Habitat and Mortality Relationships of Wild Turkey Gobblers in the Georgia Piedmont

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Abstract: Increasing hunting pressure and habitat loss have raised concerns about the age structure and potential overharvest of wild turkey (*Meleagris gallopavo*) populations in Georgia. Nineteen juvenile and 15 adult gobblers were radio-tracked during January 1989–June 1991 in the vicinity of Clark Hill Wildlife Management Area (WMA). Gobblers avoided the WMA in spring and summer, preferring fields and pastures on private land. They preferred the WMA in fall and winter. Upland hardwood was the most preferred habitat type. Recorded mortalities (27) resulted from spring hunting (23), mammalian predation (3), and unknown (1). Annual survival of instrumented gobblers was 44%, 44%, and 64% for 1989, 1990, and 1991, respectively. Overall annual survival of adults and juveniles was 36% and 63%, respectively. Annual harvest rates of instrumented gobblers averaged 45%. Adults made up 78% of the instrumented gobblers harvested. The low harvest of juveniles should allow substantial recruitment into adult age classes. However, intensive hunting greatly limits the number of gobblers surviving >2 years.

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A successful restoration program and changing land use patterns in Georgia have increased eastern wild turkey populations and interest in turkey hunting dramatically (see Ielmini 1992 for historical background). Now, habitat losses, decreases in land available for wildlife management, and increases in hunting pressure are primary concerns.

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This study was initiated primarily to address public concerns that recruitment of juvenile gobblers into the adult class was inadequate for quality turkey hunting, especially on intensively hunted areas. The primary objectives of the study were to estimate rates of harvest and non-harvest mortality for gobblers of each age class and determine seasonal habitat use by gobblers, including any shifts associated with hunting activity and habitat types in which gobblers are more susceptible to various mortality agents.

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Methods

Study Area

The study area, described in greater detail elsewhere (Table 1 and Ielmini 1992), was located in the Piedmont physiographic province of eastern Georgia near Thomson. It consisted of the Clark Hill Wildlife Management Area (WMA) as the core, and private land in portions of Lincoln, McDuffie, and Wilkes counties. The entire study area, excluding water, was 22,110 ha, with the WMA core occupying 5,670 ha. The boundary of the study area was determined from the movements of the instrumented turkeys. The WMA consisted of a narrow strip (500–1,000 m in most places) bordering the Clark Hill (Thurmond) Reservoir and a 1,940-ha peninsula.

The topography is gently rolling to steep, with elevations ranging from 101 m (the normal pool elevation of Clark Hill Reservoir) to 171 m above mean sea level. The predominant forest cover was pine (*Pinus taeda, P. echinata*), which made up >50% of the area. Much of the private land was owned by forest industry, and pine plantations and clearcuts made up about 15%. There were no pine plantations and very few clearcuts on the WMA. Most of the pine stands on the WMA were managed on long (≥80 years) rotations with shelterwood thinnings; some of the older stands (200–400 ha) were burned annually. Pine-hardwood and upland hardwood forests, mainly oak-hickory (*Quercus* spp.-*Carya* spp.), made up about 5% of the area. Some bottomland hardwood forests were present (<3%), but only upstream from the reservoir. Open habitats on the WMA were primarily small agricultural fields. These plots averaged 0.7 ha and were planted with small grains and cool season forages. In addition, there were 3 large fields (30 ha total) planted with cool season forages for Canada geese (*Branta canadensis*). Old fields, pastures, and recent clearcuts provided a patchwork of large open areas interspersed with forests on surrounding private land.

Hunting within the study area during fall was primarily for white-tailed deer (*Odocoileus virginianus*). Turkeys were hunted during a spring season which began in late March and continued for 42–54 days in each of the 3 years of the study (1989–1991). Deer and turkey hunters were required to sign in at the WMA checking station, but no quota was imposed on the number of hunters. A statewide limit of 2 gobblers was in effect.

Field Methods

Turkey populations were estimated each winter by direct count (Speake et al. 1969, Gardner et al. 1972). Trapping of turkeys occurred from 1 January until 10 days before the beginning of the turkey hunting season which began on 29 March 1989 and 28 March 1990. All birds were trapped on the WMA or within 45 m of its boundary. Cannon nets were used, with trap set procedures similar to those described by Austin (1965).

Birds were fitted with backpack-type transmitter packages from Wildlife Materials, Inc. Both solar-powered and battery-powered transmitters equipped with mortality detection switches were used. Transmitters were labeled with return instructions including an address and a collect telephone number to report the kill. Mass including the harness ranged from 89.0 g to 100.0 g ($\bar{x}$ = 94.5 g).

