REPRODUCTIVE ECOLOGY OF RIO GRANDE WILD TURKEY IN THE EDWARDS PLATEAU OF TEXAS

A Thesis

by

KYLE BRADY MELTON

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2007

Major Subject: Wildlife and Fisheries Sciences

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Approved by:

Co-Chairs of Committee, Nova J. Silvy
Markus J. Peterson
Committee Member, Fred E. Smeins
Head of Department, Thomas E. Lacher, Jr.

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ABSTRACT

Reproductive Ecology of Rio Grande Wild Turkey in the Edwards Plateau of Texas.

(December 2007)

Kyle Brady Melton, B.S., Texas A&M University

Co-Chairs of Advisory Committee: Dr. Nova J. Silvy
Dr. Markus J. Peterson

The abundance of Rio Grande wild turkeys (*Meleagris gallopavo intermedia*) in the southeastern Edwards Plateau of Texas has declined since the late 1970s. Because knowledge of reproductive rates is important to understanding the dynamics of a population, radio-tagged hens were monitored during the 2005–2007 reproductive seasons to evaluate and compare reproductive parameters from areas with both declining and stable population trends.

During January–March of 2005–2007, turkey hens were captured and radio-tagged on 4 study areas; 2 within a region of stable turkey populations, and 2 within a region of declining populations. Monitoring occurred from January–July each season to determine nest- site locations. Nesting attempts, nest fate, clutch size, initiation date, and nest age were recorded. Nests were monitored ≥3 times weekly in order to estimate production parameters and daily nest survival. Poults were captured by hand and fitted with a 1.2 glue-on transmitter and monitored daily to estimate daily survival.

Estimates show production was greater in stable regions than declining regions of the Edwards Plateau. Eighty-four percent of hens attempted to nest in the stable region

and 67% attempted in the declining region. Eighteen of 102 nests were successful (≥1 egg hatched), in the stable region and 7 of 60 nests were successful in the declining region. Nest-survival analysis showed an influence of temporal variation within years, yet no differences in nest survival were detected between stable and declining regions. Poult survival also showed no difference between regions.

The 2 overall objectives of this study were to determine if nesting parameters and nest survival were limiting factors in Rio Grande wild turkey abundance in the Edwards Plateau. Regional differences in production suggest the cause of the decline in the southeastern portion of the Edwards Plateau could be associated with lower reproductive output and consequently, success. Regional differences in nest survival were not detected, thus not likely to cause differences in turkey abundance between regions.

DEDICATION

I dedicate this work to my late father, James M. Melton, who always encouraged me to pursue my dreams and God. Thanks Pal!

ACKNOWLEDGEMENTS

A work such as this comes from no one individual. Only a cooperative effort combining experience could make it possible. The information within is an articulation of what I have learned over the years, yet few ideas are mine. That is what makes thanking others an important place to start as well as a blessing.

I would like to thank my committee co-chairs, Dr. Nova J. Silvy and Dr. Markus J. Peterson for their guidance and support throughout the course of my research. I am grateful for the opportunity to have been able to work with them and am indebted to them for their willingness to have me as a graduate student. I also would like to thank Dr. Fred E. Smeins, committee member, for his guidance both in the field and in the classroom, and for the time he took to be on my committee. I would especially like to thank Dr. Bret A. Collier for his guidance and patience with me. Over the years I have learned a great deal from each one and been influenced and enriched from their knowledge and friendship.

I thank Donnie Frels Jr. and the Kerr Wildlife Management Area staff, and Max Traweek and the Texas Parks and Wildlife Region II personnel for their assistance with trapping and field work. I would like to extend a special thanks to Ray Aguirre for all his assistance trapping, tracking, and help contacting landowners. Not to mention the occasional word of encouragement. I have been truly blessed to have worked along side them all.

I would be remiss if I did not thank my fellow turkey chasers Steve Metz, and Justin Dreibelbis. I am forever indebted to them both, not only for their labor but for their friendship as well. I must thank them for sharing in the pain and frustration of chasing turkeys. I also would like to thank my one and only intern, Carrie Koennecke for her efforts in collecting data during long, hot summer days.

Finally and most important, I wish to thank my family, they deserve more thanks than I can express. Their love, support and encouragement have been unwaning. Words cannot convey my appreciation, affection, and love to them all. Thank you!

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CHAPTER I

INTRODUCTION

Pre-European settlement, Rio Grande wild turkey (*Meleagris gallopavo intermedia*) numbers were estimated at 1.8 to 2 million individuals (Beasom and Wilson 1992). However, by the 1940s most of the population disappeared across their original range and ≤100,000 remained in Texas, with 64,000–70,000 in the Edwards Plateau (Walker 1950, Beasom and Wilson 1992). Since the 1970s, portions of the Edwards Plateau region experienced further decline in Rio Grande wild turkey abundance (Collier et al. 2007, Fig.1.1).

Changes in population trajectories in wildlife populations is of great concern to wildlife managers and requires valid estimates of factors influencing population dynamics in order to sustain populations properly. Multiple factors cause changes in natality, mortality, and movements within a population (Gotelli 1959). Natality is often the most important characteristic influencing population vitality and a major factor determining the potential yield from a population (Dasmann 1964). Since natality directly influences the recruitment rate of a population; it alone is of vital concern to wildlife researchers.

Recent work in the Edwards Plateau showed nesting habitat and vegetative characteristics to be similar between regions of stable and declining Rio Grande wild turkey populations (Randel et al. 2007), and work by Collier et al. (2007) indicated that

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This thesis follows the style of the Journal of Wildlife Management.

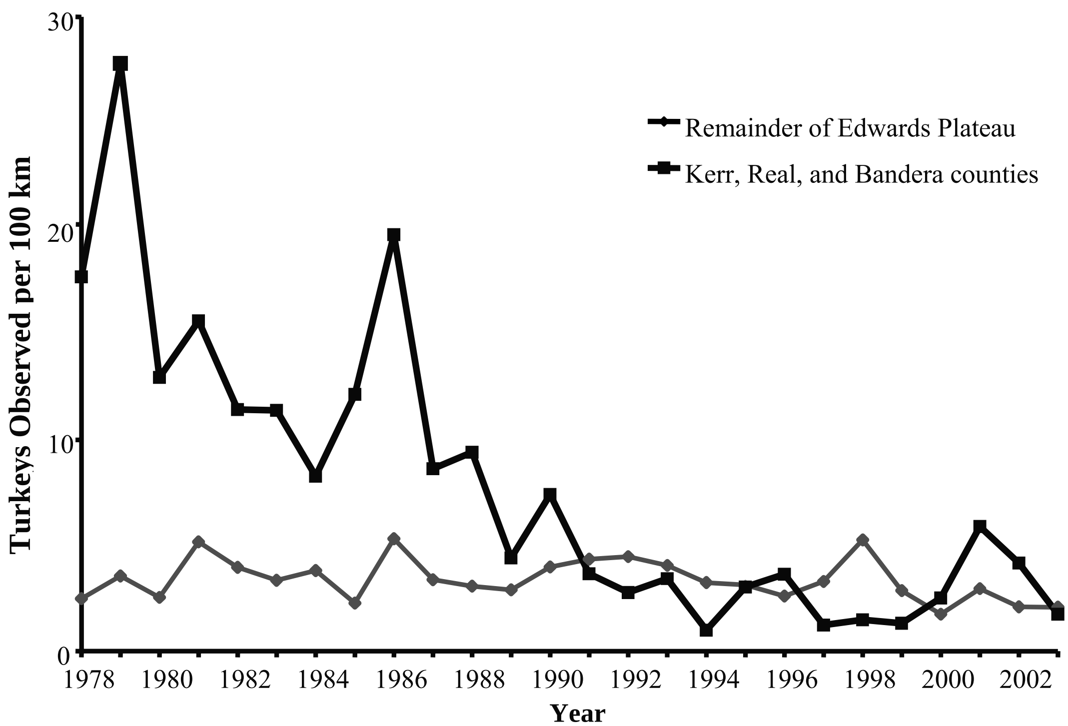

Figure 1.1. Number of Rio Grande wild turkeys observed per 100 km^2 by Texas Parks and Wildlife Department biologist during summer production surveys for Bandera, Kerr, and Real counties, and the remainder of the Edwards Plateau (excluding 12 counties averaging <1 turkey observed per 100 km^2), Texas, USA 1975–2003 (Collier et al. 2007).

survival was similar between regions. Thus, I evaluated reproductive parameters that may cause natality differences between regions. Objectives of this study were: (1) to determine if reproductive parameters and poult survival varied between stable and declining regions, (2) to determine if nest survival varied between stable and declining regions of the Edwards Plateau.

