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EFFECTS OF HURRICANE BRET ON NORTHERN BOBWHITE SURVIVAL IN SOUTH TEXAS

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ABSTRACT

The impacts of intense storms such as hurricanes on wildlife rarely are documented. We had the opportunity to monitor the impact of Hurricane Bret on northern bobwhite (*Colinus virginianus*) survival and reproduction in Brooks County, Texas. On 22 August 1999, Hurricane Bret struck our study area, which received >45 cm of rain and experienced wind gusts >160 km/h. We documented the survival of bobwhite adults ($n = 82$), broods ($n = 15$), and nests ($n = 4$) via radiotelemetry before and after the hurricane. Only 11 (13%) adult bobwhites were killed, with 4 killed directly from exposure to the hurricane. Broods experienced higher mortality, with 7 (47%) broods killed during the hurricane. Six of the 7 dead broods were <1 week old. Sizes of the 8 surviving broods were reduced from a mean brood size of about 11 chicks prior to the hurricane to a mean size of 4 after the hurricane ($P = 0.01$). Of the 4 nests monitored, 3 were depredated and eggs in 1 nest hatched the weekend of the storm. Hurricanes may negatively impact the survival of young (i.e., <2 weeks old) bobwhite broods.

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Key words: *Colinus virginianus*, hurricane, Hurricane Bret, mortality, northern bobwhite, survival, weather

INTRODUCTION

Natural disasters such as hurricanes are unpredictable, devastating phenomena. Hurricanes can generate winds >200 km/hr and torrential rain at a rate of 10 cm/hr. While their impact on physical structures (e.g., buildings, trees, etc.) may be readily assessed, the effects of hurricanes on wildlife remain obscure and relatively unknown. A few studies have reported the impacts of hurricanes on wildlife, namely wild turkeys (*Meleagris gallopavo*; Baumann et al. 1996) and white-tailed deer (*Odocoileus virginianus*; Labisky et al. 1999). However, to our knowledge, the effects of hurricanes on northern bobwhites have never been reported.

Hurricane Bret made landfall on the southern coast of Texas at Kennedy County on 22 August 1999 (Na-

tional Weather Service, Corpus Christi, Texas). The hurricane was classified as a Category 4 on the Saffir-Simpson Scale with peak winds of 224 km/hr. The hurricane deposited approximately 64 cm of rain in some coastal locations, but weakened as it moved westward over land.

The eye of Hurricane Bret passed over Brooks County where a radiotelemetry study on bobwhite population ecology has been ongoing since August 1998. We report the effects of Hurricane Bret on bobwhite survival based on our radiomarked population of bobwhites.

STUDY AREA

The study area is within the Rio Grande Plains ecoregion of Texas (Gould 1975). The vegetation for the ecoregion is characterized as a South Texas mixed-brush community (Scifres 1980:30). Vegetation specific to the study area consists predominantly of honey mesquite (*Prosopis glandulosa*), huisache (*Acacia*

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smallii), granjeno (*Celtis pallida*), live oak (*Quercus virginiana*), and pricklypear cactus (*Optunia lindheimeri*). Predominant forbs include croton (*Croton* spp.), sunflower (*Helianthus annuus*), dayflower (*Commelina erecta*), and partridge pea (*Chamaecrista fasciculata*). Predominant grasses include little bluestem (*Schizachyrium scoparium*), paspalum (*Paspalum* spp.), three awn (*Aristida* spp.), gulf cordgrass (*Spartina spartinae*), King Ranch bluestem (*Bothriochloa ischaemum*), Kleberg bluestem (*Dichanthium annulatum*), sandbur (*Cenchrus incertus*), red lovegrass (*Eragrostis secundiflora*), and buffelgrass (*Pennisetum ciliare*).

Climatic conditions are classified as semi-arid, subhumid and are characterized by a high rate of evaporation (National Cooperative Soil Survey 1987). The months of May and October receive the greatest amount of precipitation (8.6–10.4 cm), and the mean annual rainfall is 57.7 cm. The 30-year mean temperature is 22° C (range 15.2–28.8° C). January is the coldest month (mean 12.2° C), and August is the hottest month (mean 29.4° C).

