Post-capture Survival of Wild Turkeys: Effects of Age, Sex and Environment

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Abstract: Effects of capture on study animals requires thorough examination. We investigated effects of age, sex, and environmental conditions on probability of eastern wild turkey (*Meleagris gallopavo silvestris*) post-capture survival in central Mississippi during winter and summer capture periods, 1984–1995. Females were more likely to die from capture-induced stress than males during winter capture; adult hens were more likely to die than subadult hens during summer. Survival rates of hens captured versus those not captured in a given period were similar. Environmental conditions did not affect probability of death from capture stress. We recommend researchers and managers, when possible, curtail trapping during periods of extreme cold or heat and that researchers quantify human-induced mortalities of research animals.

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The assumption that the capture process does not differentially affect study animals among capture periods or among cohorts is fundamental to data derived from capture of wild animals. However, McMahon and Johnson (1980), Clark (1985), and Spraker et al. (1987) determined capture stress affected survival of wild turkeys (*Melaegris gallopavo*). Miller (1990) reported that attachment of radio-transmitter and environmental change influenced survival rates of translocated eastern wild turkeys (*M. g. silvestris*). However, these studies were conducted on relocated turkeys that may have experienced additional stress from being transported and released into a new area. None of these studies examined survival of wild turkeys captured and subsequently released at the capture site.

In east-central Mississippi, some component of the capture process reduced wild turkey reproductive success, biasing reproductive estimates derived from radio-tagged turkeys (Weinstein et al. 1995). If survival is likewise affected by capture, the underlying assumption that capture does not affect a turkey's survival probability, inherent to survival analyses using radio-tagged animals, will be violated. Furthermore, increasing public awareness of wildlife issues and research necessitates justification for research techniques and quantification of adverse effects on study animals. Our objectives were to investigate effect of summer (Jul–Aug) and winter (Jan–Mar) capture on susceptibility of wild turkey sex and age classes (adult and subadult, males and females) to capture-induced mortality and to determine if capture affected survival rates of radio-tagged hens successfully released after capture.

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Methods

Study Area

We conducted the study on the 14,410-ha Tallahala Wildlife Management Area (TWMA) located in the Bienville National Forest in parts of Scott, Newton, Jasper, and Smith counties, Mississippi. It was located in the Lower Coastal Plain Province and the Blackland Prairie Resource Area (Pettry 1977). Most (95%) of TWMA was forested with 30% in mature bottomland hardwood forests, 37% in mature pine (*Pinus* spp.) forests, 17% in mature mixed pine-hardwood forests (30%–70% pine) and 11% in 1- to 14-year-old loblolly pine (*P. taeda*) plantations.

Turkey Capture

We captured wild turkeys by cannon net (Bailey 1976) or with alphachloralose (Williams et al. 1966) from 7 January to 4 March (WINCAP) and 1 July to 25 August (SUMCAP), 1984–1995. For both capture procedures, we used cracked corn for bait. We removed cannon-netted turkeys from the net and placed them in cardboard boxes sized for wild turkeys (76.2 cm × 35.6 cm × 61 cm). Turkeys were sexed, classified as adults or subadults (Williams and Austin 1988), and marked with 2 patagial wing tags (Knowlton et al. 1964) and 2 metal, triple-lock leg bands. We fitted most turkeys with 108 g, motion-sensitive, backpack radio-transmitters (Wildl. Materials, Carbondale, Ill.) and released them at capture sites. Cannon-netted turkeys were released within 10–45 minutes of capture. We transported tranquilized turkeys to TWMA headquarters for marking and recovery and released them the next day. Turkeys were captured and radio-tagged as part of an ongoing study of wild turkey ecology.