STUDY AREA

I conducted research on the Edwards Plateau region of Texas from January 2005 through July 2007 on 4 study areas; 2 representing the region with stable Rio Grande wild turkey abundance (Kerr and Real counties) and 2 representing the region with declining abundance (Bandera and Medina counties; Collier et al. 2007; Fig. 1.2). Stable areas included a privately owned working cattle ranch (4,843 ha) along with the Kerr Wildlife Management Area (2,627 ha) along the North Fork of the Guadalupe River approximately 20 km northwest of Hunt, Texas, and a privately owned game ranch (984 ha) located along the Frio River in Real County approximately 9.5 km north of Leakey, Texas. Declining areas included a corporately owned cattle ranch (8,858 ha) located along the Medina River in Bandera County, approximately 18.8 km northwest of Medina, Texas, and a privately owned working cattle ranch (2,910 ha) located in Bandera County approximately 17 km south of Bandera, Texas.

Study sites were rangelands managed for native and exotic game species with flat to rolling divides, shallow soils, and limestone bedrock (Gould 1975). Average precipitation ranged from 35 cm/yr in the western portion to 85 cm/yr in the eastern portion of the study area (Riskind and Diamond 1988). The climax vegetative community included various species of bluestem (*Andropogon spp.*), gramas (*Bouteloua spp.*), and panicum (*Panicum spp.*), in addition to mid and over-story species of Ashe juniper (*Juniperus ashei*), live oak (*Quercus virginiana fusiformes*), and shinnery oak (*Q. pungens vaseyana*) (Gould 1975). Livestock grazing occurred on all sites except for in Real County, and supplemental feeding for both native and exotic game species occurred in stable sites.

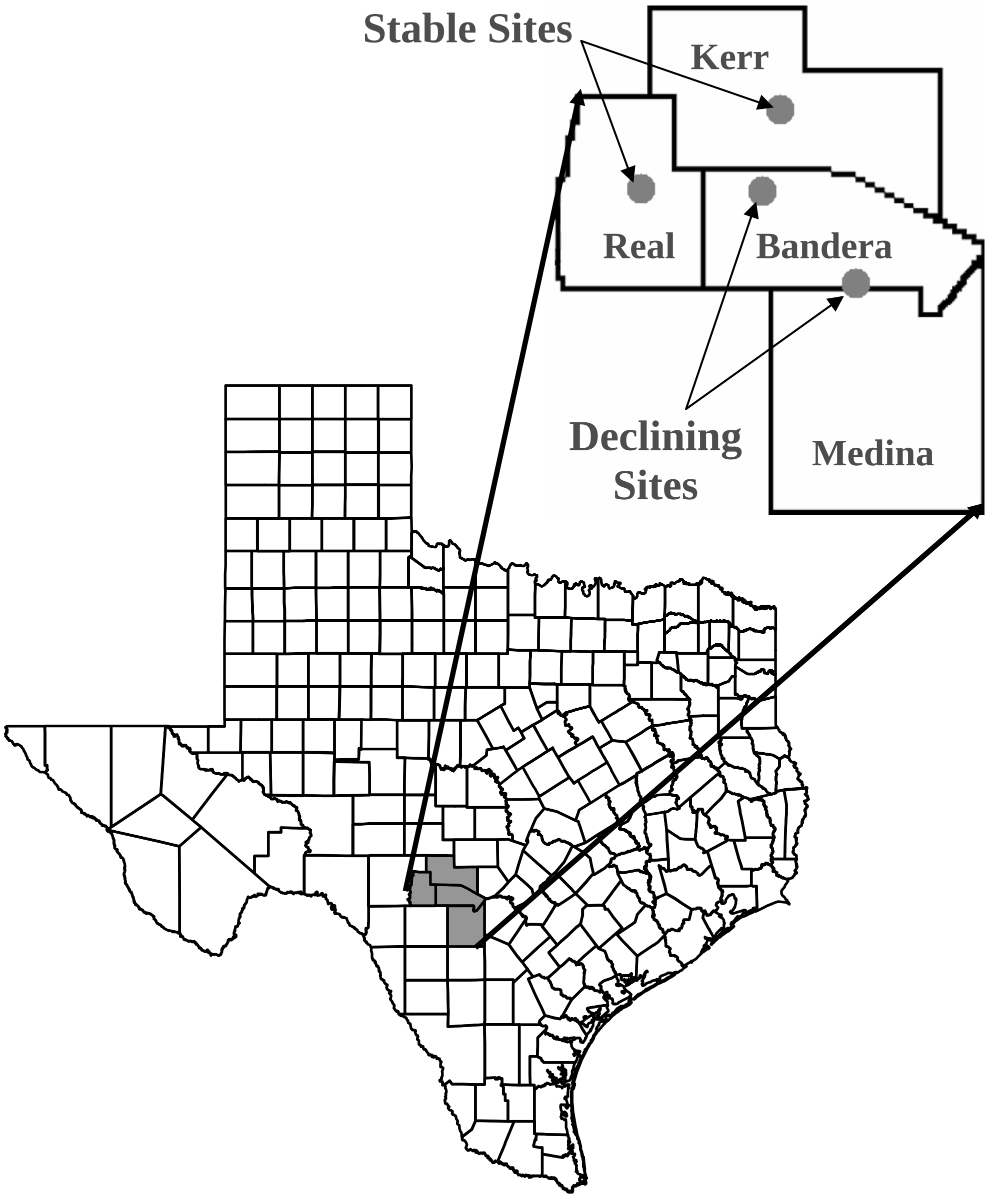

Figure 1.2. Location of study sites for Rio Grande wild turkey project in Edwards Plateau, Texas, 2005–2007.

CHAPTER II

REPRODUCTIVE PARAMETERS OF RIO GRANDE WILD TURKEYS ON THE EDWARDS PLATEAU OF TEXAS

Rio Grande wild turkey (*Meleagris gallopavo intermedia*) numbers were estimated at 1.8 to 2 million individuals pre-European settlement (Beasom and Wilson 1992). By the 1940s, however, populations in Kansas and Oklahoma disappeared and ≤100,000 remained in Texas (Walker 1950, Beasom and Wilson 1992) with strongholds in the Edwards Plateau centered on Kerr County (Walker 1954). Since the 1970s, portions of the southeastern region of the Edwards Plateau experienced further declines in Rio Grande wild turkey abundance (Collier et al. 2007). Multiple factors such as natality, mortality, and emigration could potentially cause numerical and structural changes within these populations (Everett et al. 1980). The mechanisms that caused this decline in Rio Grande wild turkey abundance in the southeastern Edwards Plateau are unknown.

Frequently in avian studies, natality research focuses on estimation of nest success and/or nest survival (Dinsmore et al. 2002, Shaffer 2004). However, evaluation of recruitment requires not only nest survival data, but also data on other reproductive parameters (e.g., clutch size, number hatched). Factors such as nesting chronology, where intra-year variability can delay nesting and influences renesting success (Vangilder et al. 1987), variation in percentage of hens nesting, and frequency and duration of nesting and renesting attempts all influence recruitment, thus affecting long-term viability of wild turkey populations (Everett et al. 1980, Reagan and Morgan 1980).

Recent research has shown survival of adult and juvenile turkeys was similar between regions of stable and declining Rio Grande wild turkey abundance on the Edwards Plateau (Collier et al. 2007). I evaluated reproductive parameters that may cause natality differences between regions. Here I report reproductive parameters and estimates of poult mortality for populations of Rio Grande wild turkeys characterized by 2 distinct trends in abundance.

METHODS

I captured Rio Grande wild turkeys during January–March in 2005–2007 using drop nets (Baldwin 1947, Glazener et al. 1964) and walk-in funnel traps (Davis 1994, Peterson et al. 2003) baited with whole shelled corn and milo. I sexed and aged (juv, ad) captured Rio Grande wild turkeys (Pelham and Dickson 1992) and classified juveniles as those individuals hatched the previous year (6–10 months old; Collier et al. 2007). I banded each individual with a unique Texas Parks and Wildlife Department (TPWD) aluminum leg band and fitted each with a backpack style radio transmitter (Advanced Telemetry Systems Inc., Isanti, Minnesota, USA). I monitored hens ≥3 times weekly (≥5 times weekly during nesting season) using ground triangulation and visualization (White and Garrot 1990).

I determined initiation of nesting and incubation by hen movement patterns (Ransom et al. 1987, Paisley et al. 1998, Nguyen et al. 2004). I located nests ≤1 day after we suspected hens were incubating to determine nest location (UTM), initiation date, clutch size, and approximate nest age. I floated eggs to determine approximate nest age (Westerskov 1950). For a subset of active nests, I placed a digital infrared trail camera (Game Spy 100, Moultrie Feeders, Alabaster, Alabama, USA) at the nest site to determine nesting behavior patterns as well as gather information on nest predation. I monitored nesting hens by triangulating ≥3 times weekly from a distance of ≥100 m to prevent further disturbance to the nesting area, and assumed if the hen locations remained constant the nest was still active. One week before estimated hatch date, I monitored nests daily to ensure capture of poults within 3 days of hatching.

