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Greater Prairie Chicken Nesting Habitat, Sheyenne National Grassland, North Dakota

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Abstract.-Greater prairie chicken *(Tympanuchus cupido pinnatus)* populations and habitats have declined dramatically in the Great Plains. The Sheyenne National Grassland (SNG) has the largest population of greater prairie chickens in North Dakota, but this population has declined over the past 15 years. Lack of nesting habitat has been identified as a significant factor contributing to the decline in greater prairie chicken populations throughout their range. We used the Habitat Suitability Index (HSI) model for greater prairie chickens to evaluate the nesting habitat conditions on the SNG. This population of greater prairie chickens appears to sustain itself on the brink of extirpation by nesting in the few areas that provide nesting cover and in private alfalfa fields. Encroachment of woody plants into the SNG, changes in private land-use patterns, removal of forage by domestic livestock contribute to the low suitability of the SNG for nesting by greater prairie chickens.

INTRODUCTION

The Sheyenne National Grassland (SNG) is approximately 28,745 ha of federally administered prairie in southeastern North Dakota. Within its administrative boundary there are an additional 25,910 ha of interspersed private cropland and prairie. The SNG contains the largest population of greater prairie chickens *(Tympanuchus cupido pinnatus)* in the state of North Dakota (Kobriger et al. 1987). Greater prairie chickens are not native to the SNG, but are considered a naturalized immigrant in North Dakota (Johnson and Knue 1989). Prairie chickens apparently moved into North Dakota from the north-central part of the United States during the Euro-American settlement in the 1870's and 1880's (Johnson and Knue 1989, Evans 1968). Greater prairie chicken populations and their habitats (native tall grass prairie) have declined to a small fraction of their historical range (Hjertaas et al. 1993, Samson and Knopf 1994). Thus, the population of greater prairie chickens on the SNG has both regional and national importance.

Numbers of prairie chickens on the SNG increased from the early 1960's through the early 1980's (Kobriger et al. 1987). Since then, prairie chicken numbers on the SNG have declined from a high of 410 males in 1983 to a low of 84 males in 1994 (Kobriger et al. 1987, unpubl. data, Sheyenne National Grassland, Lisbon, ND). State and federal natural resource management agencies, and conservation groups are concerned that management of the SNG may be contributing to the decline in the greater prairie chicken population. Lack of suitable nesting habitat has been identified as the most significant factor limiting populations of greater prairie chickens across their range (Kirsch 1974, Westemeir 1973) and in North Dakota (Svedarsky 1979).

Habitat suitability index (HSI) models are an accepted method for quantifying species' habitats as numerical index (Schamberger et al. 1982). Biological and habitat information are synthesized to formulate index values between zero (unsuitable) and one (optimum) for habitat requisites considered important to a species (U.S. Fish and Wildlife Service 1980). We conducted HSI analyses to assess habitat conditions for greater prairie chickens on the SNG at three scales: 1) the western portion of the SNG and adjacent private lands, 2) the Durler/Venlo Management unit, and 3) areas $\leq$1.6 km of the 14 active booming grounds.

METHODS

The HSI model for greater prairie chickens (Prose 1985) identifies two habitat components, nesting cover and winter food, as the most important habitat

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ponents for prairie chickens. The HSI for nesting cover is based on grassland vegetation height/density (expressed as visual obstruction measurements on a pole, Robe1 et al. 1970) for nesting cover in the spring (figure 1).

We mapped the lowland, midland, and upland grassland vegetation types (Manske and Barker 1987) on 1:24,000 aerial photos of the SNG. Most nesting by greater prairie chickens on the SNG occurs within 1.6 km of leks (Newell et al. 1987). The Custer National Forest Land Management Plan (U.S. Forest Service, Custer National Forest, Billings, MT, 1986) requires that nesting habitat for prairie grouse be assessed within 1.6 km of leks. During October and November, 1994, we estimated height/density of vegetation in these vegetation types from 81 transects within 1.6 km of greater prairie chicken leks in the northern and western portion of the SNG. At each of 10 stations on each transect, we recorded the height that vegetation obstructed 100 percent of a pole (VOR) marked in 0.5 dm increments when viewed from four directions (at 90" azimuths) at a distance of 4 m and a height of 1 m from the pole (Robelet al. 1970). VORs were averaged for each station and the average among stations was used to estimate transect VORs. We placed six transects in upland vegetation, 51 transects in midland vegetation and 26 transects in lowland vegetation. Data from these transects were used as VOR estimates in the mapped vegetation polygons they were collected in. For all other mapped vegetation polygons, these VOR data served as calibrations for ocular estimates of five VOR classes (0 - 0.50 dm, 0.51 - 1.0 dm, 1.01 - 1.5 dm, 1.51 - 2.0 dm, and >2.0 dm) during field reconnaissance. Maps of vegetation and VOR class assignments were transferred to 1:24,000 U.S. Geological Survey maps and the area of each vegetation was planimetered for use in the HSI estimates.

