

Bombing and Sonoran Pronghorn: A Clear and Present Danger?

PAUL R. KRAUSMAN,^{1,2} *Wildlife Conservation and Management, School of Natural Resources, University of Arizona, Tucson, AZ 85721, USA*

LISA K. HARRIS, *Harris Environmental Group, Inc., 1749 E. 10th Street, Tucson, AZ 85719, USA*

RYAN R. WILSON,³ *Wildlife Conservation and Management, School of Natural Resources, University of Arizona, Tucson, AZ 85721, USA*

JAMES W. CAIN, III,⁴ *Wildlife Conservation and Management, School of Natural Resources, University of Arizona, Tucson, AZ 85721, USA*

KIANA K. G. KOENEN, *Department of Conservation and Recreation, Division of Water Supply Protection, 485 Ware Road, Belchertown, MA 01007, USA*

ABSTRACT The United States Air Force (USAF) uses part of Sonoran pronghorn (*Antilocapra americana sonoriensis*) habitat for bombing exercises (i.e., Barry M. Goldwater Air Force Range [BMGR], southwest AZ, USA) that could be detrimental to the endangered subspecies. To minimize injury or death to Sonoran pronghorn, the USAF and United States Fish and Wildlife Service developed a monitoring protocol that would eliminate live ordnance delivery in the vicinity of pronghorn. From 1998 to 2003, we searched for pronghorn on or near military targets prior to ordnance delivery. If we observed pronghorn within 5 km of a target, the target was closed for ≥ 24 hours. We monitored bombing ranges on BMGR and closed $>5,000$ targets for $>1,000$ days due to military activity. To our knowledge, no pronghorn were killed or injured. We recommend that the monitoring program continue as long as military activity occurs in pronghorn habitat. (JOURNAL OF WILDLIFE MANAGEMENT 71(8):2820–2823; 2007)

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The Sonoran pronghorn (*Antilocapra americana sonoriensis*) is federally listed as an endangered subspecies by the Endangered Species Act of 1973, as amended. Of Sonoran pronghorn range in the United States, 40% is located within Barry M. Goldwater Air Force Range (BMGR), a bombing and gunnery range in southwestern Arizona, USA. The range of Sonoran pronghorn covers 88% (5,739 km²) of BMGR (United States Fish and Wildlife Service [USFWS] 1997).

This subspecies has been listed as endangered for >30 years, but factors limiting the population have not been determined (USFWS 1998). In December 1992, the United States population was estimated at 119 animals but declined to 21 animals (range = 18–33) by December 2002 (J. J. Hervert, Arizona Game and Fish Department [AGFD], and J. R. Morgart, USFWS, unpublished data). Because 40% of pronghorn habitat in the United States is on BMGR, the United States Department of Defense is concerned with interactions between the military mission and the recovery of endangered species, especially in areas where live ordnance, chaff, and flares are dropped onto Sonoran pronghorn habitat by military aircraft. The effects of these activities could include stress, injury, or death to Sonoran pronghorn.

To ensure that military activity would not impair recovery, or that pilot training would not be reduced, the USAF began a monitoring program on BMGR to minimize their potential impacts on pronghorn. There are 3 ranges on BMGR where Sonoran pronghorn occur that are also military bombing targets: North Tactical Range (NTAC), South Tactical Range (STAC), and Range 1. Our objective was to describe mitigation measures used to minimize injury or death to Sonoran pronghorn during military activities that use live and inert ammunition and to evaluate the success of the program.

STUDY AREA

We conducted our study on NTAC, STAC, and Range 1, BMGR in southwestern Arizona from 1998 to 2003. We compiled data for each year from 15 July to 14 July of the following year.

Average daily temperatures ranged from 19° C to 32° C annually. Temperatures in winter rarely dropped below 0° C, and maximum temperatures often exceeded 43° C during summer. Average annual precipitation of 127 mm occurred in a bimodal pattern from December to February and from July to September (Krausman et al. 2004).

Habitat of Sonoran pronghorn in the United States included broad alluvial valleys separated by block-faulted mountain and surface volcanoes (USFWS 1998). Elevation varied from 122 m to 488 m. The BMGR included Lower Colorado River Valley and Arizona Upland plant communities (Brown 1982).

Land use of NTAC, STAC, and Range 1 was restricted to military operations. Additional information about the study area was reported by the USFWS (1998) and Krausman et al. (2004).