METHODS

We captured bobwhites using standard funnel traps and night netting during spring and summer 1999 in Brooks County, Texas. Bobwhites weighing over 150 g were fitted with a 6–7 g neck-loop radio transmitter and an aluminum leg band. We monitored bobwhites using radiotelemetry at least twice weekly during spring (Mar–Apr) and thrice weekly during the nesting season (May–Aug). This allowed timely inspections of bobwhite mortalities, nest locations, and nest fate.

On the evening of 22 August 1999, Hurricane Bret moved inland, passing through Kennedy County into Brooks County. Adult bobwhites and broods were monitored prior to the hurricane on 21 August 1999. Once the hurricane had passed, we resumed monitoring on 24 August.

We compared the number of nests found during May–October of 1999 (hurricane data) with 2000 (no hurricane) to evaluate the influence of Hurricane Bret on length of the nesting season. We evaluated the effect of added moisture generated by Hurricane Bret on weather by comparing the Modified Palmer Drought Severity Index (PMDI) for these months between years. Palmer indices (Palmer 1965) use precipitation, temperature, Thornthwaite's (1948) evapotranspiration index, runoff, soil recharge, and average regional weather conditions to quantify departures from normal weather conditions. The values for PMDI can range from ≥ 4.0 (extreme wetness) to ≤ -4.0 (extreme drought). Near normal values range from about 1.50 to -1.50 . Weather data were obtained from the National Oceanic and Atmospheric Administration's (NOAA) National Climate Data Center (<http://www.ncdc.noaa.gov>).

Because of our low sample size (<100 radio-marked bobwhites), we emphasize descriptive statistics. However, we used paired *t*-tests (Ott 1992) to analyze the change in brood size before and after the

hurricane. We used Kruskal-Wallis one-way analysis of variance by ranks test (Daniel 1987) to compare brood age in days with brood fate. Statistical results are stated as ($x \pm SD$). We considered results significant at $\alpha = 0.05$.

RESULTS

Hurricane Bret moved over our study area during the late evening hours of 22 August 1999 depositing >45 cm of rain and producing wind gusts >160 km/hr. Because South Texas rangeland is relatively flat (i.e., elevation ranging about 0–300 m above sea level), this resulted in large expanses of rangeland inundated >24 cm deep. During the hurricane, we were monitoring a total of 82 adult bobwhites, 15 broods, and 4 active nests being incubated.

Adult bobwhites were not severely impacted by the storm. Eleven (13%) adult bobwhites were killed. Of these 11, 4 bobwhites were killed directly from exposure to the hurricane, apparently by drowning. We found these 4 bobwhites intact, floating in standing water. The remains of the other 7 bobwhites suggested they had been depredated (i.e., body not intact but rather dismembered). However, we are unsure if the 7 depredated bobwhites were killed by the hurricane and subsequently scavenged by predators.

Broods suffered a higher mortality than adults, with 7 (47%) broods killed during the hurricane. There was no difference in age between surviving broods (11.8 ± 7.8 days) and dead broods (6.3 ± 4.7 days; $P = 0.19$). However, 6 of the 7 broods that died were <1 week old. The 8 surviving broods experienced a 64% reduction in size. Brood size differed before (11.2 ± 2.2 chicks) and after (4.2 ± 3.1 chicks) the hurricane ($P = 0.01$).

Three of the 4 nests were depredated sometime during the hurricane (21–23 August 1999). The eggs of the remaining nest hatched between 21 and 23 August 1999. These chicks were the youngest brood being monitored and did not survive the hurricane. We found the brood on a small "island" (<30 cm in diameter) at the base of a mesquite tree that was surrounded by water over 25 cm deep. Brood remains suggested a raptor kill because only 8 sets of chick wings and 2 sets of adult leg bones were found. This was typical of an avian kill, as the carcasses had clipped wings and bones stripped of the muscle. Because the chicks were 1–2 days old during the hurricane and thus not capable of flying, it is likely that this brood sought refuge on this small island as the water level rose, thereby facilitating depredation. The juxtaposition in which other dead broods were found after Hurricane Bret is noteworthy. Dead broods usually were found drowned in standing water, with the attending adult dead <30 cm away from the brood.

