HABITAT SELECTION BY COLLARED PECCARIES IN TRANS-PECOS TEXAS

M. Clay Green,* Louis A. Harveson, and Lynn E. Loomis

Department of Natural Resource Management, Sul Ross State University, Alpine, TX 79830
Present address of MCG: Department of Biology, University of Louisiana–Lafayette, Lafayette, LA 70504
**Correspondent: mcg7576@louisiana.edu*

The collared peccary (*Pecari tajacu*) has one of the largest geographical distributions of any ungulate of the Americas (Sowls, 1997). Each herd has a territory or home range defined by neighboring herds that restrict herd movement within its boundaries. The terms territory and home range are compatible and used interchangeably in most literature on collared peccaries (Sowls, 1997). Although collared peccaries are relatively abundant in the Trans-Pecos region, only 2 published studies on population ecology have been conducted. Bissonette (1978) investigated influence of temperature extremes on collared peccary behavior in Big Bend National Park, Texas. In all seasons, collared peccary herds bedded during temperature extremes, whether day or night, and were most active at intermediate temperatures. Research using radio telemetry has been conducted to determine home ranges of collared peccaries in Arizona and south Texas, but not in Trans-Pecos Texas. Bissonette (1982) also observed collared peccary herds at Big Bend National Park investigating herd size, home range, behavior, and group dynamics utilizing visual observation in lieu of radio tracking. These observations were limited to 2 lower elevation vegetation types, lechuguilla (*Agave lechuguilla*)–creosote (*Larrea tridentata*)–cactus association (1,000 to 1,160 m) and sotol–grassland association (1,000 to 1,370 m). In the Davis Mountain region (elevations >1,420 m) of Trans-Pecos Texas, collared peccaries have never been studied. Our goal was to describe population characteristics of collared peccary herds in the Davis Mountains by use of radio telemetry. Our overall objective was to determine herd size, home range, and habitat selection of collared peccary herds at the Barillos Dome.

We conducted research on the O6 Ranch in Jeff Davis Co., Texas within the Chihuahuan Desert. The ranch is located in the Davis Mountains between Alpine and Fort Davis, Texas. Climate is characterized by dry winters and springs with most precipitation occurring in late summer and early fall months. Average annual precipitation in Alpine, Texas is 42.9 cm (Owenby and Ezell, 1992). The study site is ca. 16 km north of Alpine. Summers are usually mild with average monthly temperatures ranging from 21 to 24°C (Owenby and Ezell, 1992).

Collared peccaries belonging to 3 different herds, identified as blue, green, and yellow, were captured between October and December 1997. We captured collared peccaries with modified box traps (1.00 by 1.25 by 1.85 m) in areas with tracks, scat, and visual observations of collared peccaries. Traps were baited with corn, set in the evening, and checked the following morning. Collared peccaries were tranquilized using Telazol (tiletamine hydrochloride and zolazepen hydrochloride) reconstituted with xylazine hydrochloride at a 1:1 ratio at an average dosage rate of 17.4 mg/kg or with a 2:1 mg mixture of ketamine hydrochloride and xylazine hydrochloride at an average dosage rate of 18.4 mg/kg (Gallagher et al., 1985; Gabor et al., 1997). After sedation, each individual was ear tagged, weighed, and sex and age were determined. Age was determined from the tooth-replacement pattern (Kirkpatrick and Sowls, 1962; Heffelfinger, 1997). Handling time was limited to the aforementioned procedures and all animals were released in the same area where they were captured.

All individuals were tracked ≥2 times per week between sunrise and sunset from date of capture to October 1998. We followed the radio signal until a visual or audial observation was obtained. Where dense brush or caves prevented visual sighting, location of the collared

individual was confirmed through sound. When no visual or audial observation occurred, approximate locations, determined by single-observer triangulation and from topographic relief, were plotted on 7.5 minute topographic maps and recorded as Universal Transverse Mercator (UTM) coordinates. Due to extensive relief, landforms (e.g., arroyos, ridges, and water sources) and a compass were used to estimate the location of the individual. We determined observer error using randomly selected locations consisting of the various vegetation communities and various grades of topographical relief (ridges, hillsides, creek beds). These locations were estimated on topographical maps and compared with locations obtained from a hand-held Magellan (Magellan DIS, Inc. Plano, Texas) Global Positioning System (GPS) estimate of the same location. Inherent error (minimum 4 satellites: ± 30 m) of the Magellan GPS device was incorporated in the error estimation. Upon visual sighting, the number and class of collared peccaries (e.g., adult, juvenile, and neonate) accompanying the radio-collared individual, sex of each individual and habitat, based on vegetation sampling, were recorded.

