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Research Note

Female White-Tailed Deer Body Condition and Diet After a Large Spring Wildfire

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Abstract

Frequency of large rangeland wildfires may increase in the southwestern United States and northeastern Mexico as a result of exotic grass invasion and reduced emphasis on livestock production, but effects of such fires on white-tailed deer (*Odocoileus virginianus*) are poorly documented. A large wildfire burned > 90% of the 6 151-ha Chaparral Wildlife Management Area in southern Texas during March 2008, creating an opportunity to study short-term effects of wildfire on white-tailed deer food habits, body condition, and pregnancy. We harvested 26 female deer between 7 April and 20 June 2008 and recorded dressed body weight, body condition, number of corpora lutea, and number and size of fetuses. We used rumen contents to quantify forage classes consumed. Deer ate prickly pear (*Opuntia engelmannii*) pads and emergent grasses during April and shifted to forbs and browse as vegetation communities recovered. Deer consumed mesquite (*Prosopis glandulosa*) beans and prickly pear fruit during mid-June. Body condition measures did not vary during the collection period, suggesting deer were able to acquire sufficient nutrients to meet requirements. Fetal development rate appeared normal. Precipitation (11.4 cm) during late April and May probably allowed vegetation to recover from the wildfire. White-tailed deer are resilient opportunists and were able to maintain body condition and pregnancy after a large-scale wildfire.

Resumen

La frecuencia de grandes incendios en los pastizales del Suroeste de los Estados Unidos y Noreste de México puede amentar como resultado de la invasión de pastos exóticos y poco énfasis en la producción ganadera, pero el efecto de estos incendios en el venado cola blanca (*Odocoileus virginianus*) está poco documentado. Un gran incendio en el Área de Manejo Silvestre del Chaparral en el Sur de Texas durante marzo de 2008 donde se quemo más del 90% del total de 6%hairsp;151 ha creó una oportunidad para estudiar el efecto a corto plazo de incendios en los hábitos de alimentación, condición corporal y preñez del venado cola blanca. Se cazaron 26 hembras de venado entre el 7 de abril y 20 de junio de 2008 y se registró el peso de animal completo, condición corporal, número de cuerpos lúteos y numero y tamaño de los fetos. Usamos el contenido ruminal para cuantificar la clase de forraje consumido. Los venados comieron pencas de nopal (*Opuntia engelmannii*) y pastos que rebrotaron en abril y cambiaron a hierbas y arbustos conforme las comunidades vegetales se recuperaban. Los venados consumieron vainas de mezquite (*Prosopis glandulosa*) y tunas a la mitad de junio. La condición corporal no varió durante el periodo de colecta sugiriendo que los venados pueden conseguir suficientes nutrientes para llenar sus requerimientos. La tasa del desarrollo fetal aparentemente fue normal. La precipitación (11.4 cm) durante finales de abril y mayo probablemente permito a la vegetación recuperarse del incendio. Los venados cola blanca son oportunista resilentes y fueron capaces de mantener la condición corporal y preñez después de un incendio a gran escala.

Key Words: fetal growth, food habits, mesquite rangeland, *Odocoileus virginianus*, pregnancy, South Texas

INTRODUCTION

White-tailed deer (*Odocoileus virginianus*) are an ecologically and recreationally important large herbivore on rangelands of the southwestern United States and northern Mexico. These areas are arid to semiarid and thus susceptible to wildfire. Prescribed fire is generally accepted as a beneficial management practice for white-tailed deer on rangelands, and its effects, especially on deer habitat and forage, have been studied (Soper et al. 1993; Fulbright and Ortega-S. 2006; Zimmerman et al. 2006). In contrast, effects of wildfire on white-tailed deer may vary from those of prescribed burns, at least in the short term, because of differences in the size of area and conditions of the burn. Furthermore, short-term effects of fire on deer are poorly understood because most studies have focused on effects months to years after a burn and few have investigated demographic effects (e.g., Rasmussen et al. 1983; Soper et al. 1993; Leslie et al. 1996; Rogers et al. 2004).

