SONORAN PRONGHORN RECOVERY: HABITAT ENHANCEMENTS TO INCREASE FAWN SURVIVAL

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Abstract: Sonoran pronghorn (*Antilocapra americana sonorensis*) are listed as endangered. From 1994 to1998, fawn recruitment has varied from zero fawns in 1996 and 1997 to 33 per 100 does in 1998. Fawn mortality occurs during 2 time periods: late spring and summer. Recruitment is correlated with the amount and timing of rainfall. During the spring, nutritious forage is necessary for increased energy demands of lactating females and newly weaned fawns. When winter rains are above normal, and corresponding forage conditions are good, fawns survive at least through spring. The second period of high fawn morality was noted during July and August. This is most likely due to increasingly higher temperatures, reduction and desiccation of forage, and increased water needs of fawns. Recruitment of fawns is key to recovery of Sonoran pronghorn. In this paper, we outline our proposal to provide additional and longer lasting forage through habitat manipulations and irrigation. Increased nutritious forage and supplemental water at critical times, when does are lactating and fawns are foraging for themselves, may increase fawn recruitment.

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INTRODUCTION

Sonoran pronghorn *(Antilocapra americana sonoriensis)* are 1 of 5 subspecies of pronghorn antelope and are found only in southwestern Arizona and parts of west-central Sonora, Mexico. Sonoran pronghorn were listed as endangered in

1967 by the U.S. Fish and Wildlife Service. Current estimates indicate there are < 142 individuals in the United States (U.S.) (Bright et al. 1999). In the U.S., they inhabit the harsh Sonoran Desert where summer temperatures often exceed 40^{o} C and rainfall averages < 130 mm. Sonoran pronghorn habitat consists of the wide, flat, alluvial valleys dominated by creosote (*Larrea tridentata*) and bursage (*Ambrosia spp*.) and the more complex bajadas on lower slopes of mountains. Small ephemeral washes bordered by paloverde (*Cercidium spp.*) and ironwood (*Olneya tesota*) flow from the bajadas into the valleys and provides forage resources and thermal protection. In Arizona, Sonoran pronghorn are found on the Cabeza Prieta National Wildlife Refuge (CPNWR), Organ Pipe Cactus National Monument (OPCNM), Barry M. Goldwater Range (BMGR), and some adjacent public and state lands south of Interstate 8.

Their historical range has been altered and fragmented by human activities, such as damming and diverting large rivers for agriculture, construction of highways and fences, livestock grazing, settlement, recreation and some military activities (USFWS 1998). Low-level Border Patrol flights relative to illegal immigration may also impact pronghorn. These types of activities have reduced the amount and quality of habitat available to Sonoran pronghorn, possibly leading to low population levels.

Although Sonoran pronghorn range has been reduced by numerous past and ongoing human activities (construction of roads, recreation, etc.), available data indicate that reproductive success and fawn survival are largely governed by environmental factors, not by current land-use practices. No differences in mortality rates were detected between the heavily use BMGR and the largely protected CPNWR / OPCNM area (Hervert et al. 2000). However there are significant correlations between fawn mortality and the amount and timing of rainfall (Hervert et al. 2000). Availability of nutritious forage for lactation and young fawns, which is dependent on rainfall, is critical.

Sonoran pronghorn diet has been studied through microhistological analysis of fecal pellets collected from 1994 through 1998. These analyses have shown that forbs and shrubs make up the majority of Sonoran pronghorn diets (Hervert et al. 2000). Forbs are selected when they are available, such as in wet summers. Browse makes up the main component of their diet when forbs are not available, such as during droughts. Nutritional analysis indicate that forbs contain large amounts of protein, as well as being highly digestible and providing preformed water, while shrubs are high in fat (Hughes and Smith 1990, Fox 1997). Numerous studies of pronghorn feeding habits in other parts of the country confirm that nutritious forbs are the most selected forage items for pronghorn when they are available (Beale and Smith 1970, Yoakum 1990).