Home-range size for each herd was determined using CALHOME software (Kie et al., 1994). The 95% minimum convex polygon (MCP) was used to determine overall home range (Mohr, 1947). Core areas were estimated using the 75% and 50% adaptive kernel (ADK; Worton, 1989). Home range and core areas were calculated for winter (December through February), spring (March through May), summer (June through August), and autumn (September through November). Mean herd size for each herd and total overall herd size were determined from visual observations of collared individuals. Comparison of overall mean herd size using all 3 herds and mean herd size using only the blue and yellow herds were made using a *t*-test. Collared peccary density was estimated by summing the 3 herd size maximas and the home-range areas (95% ADK). These data, expressed as a ratio (herd size : home-range area), were applied to the entire study site for estimation of density and total population.

Generation of an initial habitat map and a preliminary list of vegetation communities was completed using visual observation and aerial photographs (size: 94 cm by 94 cm; scale: 1: 3937; USDA-FSA, Aerial Photography Field Office, Salt Lake City, Utah, 84119). Vegetation sampling (plant species and soil surface features) was conducted in clusters of 3 20-m^2 circular quadrats, placed in a straight line separated by 10 m. (Vanzant, 1994). Herbaceous and woody plant cover were estimated within each quadrat. Because collared peccaries use sacaton flats year-round for sleeping or resting, stands of *Sporobolus* >1 m tall were treated as woody plant cover (Bock and Bock, 1979). Upon determination of dominant herbaceous and woody plant species, each cluster was grouped and classified using TWINSPAN statistical software (Hill, 1979). Once each site was classified, a vegetation community map was generated. Plant community boundaries were digitized in IDRISI (Clark Labs for Cartographic Technical and Geographical Analysis, Worcester, Massachusetts).

Third order habitat selection was estimated by using habitats within the home range as available habitat, and observed location within particular habitats as habitat used (Johnson, 1980). For habitat selection analysis (preference and avoidance), expected and observed frequencies were estimated and compared using Chi-square analysis. Preference and avoidance were determined using the 90% family confidence coefficient, or Bonferroni normal statistics (Miller, 1966; Neu et al., 1974). Greater use of a specific habitat than is in proportion to its availability indicated preference. Less use of the specific habitat than is in proportion to its availability indicated avoidance.

Fifteen collared peccaries (10 adults, 5 juveniles) from 3 herds were trapped, sedated, and radiocollared (6, 4, and 5 from the blue, green, and yellow herds, respectively). Eight males and 7 females were captured (male : female—blue, 3:3; green, 4:0; yellow, 1:4). Age ranged from 11 to 12 months to 4 to 6 years with a mean of 41 months. We collected 381 observations (218 visual) for the 3 herds. Observations occurred between sunrise and sunset, with 32% between 0600–1000 h, 30% between 1000–1400 h, 23% between 1400–1800 h, and 15% between 1800–2200 h. Observations occurred 30% in winter (n = 115), 32% in spring (n = 123), 25% in summer (n = 93), and 13% in autumn (n = 50). Because of limited sample size, autumn observations were not

TABLE 1—Mean size of home range (ha), estimated by 95% minimum convex polygon (MCP), 75% adaptive kernel (AK), and 50% AK, for collared peccaries on the O6 Ranch, Jeff Davis Co., Texas, 1997 to 1998.

Season	Number of collared individuals	Number of locations	95% MCP Mean ± *SE*	75% AK Mean ± *SE*	50% AK Mean ± *SE*
Winter	11	112	111 ± 25	103 ± 19	34 ± 18
Spring	7	120	97 ± 21	76 ± 19	37 ± 10
Summer	6	149	108 ± 3	66 ± 9	20 ± 1
Annual	15	381	165 ± 14	111 ± 5	46 ± 8

used in seasonal analysis. The mean radius (± *SE*, range) of error for radio telemetry was 85.65 m ± 10.83, 0–217 m (n = 27). No difference was found between mean mass for adult males (23.62 ± 2.15 kg) and females (22.13 ± 2.94 kg; t = 0.942, df = 13, P = 0.371).