¹ E-mail: paul.krausman@umontana.edu

² Present address: Wildlife Biology Program, College of Forestry and Conservation, The University of Montana, Missoula, MT 59812-0596, USA

³ Present address: Department of Wildland Resources, Utah State University, Logan, UT 84322, USA

⁴ Present address: Center for African Ecology, School of Animal, Plant, and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

METHODS

We used observers to search each tactical range for pronghorn prior to high explosive (live) ordnance deliveries. We arrived at the tactical ranges at first light (i.e., approx. 0400–0500 hr) and our observations were the first activities scheduled for the day by the USAF. Monitoring lasted 2–3 hours in each range. We visually located pronghorn from the ground, hillsides, and observation towers. Observation towers were 7 m above ground level and were strategically placed around primary targets (i.e., high-explosive hills, hills that are bombed) to maximize viewing opportunities. During this study, AGFD monitored movement of radio-collared pronghorn so we used telemetry and a Telonics® frequency monitor (TDP2 advance digital data processor; Telonics, Mesa, AZ) to perform an initial radiotelemetry scan for any pronghorn in the area. We recorded every location of a pronghorn as an observation. We could not identify all individuals because we observed animals up to 10 km from observation sites. However, we estimated the minimum number of individual pronghorn using ranges based on collared animals, group size, and recognizable individuals. We took a compass bearing for each signal heard and used binoculars (10 × 42; 15 × 56), spotting scopes (20 × 60), and telemetry to locate collared animals. When we located animals, we recorded their location, number, and group composition (i.e., M, F, fawn). When we did not locate radiocollared pronghorn, we initiated a systematic visual scan using binoculars and spotting scopes. The scan area was a circle divided into 4 quadrants with the observers at the center. We systematically scanned each quadrant, overlapping viewing areas of each section until we searched the entire viewing area. We alternated scan direction clockwise and counterclockwise, and conducted periodic telemetry checks for collared animals during systematic scans. When we detected a radiosignal, we abandoned the systematic scan and searched for the radiocollared pronghorn. If we failed to observe the collared animal (because it was not in view) within an hour, one observer continued the systematic scans of quadrants while the other observer continued to search for the collared pronghorn.

We monitored NTAC and STAC each Monday (first weekly fly day) regardless of military activity or animal presence. These monitoring periods were classified as required. This ensured each range would be monitored weekly. If we located Sonoran pronghorn, we conducted monitoring the next day. If we recorded no locations, we monitored the following day if pronghorn had been seen at the site in the previous 7 days by us, AGFD biologists, military personnel, or other biologists.

We only monitored Range 1 the day following a reported sighting of pronghorn. In addition to required monitoring, we looked for pronghorn each morning prior to live ordnance missions (i.e., live) and the day after pronghorn were observed on any range. Other monitoring occurred during Maverick missions (i.e., firing Maverick rockets), explosive ordnance disposal detonations (i.e., EOD), and

range clearance to minimize ground personnel disturbance on pronghorn (i.e., special). Range activity was scheduled by Range Operations, Luke Air Force Base, Arizona. We received weekly AGFD reports of pronghorn locations and scheduled military activity from Range Operations.

We reported all pronghorn locations to Range Operations ≥ 30 minutes before the first scheduled mission via military communications. If we observed a Sonoran pronghorn within a 5-km radius (i.e., buffer zone) of a high-explosive target, deliveries were cancelled. Deliveries were also cancelled within a 3-km radius of any pronghorn locations outside the buffer zone for the remainder of the day.

Other mitigation measures included decreased speed limits (i.e., 8–16 km/hr) on roads near sightings of pronghorn, road closures within 1 km of any reported pronghorn, and restricted vehicle use (i.e., ≤ 4 vehicles) on roads within 3 km of any reported pronghorn sightings (i.e., special). We reported pronghorn locations to the range communication monitor, which were placed on a range map available to all incoming range personnel to review before using tactical ranges.

When ordnance was accidentally dropped on non-approved areas (or targets; i.e., incidental), we visited the site within 24 hours and conducted systematic searches for evidence of pronghorn injury or mortality. Detailed monitoring protocol for Sonoran pronghorn used herein (Harris Environmental Group 2002) was approved by the USFWS and Department of Defense. Additional monitoring information is available from Harris Environmental Group (2002). We tabulated the number of times each range was monitored for each type of military activity (i.e., required, live, Maverick, EOD, special, incidental), number, and classification of Sonoran pronghorn observed, number of targets closed, and number of days that targets were closed due to the presence of Sonoran pronghorn.

