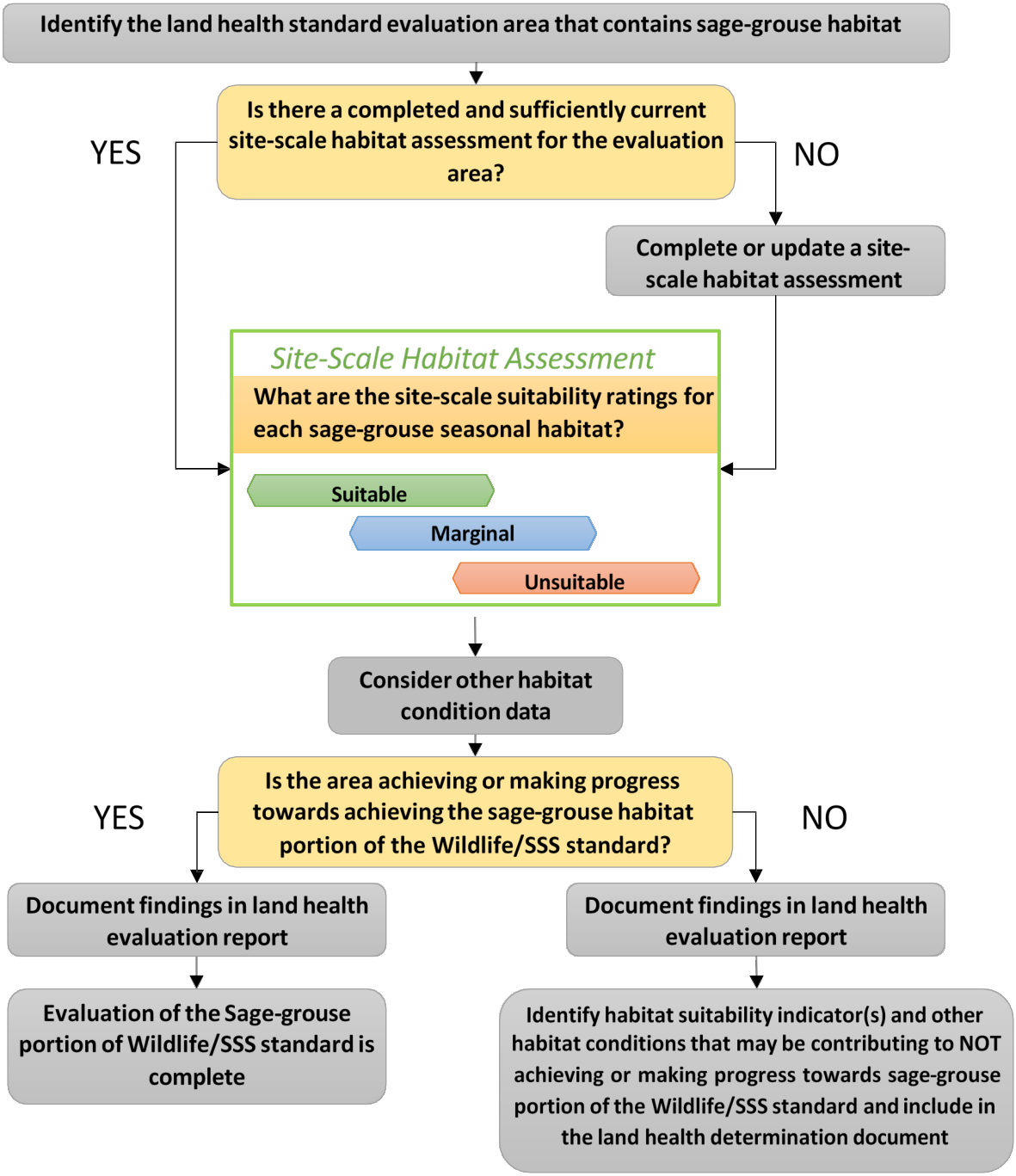
Figure 8-1. Flowchart on Incorporating the Results of Site-Scale Sage-Grouse Habitat Assessment* into Wildlife/SSS Standard in the Land Health Assessments and Evaluations**