I classified nests as successful if ≥1 egg hatched and unsuccessful if abandoned (hen left the nest area and eggs remained unhatched) or depredated (nest or eggs exhibited obvious signs of disturbance or destruction). I estimated nesting rate (the proportion of females monitored that attempted to nest) and hen success (the proportion of hens that had successful nests) for study areas regions characterized by stable versus declining turkey abundance.

I captured poults by hand ≤3 days of a nest hatching. During poult captures, I left ≥1 poult for the hen to call back (Hubbard et al. 1999). I weighed (g) each poult and fitted 1–4 poults from each brood with a 1.2 g glue-on transmitter (Advanced Telemetry Systems Inc, Isanti, Minnesota, USA), following the approach of Bowman et al. (2002) and Spears et al. (2005). I monitored poults at least once daily via radio telemetry and I visually located radio-tagged poults when possible. When radio signals or lack of movement suggested mortality, I located the poult and determined cause of death (e.g., predation, thermoregulation, starvation) based on physical evidence. I estimated poult survival for study areas regions characterized by stable versus declining turkey abundance using the Kaplan-Meier method (Pollock et al. 1989) implemented in R (R Core Development Team 2006).

RESULTS

I captured and radio-tagged 94 Rio Grande wild turkey hens during 2005–2007; 49 in the stable region and 45 in the declining region. Death of the hens, transmitter failure, or land access issues prevented me from monitoring 34 individuals during the reproductive seasons of my study. I also included 19 hens captured and radio-tagged during an earlier phase of the study. I monitored 45 hens for 1 nesting season, 25 for 2 nesting seasons and 9 for 3 nesting seasons and obtained reproductive information from 68 hens; 38 in the stable region and 30 in the declining region.

Twenty-five of 32 (78%) radio-tagged hens attempted to nest in the stable region in 2005 while 6 of 9 attempted to nest in the declining region. In 2006, 23 of 27 (85%) attempted to nest in the stable region compared to 11 of 24 (46%) in the declining region. In 2007, 17 of 18 hens attempted to nest in the stable region and 21 of 24 (87%) attempted in the declining region. Renesting frequency was higher in stable (9 of 19; 10 of 19, and 12 of 15) than declining (2 of 10, 2 of 10, and 14 of 19) during 2005–2007, respectively. I found little variation in the range of first nest incubation initiation dates between years; 11 April–29 May for 2005 (n = 31), 11 April–24 May for 2006 (n = 34), and 2 April–30 May for 2007 (n = 38). For all years combined, 78% of the monitored hens initiated nests in the stable region and 63% initiated nest in the declining region before 25 April (Fig. 2.1). Initiation of renest attempts varied widely and ranged from

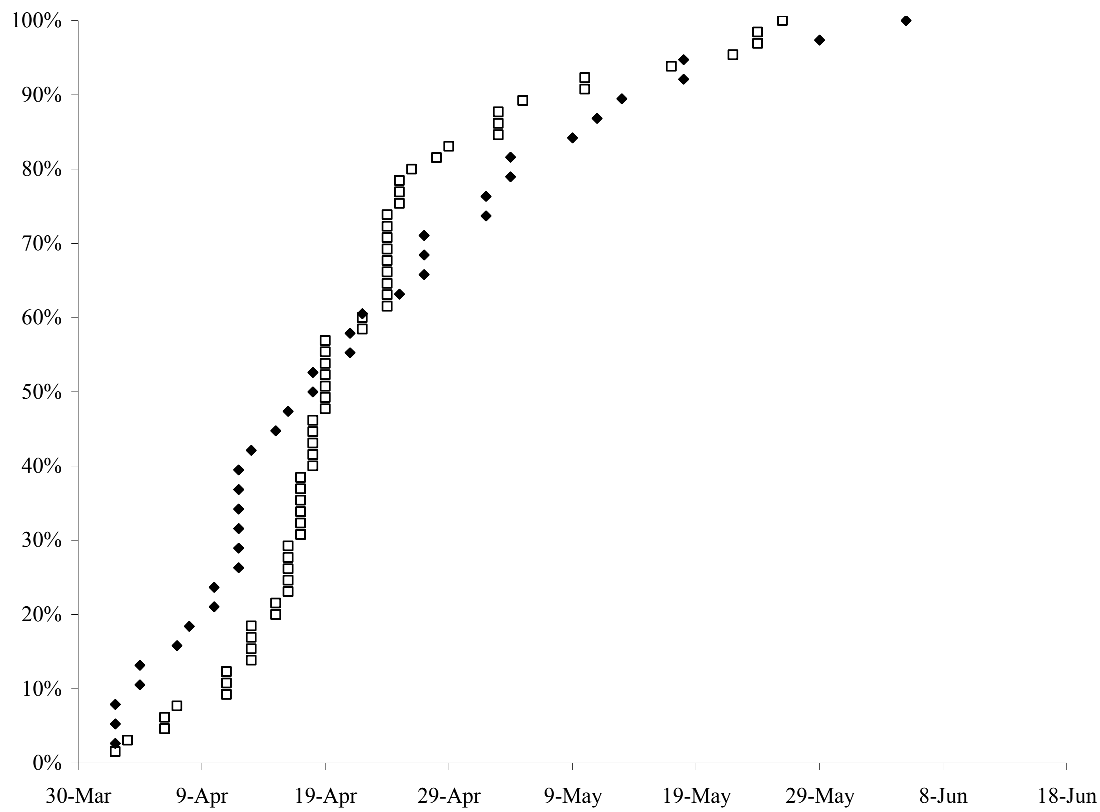

Figure 2.1. Date of initiation of Rio Grande wild turkey initial nest attempts with the stable and declining regions denoted by squares and diamonds, respectively, and graphed as a cumulative percent for radio-tracked turkeys on the Edwards Plateau, Texas, 2005–2007.

the 20 April–2 July (Fig. 2.2). Hatching dates ranged between 1 May and 4 June for initial nests and between 19 May and 27 July for renest attempts.

I obtained data from 162 nests, including 103 initial and 59 renesting attempts over the course of the study. Nest success varied between regions; 18 of 102 (17%) nests were successful in the stable region, and 7 of 60 (12%) were successful in the declining region (Table 2.1). Hen success also varied by region; 7 of 25 (28%) hens in 2005, 5 of 24 (21%) hens in 2006, and 6 of 17 hens in 2007 were successful in the stable region; while 1 of 6 in 2005, 1 of 11 in 2006, and 5 of 21 (24%) in 2007 were successful in the declining region. Clutch sizes averaged 10.9 (*SD* = 3.44, range 2–26) in the stable region and 10.8 (*SD* = 2.73, range 2–17) in the declining region. Average time spent incubating after nest location and before an event (i.e., hatch or nest depredation) was 15 days (range 3–32) for the stable region and 18 days (range 3–39) for the declining region. Predation was the primary cause of nest failure, accounting for 65 and 67% of loss in the stable and declining regions, respectively (Table 2.2). I captured photographic evidence that raccoons (*Procyon lotor*), skunks (*Mephitis mephitis, Siplogale spp.*), gray foxes (*Urocyon cinereoargenteus*), feral hogs (*Sus scrofa*), snakes (*Elaphe spp.*), and ravens (*Corvus corax*) were active nest predators.

I followed 24 broods (9 in 2005, 5 in 2006, and 10 in 2007) and radio-marked 33 of 64 captured poults during the 2005 and 2006 seasons. Ninety-four percent of all observed mortality of radio-tagged poults occurred before the crucial 10–14 days post hatch period. During the 2005 and 2006 seasons, 3 of 14 broods survived to 2 weeks of age; however, brood size dropped in all occasions from 11 poults to 1 poult. Flush

