Potential Effects of Capture and Radio-monitoring on Eastern Wild Turkey Reproduction

Mike Weinstein, *Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762*

Darren A. Miller, *Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762*

George A. Hurst, *Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762*

Bruce D. Leopold, *Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762*

Abstract: Wildlife researchers often assume capturing and marking do not influence marked animals' behavior, but this assumption is seldom tested. Therefore, we investigated effects of capture on reproductive success of eastern wild turkeys (*Meleagris gallopavo silvestris*) in east-central Mississippi. Hens were captured by cannon net, wing-tagged, radio-marked, and released between January and March 1990–1993. Marked and unmarked hens were observed at July and August bait sites 1990–1993; those observed with ≥1 poult were classified as reproductively successful. Hens captured during January-March, prior to the reproductive period, were less likely to be reproductively successful than either unmarked hens (P = 0.009) or hens captured in previous years (P = 0.048). We concluded that some factor in the capture process affects turkey reproduction in year of capture, but that this effect diminishes over time. Our results indicated that past studies of wild turkey reproduction using cannon net captured and radio-equipped hens may have underestimated reproductive success. We recommend using a non-intrusive method to obtain data concerning reproductive success of wild turkeys.

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An underlying assumption often made by researchers using radio-telemetry is that capture and marking (i.e., radio-equipping) do not affect animals under study. Attention given to gaining reliable scientific knowledge (Romesburg 1981, Matter and Mannan 1989, Romesburg 1989) emphasizes a need to test assumptions. Additionally, effects of research techniques on captive and free-ranging animals have generated increasing public scrutiny. Therefore, effects of capture and radio-equipping animals should be investigated, particularly as they influence demographic parameters, such as reproduction.

Studies investigating effects of radio-equipping birds have been conducted. Ramakka (1972) found radio-equipped male woodcock (*Scolopax minor*) displayed aberrant breeding behavior. Reduced reproduction, behavioral abnormalities, and physiological stress from radio-equipping also have been reported for several waterfowl and waterbird species (Greenwood and Sargeant 1973, Perry 1981, Massey et al. 1988, Wanless et al. 1988, Pietz et al. 1993, Rotella et al. 1993) and gallinaceous species (Erikstad 1979, Boag 1972, Burger et al. 1991). Nenno and Healy (1979) investigated behavioral responses for 29 days post-instrumentation on radio-equipped captive wild turkeys. Spraker et al. (1987) reported capture myopathy in wild turkeys. Miller (1990) investigated effects of cold temperatures, rocket-netting, radio packages, and environmental change on survival of translocated eastern wild turkeys; change in environment and radio transmitters influenced survival rates.

Information regarding effects of capture and radio-equipping free-living wild turkey hens on their reproductive success is lacking. Therefore, our objective was to determine if capture and radio-equipping affected reproductive success of wild turkey hens.

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Methods

Our study was conducted in east-central Mississippi (Kemper County) in the Interior Flatwoods Land Resource Area (Pettry 1977). The 9,700-ha study area was covered by 70% loblolly pine (*Pinus taeda*) plantations, 17% mature pine-hardwood forests, 10% mature hardwood forests, and 3% non-forested areas (Stys et al. 1992).

Capture Technique

We captured turkey hens between late January and mid-March 1986–1992, and between late June and mid-August 1986–1989. We also captured turkeys during the first 2 weeks of March 1993. We attempted capture at permanent bait sites along gated roads in pine plantations using cannon nets (Bailey 1976). Bait sites were 1-m diameter circular areas of sand with 2–7 liters of cracked corn. We checked and rebaited sites at 1130 and 1800 hours daily. We determined turkey use from presence of droppings, tracks, feathers, and/or direct observations of turkeys. We attempted turkey capture, via cannon net, at bait sites receiving consistent hen use. To maximize trapping efficiency as part of a larger study, bait sites with known hen use received priority.