Six of the 15 collared individuals died during the study (December: B1, B2, G1; January: B4, G3; March: G4). Necropsies of 3 individuals (B1, B2, G4) revealed pneumonic symptoms in the lungs and congestion (darkened color) of the heart and liver. Seven other individuals (B4, G1, G3, 4 uncollared) died from one of several following probable causes: Telazol/xylazine overdose, drowning, and road kill. Ten individuals from the 3 herds (B:0, G: 7, Y:3) were born during this study. All births occurred in the months of August and September.

Mean herd size was 4.70 ± 0.36, 2.51 ± 0.29, and 10.41 ± 0.44 for the blue, green, and yellow herds, respectively. The mean herd size for all herds was 5.47 ± 0.35. Herd sizes for the blue, green, and yellow herds ranged from 1 to 11, 1 to 14, 1 to 17, respectively. The blue and green herd maxima occurred during fall months. All 3 collared individuals in the green herd were males and were with ≤2 other animals 71% of the time. When these individuals were observed with ≥3 others, mean herd size was 6.77 ± 0.85. In 65% of observations, the yellow herd consisted of >10 collared peccaries. We estimated the study site to have a population of 99 collared peccaries with a mean density (±*SD*) of 6.0 ± 0.5 animals/100 ha.

Mean home-range area (95% ADK and MCP) was 247 ± 16 ha and 165 ± 14 ha, respectively. The blue herd occupied the largest home range as computed by the 95% ADK (272 ha) and 95% MCP (192 ha) methods. The mean core area (ADK 75% and 50%) was 111 ± 5 ha and 46 ± 8 ha, respectively. For 75% and 50% MCP, the mean (±*SE*) core area sizes were 112 ± 19 ha and 69 ± 7 ha. The blue herd used the largest core area for both the 75% MCP (120 ha) and 50% MCP (57 ha) methods. Home ranges and core areas did not differ significantly from season to season (Table 1; 95% MCP: $F_{2,6}$ = 0.15, P = 0.863; 75% ADK: $F_{2,6}$ = 1.33, P = 0.333; 50% ADK: $F_{2,6}$ = 0.57, P = 0.593).

A total of 64 vegetation clusters was used in habitat analysis and construction of the habitat map. We delineated 10 vegetation communities including juniper/catclaw mimosa/sideoats grama (*Bouteloua curtipendula*) shrubland, sotol/tanglehead (*Heteropogon contortus*) shrubland, catclaw mimosa/sideoats grama shrubland, gray oak (*Quercus grisea*)/bullgrass (*Muhlenbergia emersleyi*) herbaceous, gray oak-hackberry (*Celtis laevigata*)/sideoats grama woodland, emory oak (*Q. emoryi*)/plains bristlegrass (*Setaria leucopila*) forest, catclaw mimosa-whitebrush/sideoats grama shrubland, hackberry-mesquite/blue grama (*Bouteloua gracilis*) shrubland, mesquite/blue grama herbaceous, and mesquite/giant sacaton herbaceous.

Collared peccary herds selected habitats disproportional to the available habitat within each herd's home range ($P \leq 0.05$; Table 2). Herds preferred the juniper/catclaw mimosa/sideoats grama shrubland, the gray oak-hackberry/sideoats grama woodland, and the emory oak/plains bristlegrass forest and avoided the sotol/tanglehead shrubland, the catclaw mimosa-whitebrush/sideoats grama shrubland, and the mesquite/giant sacaton tall grassland.

Observed mean herd size at Barillos Dome in the Davis Mountains (5.47 ± 0.35) was lower

TABLE 2—Third order habitat selection for collared peccary herds at Barillos Dome, Jeff Davis Co., Texas, 1997–1998.