All turkeys were released at their respective capture sites. Monitoring began immediately and continued until the recovery of the transmitter, permanent loss of the signal, or the end of the study (June 1991). Attempts were made to locate each bird at least once daily. Azimuths to telemetered birds were recorded from fixed positions established as needed. When a transmitter's mortality signal was activated, personnel immediately triangulated the position of the bird and approached it to verify that it was dead, and if so, to determine the cause of death. Contact was made with many of the hunters killing instrumented turkeys before they left the area, and eventually all hunters killing an instrumented turkey were interviewed and information regarding the kill was recorded.

A 1:24,000-scale habitat map of the study area was created from aerial photographs. Habitat types identified on these photographs were ground-verified. The map was digitized, and the percentages of the different habitat types available were calculated.

In 1989 and 1990, daily estimates of the maximum number of hunters present on Clark Hill WMA were made based on observations of vehicles and hunters on the area as well as hunter sign-in sheets. (Hunters were required to sign-in only once during the turkey season.) General impressions of hunting pressure on private land within the study area were formed based on numbers of vehicles and hunters recorded during daily telemetry operations, hunter interviews, and information from Department of Natural Resources biologists and law enforcement personnel.

Data Analysis

Locations of the radio-tracked turkeys were based upon 2,272 sets of azimuths. Each set included $\geq$3 azimuths, all taken within 1 hour. Modification of a computer

program developed by White and Garrott (1990) allowed calculation of the maximum likelihood estimate (Lenth 1981) and the 95% confidence ellipse about each location (point). Locations with confidence ellipses exceeding 5.0 ha were excluded from the analyses, resulting in the rejection of 10.8% of the data. The remaining 2,027 locations were electronically plotted for each gobbler and overlaid on the habitat map. Ninety-three percent of these locations were obtained on different days during the monitoring period of each bird, and the maximum number of locations plotted per day for a particular turkey was 2.

Seasonal habitat use was calculated for 1989–1990 based upon the frequency with which locations occurred within different habitat types. Upon rejection of the null hypothesis that habitat use was proportional to habitat availability (Chi-square goodness-of-fit test), a test was conducted to determine avoidance or preference (Neu et al. 1974). Statistical significance was indicated at $P \leq 0.10$.

Capture and kill dates were recorded for each instrumented gobbler and were used in estimating mortality and survival rates for all gobblers as a group and separately for the adult and juvenile gobbler age classes.

Mortality and survival rates were calculated by the binomial distribution method and a computer program (White and Garrott 1990) based upon the Kaplan-Meier product limit estimator (Kaplan and Meier 1958). The program incorporated the staggered entry of animals into the marked population (Pollock et al. 1989).

Results and Discussion

Habitat Availability

Nine habitat types were delineated on the study area. In order of area covered, they were mature pine, upland hardwood, field (including pastures and food plots), 5- to 10-year-old pine plantation, clearcut (pine plantation <5 years old), bottomland hardwood, 11- to 20-year-old pine plantation, and cutover (commercial timber removed, no further treatment). The study area was subjectively defined by natural boundaries to encompass all locations of the instrumented turkeys, and all habitats within the study area were assumed to be available for use by the turkeys. Almost half of the study area was mature pine forest (47%) and about 10% of the area was fields. There were large differences in habitat composition between the WMA and surrounding private land (Table 1).

Habitat Use

Habitat use was determined for 34 gobblers (2,027 locations). Overall (adult and juvenile gobblers combined over the entire study area) the most frequently used habitat types during 1989 and 1990 were mature pine (35.9%), upland hardwood (21.2%), and field (15.4%) (Table 1).

Because of the narrowness of the WMA, movement of turkeys was physically directed toward or onto private land. In spite of this, the WMA was preferred over the private land year-round. Gobblers preferred the WMA in fall and winter but

Table 1. A comparison of availability (% of total area) of all habitat types and their use (% of total locations) by 34 radio-tracked wild turkey gobblers on and around Clark Hill Wildlife Management Area, Georgia, 1989–1990.

Habitat	WMA land		Private land		Total	
type[a]	% Area	% Use	% Area	% Use	% Area	% Use
Mature pine	18.1	16.5	28.8	19.4	46.9	35.9
Upland hardwood	3.3	8.6	9.3	12.6	12.6	21.2
Field	0.4	0.8	9.4	14.6	9.8	15.4
Pine-hardwood	1.1	2.3	8.6	9.5	9.7	11.8
Pine plantation, 5–10 years old	0.0	0.0	5.6	2.1	5.6	2.1
Clearcut	<0.1	<0.1	4.3	3.9	4.3	3.9
Bottomland hardwood	2.7	3.2	1.4	2.5	4.1	5.7
Pine plantation, 11–20 years old	0.0	0.0	3.7	3.2	3.7	3.2
Cutover	0.0	0.0	1.3	0.8	1.3	0.8
Other[b]	0.0	0.0	2.0	0.0	2.0	0.0
All	25.6	31.4	74.4	68.6	100.0	100.0

[a]Locations occurring in ecotones were equally apportioned among the adjacent habitat types.
[b]Areas of intensive human activity available to but unused by monitored gobblers.

avoided it in spring and summer. Preference for the WMA during the fall and winter occurred even in 1991 when there was no baiting in conjunction with trapping. Greater human activity on the private land during the fall and winter may have contributed to disproportionate use of the WMA.

