A VALIDATION OF ARIZONA'S LANDSCAPE-LEVEL PRONGHORN HABITAT MODEL

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Abstract: Results of an earlier pronghorn (*Antilocapra americana*) habitat analysis (Ockenfels et al. 1996*a*) indicated that a model developed to evaluate landscape-scale pronghorn habitat identified useable pronghorn habitat. The model separated relative levels of quality with reasonable consistency, however, its ability to discern higher quality from more moderate habitat was low. Assessment of the habitat model in a different area of the state seemed necessary to determine reliability. We were able to validate the model during a project in a shortgrass prairie of northern Arizona, using locations from 29 radiocollared pronghorn acquired during a 2-year period. We compared proportion of pronghorn locations in each habitat rating class with proportion of the study area in each rating class. Non-random use of rated sections (2.6 km^2) by pronghorn occurred ($P < 0.001$); 82% of locations occurred in sections evaluated as moderate quality habitat. Sections rated as moderate or higher were sections pronghorn used above availability, whereas sections rated as lower quality than moderate were used less than available. The model is appropriate for identifying suitable habitat at a landscape level.

PROCEEDINGS PRONGHORN ANTELOPE WORKSHOP 19:63-70

Key words: *Antilocapra americana*, habitat analysis, habitat, landscape, model, pronghorn, shortgrass prairie.

Habitat loss, particularly loss of movement corridors from fences used to control livestock movements within pastures and along highways, and habitat degradation from long-term vegetative community changes due to livestock overuse and fire suppression have greatly impacted pronghorn populations (Ockenfels et al. 1994). In fact, as a result of habitat loss and degradation, some Arizona pronghorn populations have been extirpated (Nelson 1925, Knipe 1944, deVos 1999), or isolated.

The Arizona Game and Fish Department has identified and mapped Arizona pronghorn populations since the early 1920s (Nelson 1925, Knipe 1944) and has conducted aerial surveys since 1946. However, an assessment of pronghorn habitat quality, occupied and potential, was not systematically evaluated until 1994-96 (Ockenfels et al. 1996*b*) when a landscape-level habitat model was developed. This Statewide Pronghorn Habitat Evaluation Model used

5 key pronghorn habitat variables (topographic ruggedness, vegetative structure and species richness, water availability, human disturbance, and fence density and structure) to determine statewide habitat quality of potential pronghorn habitat. Potential pronghorn habitat was determined using slope (<20%) and general vegetation type (i.e., grasslands). Accuracy of this model was tested in 4 state Game Management Units (GMU) where pronghorn locations were overlaid onto an evaluated map of each GMU. Most (73.3%, 92.0%, 98.5%, and 95.6%) pronghorn locations occurred in sections rated as high, moderate, or low quality classes. Furthermore, using this evaluation method, we were able to identify habitat factors that decreased the quality of potential pronghorn habitat.

In 1997, we initiated a 2-year study in northern Arizona to evaluate the utility of this model in another area using radiomarked pronghorn. Also, it was important to establish validity of the model in this area because we needed to refer to the habitat factors identified as problems during the evaluation as a starting point to make habitat enhancement recommendations for another aspect of this project.

If the model was valid, we predicted that radiomarked pronghorn would use high-quality sections more than they were available and would avoid sections evaluated as low quality. If the model was invalid, we predict that no relationship between pronghorn use and habitat rating would occur. Establishing validity of the model in this area was necessary to confirm and further determine habitat quality enhancement recommendations for the area.

STUDY AREA

The study area was located on the Colorado Plateau in north-central Arizona at an elevation of 1,676-1,829 m and included 2 adjacent ranches that comprised approximately 182 km^2 of predominantly private land. The southern end of the study area consisted of mixed sections of state and private lands.

This area was typically arid; precipitation averaged <19cm and ranged from <25 - 51 cm annually, most of which occurred during summer (July - September) monsoons (Thybony and Thomas 1998). Terrain consisted of flats and gentle, rolling hills bisected longitudinally by steep-walled Cataract Canyon, a major drainage to the Colorado River.