RESULTS

We monitored 3 ranges for 6 general types of military activity that could potentially influence Sonoran pronghorn (Table 1). Over the 5-year study, the required monitoring was most common (range = 0–256 times/yr) followed by live ordnance (range = 0–113 times/yr), and special (range = 0–75 times/yr; Table 1). Other activities were not common (Table 1).

We made 4,709 observations of pronghorn during the study (range = 304–1,614/yr; Table 2). We estimated that 16, 25, 19, 17, and 13 different pronghorn used the ranges over years 1, 2, 3, 4, and 5 of the study, respectively. Depending on year and area, unknown classifications of pronghorn ranged from 9.2% to 75.9% (Table 2).

Over all ranges, targets were closed 5,218 times and for ≥ 2 days on 1,114 occasions from 1998 to 2003 (Table 3). Throughout the study, more targets were closed on STAC ($\bar{x} = 654.2 \pm 169.3$ [SE]) and for more days ($\bar{x} = 151.6 \pm 42.1$ d) than on NTAC (\bar{x} closures = 386.6 ± 94.0 ; \bar{x} d = 70.4 ± 12.3) or Range 1 (\bar{x} closures = 2.8 ± 2.8 ; \bar{x} d = 0.8 ± 0.5).

Table 1. Number of times North Tactical Range (NTAC), South Tactical Range (STAC), and Range 1, Barry M. Goldwater Range, Arizona, USA, were monitored for Sonoran pronghorn during military activities, 1998–2003.

Area	Activity	Yr ^a					\bar{x}	SE
		1998–1999	1999–2000	2000–2001	2001–2002	2002–2003		
NTAC	Lives ^b	82	64	78	88	78	78.0	3.9
NTAC	Required ^c	43	123	114	55	48	76.6	12.3
NTAC	EOD ^d	2	6	4	5	4	4.2	0.7
NTAC	Maverick ^e	0	0	5	3	4	2.4	1.0
NTAC	Special ^f	0	2	1	38	55	19.2	11.5
NTAC	Incidental ^g	0	0	2	2	0	0.8	0.5
STAC	Lives	69	39	95	113	74	78.0	12.5
STAC	Required	101	149	256	159	64	145.8	32.4
STAC	EOD	0	8	0	13	3	4.8	2.5
STAC	Maverick	0	0	3	0	0	0.6	0.6
STAC	Special	0	57	0	70	75	40.4	16.8
STAC	Incidental	0	0	2	1	1	0.8	0.4
Range 1	Lives	0	0	0	0	0	0	0
Range 1	Required	0	2	0	0	0	0.5	0.5
Range 1	EOD	0	2	3	0	0	1.3	0.8
Range 1	Maverick	0	0	0	0	0	0	0
Range 1	Special	0	0	0	0	0	0	0
Range 1	Incidental	5	0	1	1	0	1.8	1.1

^a Yr are 15 Jul–14 Jul of the next yr.

^b Live ordnance missions.

^c Required include Monday observations and any day after Sonoran pronghorn are obs on the range.

^d EOD = explosive ordnance disposal detonations.

^e Maverick = Maverick missions.

^f Special = missions to reduce ground personnel from disturbing pronghorn.

^g Miscellaneous observations from nonbiologists or at unscheduled monitoring periods.

When targets were closed to the military because of the presence of Sonoran pronghorn, the USAF likely rescheduled activities or conducted modified missions on ranges outside Sonoran pronghorn habitat. However, we were not able to obtain those data from the Department of Defense.

During our study, we did not document injury or mortality of Sonoran pronghorn due to military activity on NTAC, STAC, or Range 1. We did not document mortality or injury caused by the military anywhere on BMGR. Thus, the monitoring program was successful because we were able to close sites to military ordnance when occupied by

pronghorn. However, there were accidental ordnance drops in some years. In 1999–2000, 2 ordnance drops occurred on closed targets, in 2000–2001 an unspecified range incident (i.e., the Department of Defense would not specify what happened) occurred on closed targets, and ordnances were delivered 3 times to closed targets in 2001–2002. During the same year, monitors failed to report pronghorn within 3 km of a target on one occasion. There were 7 other accidental drops of ordnance on areas that were not closed throughout the 5 years of the study. To our knowledge, no pronghorn were injured or killed during these accidents.