We removed captured hens from the net and placed each bird singly in a cardboard box sized for turkeys. We removed birds from boxes and marked each turkey with 2 numbered cattle ear tags attached patagially, 1 per wing (Knowlton et al. 1964). To minimize handling time, we abandoned leg-banding after 1986. We aged turkeys as juvenile or adult from coloration and banding pattern of the 9th and 10th primaries (Larson and Taber 1980). We affixed a 108-g motion-sensitive radio-transmitter (Wildl. Materials, Inc., Carbondale, Ill.) to each hen. We released turkeys at the capture site between 10–45 minutes after capture. Turkeys were handled by 2–4 trained and experienced personnel.

We located hens thrice daily, thrice weekly during spring (March–June), and as often as possible, usually twice daily twice weekly, throughout the year. We determined locations by triangulation from the 2 closest, if possible, permanent stations (N = 144). This research was conducted under Mississippi State University Institutional Animal Care and Use Committee (IACUC) protocol number 93-030.

Summer Bait Site Observations

We checked 25–28 bait sites per year from early July to mid-August 1990–1993 between 1100–1245 hours and at 1800 hours. Bait sites used for observation were a subset of sites used for wild turkey capture and were located consistently between years. Selection of observation bait sites was independent of capture success at that site. Bait sites receiving turkey use twice in succession within the 4 previous periods (i.e., morning and afternoon) were pooled and as many sites that could be monitored by available personnel were randomly chosen (N = 1–6). After a bait site was monitored, regardless if turkeys were observed, selection criterion was reset. Last observation days each year (1990–1993) were 14–18 August at which time all (25–28) sites were monitored simultaneously in the morning and afternoon periods.

Observation periods spanned 0600–1100 hours and 1300–1800 hours. Observations were standardized among observers and bait sites by recording only turkeys that entered a 10 × 20 m sighting area centered on the bait. Observers were located in blinds 15–30 m from bait sites. Observers recorded sex, tag number or unmarked, and number of poults. Hens were classified as captured (CAPMARK) or not captured (NOTMARK). We classified captured hens by time of capture: (1) winter immediately preceding observation (WINTCAP), and (2) those captured previously to the winter immediately preceding observation (PREVCAP).

Data Analyses

We tested the null hypothesis that hen classes (NOTMARK, WINTCAP, and PREVCAP) did not differ significantly ($\alpha = 0.05$) with respect to reproductive success. A hen was considered successful if observed with ≥1 poult (Vangilder 1992:146). We assumed poults accompanying hens were their offspring. Observation data were analyzed using log linear analysis with HILOGLINEAR

(SPSS 1990:B139–58) (CAPMARK vs. NOTMARK, WINTCAP vs. NOTMARK, and PREVCAP vs. NOTMARK) and the binomial test of 2 proportions (BTTP) (Zar 1984) (PREVCAP vs. WINTCAP) in BDLSTAT (Leopold 1986). Because PREVCAP and WINTCAP were not mutually exclusive groups, BTTP was used for this comparison. Variables in the analyses were (1) year hen was observed, (2) marked status of hen, and (3) hen reproductive success.

NOTMARK consisted of a randomly chosen hen per bait site. This sample was obtained each year on the last observation day in the afternoon period to eliminate duplicate observations of the same hen. Although this is a randomization restriction, we used this procedure to protect against a lack of independence (i.e., duplicate observations of the same hen). Marked samples consisted of any marked hen recorded during July-August observation periods. If multiple sightings of marked hens occurred, a randomly chosen observation was used.