Community	Availability (proportion)	Observed observations	Expected observations	Used P^i (proportion)	Confidence intervals[c] (90% family coefficient)
Juniper/catclaw mimosa/sideoats grama	0.071	52	27.1	0.136[a]	$0.091 \leq P^i \leq 0.181$
Sotol/tanglehead	0.034	5	13.0	0.014[b]	$-0.001 \leq P^i \leq 0.290$
Catclaw mimosa/sideoats grama	0.216	81	82.4	0.210	$0.156 \leq P^i \leq 0.264$
Gray oak/bullgrass	0.096	26	36.6	0.068	$0.035 \leq P^i \leq 0.101$
Gray oak-hackberry/sideoats grama	0.014	18	5.3	0.047[a]	$0.019 \leq P^i \leq 0.075$
Emory oak/plains bristlegrass	0.017	52	6.6	0.136[a]	$0.091 \leq P^i \leq 0.181$
Catclaw mimosa-whitebrush/sideoats grama	0.234	36	89.1	0.094[b]	$0.056 \leq P^i \leq 0.132$
Hackberry-mesquite/blue grama	0.113	58	42.9	0.156	$0.108 \leq P^i \leq 0.204$
Mesquite/blue grama	0.073	18	27.8	0.047	$-0.026 \leq P^i \leq 0.075$
Mesquite/giant sacaton	0.132	35	50.2	0.092[b]	$0.054 \leq P^i \leq 0.130$
Total	1.000	381	381.0	1.000	

[a] preference
[b] avoidance
[c] $\chi^2 = 417.99$, $v = 9$, $P = 0.05$

than reported in Big Bend National Park (14.4; Bissonette, 1982). The mean was also lower in comparison with mean herd sizes in Arizona (Knipe, 1957; Sowls, 1984; Day, 1985) and south Texas (Green et al., 1984; Hellgren et al., 1984) ranging from 7.9 to 18.4 and 11 to 25, respectively. Variability in reported herd size may result from herds often subdividing into smaller groups or subgroups. Separation of collared peccaries into small groups has been reported in Texas (Bissonette, 1982). Green et al. (1984) observed variability of group size and concluded that counts of all members seen at one time do not necessarily reflect accurate herd size. This assumption might best be used in drawing conclusions from our data. Of the 218 visual observations, 17% were solitary individuals. However, when these individuals were seen with other collared peccaries, the maximum herd size observed for the blue, green, and yellow herds were 11, 14, and 17, respectively. Schweinsburg (1971) promoted the belief that solitary individuals are generally afflicted or disabled collared peccaries. However, Oldenburg et al. (1985) reported that 8% of their observations were solitarios that were not sick or disabled. For 60 days, collared peccary (B4) was observed by himself 82.5% of the time. He did not appear weak or disabled until a few observations prior to his death. In the yellow herd, individuals were seldom seen alone or even in groups of ≤5.

The density of collared peccaries (number/100 ha) at Barillos Dome (6.0) was higher than reported densities (3.0 to 4.7) in Arizona (Day, 1985). The density was similar to estimates in south Texas (3.8 to 8.8) and Big Bend National Park (3.3 to 11.0; Low, 1970; Bissonette, 1982). However, density was considerably higher than density estimates (2.0) of collared peccaries occurring sympatrically with feral hogs in south Texas (Ilse and Hellgren, 1995). Home-range area of collared peccary herds varies greatly among regions. In Arizona, mean home-range area (95% MCP) varied from 104 to 469 ha (Minnamom, 1962; Schweinsburg, 1971; Bigler, 1974; Day, 1985). In south Texas, mean areas were generally lower (174 to 242 ha) using MCP (95%) method (Green, 1982; Oldenburg, et al., 1985). Bissonette (1982) reported a mean home-range area of 216 ha in Big Bend National Park. The mean 95% MCP home-range area (165 ± 14 ha) at Barillos Dome is more similar to home-range areas in south Texas than that of Big Bend National Park or Arizona.