Data Analysis

On TWMA a complete mast (*Quercus* spp.) failure occurred during fall/winter of 1984–85 and 1987–88 (Seiss 1989, Palmer et al. 1993, Hurst 1995). Additionally, the worst drought in Mississippi history, during which 37% below-average precipitation was recorded, occurred during summer 1987–summer 1988 (Seiss 1989, Hurst 1992, 1995). We wanted to determine if adverse environmental conditions may have caused turkeys to be more susceptible to trap-related mortality. Therefore, we divided capture periods into "normal" years and "adverse" years. For these analyses, adverse periods occurred during summer 1987 and 1988 (drought effect), winter 1985 (mast failure effect) and winter 1988 (both drought and mast failure effects).

We tested the hypotheses that (1) proportion of turkeys dying from capture stress was equal between capture techniques (alphachloralose and cannon net), (2) proportion of turkeys dying from capture stress did not differ with respect to cohorts (adult and subadult males and females) within adverse or normal years between SUMCAP and WINCAP and (3) survival of radio-tagged hens released from capture did not differ from hens previously captured. We used the binomial test of 2 proportions (BTTP) to test the first hypothesis at $\alpha = 0.10$. We considered turkeys killed at the capture site and radio-tagged turkeys found dead within 5 days of capture as trap-related mortality. Because proficiency of turkey capture personnel may have differed, we excluded turkeys that were killed from obvious injury (e.g., hit by cannon net, broken wing, drowned, over-dosed). This was done to include only those turkeys that probably died of capture stress. We did not include juveniles (turkeys hatched that spring) because they were only captured during summer. For the second hypothesis, we used a log-linear model (Fienberg 1977) to test for significant interactions, with respect to proportion of turkeys dying from capture stress, among cohorts, capture period and year (normal vs. adverse) at $\alpha = 0.10$. If significant interactions were detected, Fisher's Exact Test (Daniel 1990) was used to test for differences in frequency of trap-related mortalities between age/sex groups within interacting factors. Method of capture was not included in the overall log-linear model because alphachloralose was not used uniformly over all years resulting in empty cells within the log-linear analysis.

For the third hypothesis, we calculated hen survival rates for SUMCAP hens, WINCAP hens, and hens not captured during particular summer (NOTSUM hens) or winter (NOTWIN) capture periods. For example, NOTSUM 1989 included all hens captured previous to summer 1989 that were radio-monitored during the 1989 summer capture period. We estimated survival rates using the Kaplan-Meier staggered entry design (Pollock et al. 1989). All captured hens released with a transmitter were included in analyses. We calculated hen survival rates for 180 days for SUMCAP and NOTSUM hens and 120 days for WINCAP and NOTWIN hens. These intervals were chosen to prevent calculating a survival rate for a hen captured in 2 consecutive periods. Within intervals, we wished to determine at what time (e.g., 30 days post-capture, 60 days post-capture, etc.) survival rates between groups (SUMCAP vs. NOTSUM and WINCAP vs. NOTWIN) attained equality. Therefore, we tested survival rates for significance ($\alpha = 0.10$) every 30 days within each period within years using generalized chi-squared hypothesis testing (Sauer and Williams 1989). To investigate effects of capture for a set time period after capture, all hens were back-dated to the same day. Hens retained number of days at risk but were analyzed as if they were all captured the same day so that number of days post-capture was the same for all hens.

Only those capture intervals when at least 10 hens were available were used for survival analyses. We did not use a lag-time between capture and beginning of radio-monitoring. We used only adult hens for survival analyses because adult and subadult hens on TWMA have different survival rates (D. A. Miller, unpubl. data). Gobbler survival rates were not estimated because 93% of gobbler mortality occurred during spring hunting season on TWMA (Godwin et al. 1991) and gobblers were minimally susceptible to capture stress (see Results).

