Table 2-6. Proposed Habitat Objectives for Greater Sage-Grouse

Life Requisite	Habitat Indicator	Objective	Notes	Remarks
GENERAL				
All life stages	Rangeland Health Standards	Meeting all standards[1]		1
LEK				
Cover	Availability of sagebrush cover	Has adjacent sagebrush cover	Connelly et al. 2000 Blomberg et al. 2012	2
Security	Proximity of trees > 1 meter above shrub canopy	Within 1.86 miles (3 km): • none within line of sight of the lek	Connelly et al. 2000 (modified)	3
	Tree cover	Within 1.86 miles (3 km): • <3.5% conifer land cover		
	Proximity of tall structures	None within 3 miles (5km)	Coates et al. 2011	4
NESTING				
Cover	Sagebrush canopy cover (%)	≥20	Kolada et al. 2009a Kolada et al. 2009b	5
	Sagebrush species present	Includes *Artemesia tridentata* subspecies	Coates et al. 2011 Kolada et al. 2009a Kolada et al. 2009b	6
	Residual and live perennial grass cover (%)	≥10 if shrub cover <25[2]	Coates et al. 2011 Coates and Delehanty 2010	7
	Annual grass (%)	<5	Blomberg et al. 2012	8
	Total shrub cover (%)	≥30	Coates and Delehanty 2010 Kolada et al. 2009a Lockyer et al. In review	9
	Conifer encroachment (%)	<5	Casazza et al. 2011 Coates et al. In prep (A)	10
BROOD-REARING/SUMMER				
Cover	Sagebrush canopy cover (%)	≥10	Connelly et al. 2000	11
Cover and Food	Perennial forb canopy cover (%)	≥5 arid ≥15 mesic	Casazza et al. 2011 Lockyer et al. In review	12
Food	Riparian Areas/Meadows	Manage for PFC		13
	Perennial forb availability (riparian areas/meadows)	≥ 5 plant species present[3]	Casazza et al. 2011	14
Security	Conifer encroachment (%)	<3 phase I (>0% to <25% cover) No phase II (25 – 50% cover) No phase III (>50% cover) within 0.53-mile (850-meter) buffer of microhabitat plot	Casazza et al. 2011 Coates et al. In prep (A)	15
	Riparian Area/Meadow Interspersion with adjacent sagebrush	Perimeter to area ratio of 0.15 within 522-foot (159-meter) buffer of the	Casazza et al. 2011	16

Life Requisite	Habitat Indicator	Objective	Notes	Remarks
		microhabitat plot		
WINTER				
Cover and Food	Sagebrush canopy cover (%)	≥10	Connelly et al. 2000	17
	Sagebrush height in centimeters(cm)	≥25	Connelly et al. 2000	18
	Conifer encroachment (%)	<5 phase I (>0% to <25% cover) No phase II (25 – 50% cover) No phase III (>50% cover) within 0.53-mile (850-meter) buffer of microhabitat plot	Coates et al. In prep (A) Coates et al. In prep (B)	19
	Sagebrush extent (%)	>85% sagebrush land cover within 0.53-mile (850-meter) buffer of the microhabitat plot	Coates et al. In prep (B)	20
	Sagebrush species comp (%)	*A. t. tridentata* sites >50% *A. arbuscula* sites >25% *A. t. vaseyana* sites >25%	Coates et al. In prep (B)	21

[1]Upland standards are based on indicators for canopy and ground cover, including litter, live vegetation, and rock, appropriate to the ecological potential of the site.

[2]Assumes upland rangeland health standards are being met.

[3]Standard considered in addition to PFC. Measured ESD/Daubenmire (25cm x 50cm frame). Includes all mesic plant species, not only perennial forbs.