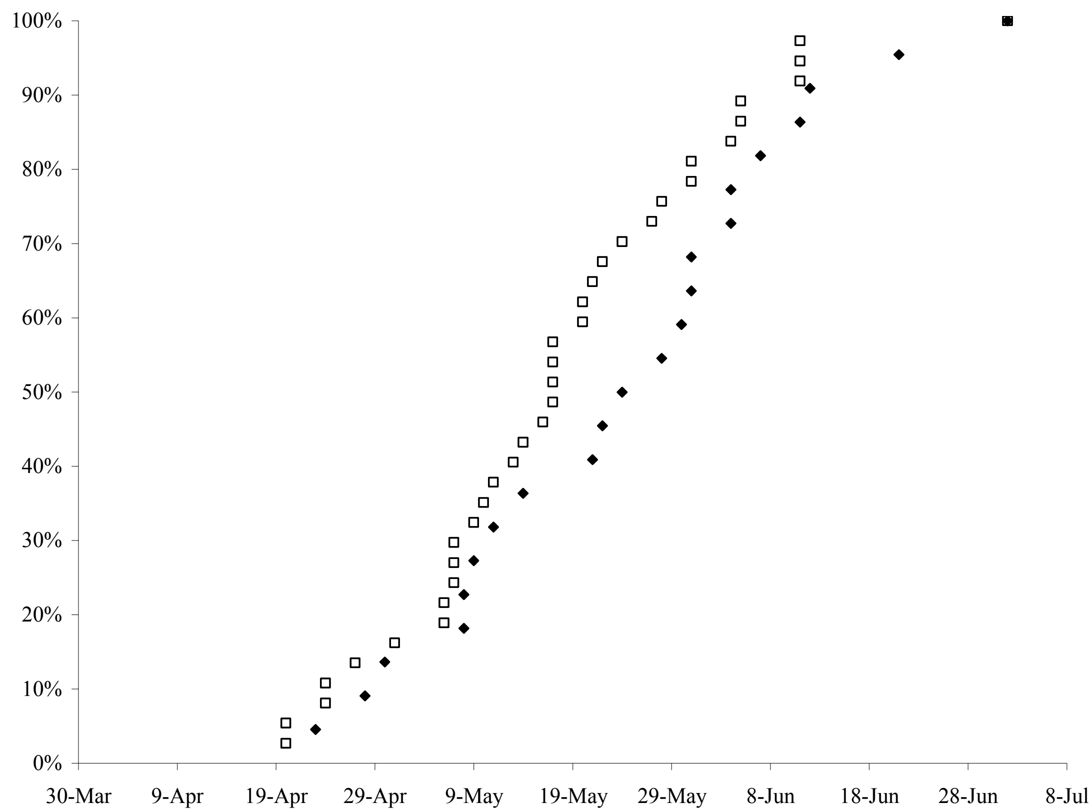

Figure 2.2. Date of initiation of Rio Grande wild turkey renest attempts with the stable and declining regions denoted by squares and diamonds, respectively, and graphed as a cumulative percent for radio-tracked turkeys on the Edwards Plateau, Texas, 2005–2007.

Table 2.1. Number of successful initial nests and renests of Rio Grande wild turkey hens by year and region, Edwards Plateau, Texas, 2005–2007.

		Initial success	Renest success
2005			
	Stable	6 (*n* = 25)	1 (*n* = 11)
	Declining	1 (*n* = 6)	0 (*n* = 2)
2006			
	Stable	4 (*n* = 23)	1 (*n* = 11)
	Declining	1 (*n* = 11)	0 (*n* = 2)
2007			
	Stable	2 (*n* = 17)	4 (*n* = 15)
	Declining	2 (*n* = 21)	3 (*n* = 18)
Total			
	Stable	12 (*n* = 65)	6 (*n* = 37)
	Declining	4 (*n* = 38)	3 (*n* = 22)

Table 2.2. Number (percentage) of Rio Grande wild turkey nests depredated or abandoned by year and region, Edwards Plateau, Texas, 2005–2007.

		Predated	Abandoned
2005			
	Stable (*n* = 36)	24 (67)	5 (14)
	Declining (*n* = 8)	7 (88)	0 (0)
2006			
	Stable (*n* = 34)	23 (68)	6 (18)
	Declining (*n* = 13)	6 (46)	6 (46)
2007			
	Stable (*n* = 32)	19 (59)	7 (22)
	Declining (*n* = 39)	27 (69)	7 (18)
Total			
	Stable (*n* = 102)	66 (65)	18 (18)
	Declining (*n* = 60)	40 (67)	13 (22)

counts on radio-monitored hens that had successfully hatched a clutch indicated that no poults survived the 2005 season and only 1 unmarked poult survived the 2006 season. Flush counts during the 2007 season showed 7 of 10 monitored broods survived to 2 weeks of age with 16 poults surviving the season.

Radio-tagged poults survived on average 6 days (range 2–18; Fig 2.3). Observed causes of poult mortality were predation (17/33), followed by inclement weather (5/33), with remaining causes of death (11/33) unknown. On 2 occasions, 1 week apart, I found a poult transmitter from different monitored broods in the same red-tailed hawks' (*Buteo jamaicensis*) nest. I also witnessed a coach-whip snake (*Masticophis flagellum testaceus*) consuming an unmarked poult from another monitored brood.

DISCUSSION

My data are consistent with the hypothesis that declining Rio Grande wild turkey abundance observed in the southeastern Edwards Plateau was likely caused by lower production potential (percentage of hens nesting) rather than the more commonly measured reproductive variables (nest survival, clutch size, etc.) than in the northwestern portion of the Plateau. I found production potential was lower in declining regions than in stable regions each year. I documented 17 and 12% nest success over the course of my study in the stable and declining regions, respectively. For a 3 year period (2001–2003), Randel et al. (2007) estimated nest success in the Edwards Plateau at 35% across both stable and declining regions. However, nest success fluctuated from 17–47% in the stable region and from 15–56% in the declining region (Randel et al. 2007).

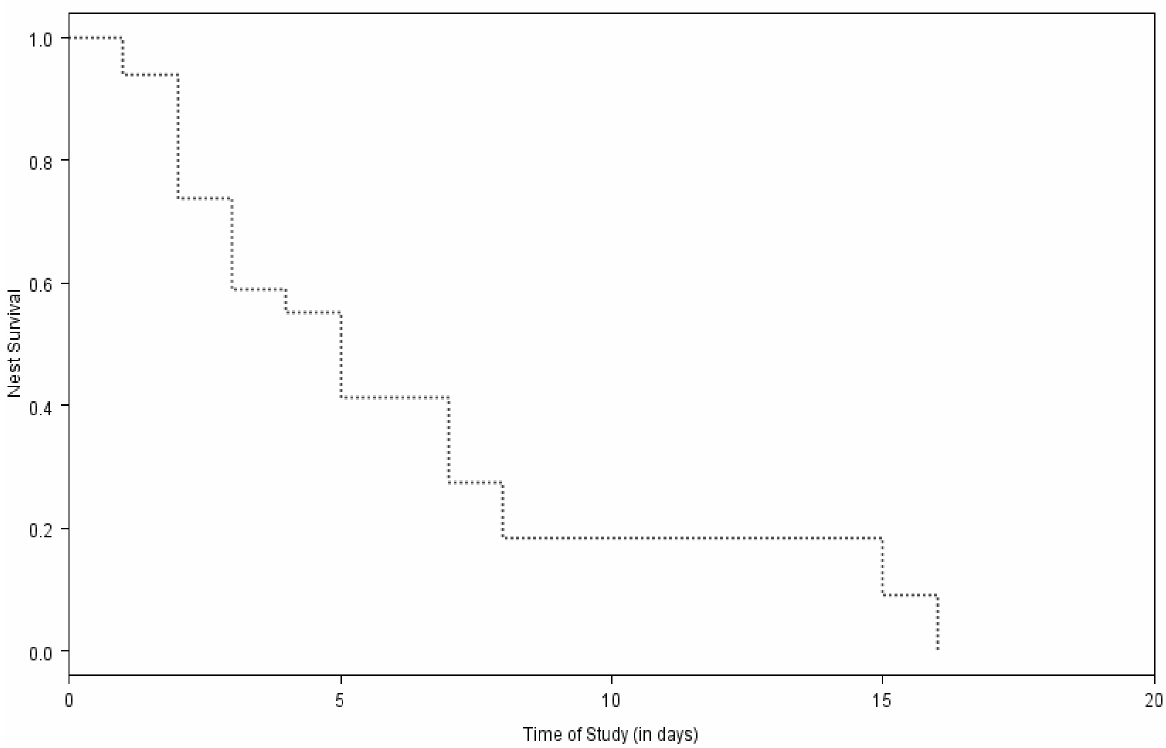

Figure 2.3. Kaplan Meier survival curve for Rio Grande wild turkey poults (*n* = 33) radio-tagged on the Edwards Plateau, Texas, 2005–2006.

Cook (1972) estimated Rio Grande wild turkey nest success at 39% on the Edwards Plateau from 1968 through 1971. However, the methods (incidental locations) used by Cook (1972) to locate nests could have limited detectability of depredated nests, thus leading to overestimates of nest success. Both Reagan and Morgan (1980) and Hohensee and Wallace (2001) estimated nest success at 23 and 35%, respectively, in Texas, while Schmutz and Braun (1989) found 50% nest success for Rio Grande wild turkeys outside their historic range in Colorado. Thus, Rio Grande wild turkey nest success during my study was lower than previously published estimates.

Low reproductive output in wild turkeys often is attributed to nutritional deficiencies (Pattee and Beasom 1979, Roberts and Porter 1998). Production variation between stable and declining regions may result from differences in the nutritional status of hens between supplementally fed and unfed regions (stable and declining regions, respectively). Pattee and Beasom (1979) reported approximately 230% more hens with poults and approximately 270% more poults in supplementally fed areas than unfed areas. Production potential, nest success, and hen success percentages were all higher in the stable, supplementally fed, region compared to the declining, unfed, region, suggesting supplemental feeding regimes currently implemented in the stable regions increased production potential in the stable region.

