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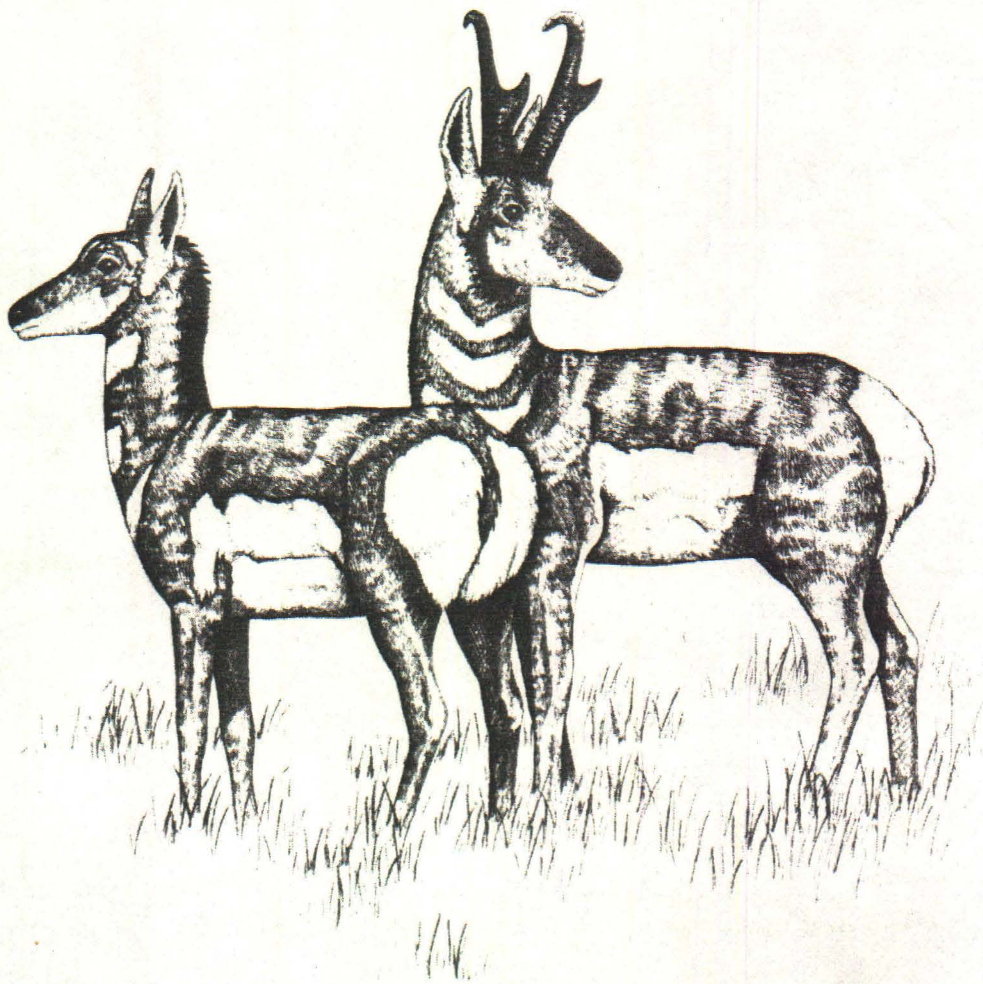
HABITAT SUITABILITY INDEX MODELS: PRONGHORN



Fish and Wildlife Service

U.S. Department of the Interior

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June 1984

HABITAT SUITABILITY INDEX MODELS: PRONGHORN

by

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PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for the HSI model that follows. In addition, this same information may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

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PRONGHORN (Antilocapra americana)

HABITAT USE INFORMATION

General

The pronghorn (Antilocapra americana) is commonly found in association with grasslands and sagebrush (Artemisia spp.) communities. In 1964, 62% of North American pronghorn were associated with grasslands (41% shortgrass, 21% mixed), 37% were on grassland-brushland [33% bunchgrass-sagebrush, 3% galleta (Hilaria spp.)-woodland, 1% grama (Bouteloua spp.)-mesquite (Prosopis spp.)] and 1% were associated with deserts (Yoakum 1972). The highest densities of pronghorn occur on rangelands with an annual precipitation rate of 25.4 to 38.1 cm (10.0 to 15.0 inches) (Autenrieth 1978).

Food

Foods utilized by pronghorn vary seasonally depending upon the availability, palatability and succulence of vegetation (Hoover et al. 1959). Vegetation consumed includes practically all available species although there is a high preference for more succulent forage (Yoakum 1978). Pronghorn will move from relatively dry ranges to more mesic sites in search of succulent vegetation. When forbs are scarce, pronghorn select the most succulent alternative browse available (Beale and Smith 1970).

The average annual diet of pronghorn in the short grass plains region of Colorado was approximately 43% forbs, 40% browse, 11% cacti (Opuntia spp.), and 6% grass (Hoover 1966). Cole and Wilkins (1958) presented data suggesting similar annual dietary trends for pronghorn on grama-needlegrass-wheatgrass (Bouteloua-Stipa-Agropyron) cover types in central Montana. However, Severson et al. (1980) reported annual diets of 5% forbs, 3% graminoids, and over 90% browse for sagebrush-grass ranges in central Wyoming. These data suggest variable food habits dependent on availability throughout the range of pronghorn.

Considering only food habits, ranges dominated by approximately equal proportions of forbs and browse, with some cacti and grasses, would provide the highest carrying capacity for pronghorn (Hoover 1966). However, Yoakum (1974) stated that the most important factor influencing high population density antelope ranges in the Great Basin was that the range be in approximately 50% food production, consisting of approximately 40 to 60% grass, 10 to 30% forbs, and 5 to 10% in browse.

Browse was the most heavily utilized winter food by pronghorn in Alberta even though its availability was extremely limited (Mitchell 1980). Browse accounted for more than 90% of the winter diet of pronghorn in Utah (Beale and Smith 1970), 93% of the winter diet in Montana (Bayless 1969) and 71.6% and 54.2% of the fall and winter diet, respectively, in Colorado (Hoover 1966). Sagebrush, rabbitbrush (Chrysothamnus spp.), and bitterbrush (Purshia tridentata) were identified as particularly important pronghorn forage in the Great Basin (Yoakum 1982). Big sagebrush (A. tridentata), bitterbrush, and saltbush (Atriplex spp.) were important pronghorn winter forage plants in Montana (Bayless 1969). Black sagebrush (A. nova) was the most important source of browse on pronghorn winter range in Utah (Beale and Smith 1970). Other important species were winterfat (Ceratoides lanata), brickellia (Brickellia spp.), and Douglas rabbitbrush (C. viscidiflorus).

Habitats dominated by sagebrush have often been reported to be a key component of northern pronghorn ranges (Dirschl 1963; Martinka 1967; Bayless 1969; Beale and Smith 1970; Barrett 1980). Pronghorn populations in Alberta with access to winter ranges containing concentrations of sagebrush were more stable than herds which inhabited ranges supporting lesser amounts of sagebrush (Barrett and Vriend 1980). Dirschl (1963) indicated that abundance of shrubs was a prime factor determining carrying capacity of winter ranges.

Spring is the only time of year when grasses appear to comprise a significant portion of the pronghorn's diet (Hoover 1966; Beale and Smith 1970). The high protein content of early spring growth in grasses (Cook and Harris 1952; Fierro 1977) may be particularly beneficial to pronghorn at a time when other forage species are of poor quality (Wallmo et al. 1977). Grass is also consumed during green-up periods in warm weather (Bayless 1969). Grasses other than wheat (Triticum aestivum) were found to be a relatively unimportant component of the pronghorn's diet in Kansas (Sexton et al. 1981). Pronghorn in Utah were not observed to use dry, mature grass at any time (Beale and Smith 1970).

Wheat was a major constant (74%) of the November through April diet of pronghorn living in the vicinity of green wheat fields in Colorado (Hoover 1966). At least 60% of the pronghorn diet in Kansas from October through March was wheat (Sexton et al. 1981). The proportion of wheat in the diet decreased to 1.7% by April. Pronghorn concentrated where they had access to cropland and native vegetation during severe winter weather in Alberta (Mitchell 1980), but did not consistently winter in areas which contained more than 25% of the land area in cultivation (Barrett 1980). Sexton et al. (1981) reported that pronghorn in Kansas inhabited areas consisting of up to 30% agricultural land. The amount of use of grain fields is dependent on their proximity to native rangelands (Cole and Wilkins 1958). Grain fields in Montana less than 0.8 km (0.5 mi) from native rangelands received greater use by antelope, during all seasons of the year, than did fields more than 0.8 km from rangelands.

Water

Water is a critical component of pronghorn ranges during summer and fall. Pronghorn will drink water daily if it is available (Einarsen 1948). Ranges which produce and maintain high pronghorn densities have water available every 1.6 to 8.0 km (1.0 to 5.0 mi) (Yoakum 1974). Sundstrom (1968) observed 95% of over 12,000 pronghorn in Wyoming within a 4.8 to 6.4 km (3.0 to 4.0 mi) radius from water. The maximum distance from pronghorn kidding sites in Alberta to open water was less than 4.0 km (2.5 mi) (Barrett 1981), but the mean distance was only 586 ± 31 m (641 ± 34 yd).

Water consumption by pronghorn has been reported to be inversely related to the succulence of available forage (Beale and Smith 1970). Pronghorn were not observed drinking water when forbs with a high moisture content were abundant.

Pronghorn in Colorado were reluctant to drink from stock tanks; however, they did drink overflow water (Hoover et al. 1959). Autenrieth (1978) reported that pronghorn will utilize most facilities designed for livestock watering and that such facilities should remain useable throughout the summer and fall on northern ranges and year-round on southern ranges. Where natural water is limited or absent, development of water sources may encourage better distribution of pronghorn.

Winter water requirements are often assumed to be provided by snow, but unfrozen water sources may be important on ranges when snow is absent. Guenzel et al. (1982) found that pronghorn distributions were strongly affected by an unfrozen water source during a relatively snow-free winter in south-central Wyoming. Wyoming Game and Fish Department employees noted water stress in pronghorns in areas with frequently long, snow-free periods in winter (Cook 1984). These areas received only about 0.7 cm (0.3 inches) of precipitation per month in the winter.

Cover

Pronghorn typically inhabit land forms characterized by low rolling, expansive terrain (Autenrieth 1978). Pronghorn were never observed for more than a few minutes at a time where their view was restricted by terrain or other natural features (Prenzlow et al. 1968). Kindschy et al. (1982) felt that areas with less than 5% slope were optimum for pronghorn.