White-tailed deer and other ungulates are large and mobile; thus, short-term effects of fire have been assumed to be minimal because deer are able to move temporarily to unburned areas (Singer et al. 1989). However, fragmentation of rangelands

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from agriculture, urban development, transportation corridors, and game-proof fencing may limit the ability of deer to use unburned areas. Furthermore, wildfire frequency in southwestern rangelands is predicted to increase because many landowners are removing livestock to focus on wildlife management objectives, and invasive exotic grasses increase fire frequency (Fulbright and Ortega-S. 2006). Thus, understanding short-term effects of fire on white-tailed deer foraging, body condition, and demographics is increasingly important.

An opportunity to study effects of wildfire on white-tailed deer occurred 14–15 March 2008 on the Chaparral Wildlife Management Area (WMA) in southern Texas when a 27 000-ha wildfire burned 91% of the property. The fire was especially intense in many areas of the Chaparral WMA because 77 cm of precipitation during May–September 2007 allowed accumulation of large amounts of senescent vegetation that served as fine fuel for the wildfire. The Chaparral WMA is isolated by a 2.4-m high net-wire fence, and because of dry conditions (<0.75 cm/mo of precipitation during the preceding 6 mo) there was concern that deer may not be able to maintain body condition or normal gestation after the fire. Our objective was to document female white-tailed deer forage use, body condition, and pregnancy status after the extensive spring wildfire.

METHODS

Study Area

Our study was conducted on the Chaparral WMA, a 6 151-ha property owned by Texas Parks and Wildlife Department (TPWD) located 160 km southwest of San Antonio, Texas. A game-proof fence surrounds the property and divides the WMA into two large pastures ($>2\,500$ ha) and two smaller pastures. Our study was conducted in the western pasture of the two large pastures, which was 2 615 ha. Vegetation was typical of the Tamaulipan Biotic Province (McLendon 1993), with diverse woody plant communities containing honey mesquite (*Prosopis glandulosa*), granjeno (*Celtis pallida*), hogplum (*Colubrina texensis*), brasil (*Condalia hookeri*), blackbrush acacia (*Acacia rigidula*), and many other species (Rogers et al. 2004). Herbaceous vegetation was composed of diverse annual and perennial forb communities, native grasses such as hooded windmill (*Chloris cucullata*), bristlegrass (*Setaria* spp.), and grama grasses (*Bouteloua* spp.), and exotic species such as buffelgrass (*Cenchrus ciliaris*) and Lehmann lovegrass (*Eragrostis lehmanniana*; Flanders et al. 2006). Prickly pear (*Opuntia* spp.) was common across much of the study area. The area had a dormant season cattle grazing program, but because of the dry winter and spring conditions during 2007–2008, no livestock had grazed the property for >12 mo before the wildfire. Prescribed fire was used as a management technique since 1996 with 0–1 600 ha burned/yr, although no prescribed fire had been applied after summer 2005. Above-ground portions of woody vegetation had been removed mechanically using a pasture aerator (large cylinder similar to a roller-chopper but with discontinuous, offset blades; see Rogers et al. 2004) from patches <10 ha in size and totaling 48 ha during 1998–2000 and an additional 119 ha in 2007. Supplemental feed had not been provided since the property was purchased by TPWD in 1969, although modest amounts of corn were used as bait during the hunting season.

Wildfire

During 14 March 2008, a large wildfire ignited south of the Chaparral WMA and burned on the area for 25–30 h beginning on the evening of 14 March. Complex burn patterns resulted from daytime and nighttime burns and winds changing from southerly, to northerly, and finally easterly. Forty-eight percent (1 267 ha) of the study area was intensively burned, such that all herbaceous material was burned and woody plants were either killed or the entire above-ground portion was consumed. Another 35% (926 ha) of the area was moderately burned, burning nearly all herbaceous material and top-killing woody vegetation but allowing extensive root sprouting. Seven percent (192 ha) of the area experienced low-intensity burning, generally consuming most herbaceous material, but usually causing only defoliation of woody plant species. The remaining 9% of the area was not burned.