Acronyms:

SSS – Special Status Species
* Following the Sage-Grouse Habitat Assessment Framework (Stiver et al. 2015)

**For the complete land health standards evaluation and causal factor determination workflow, refer to: Kachergis, E., N. Lepak, M. Karl, S. Miller, and Z. Davidson. 2020. Guide to Using AIM and LMF Data in Land Health Evaluations and Authorizations of Permitted Uses. Tech Note 453. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO.

Attachment 8-1. Justification for Invasive Annual Grass as a Habitat Suitability Indicator at the Sage-grouse Habitat Assessment Framework (HAF) Site-Scale

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Finalized on: October 12, 2023

BACKGROUND

Invasive annual grasses, such as cheatgrass, medusahead, and ventenata species, are a recognized threat to sagebrush ecosystems (Chambers et al. 2016, Remington et al. 2021, Rowland et al. 2019) causing reduced ecosystem function, displacement of native vegetation, increased fire risk and reduced rates of post-fire recovery (D'Antonio and Vitousek 1992, Bradely et al. 2018) all of which can lead to degradation and/or loss of sage-grouse habitat (Nelle et al. 2000, Wik et al. 2002, Coates et al. 2015, Coates et al. 2016, Lockyer et al. 2015, Steenvoorden et al 2019, Brussee et al. 2022, Poessel et al. 2022). The Bureau of Land Management (BLM) uses the Sage-grouse Habitat Assessment Framework (HAF; Stiver et al. 2015) to assess sage-grouse habitat suitability at multiple spatial scales (mid-, fine- and site-scale) by examining scale-specific indicators that represent both habitat requirements (i.e., food, water, cover, security) and threats to habitat (i.e., anthropogenic disturbances, proximity of trees to leks). However, invasive annual grasses are not included as an indicator of habitat suitability at any scale of the HAF (Stiver et al. 2015). This omission has been recognized by both authors and implementors of the HAF as a shortcoming that should be remedied, as supported by scientific literature.

The purpose of this document is to:

- Provide scientifically based rationale for including invasive annual grass cover as an additional indicator in HAF site-scale habitat assessments (Stiver et al. 2015, revised), and
- Recommend scale-specific benchmarks for invasive annual grass cover for HAF site-scale assessments based on scientific literature relevant to that scale.

RATIONALE

Research has shown that invasive annual grasses can reduce habitat suitability for sage-grouse, at the site-scale (i.e., microhabitat), by displacing native vegetation and altering habitat composition and structure (Chambers et al. 2016, Coates et al. 2017, Brussee et al. 2022). This degradation can cause sage-grouse to avoid areas with invasive annual grasses (Lockyer et al. 2015, Coates et al. 2017, Poessel et al. 2022) and can cause lower occupancy and survival rates in areas with invasive annual grasses (Wik et al 2002, Kirol et al. 2012, Lockyer et al. 2015). General speaking, studies have shown that greater sage-grouse will use areas with relatively low amounts of invasive annual grasses for nesting and brood-rearing; however, in areas with relatively higher amounts of invasive annual grasses, rates of occupancy and/or survival are lower (Coates et al. 2017, Dinkins et al. 2016, Lockyer et al. 2015, Schreiber et al. 2015, Stonehouse et al. 2015, Wik 2002).