Microhabitats provided by topographic relief apparently increase habitat quality during winter. Montana pronghorn selected microhabitats with more favorable conditions during winter (e.g., lower wind velocities, less snow, less dense snow), than the average for the whole area (Bruns 1977). During the fall and winter pronghorn spent more time in basins ≥ 1.6 km (1 mi) in diameter than at other times of the year in Colorado (Prenzlow et al. 1968). Amstrup (1978) occasionally observed pronghorn on slopes of 50% or more, but only 7% of all observations were on slopes exceeding 20%. However, pronghorn in Colorado did not move to sheltered environments such as groves of trees, haystacks or large rocks, or into canyons during storms (Prenzlow et al. 1968).

Topographic variation may also increase the probability that snow-free foraging areas exist during winter. Pronghorn often frequent areas of reduced snow accumulations (e.g., edges of ditches, creek beds, the lee side of thick stands of sagebrush) for foraging during winter (Bruns 1977). When normal winter feeding areas become snow-covered, pronghorn move to steeper windswept areas where vegetation is morc exposed (Einarsen 1948). Martinka (1967) reported pronghorn dying of malnutrition during a severe winter when excessive snow depths prohibited the use of coulees and restricted the animals to a grassland type. Only minor losses occurred on winter ranges where big sagebrush and silver sagebrush (*A. cana*) were available on southern exposures and windblown ridges. Winter concentrations of pronghorn in Alberta were often observed in, and adjacent to, breaks and coulees which provided protection from the wind, and increased availability of shrubs (Mitchell 1980). These herds were sedentary for weeks at a time where microhabitats provided food and shelter. Most pronghorn winter ranges in Alberta were associated with drainage systems containing abundant sagebrush (Barrett and Vriend 1980). High winds, in areas of high topographic diversity, act to maintain snow-free feeding sites, even in relatively severe winters (Ryder 1983).

Vegetation provides cover for many large ungulates, but tall, dense vegetation is of minimal value to pronghorn because of both limited visibility and mobility. Rangelands with an average vegetation height of 61 cm (24 inches) were less preferred than ranges averaging 38 cm (15 inches) (Yoakum 1978). Ranges supporting vegetation averaging 76 cm (30 inches) in height were rarely used by pronghorn.

Reproduction

Einarsen (1948) described traditional pronghorn fawning areas in terms of terrain characteristics and vegetation height. Optimal fawning grounds were characterized as being situated in a basin, surrounded by a low ridge of hills, where standing vegetation averaged 22.8 to 45.7 cm (9.0 to 18.0 inches) in height. Although certain topographical and plant features appeared to contribute to preferred parturition sites in Alberta, Barrett (1981) reported no evidence indicating the existence of traditional fawning areas. Habitat diversity provided by silver sagebrush, small depressions, and stands of forbs and grasses 25.0 cm (9.8 inches) or taller, contributed to above average fawn survival. Eighty-eight percent of the pronghorn fawns captured in the shortgrass prairie region of Colorado were located in the vicinity of washouts, taller grass, or rocks (Prenzlow et al. 1968). Vegetation at daytime sites, where pronghorn fawns less than 4 weeks of age were observed, was taller than the vegetation in the surrounding area (Tucker and Garner 1980). No significant differences were noted between fawn-site vegetation and the height of vegetation in the surrounding area for fawns older than 4 weeks.

Interspersion

Pronghorn home range size is dependent upon topography, the presence of physical barriers, and the amount of forage available in the area (Bayless 1969). The area required depends upon the range having all of the habitat requirements in sufficient quality and quantity for all seasons of the year

(Yoakum 1974). The geographic location and size of home ranges change throughout the year in a rhythmic pattern (Buechner 1950). The winter range may include an area as large as 6.4 by 9.6 km (4.0 by 6.0 mi). Pronghorn in Wyoming remained on an area of 2.6 to 5.2 km^2 (1.0 to 2.0 mi^2) during the summer and early fall, although daily movements covered from 0.2 to 0.6 km^2 (0.07 to 0.23 mi^2) (Gregg 1955 cited by O'Gara 1978). Pronghorn in Alberta remained relatively sedentary on their summer range and exhibited strong fidelity for their natal range (Mitchell 1980).

The timing and length of movements of pronghorn vary with altitude, latitude, weather and range conditions (Yoakum 1978). Movements are directly related to seeking the basic habitat requirements of water and forage. Differentiation of summer and winter ranges has been reported to be determined by snow depth (Autenrieth 1978; Yoakum 1978). Pronghorn in Saskatchewan regularly avoided areas where snow exceeded 18 cm (7 inches) in depth (Pyle 1972 cited by Mitchell 1980). Bruns (1977) stated that pronghorn may be "opportunistic migrants" because herds may not migrate to definite wintering areas each year. Pronghorn are believed to undertake migration only if forced to do so as a result of extreme weather or habitat conditions. Such movements would cease when more favorable habitat was reached, or a change occurred in climatic conditions. The arrival and persistence of inclement weather during the late fall prompted pronghorn in Alberta to move from the more open summer and fall ranges to topographically diverse areas adjacent to water courses (Mitchell 1980). Fall migration of Idaho pronghorn to winter ranges may not be initiated by snow depth or storms, but rather by a decreased moisture content of forage on higher elevation ranges (Hoskinson and Tester 1980). However, snow depth was reported to influence the geographic location of winter ranges, and the initiation and rate of movement back to the summer range. Bayless (1969) reported that 50% of the antelope for which home ranges were calculated were observed to "shift" home ranges. Such movements were defined as movement from the original area of activity to another area with no subsequent return to the original area. The size of pronghorn home and seasonal ranges is a result of habitat conditions and the influences of weather, thus, home range data for the species seldom has application to other areas, or even to the same range from year to year (O'Gara 1978).

Special Considerations

Compatibility of antelope and livestock is related to the number of animals using the same range, season of use, and forage condition (Autenrieth 1978). Based on dietary overlaps during the year, horses, cattle, and sheep in Wyoming's Red Desert were similar in their food preferences, whereas antelope food habits were dissimilar to those of domestic livestock (Olsen and Hansen 1977).

Because the diets of cattle and pronghorn are sufficiently different during the fall and winter there is little competition for forage (Salwasser 1980). Competition for spring grasses and forbs may result if heavy cattle grazing occurs on pronghorn ranges prior to mid-May. Cattle also may compete with pronghorn if heavy grazing is allowed on meadows within the summer range. Cattle can have a positive impact on pronghorn habitats if their early summer use of grasses favors the maintenance of annual forbs on spring and summer ranges. Pronghorn in Texas do well on overgrazed cattle ranges because forbs increase under such grazing conditions; however, sheep competed directly with pronghorn by removing many palatable forbs (O'Gara 1978).

Sheep have the highest potential for dietary overlap and competition with pronghorn (Severson et al. 1968; Salwasser 1980). Pronghorn abandoned a Montana range used by sheep (Campbell 1970 cited by O'Gara 1978). Salwasser (1980) recommended: 1) pronghorn winter ranges should not be grazed by sheep to the extent that significant use of browse occurs; 2) sheep should be excluded from spring ranges until pronghorn have moved onto their summer range; and 3) sheep should not be turned out on summer range until pronghorn fawning is completed.

Fences on pronghorn ranges may restrict movements and can be a direct cause of injury or mortality (Rouse 1962; Yoakum 1978; Salwasser 1980). Fences may have significant impacts when constructed in migration routes or where they interfere with daily movements to and from water or feeding areas (Salwasser 1980; Yoakum 1980). Pronghorn exhibit some adaptability to crawl under, go through, or jump fences as the type of construction permits (Rouse 1962). There is a general concensus among pronghorn biologists that the species usually will not jump over fences (Salwasser 1980). Citing BLM Manual 1737 (Bureau of Land Management 1975), Salwasser (1980) made the following recommendations concerning fence construction: (1) fences on cattle ranges should be constructed of three strands, with the top strand no higher than 97 cm (38 inches); the bottom wire should be barbless, and at least 41 cm (16 inches) above the ground; and (2) fences on sheep ranges should be constructed of four strands with the highest strand not exceeding 81 cm (32 inches) in height; the bottom wire should be barbless and at least 25 cm (10 inches) above the ground.

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This model has been developed chiefly for application from the Great Basin to and including the Great Plains. Model assumptions will be most realistic in regions where severe winter weather influences pronghorn population characteristics. However, the model is probably applicable for habitat evaluation throughout the historic range of *A. a. americana* (range: Great Plains of the United States and Canada, and the Great Basin). This model is not applicable for habitat evaluation for *A. a. mexicana* (range: isolated areas of southern Arizona, New Mexico, Texas, and Mexico), *A. a. peninsularis* (range: Baja California, Mexico), or *A. a. sonoriensis* (range: extreme southern Arizona to west-central Mexico). Figure 1 illustrates the approximate geographic area for which this model is applicable.

Season. This model is applicable for the evaluation of pronghorn winter range.

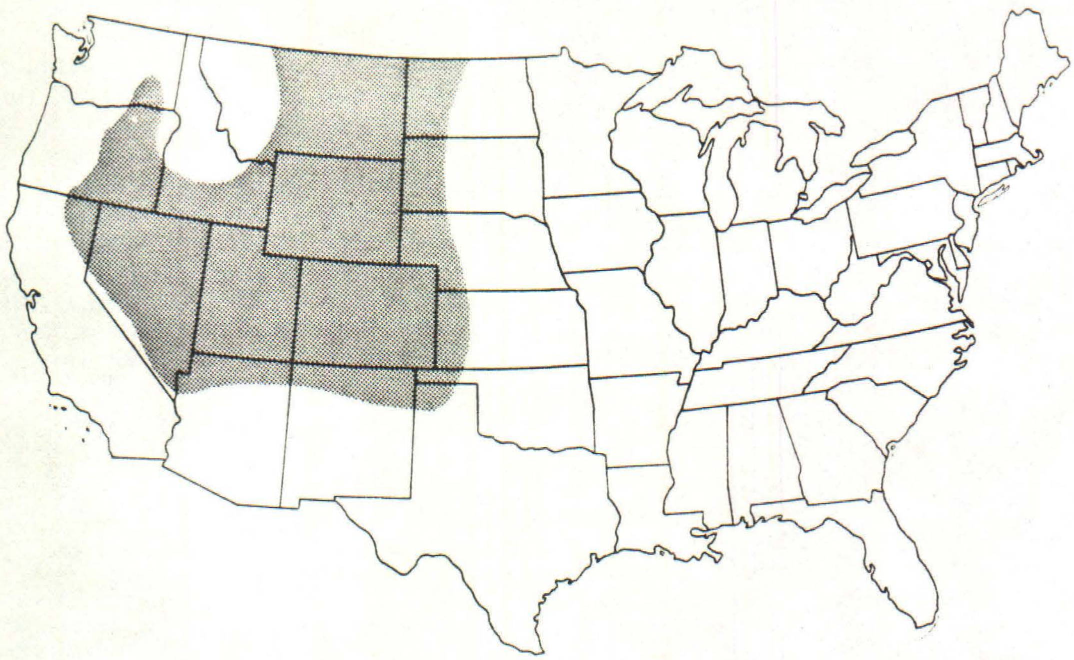


Figure 1. Approximate geographic area of applicability for the pronghorn HSI model.