Vegetation was predominately Shortgrass Plains Grassland integrating with Great Basin Grassland (Brown 1994: 115-119). Blue grama (*Bouteloua gracilis)* and ring muhly (*Muhlenbergia torreyi*) were dominant grasses. Salt-bush (*Atriplex* spp.), buckwheat (*Eriogonum* sp.), winter-fat (*Eurotia lanata*), rabbitbrush *(Chrysothamnus* spp.), and snakeweed (*Gutierrezia sarothrae*) were common shrub species. Extensive stands of rabbitbrush or snakeweed dominated poorer-condition sites. Big sagebrush (*Artemisia tridentata*) dominated much of the northern periphery. Tall shrubs, such as mexican cliffrose

(*Cowania mexicana*) and mountain mahogany (*Cercocarpus montanus*), and juniper (*Juniperus* spp.) trees occurred along Cataract Canyon. Southern and eastern boundaries consisted mainly of juniper woodlands.

Using the landscape-level model, the majority of this study area was evaluated as moderate quality pronghorn habitat. Problems identified in this area included high densities of low- to-the-ground (<40.6cm) fences, low vegetative diversity, dense tall shrub stands, and inaccessible water sources.

METHODS

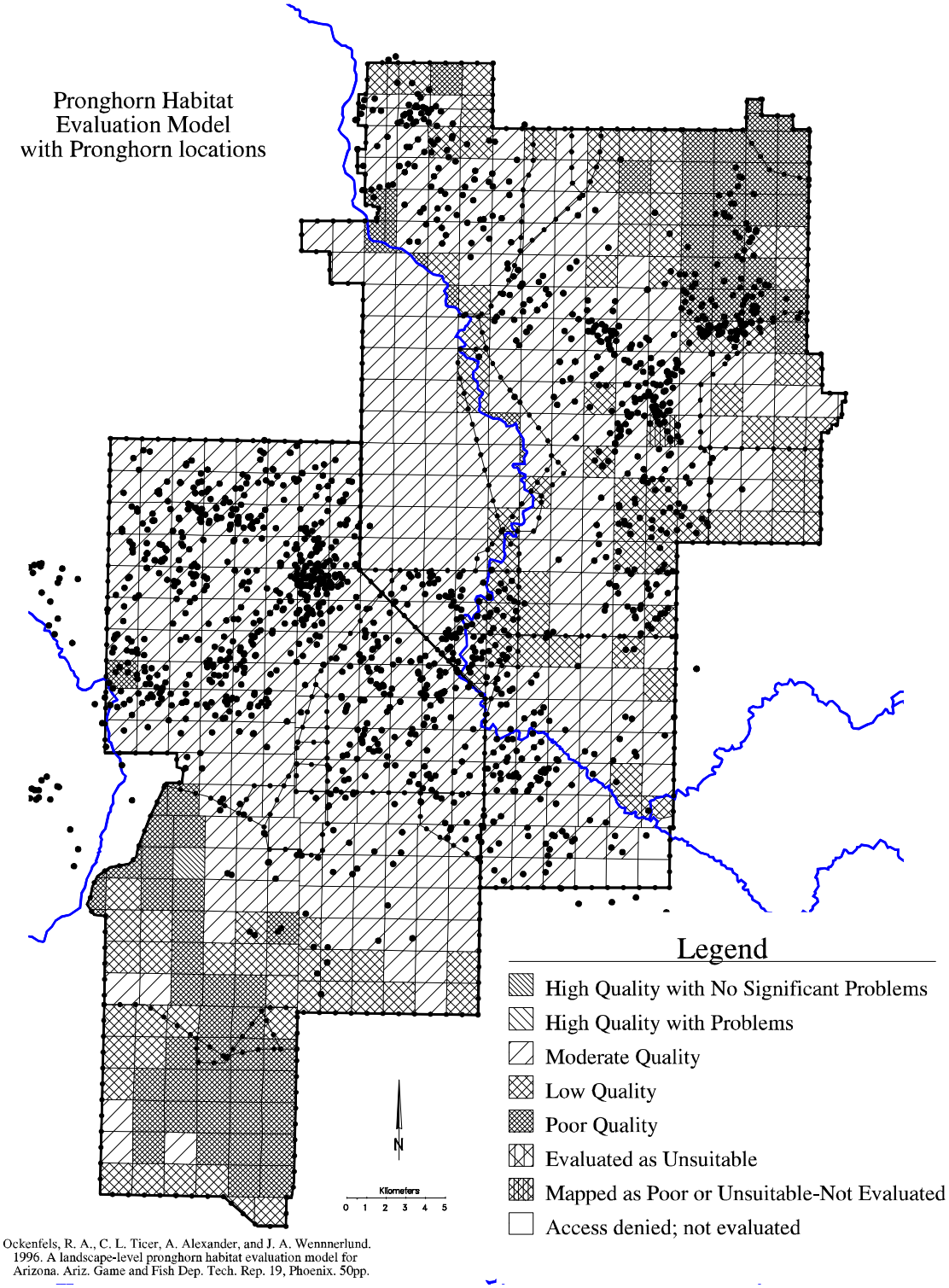
We captured, radiocollared, and eartagged adult pronghorn in March 1997, November 1998, and February 1999, using a net-gun fired from a helicopter (Firchow et al. 1986). During the first year, we aerially located pronghorn weekly during fawning season (March-July) and twice monthly the remainder of the year. Following the first year, 04/ pronghorn twice monthly using a hand-held receiver. Locations were plotted on U.S. Geological Survey (USGS) 7.5-min topographic maps. Universal Transverse Mercador (UTM) coordinates were recorded to the nearest 0.1 km for each location. Aerial and ground locations were combined and their coordinates transferred into a geographic information system (GIS).