Availability of preferred food items for pronghorn is dependent on the timing and amount of rainfall. All desert plants respond to moisture input, but annual plants are triggered by rainfall. Normal periods of rainfall in the Sonoran

desert follow a bimodal pattern, occurring as convective thundershowers in the summer and long cyclonic storms in the winter. Winter storms are the primary stimulant of plant productivity, much of it in the form of winter ephemeral plant growth (Patten 1978). Adequate winter rains are needed to sustain winter annuals into spring and early summer, when females need nutritious forage for the high energy demands of lactation and weaned fawns need quality forage for growth.

Additionally, a good summer monsoon season is needed to produce sufficient quantities of summer annuals and promote new growth on perennials, without which fawns will be unable to maintain body weight and will subsequently die. Summer monsoons also provide ephemeral sources of free standing water.

Sonoran pronghorn use certain areas of the BMGR on a much more frequent basis than surrounding areas (deVos 1989; Hervert et al. 1997*a*, 2000). These are areas that have been disturbed by military activities (e.g. HE Hill, targets, and runways), creating a more open habitat, favorable to pronghorn. In addition, the disturbed soil surface, which holds water runoff better than surrounding flat areas, promotes increased herbaceous plant growth preferred by pronghorn. Availability of late season quality forage and free standing water, which collects in clay bottomed bomb craters, allow pronghorn to occupy these areas longer and in larger groups than otherwise expected (Hervert et al. 1997*b*). Additionally, more fawns were associated with the pronghorn groups occupying the BMGR than were observed in other areas (unpubl data).

Using what we have learned through observations of pronghorn use and fawn survival on the disturbed areas on the BMGR, and knowledge of pronghorn behavior, feeding habits and nutritional requirements, we propose, through habitat manipulations, to provide areas favorable to pronghorn, during periods critical to fawn survival. By creating open habitats, with plentiful food and water, we expect to increase fawn survival.

PROPOSED METHODS

SITE SELECTION

Habitat enhancement sites will be located within current pronghorn range based on several factors. The main considerations for locating sites are: 1) areas that pronghorn are known to favor during winter and spring; 2) areas with soil types conducive to forb growth; 3) areas with existing road accessibility; and 4) areas without land use conflicts, such as military use or wilderness (Table 1).

Sonoran pronghorn are nomadic animals, covering > 900 km^2 throughout the year (Hervert et al 2000). Using the last 5 years of radio telemetry data, areas that pronghorn typically use during the winter and spring months will be determined. In addition, habitat enhancement sites may be placed in areas that pronghorn normally pass through enroute to their preferred summer habitats,

such as at the base of bajadas or near chain-fruit cholla (*Opuntia fulgida*) areas. Additional sites in summer habitats may be considered during droughts.

In addition to selecting areas that pronghorn should frequent, habitat enhancement sites must also be in soils that are conducive to forage growth and persistence. Sandy soils allow deeper penetration of moisture and allow roots to penetrate farther underground. Tevis (1958) found that the onset of wilting and drying of ephemeral forage was delayed by 2 weeks in areas of sandy dunes compared to adjacent heavier soiled flat areas. Even a slight piling of windblown sand in the flat areas produced better conditions of water penetration and retention.

HABITAT MANIPULATIONS

Most habitat enhancement sites will typically cover an area of 1 km^2, which is based on the size of the disturbed areas preferred by pronghorn on BMGR. Some areas are designed along existing roads and will only be 500-m long and approximately 30-m wide on one side of the road.

Creosote Thinning: Creosote bush has increased in the Sonoran and Chihuahuan deserts from 1910 to 1950 and continues to increase in density and area (Buffington and Herbel 1965, Herbel et al. 1985). As creosote and associated woody species increase, forage production decreases (Anderson et al. 1957). Likewise, when woody plant populations are removed or thinned, forage production increases (Scifres et al. 1979, Jacoby et al. 1982, Morton et al. 1990, Morton and Melgoza 1991).