For example, a study conducted in Nevada and California found that cheatgrass abundance was the single greatest micro-habitat feature distinguishing greater sage-grouse nest sites from random sites in the study area and that average cheatgrass cover at nest sites (7.1%; SE=1.0) was lower than at random sites (13.3%; SE=1.2) (Lockyer et al. 2015). A study in Idaho found that successful nests had lower average cheatgrass cover (1%) than unsuccessful nests (4%) while successful broods had lower average cheatgrass cover (2%) than unsuccessful broods (6%) (Wik et al. 2002). In Nevada and California, a study indicated that > 5% annual grass cover was unsuitable for GRSG during nesting and brood-rearing (Coates et al. 2017). They also recommended suitability categories for invasive annual grasses in nesting habitat specific to xeric sites (<2.5% invasive annual grass cover is suitable, 2.5 – 4.8% is marginal, >4.8% is unsuitable) and mesic sites (<2.5% invasive annual grass cover is suitable, 2.5 – 5.2% is marginal, >5.2% is unsuitable).

Although individual studies reported different values of invasive annual grass cover associated with sage-grouse site selection and nest/brood success, there was notable overlap. In studies that examined site selection (not success), they reported mean values ranging between <1% to 17% cover of invasive annual grasses at used sites (regardless of success), with most reporting <7% cover (**Table 1**). In studies that examined nest and/or brood success relative to invasive annual grasses, they reported mean values between 1% to 7% for successful sites (Wik et al. 2002, Lockyer et al. 2015) (**Table 1**). Of note, some studies have shown that sage-grouse exhibit maladaptive site selection to invasive annual grasses and other habitat indicators due to nest site fidelity (Coates et al. 2017, Brussee et al. 2022, Cutting et al. 2019) so nest/brood success may be a more accurate indicator of the impacts of invasive annual grasses to sage-grouse habitat suitability.

Collectively, this research indicates that invasive annual grasses can reduce habitat suitability for nesting and brood-rearing greater sage-grouse at the site-scale and that habitat suitability generally decreases as invasive annual grass cover increases. It is recommended that invasive annual grass cover be included as a habitat suitability indicator for sage-grouse habitat assessments conducted at the HAF site-scale, as described in the Recommendations section below.

Table 1. The table below lists and describes key aspects and findings from research that has examined the relationship of invasive annual grass cover to greater sage-grouse habitat selection and/or survival at the site-scale (i.e., microhabitat). Note that no studies specifically examined the potential impacts of invasive annual grasses on Gunnison sage-grouse.

Citation	State	Scale/ Extent	Season	Applicable Findings
Coates et al. 2017	NV	10m of nest	Nesting	Mean invasive annual grass cover at nests was 4.8% in xeric sites and 5.1% in mesic sites. Authors recommended suitability categories: • xeric sites (suitable is <2.5%, marginal is 2.5 – 4.8%, unsuitable is >4.8%) and • mesic sites (suitable is <2.5%, marginal is 2.5 – 5.2%, unsuitable is >5.2%)
		10m of brood	Brood-rearing	Mean invasive annual grass cover at brood sites was 4.3% in xeric 4.79% in mesic. Authors recommended suitability categories: • xeric sites (suitable is <2.5%, marginal is 2.5 – 4.3%, unsuitable is >4.3%) and • mesic sites (suitable is <2.5%, marginal is 2.5 – 4.8%, unsuitable is >4.8%)