We used GIS technology to assess pronghorn use of the evaluated habitat types. First, we extracted the study area from the 1996 statewide habitat evaluation database, determined km^2, and calculated percent area of each habitat quality class present. Next, we overlaid a GIS-developed cover of pronghorn locations onto the study area map (Fig. 1). We then calculated proportion of locations within each habitat quality class as our measure of pronghorn use.

We compared proportion of locations in each habitat quality rating class against availability with Chi-square contingency table analysis. We used a contingency table rather than goodness of fit analysis because we only estimated the expected distribution (Thomas and Taylor 1990). When the contingency table indicated a significant difference between the 2 distributions, Bonferroni simultaneous confidence intervals were calculated to determine which rating classes were selected or avoided (Neu et al. 1974, Byers et al. 1984). If selection or avoidance was determined for a cell, we used a Jacobs' *D* to indicate direction and magnitude of nonrandom use for that rating score (Jacobs 1974).

RESULTS

We captured, radiocollared, and eartagged 29 adult pronghorn (11F, 6M-1997, 7F-1998, and 5F-1999). We acquired 1,647 locations between March 1997 and March 1999.



Ockenfels, R. A., C. L. Ticer, A. Alexander, and J. A. Wennnerlund. 1996. A landscape-level pronghorn habitat evaluation model for Arizona. Ariz. Game and Fish Dep. Tech. Rep. 19, Phoenix. 50pp.

Non-random (X^2 = 140.52, df = 2, *n* = 1,220) use by pronghorn of available sections occurred (Table 1). Sections rated as moderate quality or high quality with problems were used more than available, whereas sections rated as low or poor quality were used less than available**.** In this study area, 94.5% of pronghorn locations occurred in sections rated as moderate (82%) or low (11.6%), quality classes (Fig. 1). We did not document pronghorn use of high quality with no significant problems habitat class probably because only 1 section of such habitat existed within this study area. Only 18.8% of pronghorn locations occurred in habitat evaluated as low and poor quality classes.

DISSCUSSION

We conclude that the statewide pronghorn habitat evaluation model adequately evaluated potential pronghorn habitat in shortgrass prairie of northern Arizona, at a landscape level. Similar to pronghorn habitat use in a shortgrass prairie of central Arizona (Ockenfels et al. 1994, 1996*a*), pronghorn in this study selected for habitat evaluated as moderate or better and avoided habitat evaluated lower than moderate quality.