Habitat selection demonstrated preference by collared peccaries for areas with substantial

(mid-level to high-level class) canopy cover. The emory oak/plains bristlegrass forest, gray oak-hackberry woodland, and juniper/catclaw mimosa/ sideoats grama shrubland communities (mean canopy cover ca. 50%) were highly preferred by 2 of the 3 herds. Additionally, these areas were adjacent to cliffs with >19% stone, boulder, and bedrock outcrop. These outcrops provided cover in the form of caves and overhangs. We believe areas with rock outcrop and considerable canopy cover were used mainly to escape extreme temperature and for protection from predators. Collared peccary herds avoided the sotol shrubland, the catclaw mimosa-whitebrush/sideoats grama shrubland, and the mesquite/giant sacaton tall grassland habitats. Although tree/shrub mean cover was 36.4% for these communities, the tree species, hackberry and juniper, measured <5.5%. Additionally, stone, boulder, and bedrock outcrops measured ≤3.2% in these communities. Although herds were observed in sacaton grasslands, use was (<9% of total observations) limited and indicated avoidance of that particular habitat. Availability of more suitable thermal cover in the form of tree cover and rock outcrop may preclude use of these sacaton grasslands.

Mean herd size and home-range area observed in this study demonstrated greater similarity to south Texas than to Arizona or Big Bend National Park. Habitat preference for areas with greater woody canopy cover was also similar to results from south Texas. However, collared peccary density was more similar to density estimates in south Texas and Big Bend National Park than Arizona. Only 2 other studies have been conducted on the demographics and habitat selection of collared peccaries in Trans-Pecos Texas (Bissonette, 1978, 1982). These studies differed considerably in mean herd size and habitat, although home-range area and density estimates were relatively similar. In contrast, Bissonette (1982) observed a negative regression ($P < 0.05$) of collared peccary density versus woody cover in Big Bend National Park. However, Bissonette (1982) determined habitat preference in conjunction with activity patterns and concluded that dense woody cover habitats lacking in succulents and forbs were not preferred during active foraging periods.

In this study, observations were recorded between sunrise and sunset. Therefore data are biased toward observations of collared peccaries resting in areas of increased canopy cover for thermal protection and not foraging quality. Additionally, the limited number of herds sampled precludes drawing broad inferences about collared peccary populations in the Davis Mountains. Although not conclusive, our results do suggest population characteristics that are more similar to south Texas populations than those of Big Bend National Park or Arizona. Additional radio-tracking studies using a greater number of herds are needed in the Davis Mountains to investigate nocturnal movement and home-range and habitat selection shifts for all seasons.

Resumen—Se estudió la selección de hábitat del pecarí de collar (*Pecari tajacu*) en el condado de Jeff Davis, Texas (Bissonette 1978, 1982). Quince jabalíes procedentes de tres manadas fueron atrapados, sedados y radiomarcados. El número promedio de jabalíes por manada (±*EE*) fue de 5.47 ± 0.35. El área de distribución promedio (polígono convexo mínimo 95%) de las tres manadas fue de 165 ± 0.14 ha. El área de distribución basal (75%, 50% adaptative kernel) fue de 111 y 46 ha respectivamente. La selección del hábitat fue desproporcionada con respecto al hábitat disponible. Los jabalíes evitaron la uña de gato (*Mimosa biuncifera*), el cedrón (*Aloysia gratissima*), el sotol (*Dasylirion*), así como el mesquite (*Prosopis glandulosa*) y zacatón (*Sporobolus wrightii*). Los pecaríes mostraron preferencia por hábitats predominantemente compuestos por robles (*Quercus*) y cedros (*Juniperus coahuilensis*) con un dosel promedio de 49.8 ± 33.1% y el rango entre 5 a 48%. Todas las observaciones fueron diurnas y podrían haber favorecido sitios de descanso y no áreas de forrageo, especialmente durante los meses del verano. Aparentemente, las características poblacionales encontradas son mas similares a las de las poblaciones de jabalíes del sur de Texas que a aquellas registradas para el Parque Nacional Big Bend.

We thank C. and D. Lacey, of the O6 Ranch, for access to the study site. We also thank R. McIvor for field assistance and equipment use. This study was partly funded by the Houston Livestock Show and Rodeo.

Literature Cited

Bigler, W. J. 1974. Seasonal movements and activity patterns of the collared peccary. Journal of Mammalogy 55:851–855.

Bissonette, J. A. 1978. The influence of extremes of temperature on activity patterns of peccaries. Southwestern Naturalist 23:339–346.

Bissonette, J. A. 1982. Ecology and social behavior of the collared peccary in Big Bend National Park, Texas. Scientific Monograph Series No. 16. United States Department of the Interior, Washington, D.C.