Results

We used 806 turkeys for analyses, of which 54 (6.7%) turkeys experienced trap-related mortality. Turkey deaths were attributed to capture stress ($N = 33$), drug overdose ($N = 8$), hit by cannon net ($N = 8$), drowned while tranquilized ($N = 3$), choked on corn ($N = 1$), and great-horned owl (*Bubo virginianus*) predation ($N = 1$). Percentage of turkeys dying from capture stress was 4.1%. Proportion dying from capture stress within 5 days of capture did not differ between alphachloralose (4/190) and cannon net (29/616) capture ($Z = 1.58$, $P = 0.114$), so mortalities were pooled over capture methods. A higher proportion ($Z = 3.15$, $P = 0.002$) of turkeys died within 5 days of capture due to obvious injury from alphachloralose capture (11/190) than from cannon-net capture (10/616).

A significant interaction was not detected among year (normal vs. adverse) and cohorts for capture stress within 5 days of capture (log-linear model, $DF = 3$, $\chi^2 = 3.08$, $P = 0.378$) indicating that proportion of turkeys killed was not dependent on year and cohort. However, a significant interaction was detected among cohort and season of capture for trap-related mortality (log-linear model), $DF = 3$, $\chi^2 = 13.76$, $P = 0.003$). Due to this interaction, we tested the hypothesis that cohorts did not differ with respect to probability of dying from capture stress within each capture season (winter and summer), pooled across years.

During SUMCAP, a higher proportion of adult females was killed than subadult females ($P = 0.038$) (Table 1) due to capture stress. There were no other cohort

Table 1. Distribution of trap-related mortalities of wild turkeys within cohorts within summer capture and winter capture periods, Tallahala Wildlife Management Area, Mississippi, 1984–1995.

	Capture Period					
	Winter			Summer		
Cohorts	M[a]	*N*[b]	Percentage	M	*N*	Percentage
Adult Males	0	158	0.0	1	47	2.1
Adult females	12	186	6.5	11	140	7.9
Subadult males	2	108	1.9	2	85	2.4
Subadult females	5	30	16.7	0	52	0.0
Totals	19	482	3.9	14	324	4.3

[a]Trap-related mortality (died within 5 days of capture due to capture stress).
[b]Number of turkeys captured.

differences ($P \geq 0.138$) in proportion dying from capture stress during SUMCAP. During WINCAP, subadult females were more likely to die of capture stress than adult females ($P = 0.067$), adult males ($P < 0.001$), and subadult males ($P < 0.001$). Adult females were more likely to be killed than subadult males ($P = 0.091$) and adult males ($P < 0.001$). Adult and subadult males did not differ with respect to probability of dying from capture during WINCAP ($P = 0.99$).

Four WINCAP periods (1985, 1986, 1988, and 1989) and 1 SUMCAP period (1988) had ≥ 10 radio-tagged hens. No significant differences were detected ($P <$ 0.10) for any of the interval comparisons (Table 2).

Discussion

Patterns of capture stress may have been related to reproductive and physiological differences among cohorts. During summer capture, adult hens were more likely

Table 2. Sample sizes (*N*) at beginning and ending of intervals, survival estimates (S) and standard errors (*SE*) for 30-day intervals during summer captured (SUMCAP), winter captured (WINCAP), not captured during that summer (NOTSUM) and not captured during that winter (NOTWIN) hens, Tallahala Wildlife Management Area, Mississippi, 1984–1995.

Year	Capture period	Hen class	*N*	Interval (Days)	S	SE
1988	Summer	SUMCAP	11 (9)[a]	30, 60	1.00	0.00
				90, 120, 150, 180	0.90	0.09
		NOTSUM	17 (11)	All	1.00	0.00
1985	Winter	WINCAP	16 (13)	All	1.00	0.00
		NOTWIN	20 (14)	30	1.00	0.00
				60, 90, 120	0.94	0.05
1986		WINCAP	17 (8)	30	1.00	0.00
				60	0.93	0.06
				90, 120	0.72	0.13
		NOTWIN	14 (7)	All	0.93	0.09
1988		WINCAP	37 (17)	30	0.78	0.06
				60	0.73	0.07
				90	0.61	0.08
				120	0.55	0.08
		NOTWIN	10 (4)	30	0.90	0.09
				60	0.79	0.12
				90	0.68	0.17
				120	0.54	0.18
1989		WINCAP	24 (13)	30, 60	0.92	0.05
				90	0.75	0.08
				120	0.54	0.10
		NOTWIN	20 (9)	30	0.95	0.05
				60	0.83	0.09
				90, 120	0.71	0.12