Results

From 1990–1993, we recorded 1,179 observations of unmarked hens (Table 1). For these years, 158 observed hens were included in data analyses (Fig. 1). CAPMARK and NOTMARK influenced hen success, with interaction (*partial* $\chi^2 = 3.93$, df = 1, $P = 0.048$). When CAPMARK hens were partitioned into WINTCAP and PREVCAP, we failed to detect an interaction (*partial* $\chi^2 = 1.26$, df = 1, $P = 0.262$) between PREVCAP and NOTMARK regarding hen success. For the comparison between PREVCAP and NOTMARK, statistical power (Cohen 1977:215–27) was estimated as 18% based on chi-square analysis (years pooled). We detected an interaction (partial $\chi^2 = 6.81$, df = 1, $P = 0.009$) between WINTCAP and NOTMARK regarding hen success.

Because no 3-way interaction was detected (partial $\chi^2 = 2.08$, df = 3, $P = 0.555$) among year, marked status, and reproductive success, years were pooled in the comparison between WINTCAP and PREVCAP hens; WINTCAP hen success was significantly less (one-tailed BTTP, $P = 0.04$) than PREVCAP hens.

Table 1. Number of unmarked hens observed in Kemper County, Mississippi, July–August, 1990–1993. Parenthetical values denote percentages of successful hens for each observation class per year (hens observed with ≥1 poult)).

Observation class	1990	1991	1992	1993
Total hen observations	275(29)[c]	338(20)	335(50)	231(32)
Last day observations[a]	48(25)	46(20)	45(56)	42(31)
Hens in analyses[b]	14(29)	10(20)	19(53)	12(41)

[a]Number of hens observed on the last afternoon of bait site observation period, 14–18 August 1990–1993.

[b]Number of randomly chosen hens observed (1 hen per bait site) on the last observation day in the afternoon period, 14–18 August 1990–1993.

[c]Numbers in parentheses denote percentages of successful hens for each observation class per year (hens observed with ≥1 poult).

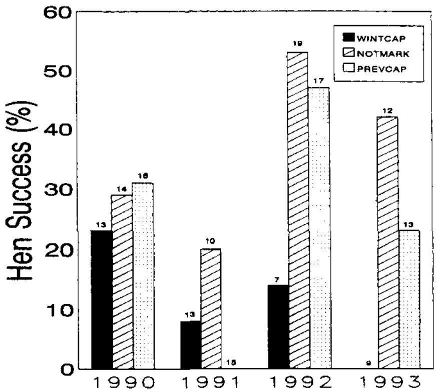

Figure 1. Reproductive success of eastern wild turkey hens in east central Mississippi, 1990–1993. Hen success is categorized by WINTCAP (hens captured current year), NOTMARK (hens never captured), and PREVCAP (hens captured a previous year). Numbers above bars denote hen observations per class.

Discussion

These results indicate that some factor significantly influenced reproduction during the nesting season immediately post-capture. A diminishing impact on reproductive success through time was suggested because PREVCAP hens were more successful than WINTCAP hens. We found no difference between PREVCAP and NOTMARK hens; however, low power of our test may have diminished our results.

Analyses assume independence in that a hen was only included once each year. The randomization restriction we employed guarded against this. Another possible independence violation would be observing an unmarked hen at more than 1 bait site in the afternoon period of the last observation day. However, we only observed 1 marked hen to use >1 bait site in a day for all years. Therefore, this assumption is probably not seriously violated.

A potential source of bias is loss of broods by hens during sampling periods. However, on our study area, no loss of poults was observed for marked hens during the observation periods (Weinstein 1994). Further, success rates were similar among hens used in analyses, total hen observations, and last day observations (Table 1). Speake et al. (1985) observed most poult losses occurred during the first 15 days post-hatch. Most poult mortality would have occurred before our observations began in July. Because a successful hen was classified on the basis of having ≥1 poult, a hen would have to lose all poults before her status would change. Furthermore, bias resulting from poult mortality would have greater impact on NOTMARK hen data as these observations occurred later in the period (i.e., last day of observation), thereby strengthening inferential power.

A possible bias is loss of marks by hens. However, misclassification would result only if both wing tags and radio-transmitter were lost. Further, this bias would have resulted in more conservative tests (decreased power).