Prior to the hurricane, we found 128 nests during April–August 1999 (pre-hurricane) and 7 nests during September–October 1999 (post-hurricane; Table 1). The eggs of the last nest hatched on 21 October 1999. During 2000, we found 39 nests during April–August

HURRICANE BRET AND BOBWHITE SURVIVAL

Table 1. Comparison of number of bobwhite nests found via radiomarked bobwhites and cumulative percentage of total nests during 1999 ($n = 217$ bobwhites) and 2000 ($n = 172$ bobwhites), Brooks County, Texas. Hurricane Bret moved across Brooks County on 22 August 1999.

Month	Year			
	1999		2000	
	<i>n</i>	Cumulative %	<i>n</i>	Cumulative %
April	19	14.1	0	0.0
May	27	34.1	14	35.9
June	31	57.0	16	76.9
July	27	77.0	8	97.4
August	24	94.8	1	100.0
September	2	96.3	0	—
October	5	100.0	0	—
Total	135	—	39	—

and 0 nests during September–October. The eggs of the last nest hatched 10 August 2000. Modified Palmer Drought Severity Index was higher (i.e., more moist conditions) during 1999 compared to 2000 (Fig. 1).

DISCUSSION

Our limited data suggest that Hurricane Bret did not severely impact adult bobwhite survival, whereas broods experienced lower survival. However, the impact of Hurricane Bret on bobwhite recruitment may have been minimal due to the timing of the hurricane relative to bobwhite nesting chronology.

Peak nesting season for south Texas bobwhites is May–July (Lehmann 1984:84–89). More than 50% of the nest production in our study area occurred during April–June 1999 based on radiomarked bobwhites. These first broods may represent about 52–73% of the fall age ratio (juveniles/adult; Guthery and Kuvlesky 1998). Because bobwhite chicks can withstand the elements at approximately 5 weeks of age (Stoddard 1931), most of the 1999 broods probably were old enough (i.e., 5–15 weeks) to survive the storm. Any broods lost to Hurricane Bret may represent only a small proportion of the overall bobwhite production.

One potential benefit of hurricanes is that the added moisture may help to extend the nesting season in south Texas. Bobwhite populations can exhibit extreme variations in productivity which have been correlated with patterns and amounts of precipitation and weather (Lehmann 1984, Guthery et al. 1988, Bridges et al. 2001). Guthery et al. (1988) reported a 2-month decrease in effective breeding season in the drier western Rio Grande Plains of Texas as compared to the more mesic eastern Rio Grande Plains. They stated that the virtual cessation of laying activity in the western Rio Grande Plains during the hottest, driest months of summer (Jul–Aug) probably reflected an adaptive response of bobwhites to the harsh conditions for laying and chick survival. Our limited data (i.e., nesting data and Modified Palmer Drought Index) indicate that the moisture and subsequent improved range conditions resulting from Hurricane Bret may have extended the nesting season during 1999 as compared to 2000.

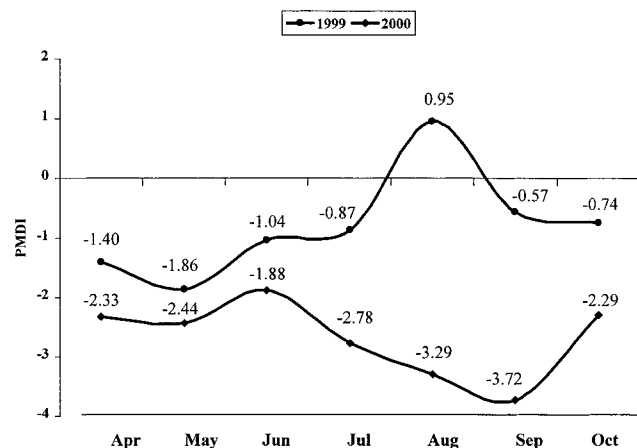


Fig. 1. Comparison of Modified Palmer Drought Severity Index (PMDI) between 1999 and 2000 during bobwhite nesting season, Brooks County, Texas. Hurricane Bret moved across Brooks County on 22 August 1999.

However, because we found drastically more nests during April–August 1999 as compared to 2000, the effects of Hurricane Bret on late nesting season (Sep–Oct) are likely confounded with other factors (e.g., heat, body condition, etc.).

We acknowledge that our low sample size and narrow scope limits our study. However, we believe our study provides insightful information on a relatively unknown subject.

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