Further, nutritional deficiencies may result from variation in spring phenology (Vangilder and Kurzejeski 1995). I found similar nest initiation ranges and nesting chronology in both stable and declining regions; however, a lower portion of hens in the declining region than in the stable region initiated nests during the peak period (Fig 2.1.).

The peak period of nest initiation for first nests ranged from 2 to 25 April and the peak hatching period ranged from 6 to 21 May. Similarly, Bailey and Rinell (1967) noted peak hatching dates for Rio Grande wild turkeys along the costal plains of Texas occurred from 5 to 15 May. Beasom (1970) found the peak hatching period ranged from 27 April to 25 May in south Texas while Cook (1972) reported the peak hatching dates for first nest attempts in the Edwards Plateau occurred the first week in June. Peak nest initiation and hatching periods were similar to those reported by previous studies, suggesting that variation in nesting chronology was unlikely to have influenced the decline in Rio Grande wild turkey abundance in the southeastern Edwards Plateau.

Nutritional deficiencies in nesting Rio Grande wild turkeys have been attributed to droughts (e.g., Markley 1967, Beasom and Pattee 1980, Melton et al. 2008). During my study, both 2005 and 2006 were drought years, but 2007 was characterized by an unusually wet spring and summer. I recorded higher nest success, more renest attempts, higher hen success, and higher poult survival during the 2007 season for both stable and declining regions than during 2005 and 2006, similar to Cook (1972). Hohensee and Wallace (2001) noted poor nest productivity during years characterized by less precipitation while Beasom and Pattee (1980) speculated soil moisture related to late summer and early fall rainfall was a key factor determining Rio Grande wild turkey production. Further, Schwertner et al. (2005) found the cumulative effects of precipitation over several months, rather than during any given month, was the best predictor of turkey production in the Edwards Plateau. Although a complex suite of weather variables undoubtedly influence annual wild turkey production (Porter and

Gefell 1996), precipitation assuredly is important in semi-arid regions such as the Edwards Plateau of Texas.

Another influence on wild turkey productivity is predation (Walker 1949, Vander Haegen et al. 1988). Predation was the primary cause of nest failure in my study, accounting for two-thirds of total nest lost in the stable and declining regions. Cook (1972) noted nest predation accounted for 44% of all Rio Grande wild turkey nest failures in the Edwards Plateau while Reagan and Morgan (1980) documented that 56% of nests were predated. I found little difference in predation rates between regions; however, as two-thirds of nest failed due to predation, nest predation may be more important than previously documented.

Lower nest success and lower hen success coupled with nest predation rates higher than previously recorded (Cook 1972, Reagan and Morgan 1980) likely contributed to the decline in Rio Grande wild turkey abundance in the southeastern Edwards Plateau since the late 1970s. Differences in production potential between regions are presumably a factor of nutritional status. Numerous factors influence nutritional status of Rio Grande wild turkey hens, precipitation and subsequent changes in breeding season phenology could be important predictors for production of Rio Grande wild turkeys in semi-arid regions such as the Edwards Plateau of Texas.

CHAPTER III

NEST SURVIVAL OF RIO GRANDE WILD TURKEYS ON THE EDWARDS PLATEAU OF TEXAS

Changes in population trajectories of wildlife populations are of great concern to managers and require valid estimates of parameters for monitoring and management planning. Many factors cause changes in natality, mortality, and movements within a population (Gotelli 1959). Natality is often the most important characteristic underlying population vitality and determining potential yield from a population (Dasmann 1964). Since natality affects population recruitment it is often the focus of wildlife research. For many species, nest survival is one component of natality (Berner and Gysel 1969, Rusch 1989, Dinsmore et al. 2002, Shaffer 2004) and a potential predictor of population vitality. Understanding how variation in nest survival affects natality is necessary for developing sound management strategies for avian species.

Nest survival is a determinant of recruitment in many grouse populations (Ryan et al. 1998, Tirpak et al. 2006). Given the importance of nest survival to bird populations, galliform recruitment may be limited by nest survival more than other avian species because of the vulnerability of ground nests. For wild turkeys (*Meleagris gallopavo*), nest survival is one critical demographic parameter influencing population size and growth (Roberts and Porter 1998). Wild turkey nest survival is affected by several factors, including precipitation (Roberts and Porter 1998) and nest cover (Badyaev 1995), and possibly factors that influence other ground nesting birds such as nesting chronology (Fields et al. 2006).

Pre-European settlement, Rio Grande wild turkey (*Meleagris gallopavo intermedia*) numbers were estimated at 1.8 to 2 million individuals (Beasom and Wilson 1992). However, by the 1940s most populations disappeared from their original range and ≤100,000 remained in Texas, with 64,000–70,000 in the Edwards Plateau (Walker 1950, Beasom and Wilson 1992). Since the 1970s, portions of the Edwards Plateau region experienced further declines in Rio Grande wild turkey abundance (Collier et al. 2007). Recent work in the Edwards Plateau showed nesting habitat and vegetative characteristics to be similar between regions of stable and declining Rio Grande wild turkey populations (Randel et al. 2007), and work by Collier et al. (2007) indicated that adult and juvenile survival was similar between regions. Collier et al. (2007) hypothesized natality as one probable factor causing the decline; thus, I focused on evaluating potential factors causing variation in nest survival that may cause natality differences between regions.

METHODS

I captured Rio Grande wild turkeys during Jan–Mar from 2005 through 2007 using drop nets (Baldwin 1947) and walk-in funnel traps (Davis 1994, Peterson et al. 2003) baited with whole shelled corn and milo. I sexed and aged captured Rio Grande wild turkeys (Pelham and Dickson 1992) classifying juveniles as those individuals which hatched the previous year (6-10 months old; Collier et al. 2007). I banded each individual with a unique TPWD aluminum leg band and fitted each with a backpack style radio transmitter (Advanced Telemetry Systems Inc, Isanti, Minnesota, USA). I monitored hens ≥3 times weekly to determined initiation of nesting and incubation by hen movement patterns (Ransom et al. 1987, Paisley et al. 1998, Nguyen et al. 2004). I located nests <1 day after I suspected hens had begun incubating to determine nest location (UTM), initiation date, and approximate nest age by floating eggs (Westerskov 1950). I monitored nesting hens by triangulating ≥3 times weekly from a distance of ≥100 m to prevent further disturbance to the nesting area, and assumed if the hen locations remained constant the nest was still active. I determined nest fate only when the hen was no longer in the general area of the nest. I defined the active nesting period as 39 days; 28 days incubation + 1day/egg in an average clutch size of 11 (Bailey and Rinnell 1967). I classified nests as successful if ≥1 egg hatched and unsuccessful if abandoned (hen left the nest area and eggs remained unhatched), or depredated (nest or eggs exhibited obvious signs of disturbance or destruction).

I combined nests information from a previous study during 2001–2004 with my data. I placed nests monitored over 7 nesting seasons (2001–2007) into groups (region and year). Because of low nest numbers due to drought conditions and fewer marked birds during 2002–2004, I combined those nesting years, resulting in 10 groups (Table 3.1). I standardized 2 April as day 1 of the nesting season and considered 28 July the last day of the nesting period. Because data collection was intensive during 2005–2007, I developed and modeled 2 independent datasets. First, using the data collected between 2001 and 2007, I modeled temporal patterns focused on evaluating inter- and intra-year variation in nest survival (Table 3.2). Based on my experience tracking hens during 2001–2007, I partitioned the breeding season into temporal frames based on temporal patterns within nest initiation dates (e.g., Hartke et al. 2006; Fig 3.1). Next, using data

Table 3.1. Description of nesting Rio Grande wild turkey hen groups based on data collected on the Edwards Plateau of Texas during 2001–2007 for nest survival modeling in program MARK.

Model Groups	**Group description**
1	Nests found in the stable region in 2001
2	Nests found in the declining region in 2001
3	Nests found in the stable region during 2002–2004
4	Nests found in the declining region during 2002–2004
5	Nests found in the stable region in 2005
6	Nests found in the declining region in 2005
7	Nests found in the stable region in 2006
8	Nests found in the declining region in 2006
9	Nest found in the stable region in 2007
10	Nest found in the declining region in 2007

Table 3.2. Notation and description of temporal models used to estimate nest survival of Rio Grande wild turkey nests in Edwards Plateau, Texas, 2001–2007.

Model notation	Model description
DSR_{region}	Daily nest survival differs by region, constant within region
DSR_{group}	Daily nest survival differs by year and region, constant within year and region
DSR_{2007}	Daily nest survival differs by first 6 years (2001–2006) and last year (2007)
$DSR_{20,97}$	Daily nest survival differs by first 20 days and last 97 days, constant among years and within temporal periods
$DSR_{2007\ 20,97}$	Daily nest survival differs by first 6 years (2001–2006) and last year (2007) and by first 20 days and last 97 days
$DSR_{year\ 20,97}$	Daily nest survival differs by year and by first 20 days and last 97 days
$DSR_{region\ 20,97}$	Daily nest survival differs by region and by first 20 and last 97 days within region, constant within temporal periods
$DSR_{group\ 20,97}$	Daily nest survival differs by year, by region and by first 20 days and last 97 days, constant within temporal periods
$DSR_{20,30,67}$	Daily nest survival differs by first 20, next 30 and last 67 days, constant among years and within temporal periods

Table 3.2. Continued.