We found that pronghorn use of habitat evaluated as poor was likely a combination of individualistic animal use and scale of the evaluation. Only 2 of 29 collared pronghorn used the Poor quality habitat in the northeastern portion of the study area. These pronghorn were often located in juniper woodlands, tall (>46cm) sagebrush shrublands, and small grassy openings within this area. Pronghorn also occasionally used peripheral areas of poor quality habitat, which may have been location measurement scale error. We visually examined 3 of these low and poor quality areas where locations appeared most numerous and clustered. We found the vegetation and terrain to be suitable for pronghorn since the vegetation was a grassland without tall (>45.7cm) shrubs and terrain was gentle (<10%). However, low (<40.6cm), to-the-ground fences and mixed vegetation within the scale of the experimental unit (i.e., 2.6 km^2) resulted in a reduced overall evaluation score of many sections. A to-the-ground, woven-wire fence ran along the periphery of several sections, resulting in a decreased evaluation score of these sections. Juniper woodlands and sagebrush flats that occurred in the northeastern corner of the study area were dissected by a series of finger-like grassy draws. We determined that 2 collared pronghorn used these draws for access. However, many locations from these 2 pronghorn also were located in the woodlands and shrublands.

We believe this model can be used as a management tool to conduct landscape-scale assessments of potential pronghorn habitat. The model will assist land managers in identifying landscape-scale habitat problems of an area currently occupied by pronghorn or by aiding in identification of unoccupied pronghorn habitat area for possible re-introduction.

Table 1. Pronghorn use of habitat sections previously rated by Statewide Habitat Evaluation Model (Ockenfels et al. 1996*a*,*b*) in northern Arizona, 1997-99.

Habitat quality	No. of locations	% of locations	Bonferroni 90% CI	km^2 available	% of area	No. of Locations expected	Jacobs' *D*
High/no problems	0	0.0		2.6	0.0	3.2	
High/problems	0	0.0		0.0	0.0	0.0	
Moderate	1370	83.1	81.2 - 85.1	887.2	66.1	1088.7	0.43
Low	187	11.4	9.7 - 13.0	261.5	19.5	321.2	-0.31
Poor	90	5.5	4.3 - 6.7	190.5	14.2	233.9	-0.48
	1647	100.0		1341.8	100.0	1647.0	

ACKNOWLEDGEMENTS

Babbitt Ranches, Inc., President Billy Cordasco graciously provided us opportunity to conduct this study on deeded and leased lands. David W. Hunt coordinated aerial support for pronghorn captures. John Hervert, Bob Birkeland, Amber A. Munig, Wade Zarlingo, Larry Phoenix, Billy Cordasco, James D. Babbitt, Mark McCullough, and Lee Leudecker assisted with capture operations. Volunteers Dr. Robert Kreycik and Dr. Clancy Gansberg provided veterinary assistance during captures. Bob Birkeland, Neil Lawson, Wade Zarlingo, Heather Whitlaw, MariAnn Koloszar, Andi Rogers, and student interns Phil James and Carl Daniels assisted in data collection. Bill Carrel and MariAnn Koloszar provided aerial location support. Sue Boe provided GIS and technical support. James C. deVos Jr., Ted McKinney and Amber A. Munig reviewed this manuscript.

Funding for this project was provided by Babbitt Ranches Inc., and Federal Aid in Wildlife Restoration Act Project F-78-R of the Arizona Game and Fish Department.

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NEW STRATEGIES FOR PRONGHORN FOOD HABIT STUDIES

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Abstract: A food habits project was conducted on pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionnus*), bighorn sheep (*Ovis canadensis*), feral horses (*Equus caballlus*) and feral burros (*Equus assinus*) on 2 national wildlife refuges, one in Oregon and one in Nevada from 1993 to 1995. We report findings emphasizing pronghorn diet and the relationship with the other 4 ungulates. Diet composition varied considerably among seasons and between years for 3 native ungulates. Digestibility correction factors were employed for the first time in pronghorn diet studies and provided a more accurate assessment of forage consumed. Pronghorn and mule deer primarily alternated use between forbs and shrubs, while bighorn alternated between grass and forbs. Both feral equids foraged on grasses with some seasonal forb use. Diet quality for all ungulate species at both refuges varied seasonally with the highest quality generally during spring when forbs were used most heavily. Lowest quality occurred during winter when forage was generally senescent. Apparent relationships of diet quality indices with weather, particularity temperature and precipitation were noted. Based on results of this project, we recommend future diet studies for pronghorn consider using digestibility correction factors, forage quality indices and correlation of diet composition with weather patterns.

PROCEEDINGS PRONGHORN ANTELOPE WORKSHOP 19:71-94

Key words: *Antilocapra americana*, diet selection, digestibility correction factors, food habits, forage quality, plant nutritional values, pronghorn, weather patterns.

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