The density of gobblers on the WMA was reduced during the spring season by their movement to private land. Others (Mosby and Handley 1943:171, Barwick and Speake 1970) have reported gobblers dispersing 5–8 km after flock break-up in late winter. The shift by Clark Hill WMA gobblers in spring and summer to private land also may be linked to a similar shift of hens off the WMA during the same period. Hen movement off Clark Hill WMA in spring to the large pasture complexes on nearby private land was likely.

Seasonal preferences for various habitats by adults and juveniles differed between the WMA and private land (Table 2). Fields on private land were used more than expected by gobblers of all age classes during the spring and summer. The fields on private land may have been more attractive than those on the WMA, because of their larger size (7 ha). Lewis (1964) suggested fields containing 4–8 ha probably would provide better brood habitat than the same area in small (0.2–0.8 ha) well-dispersed fields.

Upland hardwood was preferred more often than any other habitat type by both adults and juveniles using the WMA. Adult gobblers using the WMA preferred upland hardwood in fall and winter, and juvenile gobblers preferred it in winter, spring, and summer. Adults using private land preferred upland hardwoods in the fall, and juveniles preferred this type in the spring and summer.

Table 2. Seasonal habitat preference and avoidance by radio-tracked adult (N = 15) and juvenile (N = 19) wild turkey gobblers on and around Clark Hill Wildlife Management Area, Georgia, 1989–1990.

Habitat type	Adults		Juveniles	
	WMA	Private land	WMA	Private land
Mature pine	A:W[a]	A:Sp, Su, F, W	A:Sp, W	A:Sp, Su P:W
Upland hardwood	P:F, W	P:F	P:Sp, Su, W	P:Sp, Su
Field		P:Sp, Su		P:Sp, Su
Pine-hardwood	P:W	P:Sp, Su		A:Su, W
Pine plantation, 5–10 years old	(unavail.)	A:Sp	(unavail.)	A:Sp, F, W
Clearcut	(unavail.)	A:Sp	(unavail.)	P:Sp
Bottomland hardwood	A:F, W	P:W	P:Sp	
Pine plantation, 11–20 years old	(unavail.)	P:Sp	(unavail.)	A:Sp, F, W
Cutover	(unavail.)		(unavail.)	

[a]A = avoided, P = preferred ($P \leq 0.10$). Seasons denoted as Sp, Su, F, and W.

Mature pine was used less than expected on the WMA by adults in winter and juveniles in winter and spring. It was used less than expected on private land by adults in all seasons and by juvenile gobblers in spring and summer. There were no pine plantations on the WMA. On private land, results indicate juvenile gobblers preferred clearcuts in spring. However, these data were biased by 1 bird that occupied a clearcut for many days after being shot at (and possibly wounded) in an adjacent habitat. Pine plantations 5 to 10 years old were avoided on private land by adults in spring and by juveniles in winter, spring, and fall. Juvenile gobblers using private land also avoided 11- to 20-year-old pine plantations in winter, spring, and fall. The greater-than-expected use of 11- to 20-year-old pine plantations by adult gobblers on private land in spring may have resulted from the illegal baiting known to have occurred on one of these areas. One monitored bird was located repeatedly at this site. Lambert et al. (1990) found avoidance of younger pine plantations in the dairy-farm timberland habitats of Louisiana. However, other studies (Kennamer et al. 1980, Holbrook et al. 1985, Exum et al. 1987, Smith et al. 1990) have reported use of pine plantations, particularly by hens in the spring.

Bottomland hardwood areas on private land were preferred by adult gobblers in winter. However, on the WMA they were used less than expected by adult gobblers in the fall and winter, probably because of disturbance associated with concentrations of deer hunters in these areas (Ielmini 1992).

Mortality and Survival

Turkey density was estimated to be 2.3/km^2 in 1989 and 3.9/km^2 in 1990, based on winter censuses. Gobblers comprised 290/694 (41.8%) of the observations, of which 35.5% were adults and 64.5% were juveniles. The estimated annual winter

population on the WMA during the period 1989 to 1990 was 73 gobblers and 102 hens.