Remarks

1. This objective was added to respond to the elimination of a grass requirement for nesting Greater Sage-Grouse (GRSG) habitat where sagebrush canopy is greater or equal to 25 percent, as explained in 7 below. With this general standard in place, it is assumed that the ecological site potential is not overlooked (i.e., that ground cover, including litter, live vegetation and rock, appropriate to the ecological site potential are included). During the process of conducting an allotment evaluation, one would not consider GRSG habitat objectives to be met when grass cover consistent with the upland Rangeland Health Standard was absent.
2. Leks are typically open areas where GRSG want to maximize their visibility during display. Thus, there are no vegetation parameters identified for leks. Connelly et al. (2000) identifies leks as the approximate center of nesting activities (i.e. within various buffer widths), particularly for non-migratory populations. Blomberg (2012) demonstrated higher nesting success where leks are surrounded with sagebrush as compared to those surrounded by exotic species such as cheatgrass. Adjacent sagebrush also provides escape cover in the vicinity of a lek. The availability of sagebrush cover near leks is of demonstrated importance.
3. Studies have shown that GRSG avoid areas where tall trees/structures are present; a conditioned response to the use of these structures by perching raptors and their subsequent predation and or harassment of GRSG. Connelly et al. (2000) establishes a guideline of 3 kilometers for "powerlines or other tall structures". Subsequent research and published guidelines indicate that this may be sufficient for tall trees (Phase 2 and 3 juniper [tree stages where the understory is degraded or even absent]), but that the effect of powerlines extends to 5 kilometers.
4. See 3.
5. Previous guidelines described a range of sagebrush canopy from 15-25 percent and an accompanying standard for perennial grass cover. The guideline was supported by a synthesis of data from the eastern half of GRSG range. Data specific to Nevada and the Bi-State population in California indicate that GRSG are selecting the highest sagebrush canopy available on the landscape and that nesting success is directly linked to sagebrush canopy. The selection is indicated by the predominance of raven predation as opposed to ground predators such as badgers, ground squirrels, etc. Ravens are targeting GRSG nests based on observations of GRSG movements to and from the nesting areas. The more aerial concealment available the better nesting success.
6. Presence of sagebrush species in nesting habitat was an active variable in all studies of GRSG nesting.
7. As noted in 5, above, and as provisioned by 1above, perennial grass cover did not contribute to nesting success in dense sagebrush stands selected for nesting. Where sagebrush canopy cover declined below 25 percent, perennial grasses began to show a direct effect on nesting success. It should be noted that nesting success in instances of lower sagebrush canopy closure was always lower than in habitats with lower canopy cover and higher perennial grass cover. Perennial grass cover is a positive indicator of nesting success but does not improve nesting success as well as high brush canopy.
8. Annual grass in nesting habitat always exerts a negative impact to nest success. It provides neither a cover nor a food component for GRSG. It is also a vector for fire increasing the loss of good nesting habitat.

9. Where sagebrush canopy cover is high, other brush species play a positive role. Total canopy cover of all species is a positive attribute for nest success. The highest densities of total shrub cover yields highest nesting success.
10. This standard reflects the direct negative correlation between conifer encroachment and nesting success.
11. Immediately upon leaving the nest, cover requirements are secondary to a viable food resource for brood survival. Sagebrush remains important as a cover component, but is greatly reduced from that required for nesting.
12. With an emphasis of food resources in brood-rearing habitat, a well-represented forb component is the primary habitat component affecting brood persistence in both upland/arid and mesic settings. Data indicate that there is a direct correlation between the number of forb species present and GRSG persistence.
13. While there are specific variables for wetland and riparian habitat suitability for GRSG (e.g., perennial forb diversity) riparian and wetland functionality must be in place. The habitat must have the ability to store water in sufficient quantity to stimulate and maintain productivity. Additionally, grazing utilization must be maintained at levels to promote both functionality and species diversity. Proper Functioning Condition (PFC) as an objective is considered a minimum standard. The primary standard for brood persistence is noted in 14 below.
14. Forb diversity is a direct measure of riparian and meadow productivity and has been directly linked to brood persistence. A study by Cassazza (2011) indicates that the presence of 5 forb species on mesic sites is a threshold for maximizing brood persistence. Sites with a lower number of species present yielded lower persistence for GRSG while sites with higher forb diversity were only marginally more productive. Forb species diversity tends to provide a more persistent food resource throughout the brood-rearing period. It is suspected that overgrazed systems are likely to fall below this diversity standard, and that completely ungrazed systems will likewise fall below the standard over time as well. Riparian and meadow systems are regarded as a focal point for establishing appropriate grazing levels with respect to GRSG persistence. Methodologies for managing grazing intensities and for measuring riparian and meadow system responses are key.
15. Numerous studies (Casazza et al. 2011; Coates et al. In prep A) indicate that conifer (juniper or pinyon) presence in the vicinity of any GRSG seasonal range is always negative, and that GRSG tolerance for trees is very low. Conifer affects GRSG habitat in two ways: 1) it provides a perching substrate for raptors and, 2) over time, as conifer encroachment moves from Phase I to III it reduces and eventually eliminates favorable shrub, grass, and forb components from the habitat. Studies by Casazza et al. (2011) and Coates et al. (In prep A) indicate only a slight tolerance of Phase I (bush stage where other habitat components remain unaffected) and no tolerance for Phase II and III at the scales noted.
16. This objective highlights the type of meadow system selected by GRSG. The interface between the sagebrush and meadow edge is the most highly forb-productive area for GRSG, and provides immediate available escape cover. Thus, smaller meadow systems with a high rate of interspersion with adjacent sagebrush habitats is preferred, as opposed to larger, open riparian and meadow systems, including agricultural lands. This objective and objective 13 combined gives a complete picture of late-summer brood-rearing scenarios for GRSG and indicate both type and quality of vegetation required along with the challenge of managing those dispersed, small-scale spring and seep meadows which dot the landscape.