Cover types. This model was developed to evaluate habitat quality in the following cover types (terminology follows that of U.S. Fish and Wildlife Service 1981): Evergreen Shrubland (ES); Deciduous Shrubland (DS); Evergreen Shrub Savanna (ESS); Deciduous Shrub Savanna (DSS); Grassland (G); Forbland (F); and Cropland (C).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be utilized by a species. The majority of pronghorn in North America now exist on ranges which vary from 8 to 16 km (5 to 10 mi) in diameter (Yoakum 1978). However, the minimum winter range area for pronghorn was not reported in the literature. Several winter ranges used to evaluate the performance of this model (Cook 1984) were less than 30 km^2 (11.8 mi^2) in area. Based on this information it is assumed that an area must provide a minimum of 30.0 km^2 (11.8 mi^2) of contiguous habitat before it will be suitable as pronghorn winter range. A 30.0 km^2 (11.8 mi^2) circle has a radius of 3.1 km (1.2 mi).

Verification level. A draft of this model was evaluated against pronghorn population densities on 29 winter ranges in Colorado, Idaho, Montana, and Wyoming (Cook et al. in press). After minor modifications in variable relationships, data analysis indicated that the model addressed important habitat variables and explained 70% ($P < 0.0001$) of the variation in pronghorn densities on the winter ranges evaluated. The current model contains the modifications and improvements in variable relationships suggested during analysis of the draft model.

Model Description

Overview. This model assumes that winter habitat characteristics are the most limiting conditions affecting pronghorn distribution and abundance. We have developed this model based on the assumptions that pronghorn survival and reproductive success are functions of winter food availability. Snow depth and duration directly affect food availability on northern winter ranges. The model attempts to characterize vegetation and topographic features favoring food availability under mild to normal snow conditions. The model assumed that snow will be available to meet pronghorn winter water requirements (see Special consideration component).

The following sections provide documentation of the logic and assumptions used to translate information on pronghorn habitat use to the variables and equations used in the HSI model. Specifically, these sections cover: (1) identification of habitat related variables; (2) definition and justification of the suitability levels of each variable; and (3) descriptions of the assumed relationships between variables.

Winter food component. Pronghorn food habits vary on a regional and local basis. The availability of adequate food is a critical winter life requisite for the pronghorn in many areas of its geographic range. Forbs commonly comprise the major portion of the pronghorn's diet when evaluated on an annual basis. Utilization of browse typically exceeds that of forbs during the winter months. It is assumed that adequate spring/summer food will never be more limiting to a pronghorn population than the quality and quantity of a winter food source. This model has been developed chiefly for areas where winter snow storms may have a major influence on habitat use and pronghorn survival. Pronghorn populations inhabiting the southerly portions of the continent may not be as dependent upon browse as a winter food source as are northern populations.

Winter food characteristics of pronghorn habitat are assumed to be a function of: (1) percent shrub crown closure; (2) the average height of the shrub canopy; (3) the number of shrub species present; (4) percent herbaceous canopy cover; and (4) to a limited degree the amount of available habitat in winter wheat. The assumed relationships between shrub crown closure, shrub height, shrub species diversity, and suitability index values for pronghorn winter food quality are presented in Figure 2.

Fig. 2a

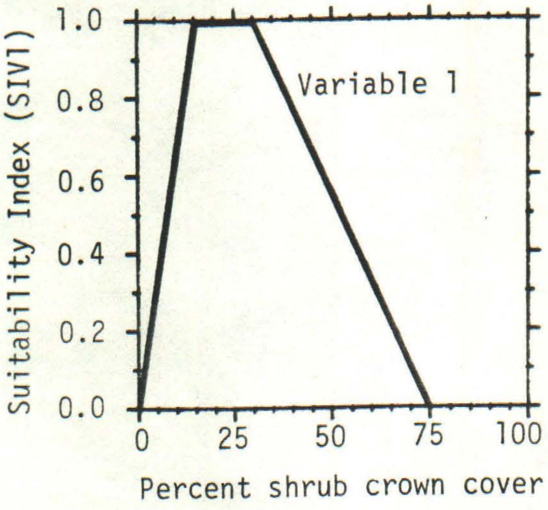


Fig. 2b

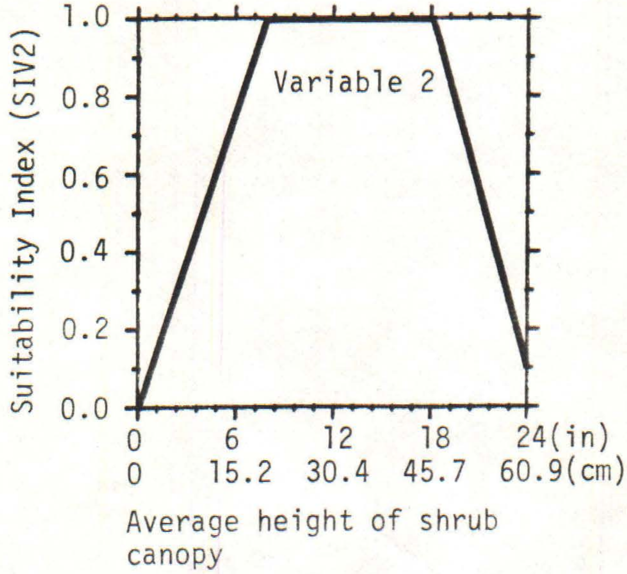


Fig. 2c

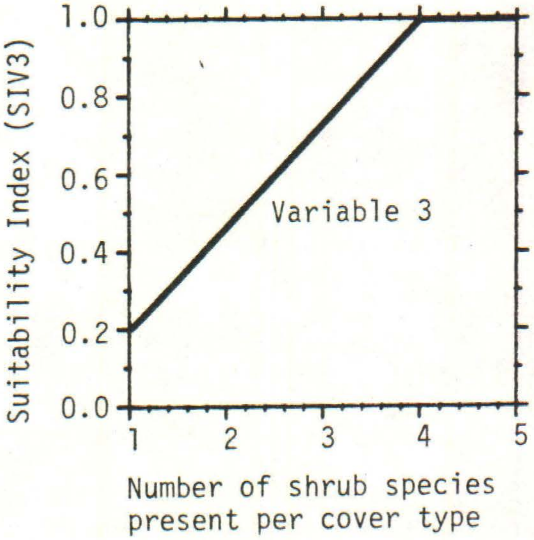


Figure 2. The relationships between shrub habitat variables and suitability index (SI) values for pronghorn winter food quality.

An optimum winter food value for pronghorn is, in part, represented when the percent shrub crown closure ranges from 15 to 30% (Fig. 2a), and the average height of the shrub canopy ranges from 20 to 46 cm (8 to 18 inches) (Fig. 2b). A shrub density and average shrub height exceeding 30% and 46 cm (18 inches), respectively, are assumed to indicate less desirable habitat quality due to interference with pronghorn mobility. Shrub cover ≥ 75% is assumed to reflect unsuitable habitat conditions, regardless of average canopy height. Average shrub height < 20 cm (8 inches) is assumed to represent less desirable habitat quality due to decreased accessibility when snow is present (Cook 1984).

The number of shrub species present (Fig. 2c) is also assumed to influence an area's potential to provide a high quality winter food source. Cover types containing four or more shrub species are assumed to represent optimum conditions. Homogeneous stands composed of only one species are assumed to have lower potential in providing an adequate winter food source.

The abundance of herbaceous vegetation and availability of winter wheat also are assumed to have an influence on the quality of a winter food source for the pronghorn. Figure 3 displays the assumed relationships between herbaceous canopy cover and the availability of winter wheat, and suitability index values for pronghorn winter food quality.

The presence of forbs and graminoids, in addition to shrubs, will often provide maximum forage diversity. Figure 3a displays the assumed relationship between the amount of herbaceous vegetation (graminoids plus forbs) present and a suitability index for winter food. Optimum conditions are assumed to exist when the herbaceous canopy coverage ranges from 10 to 40%. Herbaceous vegetative density above and below the assumed optimum conditions will result in lower SI values. Determination of a winter food value for pronghorn is chiefly a function of shrub density, therefore the complete absence of herbaceous vegetation will result in a lower food index value but will not totally limit an area's winter food potential. Sites dominated completely by herbaceous vegetation, 100% canopy closure, are assumed to have relatively low potential for providing adequate pronghorn winter food.

Winter wheat in the vicinity of, or interspersed with, rangeland is assumed to improve the winter food value for pronghorn if shrubs are present at a density of 75% crown cover or less. Figure 3b displays the relationship between the proportion of available habitat in winter wheat and a winter food suitability index for the species. Optimum winter food may be obtained if winter wheat is totally absent when shrub density and height are within optimum ranges. It is assumed that optimum amount of winter wheat will range between 5 and 25% of the evaluation area. As the percent of the evaluation area in winter wheat (including fallow) increases above 25%, habitat quality for pronghorn is assumed to decrease. Evaluation areas consisting of ≥ 50% winter wheat are assumed to provide no increased potential as winter food due to decreased availability of shrub food sources.