Deer Samples

We harvested up to five female white-tailed deer by shooting with a rifle during each of six collection periods from 7 April 2008 to 20 June 2008. Deer were harvested as encountered while traversing the study area in a vehicle or on foot, or while waiting in blinds near water sources. We recorded dressed weight (viscera removed) of all harvested deer, estimated age using tooth replacement and wear (Severinghaus 1949), then collected reproductive tracts and recorded the number and size of fetuses. We counted corpora lutea in each ovary and used discrepancies between the number of fetuses and corpora lutea as an indication of fetal mortality. We evaluated body condition using the ratio of kidney fat to kidney weight (Riney 1955), percent weight of bone marrow remaining after drying at 100°C for 24 h (Harder and Kirkpatrick 1994), thickness of subcutaneous fat on the rump (measured after making an incision perpendicular to the body surface, through the skin and fat, into the underlying muscle), and a body condition index ranging from 1 (poor) to 5 (excellent) based on the prominence of the ribs, vertebra, and pelvis (adapted from Gerhart et al. 1996). We mixed and then collected rumen contents, which were used to assess deer diets by washing the contents over a 4-mm screen, separating the remaining material into forage classes (monocot, dicot, cactus, and mast), drying for 24 h at 100°C, and weighing material in each forage class. All female and two yearling male deer were used for food habits analysis.

Analysis

To assess growth patterns of fetuses, we compared average crown-rump length of all fetuses collected during a given period to the fetal length predicted at that collection date using the equation of Hamilton et al. (1985), assuming an average breeding date of 24 December (Williams et al. 1995). We used linear regression to assess temporal trends in dressed body weight and measures of body condition that were continuous variables. Declining trends were taken as evidence that deer were unable to meet nutrient requirements after the fire. Percent of each forage class in deer diets was averaged across deer within a period and presented graphically.

RESULTS

We harvested 26 female deer ranging in age from 1 to ≥ 3 yr of age (Table 1). Three 1-yr-old females were not pregnant. Of

Table 1. Body condition of female white-tailed deer 3–14 wk after a large wildfire on the Chaparral Wildlife Management Area, Texas, April–June 2008.

	Date of collection[a]												
	9 April		26 April		8 May		22 May		5 June		20 June		
Variable	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	*P* value[b]
Dressed weight (kg)	35	5.5	35	2.5	36	2.7	33	7.3	36	1.9	36	8.5	0.845
Rump fat thickness (mm)	2.8	2.6	1.0	2.0	0.7	0.6	2.6	1.9	0.4	0.6	1.4	2.1	0.432
Kidney fat (% of kidney)	26	13.2	21	18.2	16	8.3	20	10.7	23	12.1	13	7.9	0.277
Marrow (% dry weight)	58	22.9	70	2.1	72	6.6	59	24.2	71	7.0	ND[c]		0.425

[a]Sample size of deer, by date and deer age (1, 2, and ≥ 3 yr old): 9 April (0, 0, 4); 26 April (0, 0, 4); 8 May (0, 0, 3); 22 May (1, 1, 3); 5 June (0, 1, 4); 20 June (2, 0, 3).
[b]*P* value for the test that slope = 0 for the regression between each condition variable and days since 7 April 2008.
[c]No data.

gravid females, six had single fawns, 16 had twins, and one had triplets. Three females collected in mid to late May had two corpora lutea but only a single fetus; however, we saw no evidence of resorbed fetuses, suggesting the discrepancy may have occurred because of an implantation failure or early in gestation. Fetal growth rates matched closely with those predicted, suggesting fetal growth rates had not been adversely impacted (Fig. 1). None of the four body condition measures declined with time since the burn ($P \geq 0.277$; $r^2 \leq 0.05$; Table 1). Body condition scores were 2–3 for all deer harvested and did not show a clear pattern through time.

Three weeks after the wildfire, white-tailed deer primarily ate cactus and small amounts of newly emergent grass and forbs (Fig. 2). Cactus declined as forbs increased in the diet through late May. Mast, primarily mesquite pods and fruits of prickly pear and Texas persimmon (*Diospyros texana*), became available during June and composed 80% of the diet during the final collection period.

DISCUSSION

Female white-tailed deer appeared to maintain body condition and normal gestation despite an extensive spring wildfire and being unable to move off the study area. Three factors contributed to this outcome. First, white-tailed deer consume a wide variety of plant species and parts and thus are highly adaptable (Hewitt 2011). Rumen contents of deer clearly illustrated adaptability of deer on our study area as different forages became available after the fire. Prickly pear is important deer forage in southern Texas (Arnold and Drawe 1979; Everitt and Gonzalez 1979). The fire did not consume prickly pear, but instead scorched the pads, removed the thorns, and increased availability to deer. Cactus appeared to sustain the deer until newly emergent grasses, forbs, and shrubs appeared. These herbaceous and woody forages were consumed until mast appeared, 2–3 mo after the fire. Deer in the Chisos Mountains of western Texas also ate burned prickly pear followed by vegetation regrowth after a spring fire (Leopold and Krausman 2002). Although analysis of rumen contents can be biased against highly digestible forage classes such as forb leaves (Hewitt 2011), the large changes in forage class consumption we document are likely to be accurately represented.