[a]Number in parentheses is sample size at end of interval.

to die than subadult hens. On TWMA, a higher proportion of adult hens nested (Palmer et al. 1993, D. A. Miller, unpubl. data). The additional stresses of nesting and/or raising broods may have placed adult hens in worse condition and predisposed them to mortality due to capture stress.

Stress of cold temperatures and sex-specific differences in size and physiology (Blankenship 1992) may act synergistically to cause hens to be more susceptible to winter trap-related mortality. Males ($\bar{x}$ weight = 5.95 kg, N = 109) were significantly larger (t-test, $P < 0.001$) than females ($\bar{x}$ weight = 3.47 kg, N = 103) and may therefore better tolerate the physical stress of being captured and handled. Gray and Prince (1988) determined that energy requirements of turkeys increased proportionally to temperatures below critical minimum value. Lower critical temperature was lowest in winter and was higher for females (subadult, 15 C; adult, 11 C) than males (subadult, 11 C; adult, 7 C), possibly because hens have less mass. Therefore, during winter capture period, females reach their minimum critical value first and at temperatures ≤15 C, expend more energy to thermoregulate than males.

Environmental conditions, as measured in this study, did not influence the probability of turkeys dying from capture stress nor significantly affect survival of radio-tagged hens. However, low sample sizes of radio-tagged hens produced low power and hampered our ability to detect differences. For most comparisons, captured turkeys had the same or lower survival rates than previously captured turkeys, but we were not able to detect any differences. However, a caveat is warranted regarding comparison of captured versus not captured hens. Hens captured in previous years are, on average, older and have already survived at least 6–8 months longer than newly captured hens. These older hens may be better able to survive, thus potentially causing their survival rates to be positively biased. Results of this study are inconclusive regarding effects of capture on survival of radio-tagged hens. We encourage other researchers to examine this possibility to provide more definitive conclusions.

Management Implications

Our results indicated that during winter capture periods, females were more susceptible to trap-related mortality than males. We suggest that when both sexes are captured during a single trapping effort that hens should be processed and released first. Quickly releasing hens may decrease their stress level and thus increase their probability of surviving.

Although summer trapping did not differentially affect turkey survival, high ambient temperatures in the deep South may increase probability of capture stress. Bailey (1980) suggested not trapping turkeys when ambient temperature exceeded 21.1 C. On TWMA, mean maximum temperature from 1983–1991 was 32.6 C during July and 32.8 C during August. We recommend not trapping turkeys until fall in the southern United States, when possible. TWMA is a public hunting area and it is not possible to trap during fall hunting seasons. In this scenario, we recommend only trapping in early morning. Conversely, trapping during winter may be harmful to turkeys, especially hens, if temperatures are at or below the minimum critical temperature. Researchers and managers may consider only trapping when ambient temperature exceeds 15 C.

We recommend cannon-nets for capture of wild turkeys. Cannon-netted turkeys had a lower probability of dying from overt injuries than turkeys captured with alpha-chloralose. Cannon-netting also prevents problems associated with drugged turkeys leaving bait sites before being immobilized and concerns over dosage rates for different sized turkeys.

Whenever animals have the potential to be harmed due to human intervention for research purposes, we need to justify this harm by examining how the species will benefit. Socially negative repercussions may result from harming study animals. In our study, only 6.7% of turkeys captured experienced trap-related mortality. Because of the amount of information generated by this project (e.g., Palmer et al. 1993, Hurst 1995, Miller et al. 1995, Leopold et al. 1996) on the population and habitat ecology of the wild turkey, we believe that we have provided a benefit to the species that outweighs mortalities from our capture efforts.

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