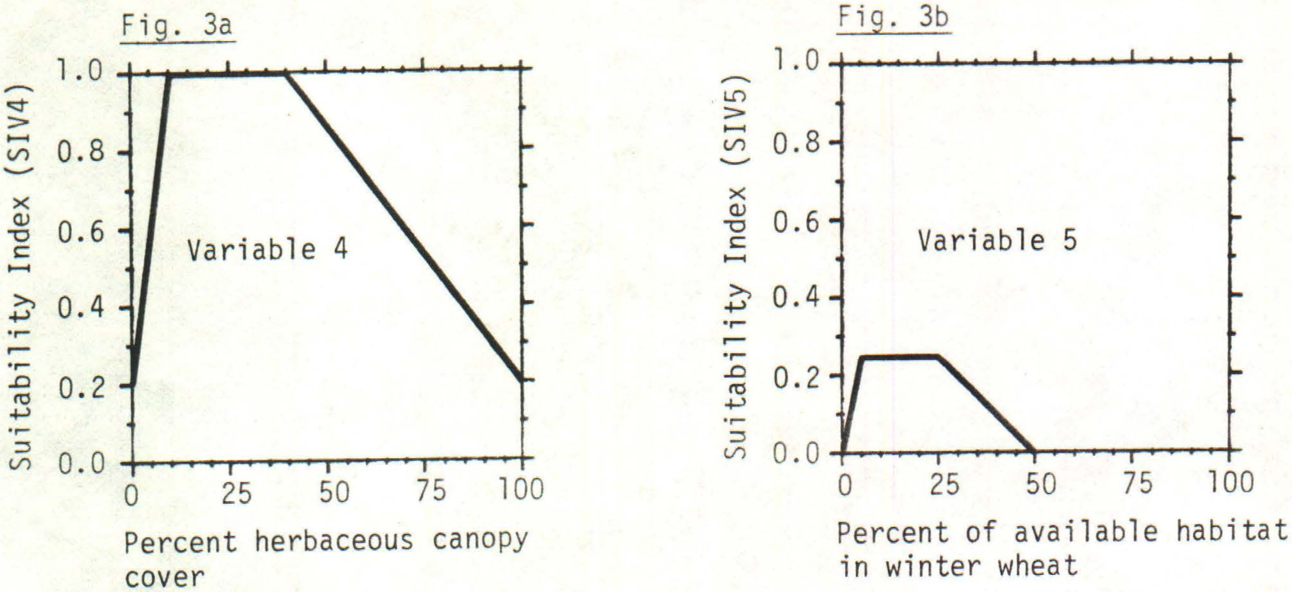


Figure 3. The relationships between herbaceous canopy cover and the amount of available habitat in winter wheat to suitability index (SI) values for pronghorn winter food quality.

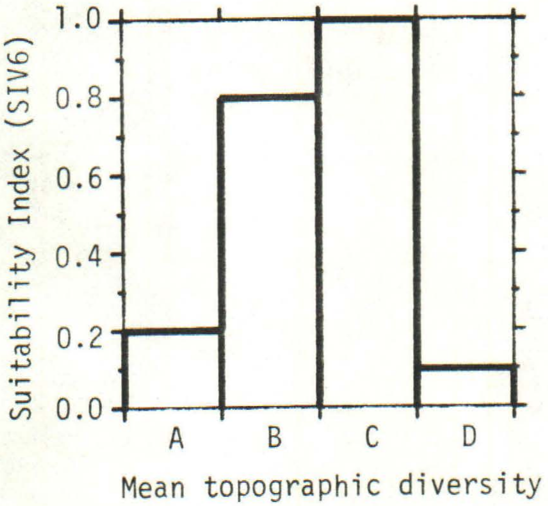
The relationships between index values calculated using the curves presented in Figures 2 and 3 are illustrated in Equation 1. Guidance for use of the model in study areas that consist of more than one cover type is provided in the Application of the Model section.

$$WFI = [V_1 \times (V_2 \times V_3 \times V_4)^{1/3}] + V_5 \qquad (1)$$

The density of shrubs, mean height of the shrub canopy, number of shrub species present, percent herbaceous canopy cover and the percent of the evaluation area in winter wheat all function to define a winter food value for the pronghorn. Percent shrub crown cover (SIV_1) has the greatest influence in determination of a winter food value in the above equation. The values calculated for average shrub canopy height (SIV_2), number of shrub species present (SIV_3), and percent herbaceous canopy closure (SIV_4) are assumed to be equal in their value for the determination of a winter food value. The geometric mean of these three SI values has a direct influence on the SI value calculated for SIV_1, percent shrub crown cover. The percent of available pronghorn habitat in winter wheat (SIV_5) may serve to slightly increase the SI value calculated for naturally occurring vegetation. However, the structure of equation 1 permits an optimum value to be obtained in the complete absence of winter wheat.

Cover component. Pronghorns typically inhabit ranges which are characterized as being expansive and low rolling. Ridges, rims, and depressions are used as thermal and escape cover and may contribute to greater diversity in food resources and foraging areas. Figure 4 displays the assumed relationships between mean topographic diversity and a cover index (CI) for the pronghorn.

Flat terrain is assumed to have a relatively low value for providing suitable winter cover conditions. Diverse terrain comprised of rolling topography, or ridges and rims, is assumed to provide high quality winter cover. Steep, broken, or mountainous terrain is assumed to have minimum potential as suitable winter cover for the species.



A) 0-2% slope; flat or nearly so
B) 3-8% slope; gently rolling
C) 9-25% slope; substantial drainages, ridges, and/or rims present
D) > 25% slope; mountainous

Figure 4. The relationship between mean topographic diversity and cover index value for pronghorn winter range.

Application of this model requires that a winter food/cover value be determined by combining the cover and winter food index values. Equation 2 is used to calculate the combined winter food/cover index (WFCI) for the pronghorn.

$$WFCI = \frac{WFI + CI}{2} \quad (2)$$

The winter food index and cover index are assumed to have equal value in determining the overall winter food/cover index value for the pronghorn.

Model Relationships

HSI determination. The calculation of a Habitat Suitability Index for the pronghorn considers the life requisite values obtained for winter food/cover (equation 2). The HSI is equal to the winter food/cover value.

Summary of model variables. Six habitat variables are used in this model to determine winter food/cover life requisite values for the pronghorn. The relationships between habitat variables, the winter food/cover index, cover types, and an HSI value are summarized in Figure 5.

Application of the Model

We recommend determining canopy cover of vegetation classes using the line intercept method. This method is relatively accurate, especially for shrubs (Pieper 1978). Model variables are calibrated based partially on data collected using this method. Other sampling techniques may produce markedly different cover estimates.

Cook (1984) separated half shrubs and true shrubs, and combined the former class with estimates of herbaceous canopy closure, during field testing of the model. Half shrubs are defined as species generally less than 15 cm (6 inches) in height, and which die back to a woody base each year. Examples of half shrubs include fringed sagewort (*A. frigida*) and saltsage (*Atriplex nuttallii*) (Table 1). Half shrubs were treated in this manner because it is assumed that their growth form and dormancy pattern more closely simulates the availability of forbs and graminoids in winter, than that of true shrubs.

Figure 6 provides variable definitions and suggested measurement techniques (Hays et al. 1981).

This model may be used to determine HSI values for evaluation areas comprised of one cover type or for areas comprised of several cover types. In situations where two or more noncropland cover types are present within the evaluation area an overall weighted HSI (weighted by area) can be determined by performing the following steps:

1. Stratify the evaluation area into cover types.

2. Determine the area of each cover type and the total area of the evaluation area.

3. Determine SI values for all variables except V_5, percent of available habitat in winter wheat, for each noncropland cover type in the evaluation area. If present, determine the proportion of the evaluation area comprised of fallow and planted winter wheat fields (V_5). Variables other than V_5 and V_6 do not require measurement in cropland cover types.

4. Determine a WFI value for each noncropland cover type using the SI values derived in step 3 and equation 1, excluding V_5.

5. Multiply the area of each cover type by its respective WFI value, sum these products, and divide the sum by the total area of all cover types including areas planted to winter wheat. Then add the SI value for V_5 (percent of available habitat planted to winter wheat) to determine the weighted WFI.

6. Determine a cover index (CI) value for each cover type, including croplands using Figure 4.

7. Multiply the area of each cover type by its respective CI value, sum these products, and divide the sum by the total area of all cover types to obtain the weighted CI value.

8. The HSI value is determined by averaging the WFI and CI values. The steps outlined above are expressed by the following equations:

$$\text{weighted WFI} = \frac{\sum_{i=1}^{n} WFI_i A_i}{\sum_{i=1}^{n} A_i} + \text{SI value of } V_5$$

where n = number of cover types

WFI_i = winter food index value of individual noncropland cover type

A_i = area of cover type i

$$\text{weighted CI} = \frac{\sum_{i=1}^{n} CI_i A_i}{\sum_{i=1}^{n} A_i}$$

where n = number of cover types

CI_i = cover index value derived from Figure 4 for each cover type

A_i = area of cover type i

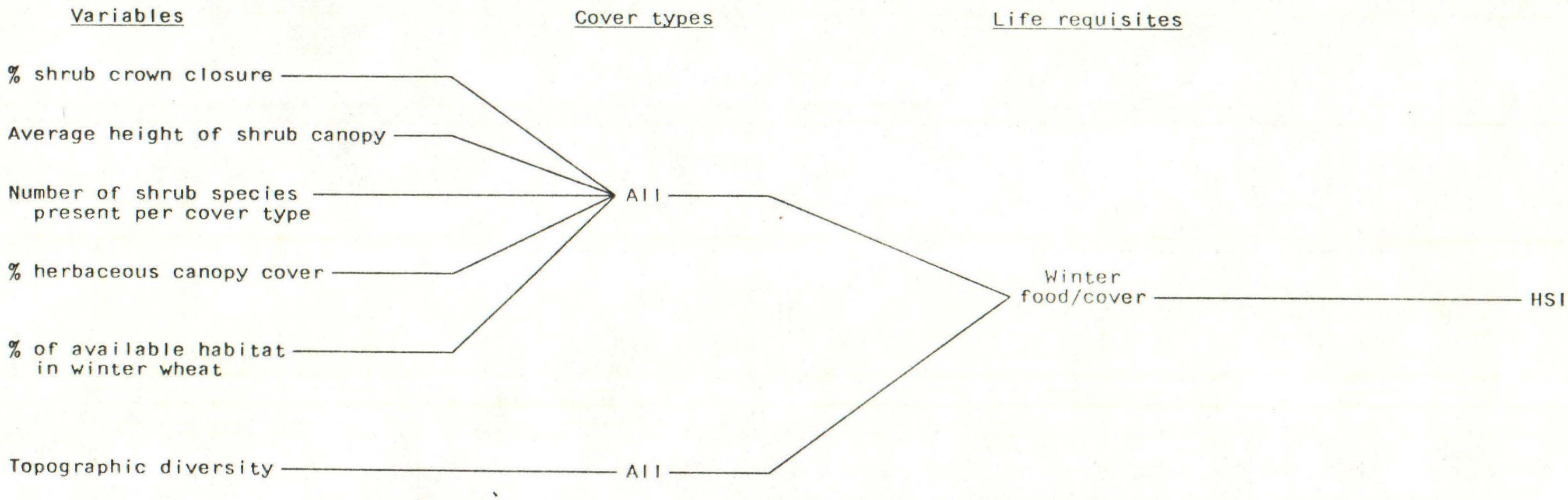


Figure 5. Relationships of habitat variables, life requisites, and cover types to the HSI for pronghorn winter range.