In addition, studies of pronghorn habitat cite visually open areas with low vegetative structure averaging < 64 cm and < 35% shrub cover as optimal for pronghorn (Yoakum 1974, 1980; O'Gara and Yoakum 1992, Ockenfels et al. 1994, Lee et al. 1998). Sonoran pronghorn use creosote flats less than expected based on availability during dry years and as expected in wet years (Hervert et al. 2000). Pronghorn may avoid creosote flats because visibility is restricted and forage is limited in this vegetation type (Arizona Game and Fish Department 1981). Duerr et al. (1999) found that Sonoran pronghorn selected areas with less cover of large shrubs than was generally available and that they seemed to avoid the dominant large shrub, creosote bush, on the tactical ranges.

Thinning large creosote bushes in the habitat enhancement sites is expected to make the areas more structurally preferable for pronghorn and to increase forage production from both natural rainfall and watering. Creosotes would not be removed in desert washes, on desert pavement terraces, or in areas where they are already sparse. Creosote will be removed by burning individual plants using a propane torch. Brown and Minnich (1986) found that creosote bushes are poorly adapted to relatively low intensity fire, as evidenced by limited sprouting and reproduction. Many creosote shrubs with living foliage after burning died later as a result of basal cambium damage.

Annual Forage Irrigation: Water will be trucked to each site receiving this treatment or a well will be drilled. Wells will be drilled on the northeastern edge of the Mohawk Dunes site and the western edge of the Granite Mountain site. These 2 areas are far from good roads, and pronghorn are expected to use the sites for long periods of time. A water truck will serve the three Aztec Hills plots. A pipeline and sprinkler system will be used to convey the water from the well or a holding tank, to each irrigated plot. Water will be applied frequently enough to promote forage growth and keep existing forage alive as long as possible while pronghorn are in the area or until summer rains relieve the need for watering. Depending on natural rainfall, watering could begin in November, and continue through May or June. Additional watering may be necessary in July and August if summer drought conditions prevail and the pronghorn stay near the plots. We anticipate applying up to 13 cm of water throughout the watering cycle. Approximately 0.75 ha within each plot (10 plots total) will receive this treatment. Watering will be done at night, when evaporation loss will be minimized and pronghorn are least likely to be disturbed.

This additional water should promote growth and sustain production of winter annuals into late spring and early summer while pronghorn are in the general area. Mortality of winter annuals is not associated with the onset of reproduction, but occurs when moisture reserves in the soil are depleted, through high temperatures and evaporation (Forseth et al. 1984). Given heavy rains from late season storms, vegetative and reproductive growth may continue for extended periods, and some annuals can "perennate" and live for 2 years (Forseth et al. 1984). Tevis (1958) found that when 5 cm of water was sprinkled on a dying population of mature ephemerals, all living individuals revived completely and resumed extensive growth and flowering.

Perennial Forage Irrigation: Preferred perennial forage species such as white ratany (*Krameria grayi*), wire lettuce (*Stephenomeria spp.*) and silverbush (*Ditaxis spp*.) will be irrigated with the same sprinkler system used to grow annuals. These perennial shrubs sustain pronghorn when annual forage is not available, and given additional water, they may stay green and more palatable. Existing plants will be watered and additional perennials may be established from seed (local sources only).

Free Standing Water: In addition to forage improvements, we propose to provide a temporary supply of free standing water at some habitat enhancement sites during the time pronghorn are using the area and water use is deemed beneficial for fawn survival. The water would be stored underground in a single length of buried polyvinyl chlorine (PVC) pipe, 61 cm in diameter and 6.5-m in length. The pipe would have a capacity of 1700 liters. The pipe would be filled by water truck and would be connected to a 76 cm deep walk-in drinker. The entire system would be buried 76 cm in the ground. There would be a valve between the PVC pipe and the walk-in trough allowing the system to be turned off.

Table 1. Proposed habitat enhancement sites and potential treatments.