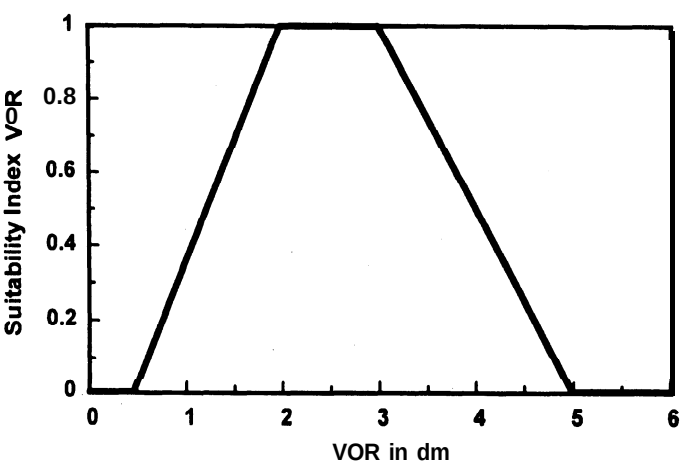

Figure 1. Relationship between average 100 percent obstruction of pole (VOR) marked in 0.5 dm increments and next cover suitability index for greater prairie chickens (from Prose 1985).

HSI for nesting cover is estimated in three steps (Prose 1985). First, a suitability index is estimated from the midpoint of the VOR classes of each vegetation type i (SI_{VORi}). Second, the percent of area providing equivalent optimal nesting habitat (EONH) is calculated using:

$$EONH = \sum_{i=1}^{n} (SI_{VOR_i})(N_i)$$

where n = total number of vegetation types, and N = percent of the area in vegetation type i. Third, HSI for nest cover is calculated from:

$$HSI = \frac{(0.735 * EONH) - 21.4}{37}$$

Characteristics of vegetation and winter snow accumulation influence the structure of vegetation in the spring for nesting by greater prairie chickens. VOR measurement collected in the fall decrease prior to spring nesting. This decrease is proportional to the height of vegetation and for the range of VOR 0.5 - 2.0 dm varies from 7-40 percent in mixed grass prairie (G. Schenbeck pers. commun., Nebraska National Forest, Chadron, NE). Over winter VOR losses on the SNG are probably different, but data are lacking. We selected 15 percent over-winter VOR losses to estimate spring nesting cover based on fall VOR estimates because the VORs for the SNG are near the lower end of the range.

Western SNG Analysis

The western part of the SNG includes most of the prairie chicken leks. This area included 3433 ha of private land and 8984 ha of SNG administered lands. We calculated the HSI for this analysis unit to show estimated contributions to the HSI for prairie chickens from adjacent private lands. VOR class

tion was available for only 5738 ha (64 percent) of the SNG lands in this analysis unit. We assumed the mapped VOR classes were representative of the remaining of the western SNG and used these data for HSI calculations in this analysis unit. For private lands in the western SNG analysis unit we assumed: 1) CRP land had VOR class > 2.0 dm; 2) hay and alfalfa had VOR cover classes <0.5 dm because of mowing approximately the third week of June that destroys existing nests and most young hatched birds; and 3) grazed pasture had VOR cover class 0.51-1.0 dm.

Durler/Venlo Management Unit

The Durler/Venlo management unit includes 3645 ha in nine range management allotments in the western SNG. The Durler/Venlo unit is a subset of the prairie chicken range in the western portion of the SNG. It includes the larger leks, highest prairie chicken numbers, and the greatest number of prairie chicken leks not shared by sharp-tailed grouse (*Tympanuchus phasianellus jamesi).* Most of the Durler/Venlo management unit is< 1.6 km from a prairie chicken lek. This portion of SNG has complete vegetation classification and mapping.