Table 1. Shrubs and half-shrubs encountered on 29 pronghorn winter ranges used to evaluate HSI model performance (Cook 1984).

Scientific name	Common name
Shrubs:	
Artemisia arbuscula	Low sagebrush
Artemisia cana	Silver sagebrush
Artemisia filifolia	Sand sagebrush
Artemisia longiloba	Alkali sagebrush
Artemisia nova	Black sagebrush
Artemisia tridentata tridentata	Basin big sagebrush
Artemisia tridentata vaseyana	Mountain big sagebrush
Artemisia tridentata wyomingensis	Wyoming big sagebrush
Atriplex confertifolia	Shadscale
Chrysothamnus nauseosus	Rubber rabbitbrush
Chrysothamnus viscidiflorus	Douglas rabbitbrush
Grayia spinosa	Spiny hopsage
Purshia tridentata	Antelope bitterbrush
Rhus trilobata	Skunkbush
Sarcobatus vermiculatus	Black greasewood
Symphoricarpos spp.	Snowberry
Tetradymia canescens	Gray horsebrush
Tetradymia spinosa	Catclaw horsebrush
Half-shrubs:[a]	
Artemisia frigida	Fringed sagewort
Artemisia pedatifida	Birdfoot sagebrush
Artemisia spinescens	Bud sagebrush
Atriplex nuttallii	Saltsage
Ceratoides lanata	Winterfat
Chrysothamnus greenei	Rabbitbrush
Gutierrezia sarothrae	Broom snakeweed
Kochia americana	Red sage
Tanacetum nuttallii	Chicken sage

[a]All half-shrubs listed were classified as either subshrubs or woody-based perennials by either Dorn (1977), or Hitchcock and Cronquist (1976), except C. *greenei* which was not specifically classified.

Variable (definition)		Cover types	Suggested technique
V_1	Percent shrub crown closure [the percent of the ground that is shaded by a vertical projection of the canopies of woody vegetation ≤ 5 m (16.5 ft) in height].	ES,DS,ESS,DSS, G,F	Line intercept
V_2	Average height of shrub canopy [the average vertical distance from the ground to the highest point of all woody plants ≤ 5 m (16.5 ft) tall].	ES,DS,ESS,DSS, G,F	Line intercept, graduated rod
V_3	Number of shrub species present per cover type [a tally of individual shrub species that are present at ≥ 1% canopy closure, (woody vegetation ≤ 5 m (16.5 ft) in height) encountered within each specific cover type sampled].	ES,DS,ESS,DSS, G,F	Line intercept
V_4	Percent herbaceous canopy cover [the percent of the ground surface that is shaded by a vertical projection of all nonwoody vegetation (grass, forbs, sedge, etc.)].	ES,DS,ESS,DSS, G,F	Line intercept
V_5	Percent of available habitat in winter wheat (the proportion of the evaluation area considered to be potential pronghorn habitat that is devoted to the production of winter wheat).	C	Remote sensing, on-site inspection
V_6	Topographic diversity [an appraisal of land surface structure (see variable for category descriptions)].	ES,DS,ESS,DSS, G,F,C	Remote sensing, topographic maps

Figure 6. Definitions of variables and suggested measurement techniques.

Special consideration component. Fences on pronghorn ranges may restrict movements and may have significant impacts if they obstruct migration routes. It is assumed that fences constructed of woven wire, or four or more strands of barbed wire, with bottom strand less than 25.4 cm (10.0 inches) above the ground will have the most impact on pronghorn movements. It is also assumed that if the study area is fenced into allotments ≤ 2.59 km^2 (1.0 mi^2) pronghorn movements will be hindered. If either of the above situations exist within the study area, then the Suitability Index for winter food/cover life requisite value should be decreased by one-half. If fences occur infrequently, or meet the quality described in the Special Considerations portion of the Habitat Use Information section of this model, little to no detrimental impact is assumed to occur.

Available water is a mandatory requirement for ranges to be of optimum value. Pronghorn will utilize naturally occurring water sources, stockponds, or livestock watering devices if unfrozen. Winter water requirements are normally met by snowfall; however, the availability of water during snow-free periods may influence pronghorn distribution and habitat use on some ranges. Insufficient data exist to develop a variable reflecting habitat suitability as a function of the interaction of unfrozen water sources and winter precipitation. However, unfrozen water sources may be crucial in areas receiving less than 1.0 cm (0.4 inches) of precipitation per winter month (Cook et al. in press). Model ratings of habitat quality may be suspect (i.e., too high) in low precipitation areas which lack available, free water in winter. We assume that three evenly-spaced open water sources per 100 km^2 (39 mi^2) are required by pronghorn on ranges routinely experiencing extended snow-free periods.

Snow distribution and accumulation are assumed to also influence forage availability on northern winter ranges. However, we do not fully understand the causal relationships involved. This model was evaluated using field data from wintering areas known to be consistently used by pronghorn in mild to normal snowfall winters, and population estimates obtained in mild to normal winters. Therefore, technically speaking, the model's ability to rate the value of pronghorn winter ranges during severe snow conditions has not been evaluated. We have attempted to partially address the issue of severe snow conditions through a treatment of topographic diversity. Areas which support a combination of windblown ridges with short shrubs, and drainages with dense, tall shrubs evidently provide a variety of foraging opportunities for pronghorn regardless of weather conditions (King 1979 in Cook 1984; Ryder 1983). Other factors, such as southern aspects also may be important during severe snow conditions (Martinka 1967). Users should be aware that there may be other factors, not addressed in this model, which affect the value of winter ranges for pronghorn use during severe snow conditions.

SOURCES OF OTHER MODELS

Kindschy et al. (1982) provide evaluation criteria and a work sheet for rating pronghorn habitat potential in the Great Basin.

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Initial Routing Date

FD ____________

DIVISION OF LANDS & RENEWABLE RESOURCES

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Saval Project Mgr.				
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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Ely District Office
Star Route 5, Box 1
Ely, Nevada 89301

IN REPLY REFER TO:
4700
(NV-043)

MAR 3 1 1986

Memorandum

To: State Director, Nevada (NV-931.3)

From: District Manager, Ely

Subject: Wild Horse and Burro Habitat Evaluation Procedures

The Ely District has reviewed the draft procedures for evaluating WH&B habitat as requested in Instruction Memorandum No. NV-86-350. Comments are in the text (see Enclosure 1).

The enclosure submitted for our review concerning base value for plant communities within the SCS Major Land Resource Areas (MLRAs) did not include MLRA 28A. This MLRA lies along the Nevada/Utah state line, and base value need to be determined for the plant communities in MLRA 28A also. MLRA 28A is presently being developed by SCS in Nevada. Information is complete for Utah though.

As our Wild Horse Specialist, Bob Brown, discussed with Milt Frei on March 27, 1986, our review of the MLRAs applicable to the Ely District will be completed before the next task force meeting. Bob will review them with one of our soil scientists and take the results of the review to the task force meeting.

Wayne M. Forman
acting

Enclosure

WILD HORSE AND BURRO HABITAT EVALUATION PROCEDURES
INITIAL PLANNING

On January 13-14, 1986 a meeting was held in the Winnemucca District Office to discuss Habitat Evaluation Procedures, and to devise parameters for a Habitat Suitability Index for the Wild Horse/Burro program in the State of Nevada.

Those present at the meeting were:

Don Armentrout, Winnemucca
Rob Smith, Winnemucca
Rodger Bryan, Winnemucca
Dick Wheeler, Winnemucca
Bob Brown, Ely
Tim Reuwsaat, Carson City
Rick Brigham, Carson City
Milt Frei, NSO

Habitat Evaluation Procedures (HEP) was defined as a system by which you can evaluate impacts of a program or project on a species and habitat. A Habitat Suitability Index (HSI) model is based on a relationship between habitat and carrying capacity of an area. Each habitat unit is assigned a rating, using either a word model or linear model for value. Once an HSI is developed, when a change in a habitat unit occurs, an equal unit change in the carrying capacity may be demonstrated.

Each word model or linear model may have modifiers which change the value of the rating either through geometric mean, arithmatic mean, sum of products or other mathematical formulas. The rating can also be based on maximum value, i.e. the overall rating is based on the highest valued variable, or minimum value, i.e. the overall rating is based on the lowest valued variable.

The following are the variables and modifiers discussed, and the models by which the ratings will be made:

I. Food

A. Cover type base value - Grass
1. Percent Preferred Species Comp.

The Winnemucca Office will be taking the lead on lumping the ecological sites in each Major Land Resource Area and determining the percentage of preferred species, and then assigning a value to this percentage from 0.0 to 1.0. This value will be modified by the seral stage of the site, unless the preferred species is not the climax species.

It was discussed whether to use each seral stage separately or to average on a plant community basis. The plant community average was chosen.

The Nevada State Office will be distributing the plant community breakdown to each district. Each district will send their comments to Milt Frei who will get back to the Winnemucca Office with the information received.

II. Water - Perennial and Potable only

A. Base Value - Distance between
   1. Amount Available - Modifiers
      a. Flow
      b. Seasonal Availability
      c. Competition

It was decided to determine the base value by distance using a linear scale or graph, the distance between the "center" of each cover type to the nearest water. Minimum (Optimum) will be 2 miles [at a value of 1.0]; Maximum [will be] 15 miles [at a value of 0.1]. Each modifier will then reduce the base value by 0.1.

Flow will be rated by word model: More than enough, sufficient, or not enough.

Seasonal Availability will be determined by the wells and pipelines in the cover type.

Two analyses should be run; one with private waters included, and one showing the potential of losing any private waters.

III. Cover

A. Vegetation
   1. Base Value - Trees vs no trees (either 1.0 or 0.0). For purposes of this study, trees will be defined as any vegetative species botanically defined as a tree.

      a. Land Forms

Land forms will be rated using a word model going from 0.0 to 1.0 to 0.0 as follows:

0.0 Steep and rocky, 100%; no washes
0.4 Steep and rocky terrain, broken frequently by washes of varying widths
0.6 Steep and rocky terrain with washes, 50 to 90%; plus level or rolling hills, 10 to 50%
0.8 Mesa-type terrain
1.0 Rolling hills broken frequently by broad washes
0.8 Rolling hills, such as alluvial fans, without washes over 4.6 m (15 ft.) wide
0.4 Level or slightly undulating, 100%; within 1.6 km (1 mi) of useable cover
0.0 Level of slightly undulating, 100% (example: dry lake beds and their margins, blue clay, or slick rock) 1.6 km (1 mi) from usable cover

IV. Space (Physical Barriers)

1. Man-made or natural barriers
2. Disturbance

1. Man-made or natural barriers will be rated using a word model as follows:

1.0 No restriction
0.75 Restriction of normal distribution and movement within the habitat is low.
0.50 Restriction of normal distribution and movement within the habitat is moderate.
0.25 Restriction of normal distribution and movement within the habitat is high.
0.0 ~~Restriction of~~ Normal distribution and movement within the habitat is eliminated.