Model notation	Model description
DSR $_{2007\ 20,\ 30,\ 67}$	Daily nest survival differs by first 6 years (2001–2006) and last year (2007) and by first 20 days, next 30 and last 67 days
DSR $_{year\ 20,30,67}$	Daily nest survival differs by year and by first 20 days, next 30 and last 67, constant within region, year, and temporal periods
DSR $_{region\ 20,30,67}$	Daily nest survival differs by region and by first 20, next 30 and last 67 days within region, constant within temporal periods
DSR $_{group\ 20,30,67}$	Daily nest survival differs by year, by region and by first 20 days, next 30 and last 67 days, constant within year, region, and temporal periods

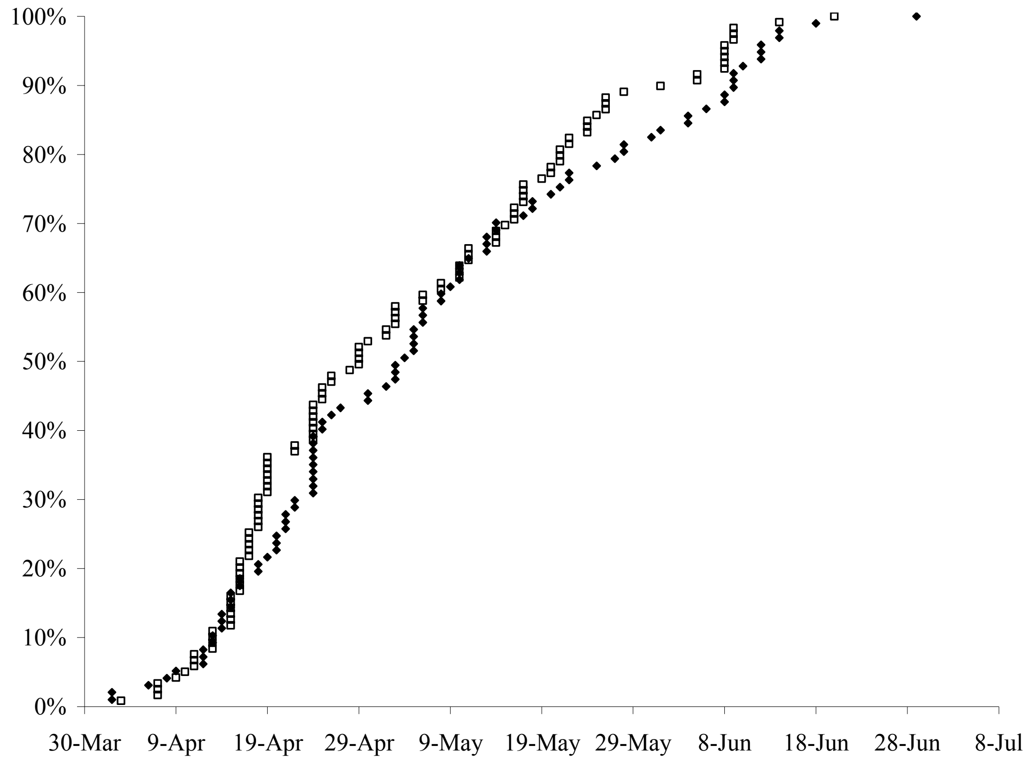

Fig 3.1. Date of Rio Grande wild turkey nest initiation for stable and declining regions denoted by squares and diamonds, respectively, and graphed by cumulative percent Edwards Plateau, Texas, 2001–2007.

from my intensive study of hen reproductive ecology (2005–2007), I evaluated nest- and hen-specific information I hypothesized affected nest survival. For the nest- and hen-specific data, I examined age cohort (juv, ad), hen age since capture (1–5), prior nesting (hen nested the year before), prior success (hen successfully hatched a nest the year before), and nest attempt all as individual covariates. I also evaluated percentage of the radio-tagged population attempting to nest relative to all radio-tagged hens (Table 3.3). All analyses were conducted using program MARK (White and Burnham 1999).

RESULTS

Three hundred four Rio Grande wild turkey hens were captured and radio-marked over 7 seasons; 170 in the stable region and 134 in the declining region. Hen mortality, transmitter failure, or land access issues prevented 43 individuals from being monitored during the reproductive season. One-hundred four hens were monitored for 1 nesting season, 94 hens for 2 nesting seasons, 43 hens for 3 nesting seasons, 16 hens for 4 nesting seasons, and 4 hens for 5 nesting seasons. During the 7 nesting seasons, 244 nests were monitored; 42 in 2001, 40 in 2002–2004, 44 in 2005, 47 in 2006, and 71 in 2007. Of the 244 nests, 136 nests were in the stable region and 108 in the declining region. Initial nest attempts ranged from 2 April–30 May and renest attempts ranged from 20 April–2 July, with 50% of all nesting attempts occurring before 26 April. Forty-six (19%) nests successfully hatched, 29 (12%) were abandoned, and 169 (69%) were depredated.

The best temporal approximating model ($DSR_{20, 97}$; $w_j = 0.29$) indicated that nest survival varied between temporal periods within a year (Table 3.4). This model

Table 3.3. Notation and description of models used to estimate nest survival of Rio Grande wild turkey nests in Edwards Plateau, Texas, 2005–2007.

Model notation	Model description
$DSR_{Attempt}$	Daily nest survival differs by nest attempt
$DSR_{\%Attempt}$	Daily nest survival differs by % of population attempting to nest
$DSR_{NestPrior}$	Daily nest survival differs by individuals with prior nesting experience
$DSR_{Success}$	Daily nest survival differs by individual with prior year success
DSR_{HenAge}	Daily nest survival differs by hens age
DSR_{Cohort}	Daily nest survival differs by age cohort
DSR_{Region}	Daily nest survival differs by region
$DSR_{NestPrior, Success}$	Daily nest survival differs by prior year nesting and prior year success
$DSR_{Region, Attempt}$	Daily nest survival differs by region and attempt
$DSR_{Region, HenAge}$	Daily nest survival differs by region and hen age
$DSR_{Region, NestPrior}$	Daily nest survival differs by region and nesting year prior
$DSR_{Region, Success}$	Daily nest survival differs by region and year prior success

Table 3.3. Continued.

Model notation	Model description
DSR $_{Region, Cohort}$	Daily nest survival differs by region and age cohort
DSR $_{Region, \%Attempt}$	Daily nest survival differs by region and % attempting to nest
DSR $_{\%Attempt*Region}$	Daily nest survival differs according to the interaction between region and % attempting to nest
DSR $_{Cohort*Region}$	Daily nest survival differs according to the interaction between cohort and region
DSR $_{HenAge*\%Attempt}$	Daily nest survival differs according to the interaction between hen age and % attempting to nest
DSR $_{Attempt*Cohort}$	Daily nest survival differs according to the interaction between nest attempt and cohort
DSR $_{Region, HenAge*\%Attempt}$	Daily nest survival differs by region according to the interaction between hen age and % attempting to nest
DSR $_{Region, Attempt*Cohort}$	Daily nest survival differs by region according to the interaction between nest attempt and cohort

Table 3.4. Plausible candidate models used to estimate daily nest survival rates for the temporal evaluation of Rio Grande wild turkey nests on the Edwards Plateau of Texas, 2001–2007.

Model	*k*	-2LogL	ΔAIC_c	w_i
DSR $_{20,97}$	2	862.01	0.00	0.29
DSR $_{2007}$	2	862.28	0.27	0.25
DSR $_{20,30,67}$	3	861.46	1.46	0.14
DSR $_{Region}$	2	864.02	2.01	0.11
DSR $_{2007\ 20,\ 97}$	4	860.54	2.54	0.08
DSR $_{Year\ 20,\ 97}$	10	849.22	3.29	0.06
DSR $_{Region\ 20,97}$	4	861.56	3.56	0.05
DSR $_{2007\ 20,\ 30,\ 67}$	6	859.45	5.47	0.02
DSR $_{Region\ 20,\ 30,\ 67}$	6	860.89	6.92	0.01
DSR $_{Year\ 20,\ 30,\ 67}$	15	844.55	8.74	0.00
DSR $_{group}$	10	855.98	10.06	0.00
DSR $_{group\ 20,\ 97}$	19	844.92	17.22	0.00
DSR $_{group\ 20,\ 30,\ 67}$	29	834.62	27.32	0.00

suggested a 2-period trend in variation in nest survival (the first 20 days of the season and the last 97 days of the season). Model averaged daily nest-survival for both periods was 0.92 (SE = 0.02, 95% CI = 0.84, 0.97), and 0.94 (SE = 0.005, 95% CI =0.93, 0.95), respectively. I found some evidence of model selection uncertainty as models accounting for variation between 2007 and all other years, as well as a 3 period temporal model also were supported. However, my nest survival estimates showed little variation between 2007 and other years (2001–2006), 0.93 (SE = 0.01, 95% CI = 0.90, 0.94) and 0.94 (SE = 0.01, 95% CI = 0.93, 0.95), respectively. The probability of a nest surviving 39 days in 2007 was 0.059% while from 2001–2006 it was 0.089.