Citation	State	Scale/ Extent	Season	Applicable Findings
Dinkins et al. 2016	WY	5m of nest	Nesting	Mean invasive annual grass cover at nests 2.14% (SE=0.11) which was higher but similar to random sites with a mean of 1.75% (SE=0.10).
Kirol et al. 2012	WY	8m of nest	Nesting	Nest selection was negatively related to the presence of cheatgrass when compared to available habitat. "Cheatgrass occurred at 6% of the nest locations and 19% of the corresponding random locations."
Lockyer et al. 2015	NV/CA	0.01ha of nest	Nesting	Average cover of cheatgrass at nests and random sites was 7.1% (SE=1.0) and 13.3% (SE=1.2), respectively. Sites with >7.1% cheatgrass cover had lower nest success. Cheatgrass was the single greatest micro-habitat feature distinguishing nests from random sites.
Schreiber et al. 2015	WY	20m of brood	Brood-rearing	Cheatgrass cover was lower at early brood-rearing sites (0.55% +/-0.38%) than at random points (0.71% +/-0.30%) but similar. Cheatgrass cover was lower at late brood-rearing sites (1.44% +/-0.65%) than at random points (2.13% +/-0.72%) but similar.
Stonehouse et al. 2015	WA		Nesting	Mean cover of invasive annual grasses at nest sites was 13% (SE=1); random sites were not assessed.
Wik et al. 2002	ID	20m of nest	Nesting	All nests had an average of 3% cover. Successful nests had lower average cheatgrass cover (1% in 20m transect) than unsuccessful nest (4% in 20m transect).
		20 m of brood	Brood-rearing	All broods had average of 5% cheatgrass. Unsuccessful broods has lower cheatgrass (2% in 20m) at use-sites than successful broods (6% in 20m).
Wing et al. 2014	UT	15m of nest	Nesting	All nest, brood, and non-brooding use sites had cheatgrass which was similar in cover to random sites. Cheatgrass cover means: Nest mean = 17.6% (0.8), Brood mean = 15.6% (0.8), non-brood females and males = 14.3% (0.7), random sites mean = 15.9% (0.8).

RECOMMENDATIONS

Based on the findings of the research summarized above (**Table 1**), invasive annual grass cover should be assessed as a habitat indicator for nesting/early brood-rearing, late brood-rearing, and wintering habitat during a HAF site-scale assessment using the following benchmarks, adjusted as warranted by best available science. Note that these benchmarks were based more heavily on research that examined nest and brood *success* relative to invasive annual grass cover (more so than research that examined *use versus availability* of habitat) because sage-grouse have been shown to exhibit maladaptive site selection (Coates et al. 2017, Brussee et al. 2022, Cutting et al. 2019). Invasive annual grasses are not assessed at the site-scale for leks because the AIM strategy does not include leks in its sampling strategy; however, invasive annual grasses are assessed for lekking habitat at the HAF *fine-scale*. There was not sufficient research to suggest different benchmarks for winter habitat due to a lack of research on winter habitat as compared to nesting and brood-rearing. If future research indicates otherwise, benchmarks may be adjusted accordingly.

Table 2. Recommended habitat suitability benchmarks for assessing invasive annual grass at the HAF site-scale.

Habitat Indicator	Metric	Benchmarks		
		Suitable	Marginal	Unsuitable
Invasive Annual Grass	% cover	<2%	2 – 5%	>5%

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Attachment 8-2. Justification for Conifer as a Habitat Suitability Indicator at the Sage-grouse Habitat Assessment Framework (HAF) Site-Scale

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BACKGROUND

Recent research has shown that conifer expansion into native sagebrush communities can reduce habitat suitability for sage-grouse (Nisbet et al 1983, Doherty et al. 2010, Fedy et al. 2014, Doherty et al. 2016, Westover et al. 2016, Baxter et al. 2017, Picardi et al. 2020, Saher et al. 2021, Brussee et al. 2022, Roth et al. 2022). The Bureau of Land Management (BLM) uses the Sage-grouse Habitat Assessment Framework (HAF; Stiver et al. 2015) to assess sage-grouse habitat suitability at multiple spatial scales (mid-, fine- and site-scale) by examining scale-specific indicators that represent both habitat requirements (i.e., food, water, cover, security) and threats to habitat (i.e., anthropogenic disturbances, predation risk). However, conifer cover is not included as an indicator of habitat suitability at any scale of the HAF (Stiver et al. 2015). This omission has been recognized by BLM personnel as a shortcoming of the HAF that should be remedied, as supported by scientific literature.

The purpose of this document is to:

- Provide scientifically based rationale for including conifer as an additional habitat indicator in HAF site-scale habitat assessments (Stiver et al. 2015, revised), and
- Recommend scale-specific thresholds for conifer for HAF site-scale assessments based on scientific literature relevant to that scale.