Remove; Meaning is changed, if left in, to No restriction.

2. Disturbance will be defined as buildings, roads, recreation, domestic livestock grazing, prospecting, mining (oil or mineral), industrial or commercial (including urban) development, farming or ranching, etc. If will be rated by word model as follows:

1.0 No disturbance
0.8 Relatively no disturbance - management activity only activity or where less than a hunderd people use each year, or where occasional grazing, prospecting, etc. may occur.
0.6 Low disturbance - area which perhaps only about 500 people use each year. Also included would be small-scale mining or other commercial uses.
0.4 Moderate disturbance - areas with roadways, used by people for recreational or commercial purposes on a daily basis which may occur repeatedly but not necessarily year-round. Includes ORV, wood cutting, etc.
0.2 High disturbance - areas used by hundreds of people each week, or concentrated conomic development with a constant use by a few people, such as ore trucks moving many times a day.
0.0 Severe disturbance - eliminates availability of habitat or removal of habitat.

After each area has commented on the cover type information developed by the Winnemucca District, Milt Frei will return to Winnemucca to go over the findings. Each district will then proceed to develop a test HSI for their own areas prior to distribution to the whole state.

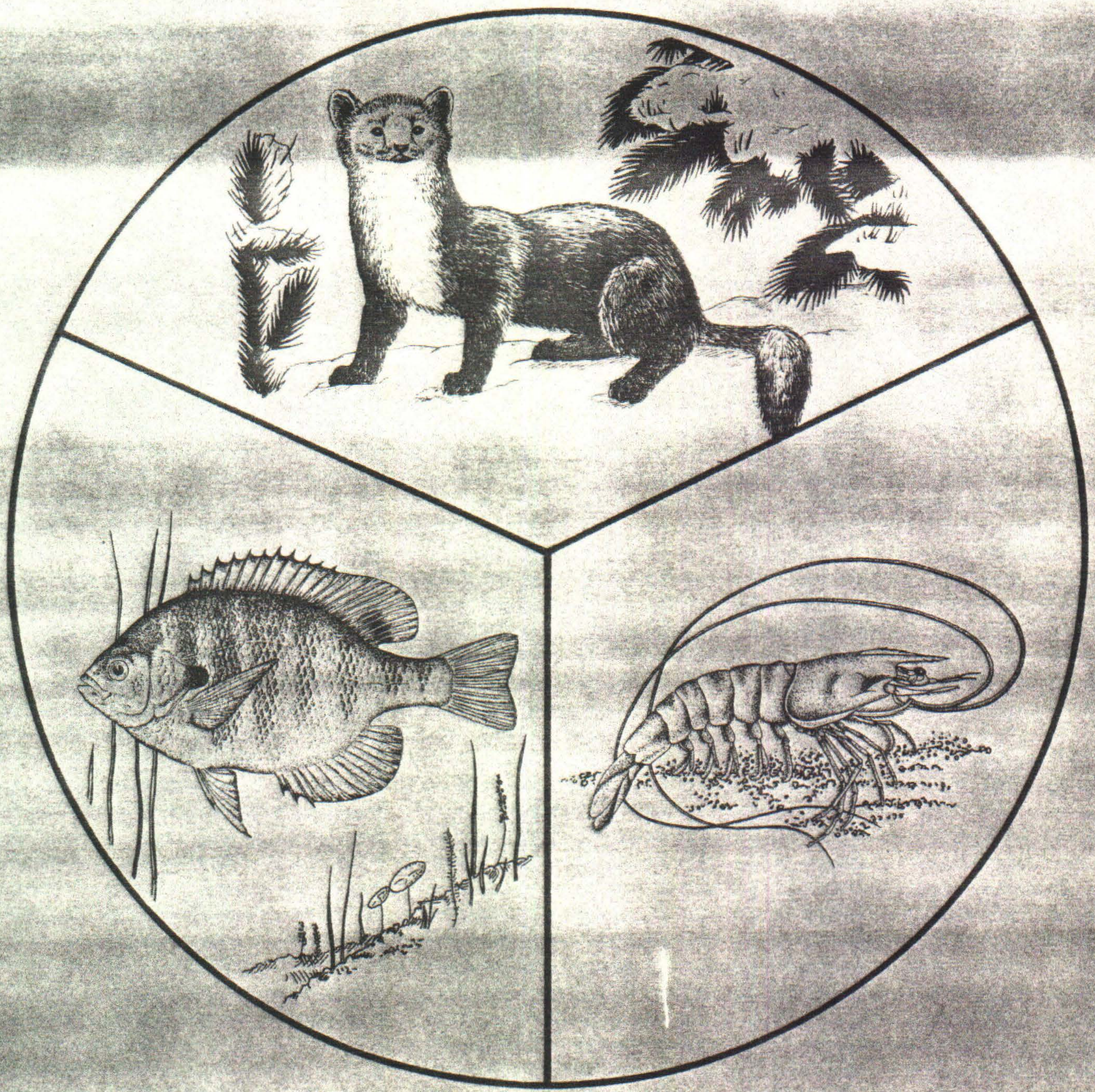
There may be a need for another meeting of all persons involved in the model development. Each District represented will bring sample data for a test run of the model.

The software for the Wang PC will be distributed to all districts once the formula for using the HSI has been developed by Don Armentrout and Rick Brigham, and test models have been run.

Biological Services Program

FWS/OBS-82/10
FEBRUARY 1982

HABITAT SUITABILITY INDEX MODELS



Fish and Wildlife Service

U.S. Department of the Interior

Enclosure 3

FWS/OBS-82/10
February 1982

HABITAT SUITABILITY INDEX MODELS: INTRODUCTION

by

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This report should be cited as:

Schamberger, M., A. H. Farmer, and J. W. Terrell. 1982. Habitat suitability index models:introduction. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10. 2 pp.

INTRODUCTION TO THE HABITAT SUITABILITY INDEX MODEL SERIES

This series provides habitat information for evaluating impacts on fish and wildlife habitat resulting from water or land use changes. The impetus for this series was the Habitat Evaluation Procedures (U.S. Fish and Wildlife Service 1980a), a planning and evaluation technique that focuses on the habitat requirements of fish and wildlife species. The habitat information in this series has been formatted according to Standards for the Development of Habitat Suitability Index Models (U.S. Fish and Wildlife Service 1981).

This series may appear similar to other sources of information that address, in general terms, the habitat requirements of fish and wildlife species. Several other efforts to compile species data bases have been initiated in recent years (e.g., Mason et al. 1979; U.S. Fish and Wildlife Service 1980b). Whereas these other data bases are descriptive in content and contain an array of habitat and population information, this series is unique in that it is constrained to habitat information only, with an emphasis on quantitative relationships between key environmental variables and habitat suitability. In addition, this series synthesizes habitat information into explicit habitat models useful in quantitative assessments.

The models in this series reference numerous literature sources in an effort to consolidate scientific information on species-habitat relationships. Models are included that provide a numerical index of habitat suitability on a 0.0 to 1.0 scale, based on the assumption that there is a positive relationship between the index and habitat carrying capacity (U.S. Fish and Wildlife Service 1981). The models vary in generality and precision, due in part to the amount of available quantitative habitat information and the frequent qualitative nature of existing information. When possible, models are included that are derived from site-specific population and habitat data.

The HSI models are usually presented in three basic formats: (1) graphic; (2) word; and (3) mathematical. The graphic format is a representation of the structure of the model and displays the sequential aggregation of variables into an HSI. Following this, the model relationships are discussed and the assumed relationships between variables, components, and HSI's documented. This discussion of model relationships provides a working version of the model and is, in effect, a word model. Finally, the model relationships are described in mathematical language, mimicking as closely and as simply as possible, the preceding word descriptions.

The models are documented for several reasons. First, the documentation explains the model's structure and inherent assumptions. Second, the model building process involves considerable judgement, and documentation provides the insights necessary to modify the model when these judgements are inconsistent with local or new knowledge. Finally, documentation should facilitate reformulation of the model to meet individual study constraints. Graphic or word model formats may be used to support reconnaissance level assessments, although repeatability may be reduced when using these model forms.

The models should be viewed as hypotheses of species-habitat relationships rather than statements of proven cause and effect relationships. Their value is to serve as a basis for improved decisionmaking and increased understanding of habitat relationships because they specify hypotheses of habitat relationships that can be tested and improved. Results of model performance tests, when available, are presented or referenced with each model. However, models that have been reliable in specific studies may be less reliable in other situations. For this reason, feedback is encouraged from model users concerning improvements to models, the availability of other habitat models, results of model tests, and suggestions that may increase the effective use of habitat information for fish and wildlife planning. Comments should be sent to one of the addresses below.

The appendices to this series contain supplementary information for model applications. This information is general in nature although certain appendices may apply to only part of the model series. For example, Appendix A provides specific guidance and model application information for inland aquatic fish species and contains sample field data sheets for collecting aquatic field data and converting those data into habitat variable values. Measurement techniques for terrestrial variables are summarized in Hays et al. (1981).

Requests for models and appendices published in this series or feedback concerning model use should be sent to one of the following addresses:

Terrestrial and Inland Aquatic Species

Office of Biological Services
Western Energy and Land Use Team
U.S. Fish and Wildlife Service
2625 Redwing Road
Fort Collins, Colorado 80526

Estuarine and Marine Species

Office of Biological Services
National Coastal Ecosystem Team
U.S. Fish and Wildlife Service
NASA/Slidell Computer Complex
1010 Gause Boulevard
Slidell, Louisiana 70458

REFERENCES

Hays, R.L., C. Summers, and W. Seitz. 1981. Estimating wildlife habitat variables. U.S.D.I. Fish and Wildlife Service. FWS/OBS-81/47. 111 pp.

Mason, W.T., Jr., C.T. Cushwa, C.J. Slaski, and D.M. Gladwin. 1979. A procedure for describing fish and wildlife: Coding instructions for Pennsylvania. U.S.D.I. Fish and Wildlife Service. FWS/OBS-79/19. 21 pp.