Bock, C. E., and J. H. Bock. 1979. Relationship of the collared peccary to sacaton grassland. Journal of Wildlife Management 43:813–815.

Day, G. I. 1985. Javelina: research and management in Arizona. Arizona and Game Fish Department. Phoenix.

Gabor, T. M., E. C. Hellgren, and N. J. Silvy. 1997. Immobilization of collared peccaries (*Tayassu tajacu*) and feral hogs (*Sus scrofa*) with Telazol and xylazine. Journal of Wildlife Diseases 33:161–164.

Gallagher, J. F., R. L. Lochmiller, and W. E. Grant. 1985. Immobilization of collared peccaries with ketamine hydrochloride. Journal of Wildlife Management 49:356–357.

Green, G. E. 1982. Evidence and importance of subgrouping behavior in javelina populations in south Texas. Unpublished Ph.D. dissertation, Texas A&M University, College Station.

Green, G. E., W. E. Grant, and E. Davis. 1984. Variability of observed group sizes within collared peccary herds. Journal of Wildlife Management 48:244–248.

Heffelfinger, J. 1997. Age criteria for Arizona game species. Special Report 19. Arizona Game and Fish Commission. Phoenix.

Hellgren, E. C., R. L. Lochmiller, and W. E. Grant. 1984. Demographic, morphologic, and reproductive status of a herd of collared peccaries (*Tayassu tajacu*) in south Texas. American Midland Naturalist 112:402–407.

Hill, M. O. 1979. TWINSPAN: a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Ecology and Systematics, Cornell University, Ithaca, New York.

Ilse, L. M., and E. C. Hellgren. 1995. Spatial use and group dynamics of sympatric collared peccaries and feral hogs in southern Texas. Journal of Mammalogy 76:993–1002.

Johnson, D. H. 1980. The comparison of usage and availability measurements for evaluating resource preference. Ecology 61:65–71.

Kie, J. G., J. A. Baldwin, and C. J. Evans. 1994. CALHOME—home range analysis program. Electronics User's Manual. United States Forest Service, Fresno, California.

Kirkpatrick, R. D., and L. K. Sowls. 1962. Age determination of the collared peccary by tooth-replacement pattern. Journal of Wildlife Management 26:214–217.

Knipe, T. 1957. Javelina in Arizona. Wildlife Bulletin Number 2, Arizona Game and Fish Department. Phoenix.

Low, W. A. 1970. The influence of aridity on reproduction of the collared peccary in Texas. Unpublished Ph.D. dissertation, University of British Columbia, Vancouver.

Miller, R. G. 1966. Simultaneous statistical inferences. McGraw-Hill, New York.

Minnamom, P. S. 1962. Home range of collared peccaries in Tucson Mountains. Unpublished M.S. thesis, University of Arizona, Tucson.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. American Midland Naturalist 37:223–249.

Neu, C. W., C. R. Byers, and J. M. Peek. 1974. A technique for analysis of utilization—availability data. Journal of Wildlife Management 38:541–545.

Oldenburg, P. W., P. J. Ettestad, W. E. Grant, and E. Davis. 1985. Size, overlap, and temporal shifts of collared peccary herd territories in south Texas. Journal of Mammalogy 66:378–380.

Owenby, J. R., and D. S. Ezell. 1992. Monthly station normals of temperature, precipitation, and heating and cooling degree days 1961–1990 Texas. Climatography of the United States No. 81. National Climate Data Center, Asheville, North Carolina.

Schweinsburg, R. E. 1971. Home range, movements, and herd integrity of the collared peccary. Journal of Wildlife Management 35:455–460.

Sowls, L. K. 1984. The peccaries. University of Arizona Press, Tucson.

Sowls, L. K. 1997. Javelinas and other peccaries: their biology, management, and use, Second ed. Texas A&M University Press, College Station.

Vanzant, T. J., III. 1994. Effects of tebuthiuron on *Acacia gregii* and *Mimosa biuncifera* regeneration in the Davis Mountains, Texas. Unpublished M.S. thesis, Sul Ross State University, Alpine, Texas.

Worton, B. J. 1989. Kernel methods for estimating the utilization distribution in home range studies. Ecology 70:164–168.

Submitted 30 June 1999. Accepted 16 June 2000.
Associate Editor was Paul R. Krausman.