Site name	Potential treatments[1]	Size (km^2)	UTM coordinate (northwest corner)
1. Mohawk Pass	C-A-W	1.0	3611000 N 262000 E
2. Mohawk Dune	C-A	1.0	3609000 N 264000 E
3. Granite Mountains #1	C-A-P-W	1.0	3592500 N 277000 E
4. Granite Mountains #2 (NW)	C-A-P	1.0	3593000 N 276000 E
5. Granite Mountains #3 (SE)	C-A-P	1.0	3592000 N 278000 E
6. Aztec Hills #1	C-A-P-W	1.0	3624700 N 277900 E (north end; 1.7-km long X 580-m wide along road)
7. Aztec Hills #2	C-A-P	0.015	3622784 N 281073 E (south end; 500-m NE along road, 30-m wide)
8. Aztec Hills #3	C-A	0.015	3622000N 282200 E (north end; 500-m south along road, 30-m wide)
9. Point of the Pintas	C-A-P-W	1.0	3592000 N 250000 E
10. Point of the Pintas #2	C-A-P	1.0	3591500 N 251000 E

[1] Treatments: C = creosote removal; A = annual forb irrigation; P = perennial forage irrigation; W = free standing water.

CONCLUSION

Fawn survival is the most critical component of the population dynamics of Sonoran pronghorn. Small changes in the recruitment level of fawns can have dramatic influences on population size and the probability of extinction (Hosack 1996). Recently fawn recruitment has been critically low, with no known recruitment in 3 of the last 5 years (Hervert et al. 2000). The key to recovery of this endangered subspecies is through the recruitment of fawns into the population.

If, as we hypothesize, a lack of nutritional forage and water resources are limiting fawn recruitment, providing quality forage and water in habitats favorable to pronghorn should increase fawn recruitment. Since the Sonoran pronghorn was listed as endangered in 1967, virtually no proactive management has taken place. Over that 33-year period, pronghorn have failed to recover on their own,

and there is no reason to expect they will in the future. In order to ensure their continual survival, meaningful habitat management strategies are needed now.

LITERATURE CITED

ANDERSON, D., L.P. HAMILTON, H.G. REYNOLDS AND R.R. HUMPHREY. 1957. Reseeding desert grassland ranges in southern Arizona. (Revised) Arizona Agricultural Experiment Station Bulletin 249.

ARIZONA GAME AND FISH DEPARTMENT. 1981. The Sonoran Pronghorn. Special Report Number 10. Arizona Game and Fish Department, Phoenix, AZ. 55 pp.

BEALE, D.M. AND A.D. SMITH. 1970. Forage use, water consumption, and productivity of pronghorn antelope in western Utah. Journal of Wildlife Management 34:570-583.

BRIGHT, J.L., J.J. HERVERT, L.A. PIEST, R.S. HENRY AND M.T. BROWN. 1999. Sonoran pronghorn 1998 aerial survey summary. Nongame and Endangered Wildlife Program Technical Report 152. Arizona Game and Fish Department, Phoenix, AZ.

BROWN, D.E. AND R.A. MINNICH. 1986. Fire and changes in creosote bush scrub of the western Sonoran desert, California. American Midland Naturalist 116(2):411-422.

BUFFINGTON, L.C. AND C.H. HERBEL. 1965. Vegetation changes on a semidesert grassland range. Ecological Monographs 35:139-164.

DUERR, A., M.A. MCLEOD AND E.L. SMITH. 1999. Sonoran pronghorn use of 2 tactical ranges on the Barry M. Goldwater Range. Luke Air Force Base Contract Number F41624-94-D-8016.

DEVOS, J.C. 1989. Evaluation of Sonoran Pronghorn movements around military activity sites on the Barry M. Goldwater Air Force Range. Arizona Game and Fish Department, Phoenix, Arizona.

FORSETH, I.N., J.R. EHLERINGER, K.S. WERK AND C.S. COOK. 1984. Field water relations of Sonoran desert annuals. Ecology 65(5):1436-1444.

FOX, L.M. 1997. Nutritional content of forage in Sonoran pronghorn habitat, Arizona. M.S. Thesis, Univ. Arizona, Tucson. 228pp.