We excluded vegetation communities that were not available for nesting by greater prairie chickens from the HSI for the Durler/Venlo management unit. This HSI analysis presents a complete picture of the nesting habitat for this area. We assigned vegetation types to mapped polygons using the dominant vegetation community in the polygons. Within these polygons, vegetation communities not capable of producing 1.5 dm VOR measurements or that are usually flooded (Manske and Barker 1987, Newell et al. 1987) were considered unavailable for nesting by greater prairie chickens. The area in each polygon assigned to a VOR class did not include unsuitable areas. For example, lowland vegetation communities dominated by species such as *Carex lanulosa* were considered unavailable because in most years the ground is flooded. Upland vegetation communities dominated by species such as *Boutelou gracilis* were considered unavailable for prairie chicken nesting because they are not capable of producing at least 1.5 dm VOR in most years.

Area Surrounding 14 Active Leks

The area within 1.6 km of active leks includes most of the nesting habitat of greater prairie chickens. This scale of analysis allowed us to evaluate HSI for areas of known greater prairie chicken occurrences. This level of analysis included the area surrounding active greater prairie chicken leks and we expected HSI from this analysis should equal or exceed the HSI's from the blocks of SNG that included areas > 1.6 km from leks and unused areas.

RESULTS

Western Sheyenne National Grassland

The 12,445 ha in the western SNG had 24 percent EONH (table 1), less than the minimum considered necessary for the HSI to be greater than zero using fall VOR estimates. When over-winter VOR losses were included, the EONH in the spring declined to 21 percent, with an HSI remaining zero.

Durler/Venlo Management Unit

EONH in the Durler/Venlo unit was lower that the western SNG. EONH was reduced by eliminating the lowlands that are usually flooded in the spring from the HSI calculations. The net result was 12 percent fall EONH and 9 percent EONH in the spring. The subsequent HSI for the Durler/Venlo unit was also zero.

Table 1. Percent equivalent optimal nesting habitat and nesting HSI for three analysis areas with and without winter VOR loss on the Sheyenne National Grassland.

Analysis area	Percent EONH[1]	HSI	Percent EONH with overwinter VOR loss	HSI
Western SNG	23.8	0	19.8	0
Durler/Venlo	11.7	0	9.3	0
≤1 .6 km leks	25.7	0	21.1	0

[1]EONH = equivalent optimum nesting habitat as defined in HSI model by Prose 1985).

Area Surrounding 14 Active Leks

The area within 1.6 km of the 14 active leks had a larger EONH (26 percent) in the fall than the other analysis units. However, the nesting HSI was zero for this area as well. Four of the lek areas provided sufficient EONH for HSI's greater than zero. However HSI estimates for spring showed that only two of these leks still provided sufficient EONH for HSI's greater than zero.

DISCUSSION

Nesting HSI

Our data suggests that nesting cover limits greater prairie chicken populations on the SNG. HSI's were zero for all the analysis units we compared. Four leks had sufficient nesting cover in the surrounding 1.6 km for HSI's greater than zero based on the fall measurements. HSI for these lek areas were less than 0.2 Only two leks had HSI's greater than zero for the area within 1.6 km from leks after over winter VOR losses were considered. HSI's for these two leks were ≤ 0.1

VOR measurements in grassland vegetation that are 2 to 3 dm are considered optimal nest cover for greater prairie chickens (Prose 1985). VOR measurements > 1.5 dm provide $SI_{VOR} > 0.7$. Only 16 percent of the western SNG was in the VOR class > 1.5 dm. In the Durler/Venlo management unit, only 7 percent of the suitable nesting area provided vegetation > 1.5 dm. For areas (1.6 km of leks, only 14 percent of the area had vegetation in the >1.5 dm VOR classes. Suitable nesting cover for prairie chickens may increase during drought years because lowlands that are usually flooded are drier and usable for nesting by hens.

Most of the nesting habitat for greater prairie chickens in the SNG is the midland community type in the humocky sandhills (Manske and Barker 1981, Manske and Barker 1987). Switchgrass *(Panicum virgatum)* communities found on the toe slopes surrounding lowland meadows provide the primary prairie chicken nesting cover on the SNG (Manske and Barker 1987, Newell 1987). Although lowlands are not considered suitable for nesting in most years, the lowland/midland interface is used for nesting by prairie chickens (Newell 1987). The lack of adequate cover for nesting in upland communities was attributed to heavy livestock utilization (Newell 1987). Historically, upland communities were likely tall grass prairie (Burgess 1964), but currently have limited capacity to provide nesting cover because they are dominated by short cool season and warm season grasses such as Kentucky bluegrass and blue grama.