U.S. Fish and Wildlife Service. 1980a. Habitat Evaluation Procedures (HEP). U.S.D.I. Fish and Wildlife Service. Division of Ecological Services. ESM 102.

U.S. Fish and Wildlife Service. 1980b. Selected vertebrate endangered species of the seacoast of the United States. U.S.D.I. Fish and Wildlife Service. FWS/OBS-80/01.

U.S. Fish and Wildlife Service. 1981. Standards for the development of habitat suitability index models for use in the Habitat Evaluation Procedures, U.S.D.I. Fish and Wildlife Service. Division of Ecological Services. ESM 103.

IN REPLY REFER TO:
4700
(NV-931.3)

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
NEVADA STATE OFFICE
300 Booth Street
P.O. Box 12000
Reno, Nevada 89520

May 8, 1986

Instruction Memorandum No. NV-86- 415
Expires: 9/30/87

To: District Managers, Winnemucca, Carson City, and Ely

From: State Director, Nevada

Subject: Wild Horse and Burro Draft Habitat Suitability Rating

I am requesting that those persons designated below meet with NV-931.3 in the Carson City District Office May 28 and 29, 1986. The purpose of the meeting is to finalize development of the subject rating system. The meeting will begin at 8:00 a.m. on May 28 in the Carson City District Office's conference room. Designated personnel are:

Richard Wheeler	Winnemucca District
Rodger Bryan	Winnemucca District
Robert Smith	Winnemucca District
Donald J. Armentrout	Winnemucca District
William R. Brigham	Carson City District
Tim Reuwsaat	Carson City District
Bob Brown	Ely District.

Managers are urged to attend this meeting. The agenda is as follows:

Thursday, May 28, 1986
8:00 a.m. - Noon
1. Review and evaluate comments and input into the Draft Habitat Suitability Rating System
2. Finalize the Draft Habitat Suitability Rating System.

1:00 - 4:30 p.m.
1. Perform in-house testing of the system using data provided by Carson City and Winnemucca Districts.

Friday, May 29, 1986
7:30 a.m. - 2:30 p.m.
1. Continue in-house testing
2. Wrap-up and designation of areas for field testing.

Finalizing the Draft Habitat Rating System at this time will allow for field testing and completion of Nevada BLM's objective to provide a viable wild horse and burro habitat evaluation monitoring system during FY86.

If there are any questions concerning this meeting, please contact Milt Frei (NV-931.3) at FTS 470-5455.

E.F. Spang
State Director

Distribution

Director (250)	1	Premier Bldg.
SCD (D-470)	1	
DM (CA-020)	1	

Form 1542–4
(April 1976)
(formerly 4–1123)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ROUTING AND TRANSMITTAL SLIP

TO				
CODE	NAME	ORGANIZATION	ACTION	ROOM NO.
	M. Frei (NSO)	N-931	8	

Indicate Action by Number

1. Necessary action
2. Approval
3. Signature
4. Prepare reply
5. Your comment and return
6. Note and surname
7. Note and return
8. Your information
9. See me
10.

From	Date	Room No.
Jerry Driver	04-10-86	
Office		**Phone**
Las Vegas D.O.		598-6403

Remarks

0 3 APR 1986

4700
(NV-053)

0 3 APR 1986

0 3 APR 1986

Memorandum

To: State Director, Nevada (NV-931.3)

From: District Manager, Las Vegas

Subject: Review of Wild Horse and Burro Habitat Evaluation Procedures

The following comments are made concerning the habitat evaluation procedures.

III. Cover

a. Land Forms

Land forms seem to be out of place under "Cover". Perhaps this should be a separate heading.

Perhaps the land form rating should be reworded slightly, to explain "rolling hills, such as alluvial fans", the phrase "rolling hills, such as" should be deleted, and the term "alluvial fans" be used alone.

Also the last part of land form: 0.0 level "or" (?) slightly undulating is misleading. If the area is not slickrock, horses like this type of terrain for foraging and because nothing obstructs the animals' vision.

We have a problem with the Ecological Site Classification in MLRA's 29 and 30. Many pinyon/juniper sites in the Las Vegas District do not receive 12-14 inches annual precipitation. Ecological site descriptions have not been completed for several P/J sites and many of the site descriptions in other range sites are incomplete or erroneous.

In MLRA 30, none of the P/J range site descriptions have the precipitation zone identified. Also, few creosote bush/- or blackbrush/- sites receive as much as eight inches of annual precipitation.

We believe more coordination with the SCS personnel who have developed the range sites is needed before these writeups are useable.

TDriver/gm 03-31-86
Wang Library / 0391a

BEN F. COLLINS

UNITED STATES GOVERNMENT

MEMORANDUM

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

IN REPLY
REFER TO:
4710
(NV-023.5)
(NV-023.7)

TO : State Director, Nevada (NV-931.3) Date: February 25, 1986

FROM : District Manager, Winnemucca

SUBJECT : Wild Horse and Burro Habitat Evaluation Procedures

Attached are the Plant Communities with Applicable Ecological sites for all the SCS Major Land Resource Areas (MLRAs) in Nevada. Base values have been determined for each Plant Community. These attachments are drafts and are being transmitted to you for your review as well as forwarding to each District for their comments.

We need comments on the base values as well as the breakdown of plant communities versus ecological sites. The base value is on a scale of 0.1 to 1.0 predicated on the percent and presence of the preferred forage species in the Potential Natural Communities (PNC) of the applicable ecological sites. We must keep in mind that plant communities are named on vegetation aspect while ecological sites are determined from species composition by weight and potential.

Each District should feel free to comment on all the MLRAs. Some Districts, however, will have more knowledge of certain MLRAs than others. These are as follows:

District	MLRAs
Elko	25 & 28
Winnemucca	23, 24, 25 & 27
Carson City	26, 27 & 29
Ely	28
Las Vegas	29 & 30
Battle Mountain	24, 28 & 29

We recommend that the District responses be returned to you N.L.T. April 1, 1986. With this type of comment period the final drafts can be completed, committee review and testing performed, and the model made workable by this field season.

If you have any questions please contact Dick Wheeler.

Frank C Shields

Enclosures:

Send out Habitat suitability Index model Booklet w/ draft to DOs for review

Form 1542-4
(April 1976)
(formerly 4-1123)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ROUTING AND TRANSMITTAL SLIP

TO				
CODE	NAME	ORGANIZATION	ACTION	ROOM NO.
931.3	Milt Frei	NSO		

Indicate Action by Number

1. Necessary action
2. Approval
3. Signature
4. Prepare reply
5. Your comment and return
6. Note and surname
7. Note and return
8. Your information
9. See me
10.

From	Date	Room No.
Dick Wheeler	12-5	
Office		Phone
WMCA		623-3676

Remarks

Milt—

Any comments/suggestions about the proposed agenda items?

I talked to Jim & Bob about a proposed meeting. It looks like Bob might not be able to meet until February

Dick

☆U.S. Government Printing Office: 1983—680-140/582

UNITED STATES GOVERNMENT

2-Way Memo

Subject: Wild Horse and Burro Habitat Evaluation Procedures
Coordination Meeting Proposed Agenda

DATE OF MESSAGE
12/4/85
DATE OF REPLY

INSTRUCTIONS
Use routing symbols whenever possible.
SENDER:
Forward original and one copy.
Conserve space.
RECEIVER:
Reply below the message, keep one copy, return one copy.

To: Richard Wheeler, Esq.

FOLD

USE BRIEF, INFORMAL LANGUAGE

I propose the following agenda be incorporated for use in the Subject meeting in order for us to follow a logical sequence of planning and accomplishment.

1. Habitat needs of wild horses and burro's (These may have to be addressed separately).

   How do the species life needs fit within the four basic habitat requirements of food, water, cover, and space?

   What are the habitat requirements of reproduction?

2. How are the above habitat requirements measurable using existing methodology?

3. How does the basic Habitat Suitibilty Index Modeling system work and how do we apply it to our needs in this instance?

From: Donald J. [illegible], Esq.

[illegible] RETAINED BY ADDRESSEE

~~1 What cover types give highest value~~
~~2. assign hi to low ratings~~

~~1.0 Dry Meadow~~
~~0.8 Artr/Grass~~
~~0.7 Arar/Grass~~

~~Cover~~ Food type base value
Modifiers 1. % preference species in composition
~~2. Distance to H2O~~
~~3. Allowable Use~~
2. Cover type acres

Water type base value
Distance between (perennial) + (Drinkable)
Amount Available
a flow
b. ownership
c. Seasonal availability (wells)
d. Competition for water
~~e. Potability~~

Cover

~~Space~~

~~Escape~~

Thermal

a. ~~Trees~~ veg structure (trees v no trees ~~and~~ / canopy cover)

b. ~~Topography~~ Land forms

1. steep broken topography
2. Rolling
3. Flat
   a. Dissected
   b. Non Dissected
4. aspect

Space

~~B~~A Physical barriers (man made + natural)

1. man made
   a. none vs presence
   b. location
2. Natural
   a. canyons
   b. lakes or playas
   c. Cliffs / escarpments

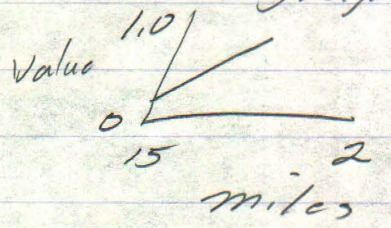
B. Human Disturbance

Food

1. Veg type by major land resource area
Handled by (Winn - Review veg types by B.M. & L.V.)

Water (perennial & drinkable by horses & available)

1. Base Value = Distance Between
minimum 2 miles
max 15 "
Will Graph through linear regression



2. Amount of Available
a. Flow
Draft wording for word model Handled by (Frei)
limit to Appropriat Mgt Level
e.g. ~~1 Excess H_2O avail.~~
1 Adequate H_2O Avail.
2 Inadequate H_2O Avail.

~~b. Seasonal availability (wells & Pipelines)~~

b. Perennial water always available is reduced by the following (each worth 1/10 of point)

1 Adequate Water avail only for AML
2. Adequate H_2O not ~~at~~ avail for all AML
3. Water not avail during season horses present
4. ~~potential for water becoming unavail due to ownership~~
5. Water unavail due to competition

Note: include ~~ownership~~ statement in instructions that rating be done two ways--1. with put waters included & 2 with put waters excluded. Includes only those waters which can be eliminated by ownership for WH use.

TABLE 21.2.