Table 2. Number of observations of Sonoran pronghorn on the North Tactical Range (NTAC), South Tactical Range, (STAC), and Range 1, Barry M. Goldwater Range, Arizona, USA, 1998–2003.

Area	Yr ^a	Classification and %							
		M	%	F	%	Fawn	%	Unknown	%
NTAC	1998–1999	99	25.1	106	26.8	7	1.8	183	46.3
NTAC	1999–2000	72	14.8	214	43.9	108	22.2	93	19.1
NTAC	2000–2001	37	10.6	168	48.3	111	31.9	32	9.2
NTAC	2001–2002	51	21.4	105	44.1	8	3.4	74	31.1
NTAC	2002–2003	15	14.3	23	21.9	14	13.3	53	50.5
STAC	1998–1999	81	20.4	164	41.3	5	1.3	97	24.4
STAC	1999–2000	125	28.0	149	33.4	26	5.8	146	32.7
STAC	2000–2001	85	11.2	429	56.7	85	11.2	157	20.8
STAC	2001–2002	223	16.2	555	40.4	230	16.7	367	26.7
STAC	2002–2003	11	5.5	32	16.0	5	2.5	151	75.9
Range 1	1998–1999	3	42.9	2	28.6	0	0	2	28.6
Range 1	1999–2000	1	33.3	0	0	0	0	2	66.6
Range 1	2000–2001	1	50.0	0	0	0	0	1	50.0
Range 1	2001–2002	0	0	1	100.0	0	0	0	0
Range 1	2002–2003	0	0	0	0	0	0	0	0

^a Yr are 15 Jul–14 Jul of the next yr.

Table 3. Number of targets closed and number of days ≥ 1 target was closed to ordnance delivery by military aircraft on North Tactical Range (NTAC), South Tactical Range (STAC), and Range 1, Barry M. Goldwater Range, Arizona, USA, 1998–2003, because Sonoran pronghorn were ≤ 5 km of targets.

Yr ^a	Area					
	NTAC		STAC		Range 1	
	Closed	D	Closed	D	Closed	D
1998–1999	339	71	493	122	14	2
1999–2000	639	87	675	153	0	0
2000–2001	549	97	967	291	0	0
2001–2002	295	72	1,034	163	0	0
2002–2003	111	25	102	29	0	0

^a Yr are 15 Jul–14 Jul of the next yr.

DISCUSSION

Others have discussed the influence of military activities on Sonoran pronghorn (Krausman et al. 2004, 2005). However, the effectiveness of the protocol to minimize injury or mortality on or near targets has not been addressed in the literature.

One role of the USAF is to train combat pilots for national defense. It may be fortunate that NTAC and STAC contain key targets for specific training. These ranges constitute a small portion of Sonoran pronghorn habitat in the United States, but they are used year-round by some pronghorn (Krausman et al. 2004); during some years they were used by most pronghorn in the United States population. For example, in December 2002 the entire United States population was estimated at 21 animals (range = 18–33). During the corresponding period in our study (i.e., 2002–2003), we estimated 13 different Sonoran pronghorn (approx. 62% of the total United States population) used the tactical ranges at some point. The disturbance to the landscape from bombing may enhance the quality of the habitat by providing depressions that can contain water after rains and yield additional vegetation from water collection (Phelps 1981, deVos 1990, Hervert et al. 2000, Krausman et al. 2005).

The Sonoran pronghorn monitoring program was an effective precautionary measure to minimize injury or death to this endangered subspecies and continues to be successful. Without the $>5,000$ target closures on $>1,000$ days during

this study, it is likely ordnance could have killed or injured part of the population. When populations are as small as that of the Sonoran pronghorn in the United States, the loss of any member is serious.

MANAGEMENT IMPLICATIONS

It is likely that bombing activity alters Sonoran pronghorn habitat to enhance forage quality (Krausman et al. 2005). However, because bomb sites are used by the Sonoran pronghorn (Krausman et al. 2005), ordnance delivery poses a major threat to individuals. We recommend that the monitoring program continue as long as military ordnance is delivered to Sonoran pronghorn habitat.

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