17. As with brood-rearing habitat, sagebrush canopy cover is of reduced importance as compared to sagebrush presence and availability. Again, food availability is the primary variable in winter habitat. Sagebrush height, allowing access to the resource in harsh winter conditions, is of importance.
18. See 17.
19. See 15.
20. Connelly et al. (2000) guidelines had previously expressed this percentage at 80, but did not specify the scale for measurement. Subsequent data (Coates et al., In prep B) refine the guidelines and apply it at the scale at which GRSG are exercising habitat selection.
21. This objective highlights species diversity as an influence in current data. Species diversity provides varying scenarios for GRSG survival under varying seasonal conditions.

Literature Cited

Blomberg, E.J., J.S. Sedinger, M.T. Atamian, and D.V. Nonne. 2012. Characteristics of climate and landscape disturbance influence the dynamics of greater sage-grouse populations. Ecosphere 3(6):55. http://dx.doi.org/10.1890/ES11-00304.

Casazza, M.L., P.S. Coates, C.T. Overton. 2011. Linking habitat selection to brood success in greater sagegrouse. In: Sandercock, MK, K Martin, G Segelbacher (eds.). Ecology, Conservation, and Management of Grouse. University of California Press. Pp. 151-167.

Coates, P. S., M. L. Casazza, E. J. Blomberg, S. C. Gardner, S. P. Espinosa, J. L. Yee, L. Wiechman, and B. J. Halstead. 2011. Evaluating greater sage-grouse seasonal space use relative to leks: implications for surface use designations in sagebrush ecosystems. Journal of Wildlife Management 77: 1598–1609.

Coates, P.S., Lockyer, Z.B., Farinha, M.A., Sweeney, J.M., Johnson, V.M., Meshriy, M.G., Espinosa, S.P., Delehanty, D.J., and Casazza, M.L. 2011. Preliminary analysis of Greater Sage-grouse reproduction in the
Virginia Mountains of northwestern Nevada: U.S. Geological Survey Open-File Report 2011-1182, 32 p.

Coates, P.S., and D.J. Delehanty. 2010. Nest predation of greater sage-grouse in relation to microhabitat factors and predators. Journal of Wildlife Management 74:240-248.

Coates, P.S. and M.L. Casazza. In prep (A). Avoidance by greater sage-grouse of pinyon pine and juniper tree encroachment within sagebrush ecosystem.

Coates, P.S. and M.L. Casazza. In prep (B). Winter habitat selection of greater sage-grouse in the Bi-State DPS.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Kolada, E.J., J.S. Sedinger, M.L. Casazza. 2009a. Nest site selection by greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1333-1340.

Kolada, E.J., J.S Sedinger, M.L. Casazza. 2009b. Ecological factors influencing nest survival of greater sage-grouse in Mono County, California. Journal of Wildlife Management 73:1341-1347.

Lockyer, Z., P.S. Coates, M.L. Casazza, S. Espinosa, D.L. Delehanty. In review. Linking nest site selection to nest survival in greater sage-grouse.

Nevada Governor's Sage-grouse Conservation Team. 2010. Nevada energy and infrastructure development standards to conserve greater sage-grouse populations and their habitats. Pp 9-11.

Stiver, S.J., E.T Rinkes, and D.E. Naugle. 2010. Sage-grouse Habitat Assessment Framework. U.S. Bureau of Land Management. Unpublished Report. U.S. Bureau of Land Management, Idaho State Office, Boise, Idaho.