RATIONALE

Studies that examine site-scale sage-grouse habitat (also referred to as microhabitat) often do not report or analyze conifer as a habitat characteristic, likely because it is not a habitat requirement of sage-grouse but rather a deterrent, especially at such a small scale (e.g., within 10m of a nest site). In a review of over 40 peer-reviewed microhabitat studies on sage-grouse, no study reported conifer cover as a standard microhabitat characteristic for sage-grouse (such as sagebrush cover, grass height, forb cover) nor did they test for a relationship between conifer and sage-grouse. A few studies, such as Duvuvuei 2013 and Wing 2014, reported frequency of nests located under conifer in Utah (see **Table 1**). Wing 2014 reported that nesting under juniper was rare and that only one of those nests was successful. Duvuvuei 2013 showed that nests were commonly placed under junipers, especially by translocated females, but suggested that use of juniper for nesting was due to maladaptation caused by a lack of sagebrush cover and extensive juniper expansion into the study area.

Most studies that examine the potential impacts of conifer on sage-grouse and their habitat are conducted at landscape scales, typically estimating conifer cover near sage-grouse locations (e.g., within 1,000m of a nest site) using remotely sensed landcover data. These studies have established that conifer cover, even in low amounts (e.g., <2 % cover), can negatively impact sage-grouse across all seasons (lekking, nesting, brood-rearing and wintering) causing avoidance and/or reduced vital rates (Nisbet et al 1983, Doherty et al. 2010, Fedy et al. 2014, Doherty et al. 2016, Westover et al. 2016, Baxter et al. 2017, Picardi et al. 2020, Saher et al. 2021, Brussee et al. 2022, Roth et al. 2022). However, these findings are mostly applicable to HAF mid- and/or fine-scale assessments which are also landscape level.

Given the established negative impacts of conifer cover on sage-grouse at landscape scales and the lack of conifer being reported in microhabitat studies (i.e., suggesting avoidance of conifer at site-scales), it is recommended that conifer be included as a habitat suitability indicator for sage-grouse habitat assessments conducted at the HAF site-scale, as described in the Recommendations section below.

Table 1. The table below lists and describes key aspects and findings from research that has examined the relationship of conifer to greater sage-grouse habitat selection and/or survival at the site-scale (i.e., microhabitat). Note that no studies specifically examined the potential impacts of invasive annual grasses on Gunnison sage-grouse.

Name	Tree Type	State	Season	Applicable Findings
Wing 2014	Juniper	UT	Nesting	GRSG females rarely selected juniper as a nesting shrub (n=4) and only one nest was successful.
Duvuvuei 2013	Juniper	UT	Nesting	Translocated GRSG females (24%) nested under juniper but was accredited to lack of sagebrush cover and extensive conifer expansion in study area.

RECOMMENDATIONS

Based on the rationale above, conifer should be assessed as a habitat indicator during HAF site-scale assessments for nesting, brood-rearing, and wintering habitat. Conifer is not being added as an additional indicator in lek assessments because existing lek indicators already incorporate conifer and other trees. The metric used to assess conifer suitability is the count of conifer and, if available, the height of those conifer relative to surrounding sagebrush (or native shrubs, if used as a surrogate), using the benchmarks shown below (adjusted as warranted by best available science). Percent conifer is not recommended as the primary metric for conifer suitability because there is insufficient science to support a benchmark at the site-scale; however, percent conifer cover may still be used as ancillary information, as interpreted by local experts, to support assessment of conifer as a habitat suitability indicator.

Table 2. Recommended habitat suitability benchmarks for assessing conifer at the HAF site-scale.

Habitat Indicator	Metric	Benchmarks		
		Suitable	**Marginal**	**Unsuitable**
Conifer	Count	• 0 trees (absence of conifer)	If height is unknown: • 1 tree If height is known: • 1 tree that is taller than local average sagebrush height, and/or • <=3 trees that are not taller than local average sagebrush height	If height is unknown: • >1 tree If height is known: • >1 tree that is taller than local average sagebrush height, and/or • >3 trees that are not taller than local average sagebrush height

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