Using the candidate models for nest- and hen- specific covariates, an interaction between hen age and percent attempting to nest was the best fitting model (Table 3.5). Daily nest survival increased as hen age increases and percent attempting increased (Table 3.6). Models developed to evaluate regional variation in nest survival between stable and declining areas were within the range of models considered plausible. However, based on the parameter estimates, there was little evidence for a region effect with survival of 0.93 (SE = 0.01; 95% CI = 0.91, 0.94) and 0.92 (SE = 0.01; 95% CI = 0.89, 0.94) for stable and declining regions, respectively.

DISCUSSION

My data are inconsistent with the hypothesis that declining Rio Grande wild turkey abundance observed in the southeastern Edwards Plateau was caused by lower nest survival than in the northwestern Edwards Plateau. I found little variation in nest survival between regions with models associated with hen-and nest- specific variables,

Table 3.5. Individual covariate models selection results for Rio Grande wild turkey nest survival Edwards Plateau, Texas, 2005–2007.

Model	*k*	-2LogL	ΔAIC_c	w_i
$DSR_{HenAge * \%Attempt}$	2	562.77	0.00	0.12
DSR_{HenAge}	2	563.21	0.43	0.10
$DSR_{\%Attempt}$	2	563.21	0.44	0.10
$DSR_{NestPrior}$	2	563.63	0.86	0.08
DSR_{Region}	2	563.96	1.19	0.07
$DSR_{Attempt}$	2	564.17	1.40	0.06
$DSR_{Attempt*Cohort}$	2	564.18	1.40	0.06
$DSR_{Success}$	2	564.19	1.42	0.06
$DSR_{Region, HenAge*\%Attempt}$	3	562.33	1.56	0.06
DSR_{Cohort}	2	564.48	1.71	0.05
$DSR_{Region, HenAge}$	3	562.61	1.84	0.05

Table 3.6. Daily nest survival estimates for Rio Grande wild turkey nest characterized by hen age and % population attempting to nest on Edwards Plateau, Texas, 2005–2007.

	% Attempting		
Hen Age	20	60	100
1	0.911 (95% CI = 0.88, 0.94)	0.915 (95% CI = 0.89, 0.93)	0.920 (95% CI = 0.90,0.93)
2	0.913 (95% CI = 0.88, 0.93)	0.921 (95% CI = 0.90, 0.93)	0.929 (95% CI = 0.91, 0.94)
3	0.915 (95% CI = 0.89, 0.93)	0.927 (95% CI = 0.91, 0.94)	0.938 (95% CI = 0.91, 0.95)
4	0.917 (95% CI = 0.89, 0.93)	0.933 (95% CI = 0.91, 0.95)	0.945 (95% CI = 0.91, 0.97)
5	0.920 (95% CI = 0.90, 0.93)	0.938 (95% CI = 0.91, 0.95)	0.952 (95% CI = 0.90, 0.98)

however, all models associated with hen- and nest- specific variables had ΔAIC ≤2; making inferences uncertain. Model uncertainty indicated these variables were poor predictors of nest survival, supporting the contention that factors such as temporal variation drive Rio Grande wild turkey nest survival and ultimately production.

My analysis of variation in nest survival for 2001–2007 indicated nest survival of Rio Grande wild turkeys was influenced by nesting chronology. Nest initiated during the first 20 days of the season had lower survival than those initiated during the last 97 days of the season. My data indicates that 40% of nesting attempts occurred during the first 20 days (Fig 5.1.). A saturation of nesting attempts in a short duration could potentially increase predator awareness and search efficiency, thus causing higher nest predation during the initial nesting period. However, I found similar predation rates across periods, 80 and 78% for first 20 and last 97 days, respectively. Nest survival is though to be attempt specific (Larson et al. 2003), so nest survival for renests could be higher than initial nests if the birds gain experience. However, I found no evidence that nesting attempt influenced nest survival.

Variation in nest survival suggests that Rio Grande wild turkey populations follow a boom-bust cycles such as other ground nesting birds (Beasom and Pattee 1980, Guthery et al. 1988, Healy 1992). Precipitation is often thought to be the dominant influence on boom-bust cycles (Lehmann 1946, Hernandez and Peterson 2007), has been noted as an influential factor in wild turkey reproductive trends (Thomas and Green 1957, DeArment 1959, Beasom and Pattee 1980, Schwertner et al. 2005), and has been shown to influence nest survival (Dinsmore and Dinsmore 2007). An unusually wet spring and summer occurred in 2007, however, nest survival was lower during 2007 than other years. Although I did not monitor precipitation, it could potentially affect nest survival by flooding nests (DeArment 1959, Zwank et al. 1988), facilitating predation (Palmer et al. 1993, Roberts and Porter 1998) or by altering vegetative cover (Beasom 1973, Fuhlendorf et al. 2001).

My results indicate that variation in nest survival between region likely did not caused the decline in Rio Grande wild turkey abundance in the southeastern Edwards Plateau, as variables influencing Rio Grande wild turkey nest survival influenced nest survival in a constant manner across all regions of the Edwards Plateau. The decline is likely attributed to variation in production potential between regions. Nest survival was lower in the stable region than in the declining region, however, production potential was higher in the stable region than in the declining region.

CHAPTER IV

POULT ADOPTION AND NEST ABANDONMENT BY A FEMALE RIO GRANDE WILD TURKEY IN TEXAS*

Species such as gulls (*Larus* spp.), terns (*Sterna* spp.), and geese (*Branta* spp.), readily adopt offspring (Pierottie and Murphy 1987, Saino et al. 1994, Larsson et al. 1995). Northern bobwhites (*Colinus virginianus*) utilize brood abandonment and adoption as a strategy for increasing nesting opportunities (Burger et al. 1995, DeMaso et al. 1997), but documented cases of gallinaceous birds adopting offspring are rare (Martin 1989, Mills and Rumble 1991). Adoption of poults by Merriam's wild turkeys (*Meleagris gallopavo merriami*) has been described (Mills and Rumble 1991), and Healy (1992) reported nest abandonment by a captive hen that was attracted to the calls of another brood. In May 2005, I observed a Rio Grande wild turkey (*M. g. intermedia*) hen adopt a poult and then abandon her own nest in Kerr County, Texas. To our knowledge, adoption in conjunction with nest abandonment has not been documented before in the wild.

As part of a study to evaluate the reproductive ecology of Rio Grande wild turkeys in Texas, I tracked a radio-tagged juvenile hen through two nesting attempts on the Kerr Wildlife Management Area in Kerr County (30° 04' N, 99° 20' W), Texas. On 11 April 2005 I found her first nest, which contained 13 eggs, and estimated nest age at 3

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days. On 15 April, the nest was depredated, and the hen subsequently renested on 28 April. After 28 April, I checked the hen's nesting status $\geq$5 times per week. On 7 May, the second nest contained 12 eggs and nearby I set up an infrared trail camera (Game Spy 100, Moultrie Feeders, Alabaster, Alabama, USA) to monitor the nest. From 8-21 May, I never observed the hen off the nest, and, based on my intensive tracking of the hen, there was no possibility that she hatched this poult several days early.

At 1600 hours CST on 21 May, I found the hen incubating her second nest. On the following day at 1100 hours, I located the hen about 600 m from the nest. I approached to ~15 m of the hen and observed her bedded down in a grassy area dominated by little bluestem (*Schizachyrium scoparium*). Upon further approach, she flushed. Within about 1 min, a poult, estimated to be 4 days old, ran from the grassy area where the hen had been bedded. I then examined the hen's nest and found all 12 eggs present and intact. I also floated the eggs and estimated that they were at day 23 of incubation (Healy 1992).

On 23 May, I relocated the radio-tagged hen in an effort to catch and radio-tag the poult; however, the hen was moving and I was unable to locate the poult. On the following day, the hen was relocated again, this time with the poult. On 26 May, I captured the poult, estimated its age as 9 days, radio-tagged it with a 1.2-g poult transmitter (Bowman et al. 2002; Advanced Telemetry Systems, Isanti, Minnesota), and released it.