HERBEL, C.H., H.L. MORTON AND R.P. GIBBENS. 1985. Controlling shrubs in the arid southwest with tebuthiuron. Journal of Range Management 36:149-151.

HERVERT, J.J., J.L. BRIGHT, M.T. BROWN, L.A. PIEST AND R.S. HENRY. 2000. Sonoran Pronghorn Population Monitoring: 1994-1998. Nongame and Endangered Wildlife Program Technical Report 162. Arizona Game and Fish Department, Phoenix, AZ.

HERVERT J.J., L.A. PIEST, W. BALLARD, R.S. HENRY, M.T. BROWN AND S. BOE. 1997a. Sonoran Pronghorn Population Monitoring: Progress Report. Nongame and Endangered Wildlife Program Technical Report 126. Arizona Game and Fish Department, Phoenix, AZ.

HERVERT, J.J., R.S. HENRY, AND M.T. BROWN. 1997b. Preliminary investigations of Sonoran pronghorn use of free-standing water. Proceedings of a Symposium on Environmental, Economic and Legal Issues Related to Rangeland Water Development. The Center for the Study of Law, Science and Technology, Arizona State University, Tempe, Arizona. Pp. 126 – 137.

HOSACK, D.A. 1996. Population Viability Analysis Workshop for the Endangered Sonoran Pronghorn (*Antilocapra americana sonoriensis*) in the United States. Draft. 22pp.

HUGHES, K.S. AND N.S. SMITH. 1990. Sonoran pronghorn use of habitat in southwest Arizona. Final Report 14-16-009-1564 RWO #6. AZ. Coop. Fish & Wildl. Research Unit, Tucson, AZ. 58 pp.

JACOBY, P.W., R.D. UECKERT, AND F.S. HARTMAN. 1982. Control of creosotebush (*Larrea tridentata*) with pelleted tebuthiuron. Weed Science 30:307-310.

LEE, R.M., J.D. YOAKUM, B.W. O'GARA, T.M. POJAR, AND R.A. OCKENFELS, eds. 1998. Pronghorn Management Guides. 18th Pronghorn Antelope Workshop, Prescott, AZ. 110pp.

MORTON, H.L. AND A. MELGOZA. 1991. Vegetation changes following brush control in creosotebush communities. Journal of Range Management 44(2):133-139.

MORTON, H.L., F.A. Ibarra-F, M.H. Martin-R and J.R. Cox. 1990. Creosotebush control and forage production in the Chihuahuan and Sonoran Deserts. Journal of Range Management 43(1):43-48.

OCKENFELS, R.A., A.A. ALEXANDER, C.L. DOROTHY TICER AND W.K. CARREL. 1994. Home ranges, movement patterns and habitat selection of pronghorn in central Arizona. Arizona Game and Fish Department Technical Report 13. 80 pp.

O'GARA, B.W. AND J.D. YOAKUM, editors. 1992. Pronghorn management guides. Proceedings Pronghorn Antelope Workshop 15 (suppl.) 101 pp.

PATTEN, D.T. 1978. Productivity and production efficiency of an upper Sonoran desert ephemeral community. American Journal of Botany 65(8):891-895.

SCIFRES, C.J., J.L. MUTZ AND W.T. HAMILTON. 1979. Control of mixed brush with tebuthiuron. Journal of Range Management 32:155-158.

TEVIS JR., L. 1958. A population of desert ephemerals germinated by less than one inch of rain. Ecology 39(4):688-695.

U.S. FISH AND WILDLIFE SERVICE. 1998. Final Revised Sonoran Pronghorn Recovery Plan. Albuquerque, New Mexico. 70 pp.

YOAKUM, J.D. 1974. Pronghorn habitat requirements for sagebrush-grasslands. Proceedings Pronghorn Antelope Workshop 6:16-24.

YOAKUM, J.D. 1980. Habitat management guides for the American pronghorn antelope. U.S. Bureau of Land Management Technical Note 347. Denver, CO. 78 pp.

YOAKUM, J.D. 1990. Food habits of the pronghorn. Proceedings Pronghorn Antelope Workshop 14:102-110