The second reason female deer appeared to maintain body condition and pregnancy after the wildfire was that Tamaulipan thornscrub is highly resilient to disturbance and responds quickly to fire with regrowth that may be of higher nutritional quality than unburned plants (Rasmussen et al. 1983; Owens et al. 2002; Schindler et al. 2004). Furthermore, the Chaparral WMA had been managed using rotational dormant season grazing, prescribed fire, and mechanical brush treatment for > 9 yr before the fire. The resulting vegetation communities were not only diverse, providing many foraging options, but also may have been more resilient.

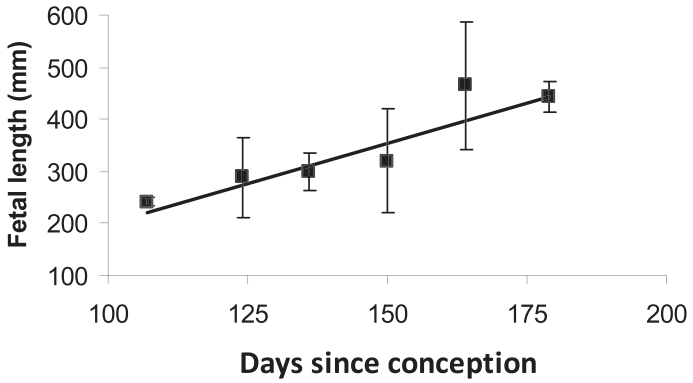

Figure 1. Crown-rump length (average and 95% CI) of fetuses from white-tailed deer collected in southern Texas after a large spring wildfire versus days since 24 December, the average date of conception for deer in this region. The solid line is the predicted size of fetuses using the equation of Hamilton et al. (1985).

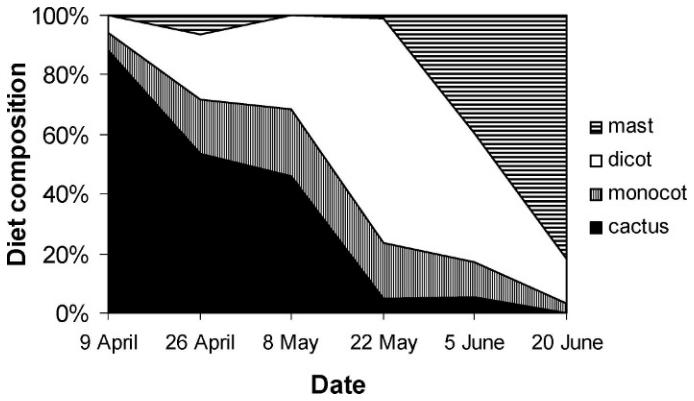

Figure 2. Diet composition of white-tailed deer based on analysis of rumen contents from deer collected during six periods after a 14–15 March 2008 wildfire in southern Texas.

A final factor influencing our results is that 11.8 cm of precipitation during late April–May 2008 enabled plants to grow from seed or unburned vegetative structures. Such succulent plant growth contains high concentrations of digestible energy and protein. If drought conditions had persisted through the summer of 2008, the wildfire may have had a larger effect on female deer body condition and reproduction.

Our ability to detect fire effects may have been influenced by our sample size, although dressed weight, marrow fat, and fetal growth patterns showed little trend, and larger samples would not likely have changed the results. Trends in kidney and rump fat may suggest a decline in body condition. Some of our condition measures may have differed by age class, but because young deer, which were likely smaller and had fewer reserves, were more prevalent in our sample during later periods, our data still suggest deer were able to maintain body condition.

IMPLICATIONS

Our findings suggest large spring wildfires are not necessarily detrimental to female white-tailed deer living in Tamaulipan thornscrub, and thus dramatic remedial actions, such as lowering deer density or supplemental feeding, are unnecessary. However, an adaptive management approach is suggested because differences in deer density, property size, and post-fire precipitation patterns could cause different outcomes.

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