Other than anecdotal evidence and the article by Mills and Rumble (1991), there is little available information on the frequency of adoption in wild turkeys. Whereas

Mills and Rumble (1991) reported poult adoption by turkey hens both with and without existing broods, the hen I observed had abandoned her clutch of 12 eggs after considerable investment (≥20 days of incubation) to care for a single poult. While such cases of abandonment and adoption are probably rare, my observations indicate that it can occur in Rio Grande wild turkeys. Possible causes might include hen physiological condition or changes in photoperiod (Scanes et al. 1979, Youngren et al. 1993, Bedecarrats et al. 1997, Sharp et al. 1998). The hen I observed was in the latter stages of incubation on a second nest when the adoption event occurred; thus, her levels of luteinizing hormone and prolactin may have changed sufficiently to promote behavioral changes (i.e., poult-rearing behavior in preference to continued incubation). Additional research is needed to clarify what might trigger simultaneous poult adoption and nest abandonment in turkeys.

CHAPTER V

ABNORMAL EGGS IN RIO GRANDE WILD TURKEY ON THE EDWARDS PLATEAU, TEXAS*

Knowledge of reproductive rates is critical to monitoring long-term dynamics of wild turkey (*Meleagris gallopavo*) populations (Vangilder 1992). Reproductive rates are influenced by multiple components of the reproductive process. Runt eggs, those having volumes <75% of the average (Koenig 1980), are perhaps the most common egg abnormality documented in domestic fowl (Pearl and Curtis 1916, Romanoff and Romanoff 1949). Several avian species, both domestic and wild, have been known to produce runt eggs (Hernandez et al. 2006), but occurrence is low for most species; approximately 1 in every 1,000–2,000 eggs (Mallory et al. 2004, Hernandez et al. 2006). Documentation in wild populations is rare (Rothstein 1973, Mallory et al. 2004). Here I report what I believe is the first observation of runt egg production by wild turkeys.

OBSERVATIONS

I tracked, via triangulation and homing (White and Garrot 1990), 11 radio-marked wild turkey hens through 2 nesting seasons (2005–2006) on a 984-ha ranch ~ 9.5-km north of Leakey, Texas, USA. One of these radio-tagged hens produced runt eggs during 3 consecutive nesting attempts (2 in 2005, 1 in 2006). This 3.7-kg hen was captured on 24 February 2004 as an adult (≥18 months of age). She produced a clutch of

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five eggs in 2004 with no abnormal appearing eggs.

I first observed a set of runt eggs on 13 April 2005 during the hen's initial nesting attempt. The first nest contained 3 runt eggs and 1 normal egg. Normal laying behavior for turkeys is to lay 1 egg per day (Healy 1992). Daily checks when the hen was off the nest confirmed that no additional eggs were laid until 18 April when 1 additional runt egg was laid (total clutch; 4 runt eggs, 1 normal egg). I continued to monitor the nest daily from 18 to 27 April during which time I did not locate the hen on the nest although she was located in the nest area. I observed 1 additional runt egg, on 28 April, bringing the clutch size to 6 (5 runt eggs and 1 normal egg). One additional runt egg was deposited between 28 April and 1 May bringing the total clutch to 7 (6 runt eggs and 1 normal egg). The normal-sized egg was depredated on 2 May and only 6 runt eggs remained. I considered the nest depredated on 4 May when the remaining eggs were found hidden under leaf litter (undamaged) in separate locations away from the nest. I collected the runt eggs, measured size and volume, and ascertained if they were viable.

I continued to radio-track the hen and documented a second nesting attempt on 30 May 2005 containing 4 runt eggs. During monitoring of the renesting attempt, the hen abandoned the nest. Within 1 week she was located >1 km from the nest and she was not observed near the nest again. I collected the 3 runt eggs on 9 June 2005 to check viability and to obtain measurements. I documented a third nest the following year by this hen on 19 April 2006, containing 12 runt eggs and 4 normal eggs. I monitored the nest and hen daily through 14 days of incubation, finding the nest partly depredated on 3 May 2006. I collected shell remains from 10 depredated eggs (8 runt eggs and 2 normal).

During my study, I located 90 nests from 69 individual hens during 2005–2006 and obtained clutch sizes for 70 nest (*n* = 885 eggs). Based on my data, runt eggs in wild turkeys occurred at a frequency of 2.4% (21/885). I measured length (mm), width (mm), mass (g), and volume (ml) using water displacement for undamaged runt eggs (*n* = 7) and undamaged/unhatched normal eggs (*n* = 176) collected during 2005–2006 (Table 5.1). Mean mass and volume of the runt eggs was 44% of normal eggs; 31% smaller than the suggested size for classifying eggs as runts (Koenig 1980). None of the runt eggs contained yolks, making them unviable.

DISCUSSION

Production of runt eggs is usually thought to be caused by a temporary disturbance to the reproductive system (Pearl and Curtis 1916, Romanoff and Romanoff 1949). Moreover, birds under environmental stress may be more prone to produce runt eggs (Mallory et al. 2004). Turkey reproduction and, therefore, egg production is negatively effected by low rainfall and soil moisture (Beasom and Pattee 1980) as well as nutritional limitation (Blankenship 1992). Continual production of runt eggs suggests a congenital defect or permanent injury to the bird's oviduct (Pearl and Curtis 1916, Mulvihill 1987). Though the frequency of runt eggs in wild turkeys is low, persisting environmental stresses presumably could alter the frequency of runt egg production consequently lowering the population's production. However, based on my data the low prevalence of runt eggs suggests that the impact of runt egg production on population trajectory is probably limited.

Table 5.1. Characteristics of normal and runt Rio Grande wild turkey eggs on the Edwards Plateau, Texas 2005–2006.

	n	Min	Max	Mean	SD
Normal					
Length, mm	176	53.4	65.6	61.0	0.19
Width, mm	176	40.7	72.0	47.1	0.24
Weight, g	176	47.4	85.1	68.7	6.46
Volume, ml	161	27.5	55.0	43.6	4.62
Runt					
Length, mm	7	39.2	49.5	44.7	0.39
Width, mm	7	33.4	37.5	35.5	0.17
Weight, g	7	23.6	34.2	30.3	3.79
Volume, ml	4	16.5	22.0	19.3	3.18

CHAPTER VI

CONCLUSIONS

Study objectives were to determine whether Rio Grande wild turkey reproductive parameters, poult survival, or nest survival varied between stable and declining regions and whether variation between regions could account for the decline in Rio Grande wild turkey abundance in southeastern Edwards Plateau. Production potential varied between regions with lower production occurring in the declining region than in the stable region. Spring phenology had little influence on production, however, supplemental feeding regimes implemented in the stable region for native and exotic game species likely contributed to higher production in the stable region than in the declining region. Lower nest success and lower hen success coupled with nest predation rates higher than previously recorded could have contributed to the decline in Rio Grande wild turkey abundance in southeastern Edwards Plateau.

Poult survival did not differ between regions. Ninety-four percent of all observed mortality of radio-tagged poults occurred before the crucial 10–14 days post hatch period. Over the 3 seasons, 17 poults survived, 1 in 2006 and 16 in 2007. Predation accounted for the majority of poult mortality (17/33) followed by inclement weather (5/33). Poult survival likely had little influence on the decline in southeastern Edwards Plateau.

Rio Grande wild turkey neat survival was driven by temporal variations. Nest initiated in the first 20 days of the season had lower survival than nest initiated in the last 97 days of the nesting season. Further, nest survival was lower in 2007 than in other years (2001–2006). Temporal variation in nest survival may result from variation in spring phenology and precipitation from year to year. Nest survival models associated with hen- and nest-specific variables showed variation in nest survival between regions. Daily nest survival rates were lower in the stable region (0.93, SE = 0.01) than in the declining region (0.94, SE = 0.01). This variation in nest survival between regions is inconsistent with the hypothesis that the decline in abundance in the southeastern Edwards Plateau was caused by lower nest survival in the declining region than in the stable region. Variation in nest survival between regions may result from differences in supplemental feeding regimes between regions. Supplemental feeding in the stable region, while no supplemental feeding in the declining regions, could account for higher production and lower nest survival in the stable region than in the declining region. Cooper and Ginnett (2000) recorded 86% of nest were depredated in supplementally fed areas while 57% of nest were depredated in unfed areas, indicating supplement feeding for native and exotic game species increased nest predation. However, nest predation rates were similar between regions during my study.

Nest survival likely had little influence on the decline in southeastern Edwards Plateau, singling the variation in production potential between regions as the cause for the decline. Altered frequency in runt egg production could consequently lower the population's production. However, given the frequency of runt egg production, the impact of runt egg production on the population trajectory is limited. Further, nest abandonment in conjunction with poult adoption is a rare occurrence and likely has little influence in population trajectory as well. Factors contributing to low Rio Grande wild turkey production in the declining region could be predation and nutritional deficiencies. Numerous factors influence nutritional status of Rio Grande wild turkey hens. Precipitation and changes in breeding season phenology could be important predictors for production and nest survival. Management practices that promote vegetative forage and cover for wild turkeys (i.e., grazing management, prescribed fire) could promote greater Rio Grande wild turkey production in the southeastern Edwards Plateau.

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