Because PREVCAP hens are more likely to be older than other hen classes, another possible bias may be age-related hen success. Potential effects of this bias differ with respect to comparison. For WINTCAP vs. NOTMARK, this bias does not exist as both are captured/observed in the same year. For PREVCAP vs. NOTMARK, we found no difference in reproductive success. If the bias had operated in this comparison, PREVCAP hens would be expected to experience higher success. Although not significant, PREVCAP were less successful than NOTMARK (Fig. 1).

In the comparison between PREVCAP and WINTCAP, age bias was potentially serious; however, only 4 juvenile hens were included within WINTCAP (2 in 1990 and 2 in 1992). If these hens were excluded from analysis, the resulting *P*-value is 0.06, still indicative of potential reproductive suppression. Of hens captured twice (the second time in winter, making them WINTCAP), only 1 of 9 was successful. This offers anecdotal evidence that any age-related reproductive success is masked by the negative effects of winter capture.

Weinstein (1994) reported that radio-equipped hens using bait sites were more likely to have successfully hatched a nest than were those radio-equipped hens which were not known to have used sites. This suggests that reproductive success rates of observed hens of all classes are higher than those of the population. However, successful unmarked hens would have to show an even more extreme bias toward bait site use than did the marked sample for this to affect our results.

All nests of hens with active transmitters were approached only once within 50 m. This disproportionate disturbance factor may bias comparisons against WINTCAP; however, no hens were known to be flushed from nests from our approach (i.e., all were still nesting 24 hours post-approach). If this bias does exist, these results still call into question reproductive rates reported from telemetry studies, as most follow similar protocols (e.g., Keegan and Crawford 1993, Rumble and Hodorff 1993).

Additionally, any factor simultaneously affecting capture and reproductive success probabilities could produce the observed patterns. For example, if hens avoiding capture in winter are more suspicious in nature and this characteristic translates into greater reproductive success, or if hens in poor condition are more likely to be captured and less likely to reproduce, we would expect similar results. Such conditions, however, would still suggest a potential radio telemetry bias, albeit from a different cause.

Effects of capture on wild turkey reproductive success became more pronounced as the study progressed. The causal agent may have been poor hen condition resulting from loss of agricultural food sources (i.e., soybean fields), low mast production, and a severe winter storm on 11 March 1993 on the study area. Additionally, in 1993 hens were captured only during March, possibly causing greater reduction of reproductive success because all captures were closer to the nesting period. Although data were insufficient to examine statistically, partition of WINTCAP by capture month appears to indicate a more severe reproductive supression as captures become later (2/8 successful for January captures, 3/16 for February, and 0/18 for March). However, average success for hens captured in January and February was still lower than the unmarked sample. Earliest observed incubation for all radio-equipped hens occurred within the 2nd and 3rd weeks of April.

A final caveat in the interpretation of these results is warranted. Our study area was dominated by pine plantations which may be low quality wintering habitat. If habitat conditions were such that hens were in poor physical condition, it is possible that they were predisposed to display greater capture stress. In northern latitudes of this subspecies' range, severe winter weather may cause comparably poor spring condition of hens (Porter et al. 1983).

Management and Research Implications

Evidence that capturing wild turkey hens influences reproductive success indicates that previous studies using hens captured by cannon net and radio-equipped to investigate reproductive success may have underestimated this parameter, at least during the first year. Research is needed to determine the latest "safe" date to capture wild turkeys to collect reproductive data. Likewise, hens must be captured and translocated early enough to allow acclimation and to recover from effects of capture.

Results indicate that developing less intrusive techniques for gathering information on reproductive success of eastern wild turkeys is warranted. Such methods may provide more reliable estimates of turkey reproductive parameters. Techniques using standardized observations, such as bait site counts, need to be investigated for collecting such information (e.g., DeYoung and Priebe 1987, Hayden 1985, Weinstein 1994).

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