One-mile-square Sections of Land Evaluated
Desert National Wildlife Range, Nevada

Classification
rn, or of high value for human use.
n this rating and have a score for Tool I of 8 or less ghorn. Sections that have a score of 12 or more for e of deficiency because of an inadequate water supply
deficiency for bighorn; or area of potential economic uman use.
n this rating are ones which should be retained at atus as buffers against further human encroachment. e sections may be improved upon for bighorn use in g habitat manipulation or change in human use.
deficiency for bighorn; or area of potential occasional human use.
n this category would be more valuable to bighorn if abitat were improved for them or if the economic were restricted or eliminated. However, there may terrain or vegetation in this area that is necessary for en though it may be used only periodically. this category should be critically examined before otentially important bighorn habitat.
y are important to bighorn. The importance may ntial to the animals, or from lack of human use or enerally, sections in this category are in rough, r they are areas that are major crossings to summer water holes.
o bighorn are those that have some feature without urvive. On Desert National Wildlife Range, the egory are those with water holes.

t improvement score may raise it 15 points or, in some cases, for the removal of live-.), so that the Potential Tool Score will

he system not only classifies the land but re habitat management can be applied most habitat for the bighorn population.

s listed in Table 21.1 were developed, first, mponents of the habitat that are used by termining the importance or preference of

each component. When the importance of each component was established, a comparative numerical value was assigned to it. Thus, when an area was analyzed, the value or values assigned became the points scored by each Tool. These are listed as follows, with an explanation of how the value or score was determined:

Tool I: Natural topography

The sources of information for this Tool were aerial photographs and two U.S. Geological Survey topographic maps: the Las Vegas (1959-NS, MR5913) and the Caliente (1959-NS, MR5193) quadrangles.

Value	Description
0	Level or slightly undulating, 100% (example: dry lake beds and their margins, blue clay, or slick rock); more than 1.6 km (1 mi) from ~~steep and rocky terrain~~. usable cover
.4	Level or slightly undulating, 100%; ~~within 1.6 km (1 mi) of steep and rocky terrain~~.
.8	Rolling hills, such as alluvial fans, without washes ~~over 4.6 m (15 ft) wide and/or more than 1.6 km (1 mi) from steep and rocky terrain~~.
~~10-12a.~~	~~Steep and rocky, 100%; no washes.~~
1.0 b.	Rolling hills broken frequently by broad washes ~~and within 1.6 km (1 mi) of steep and rocky terrain~~.
.8 c.	Mesa-type terrain.
.6 ~~10~~	Steep and rocky terrain with washes, 50 to 90%; plus level or rolling hills, 10 to 50%.
.4 ~~20~~	Steep and rocky terrain, broken frequently by washes of varying widths, ~~with at least one main wash about 15 m (50 ft) wide, and side washes at various angles, for protection from the weather and for escape~~.
0	Steep + Rocky 100%

Tool II: Vegetation Type

The vegetation types follow Bradley (1964, 1965) and Bradley and Deacon (1965). The percentage of grass in the various vegetation types is important in the classification of the habitat. Grass is specified in the evaluation of the last three vegetation types because the amount is often limited, whereas browse is relatively abundant. The forbs are dependent upon climatic conditions, and so may be abundant one year but absent the next. Since browse is relatively abundant and forbs are not dependable, they are not considered a suitable guide to the requirements of the bighorn on Desert Wildlife Range.

Cover, Vegetation

Are Trees present or are Trees Not Present

Tree defined in botanical terms & includes sufficient presence of trees as could reasonably be expected to be used as thermal & escape cover by the animals.

Trees present 1.0

Trees Absent 0.0

~~(Rauwsaat will write)~~

Landforms

See attached Natural Topography description on xerox form

Aspect

Take out or Eliminate

Space

Physical Barriers

No Restriction of dist & movement within habitat ~~physical Barriers~~ ~~value~~ = 1.0

Restriction of dist & movement within habitat low 0.75

Restriction of movement moderate 0.50

Restriction of movement high 0.25

Restriction " " eliminated 0.0

~~Access to crucial habitat eliminated 0.0~~

Define physical barriers in procedure instructions

Disturbance Factors (see attached xerox)

1.0	No disturbance
0.8	Relatively no disturbance
0.6	Low disturbance
0.4	Med "
0.2	Hi "
0.0	Severe "

e points scored for each of the three parts of this
he numerical description for each section of land

Amount and Permanence

irregularly, mainly in winter.
n needed in summer during dry years.
me when needed during dry summers.
ıring the summer.
always present.

pe of Terrain and Obstructions

er surrounded by fences or other barriers; or
n or pothole.
hills, surrounded by fences or other barriers
le by bighorn; or .8 km (.5 mi) or more from
terrain.
ith timber or other natural or minor obstruc-

y but with some timber; or natural, or minor

d rocky terrain with a clear view for at least

Competition

ock use.
livestock use and some native or feral ani-

er or other big game than by desert bighorn.
g game use other than desert bighorn, but
use.
horn use.

n for these categories and values include per-
ndings of Pulling (1946), Hansen (1965a and
elles and Welles (1961a), and Welles (1961);
ecords in the files of Desert Wildlife Range.
actual or expected, as determined by a study of
he habits or requirements of bighorn. Develop-
habitat manipulation probably will alter the
section.
n ranges or from one area to another are vitally
sually ancestral routes between summer and

winter ranges, or paths taken during times when water or food are in short supply. An entire range can be left unused when such routes are destroyed (Geist, 1967); consequently, this latter category has the highest value in the Tool.

Value	Types of Bighorn Use	Time of Year
2	Transient	Irregular
4	Rams' bachelor quarters, or infrequent use by either sex	Winter, spring, and/or early summer
6	Transient	Fall and/or spring
8	Feeding areas	Fall and winter
9	Water sources	Summer
10	Food and cover for ewes, lambs, and yearlings	Spring
20	Major crossing for bighorn between summer and winter ranges, or for food and water during other seasons, or during years of shortages	

Tool VII: Human Use

The sources of information for these categories and the values for this Tool are from Van den Akker (1960), Duncan (1960), Welles and Welles (1961a), Welles (1961), St. John, Jr. (1965), Tevis (1959), Grater (1959), McMichael (1964), Denniston (1965), and Light et al. (1966, 1967), as well as notes and records in Desert National Wildlife Range files.

The "Class" designations were developed by combining the Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service classifications for recreation and general land use and values.

Human ~~use~~ includes buildings, roads, recreation, domestic livestock grazing, prospecting, etc. Disturbance

~~*Economic use* or *Economic potential*~~ refers to mining (oil or mineral), industrial or commercial (including urban) development, farming or ranching, etc. Severe – Eliminates use

High disturbance ~~*High density human use*~~ refers to urban areas, roads or recreation areas used by hundreds of people each week, or concentrated economic development with a constant use by a few people, such as ore trucks moving many times a day.

low disturbance ~~*Medium density human use*~~ refers to recreation areas or a roadway which perhaps only about 500 people use each year. Also included would be small-scale mining, ~~grazing,~~ or other commercial uses.

Medium disturbance refers to areas with roadways used by people for recreational or commercial purposes on a daily basis, which may be occur [sic] repeatedly but not necessarily on a year round – Includes ORV use, wood cutting etc.

Relatively No disturbance

~~Low density human use~~ refers to recreation areas or a roadway which less than a hundred people use each year, or where occasional prospecting, grazing, etc., may occur.

High, medium, or low economic use or *potential* refers to land values which would support *High, Medium,* or *Low density human use,* respectively.

Relatively no human use and no economic potential (other than from bighorn) refers to human use for only the basic management needs of bighorn, the habitat, or wildlife in general. There may be only 2 or 3 visitor-days a year by people other than wildlife managers. These two or three visits may be for any of the uses mentioned previously. (The term "No economic potential" is a little ambiguous, because two or three visitors may spend as much as $1000 in order to enjoy the beauty of the scenery and animal life on a particular section of land. However, this type of economic value is dependent upon leaving the animals and habitat in a natural state and so is actually beneficial to the bighorn. Therefore, it is not considered an economic potential of the land for the purposes of this classification system.)

No disturbance

~~*Restricted use*~~ refers to parks, refuges, or public or private lands where the entry or activities of people are limited by regulations favoring ~~wildlife~~. wild horses

The background data for the Human Use Tool can be acquired from local, county, or state real property offices, and arranged in the above categories. Points can be assigned as follows:

Points	Class	Description of Density and Utilization
0	I	High density human use and/or economic potential.
4	II	Medium to low density human use and/or economic potential, unrestricted.
7	III	Medium density human use and/or economic potential with some restrictions.
7	IV	High density human use restricted, and medium economic potential, all with some emphasis on bighorn.
10	V	Medium density human use restricted, and low or no economic potential.
10	VI	Planned development for wildlife with some unrestricted human use and with some degree of economic potential or value.
15	VII	Medium density human use with restrictions and no economic potential.
15	VIII	Low density human use restricted, and low or no economic potential.
20	IX	Relatively no human use and no economic potential.
20	X	Planned development for bighorn, with human use where and when consistent with primary objective.

On Desert National Wildlife Range, the lar
the area most frequently studied, and therefor
of the Wildlife Range was analyzed first in ord
system, the correctness of the scores, and the
preliminary analysis, with only minor changes,
showed the important areas and the areas need
the preliminary analysis was a land area not
some sections were a long way from water,
beds or rolling hills far from suitable bighorn
areas with varying degrees of human or econo

The finished product was a map of thirt
which appears as Figure 21.1, showing the fi
ships of land in the southern part of the W
tested on 210 square-mile sections (totaling 5
was found to provide an accurate evaluation o
kinds of human use. Figure 21.2 is presented f
use and abundance with the evaluation in Fig
that the qualitative evaluation in Figure 21.1
actual situation, including provisions for hum

The written description and the accompa
the classification can be used to assign pri
maximum benefit for desert bighorn can be o
multiple use but directs management of each
use for wildlife or humans. Joint occupancy
people is possible when the needs of the bi
vided. For example, in Tool II, the vegetati
increase the amount and availability of the fo
obstacles around a water source can be decr
can be developed where man has taken over
VI, bighorn use of an area can be increa
tition from man or other animals, especia
such as lambing grounds, around bedding g
iting factor.

Provisions for joint occupancy by peopl
habitat should be made whenever human
tolerate many types of human activities on a
trails, or lookout points can be provided b
restricted so that bighorn are not continuall
learn to expect and accept certain types of hu

If primitive conditions are maintained,
of use will be automatically restricted a
ened. Further restrictions can be placed on