The HSI model (Prose 1985) assumes that optimum nesting habitat conditions exist when 80 percent of the area supports herbaceous vegetation with a VOR of 2 - 3 dm. However, lingering populations of greater prairie chickens can exist in areas with 10-15 percent permanent grassland (Hamerstrom et al. 1957, Prose 1985). Topfer et al. (1990) considers a spring population of 200 birds (100 males) as a minimum number to insure perpetuation of the population. Greater prairie chickens probably persist on the SNG because natural variation provides small limited areas with adequate nesting cover. These areas exist at the lowland/midland community interface, in lowlands during drought years, and in limited quantity surrounding some leks. Limited nesting also occurs in alfalfa on private lands (Newell 1987). Small populations, such as the greater prairie chicken on the SNG, are highly susceptible to extinction due to catastrophic natural events (Ruggiero et al. 1994).

Robustness of Analyses to Assumptions

Because the HSI in our evaluation were based on ocular estimates of VOR classes, we conducted analyses to estimate HSI for systematic errors in estimating the VOR classes. If we over estimated the VOR classes (e.g.,VOR was actually lower), then HSI would decline further. Because, the lower limit on HSI is zero, our conclusion of limited nesting habitat remained unchanged.

If we systematically underestimated VOR classes by one class (0.5 dm), HSI for the Western SNG increased to 0.1 for fall VOR estimates and remained zero for estimates of spring nesting cover. HSI in the Durler/Venlo unit remained zero for both spring and fall VOR estimates. HSI for the areas around active leks increased to 0.3 for fall VOR estimates, but declined to 0.1 for spring estimates of nesting cover. Because the area surrounding leks included lowlands that are flooded in most years, the HSI was probably lower. None-the-less, analyses that assume we underestimated nesting cover, still show that nesting habitat is limited on the SNG.

The VOR estimates we used for the 3433 ha private lands in western SNG analysis unit were made subjectively post hoc. Because, these post hoc estimates of private land VOR may have influenced the HSI, we conducted an analysis that would present the best possible HSI for this analysis unit. HSI for the western SNG was recalculated assigning all private lands with suitable vegetation types (hay and alfalfa, pastures, and CRP) for nesting, a SI_{VOR} of 1.0 (this analysis does not change the HSI for nest cover on lands managed by the SNG). The resulting HSI for nest cover increased for the western SNG analysis unit to 0.33. This HSI represents the upper limit for the western SNG analysis unit, but it is not realistic. Most of the area considered to have SI_{VOR} of 1.0 are grazed or mowed annually. Hay and alfalfa is usually cut by the third week of June, destroying existing nests and young broods unable to escape the mowers. Only the 251 ha of CRP in the analysis unit maintained its structural integrity throughout the nesting and brood rearing periods. None-the-less, this analysis still indicated that regional nesting habitat for greater prairie chickens is limited in the vicinity of the SNG.

Contributing Factors

The encroachment of woody and exotic plant species, changes in adjacent agricultural/land use changes, and livestock grazing practices are three human induced factors that directly or and indirectly influence nesting cover for prairie chickens on the SNG. Quaking aspen *(Populus tremuloides),* willow *(Salix* spp.) and Russian olive *(Elaeagnus angustifolia)* have encroached into prairie reducing nesting cover on the SNG (Kobriger et al. 1987, Jensen 1992). Leafy spurge *(Euphorbia esula)* has expanded from 7 percent to over 17 percent of the SNG since 1985 (unpubl. data, SNG). Encroachment of woody plants reduces and fragments suitable nesting, brood rearing and roosting cover (Svedarsky 1979); provides travel corridors and perch sites for predators (Burhnerkempe et al. (1984) and creates habitat more suitable for closely related sharp-tailed grouse (Prose 1987).

Agricultural development on private lands adjacent to the SNG over the past 10-15 years shows that remnant prairie habitats on private lands have been largely converted to croplands (unpubl. data, Nat. Res. Conserv. Serv., Lisbon, ND). Our analysis of the western SNG unit, showed that most of the suitable nesting habitat on private lands was Conservation Reserve Program comprising 250 ha in the analysis unit. No privately owed parcels of native prairie were identified in our analysis of the western SNG.

Grazing by livestock is the predominant use of the SNG. Livestock stocking rates have fluctuated between 50,000 and 60,000 AUMs over the past 10 - 15 years on the SNG. However, the size of livestock has increased approximately 40 percent during a comparable period (L. Potts, pers. commun., SNG, Lisbon, ND). These heavier animals require approximately 30 percent more forage (National Research Council 1984) than the standard AUM established for a 454 kg animal.

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