Thirty-six gobblers (21 juveniles and 15 adults) were captured on the WMA, 18 during the winter of 1989 and 18 in winter 1990. Two of the juveniles died within 4 days of release and were not included in analyses. Of the remaining 34 gobblers, 27 died during the monitoring period. The annual survival of all gobblers was 44% in 1989, 44% in 1990, and 64% in 1991 through June when the study ended. We treated the 1991 value as an annual survival estimate because during the 2.5-year study period only 2 of the 27 recorded mortalities occurred during the months July–December. We lost contact with 2 of the gobblers alive just before the 1991 turkey season. Assuming those 2 gobblers of unknown fate died during 1991 would decrease the annual survival estimate that year from 64% to 45%. The overall annual survival of adults and juveniles was 36% and 63%, respectively. The causes of mortality of the 27 gobblers were hunting (23), mammalian predation (3), and unknown (1). The hunting mortality occurred entirely within the spring turkey season.

Hunting pressure on the WMA was greatest each year during the first week of the season, with an average of 114 hunter visits. The maximum recorded number of hunters on the area on any day ranged from 25 to 40 in the 3 years. Hunter success was 7.6% in 1989, 6.9% in 1990, and 2.7% in 1991. Our general impression was that hunting pressure on private land was more evenly distributed throughout the season, and hunter success was higher than on the WMA.

Instrumented birds harvested made up 6% to 15% of the estimated gobbler population in winter on the WMA, and 13% to 19% of the estimated WMA harvest during the 3-year study. The 1 unknown cause of mortality was possibly an out-of-season shooting during the fall. There were no cases of instrumented gobblers dying unrecovered after being shot by hunters during the spring turkey season.

Eight of 15 instrumented gobblers alive at the beginning of the 1989 turkey season were killed by hunters that year. Eleven of 24 were killed in 1990, and 4 of 11 were harvested in 1991. The average annual harvest rate for the period 1989–1991 was 45%. VanSant (1986) reported 33% of the gobblers banded on Clark Hill WMA were killed by hunters. Reported harvest rates in Alabama of 36%, 20% (Everett et al. 1978), and 51% (Gardner et al. 1972) indicate considerable variability.

The differential vulnerability of adult and juvenile gobblers to harvest was clear. There were 19 juveniles and 15 adults trapped during the study, with most of the juveniles surviving to adulthood. Only 22% of the instrumented gobblers killed by hunters were juveniles. Lewis (1975) reported similar results, with juveniles averaging 25% of the spring gobbler harvest. Since 1981, juvenile gobblers have averaged 40% of the harvest on Clark Hill WMA.

Seventy-four percent of radio-marked gobblers killed by hunters were harvested on private land, even though all were trapped and released on the WMA. Similarly, 62% of the gobblers banded by VanSant (1986) on Clark Hill WMA were taken on surrounding private land.

Predation claimed 1 juvenile gobbler on private land during the summer, 1

juvenile gobbler on the WMA in winter, and 1 adult gobbler on private land in the winter. The adult gobbler was predisposed to predation because it was in poor condition when captured 10 days earlier. During monitoring, it had difficulty in flying and roosted on the ground. Necropsy revealed bacterial infections and old gunshot wounds.

Instrumented gobblers died in 6 of the 9 habitat types: field (8 birds), upland hardwood (7), mature pine (6), pine-hardwood (4), bottomland hardwood (1), and clearcut (1). The distribution of harvested turkeys by habitat type generally was a function of habitat availability or use by turkeys. But fields, which made up only 10% of the study area and 15% of use by instrumented turkeys, accounted for 35% of harvested birds.

Management Implications

Although gobbler use of the WMA was greater than expected on an annual basis, the WMA was avoided in the spring and summer. This greatly reduced the potential harvest and hunter success rate. If the shift off the WMA by gobblers is linked to hen movements, and hens are avoiding the WMA in spring and summer, then there also may be a significant problem with low production on the WMA. A lack of adequate turkey production habitat on the WMA may be the overriding cause for the seasonal shift. In a study of turkey nest site selection, nesting success, and brood-rearing habitat on Clark Hill WMA from 1977–1981, Waller (1983) reported that nesting and brood-rearing habitats on the WMA were deficient. He noted a lack of thick areas for nesting and questioned the value of the small annually planted food plots on the WMA. Everett et al. (1980) found poult survival on and near the Thomas WMA in Alabama was directly related to the type of brood-rearing habitat selected by the hens. In their study, they showed that poults using grazed pastures and woods off of the WMA had a much higher survival rate than those using small food plots planted to annual rye grass on the WMA. On Clark Hill WMA, managed openings amounted to only 1.7% of the area. The larger of these were located along the lake and were used as feeding areas for Canada geese. Most of the brood habitat available to turkeys on Clark Hill WMA was in the open forested areas, none of which were high-quality bugging areas for turkey broods.

The shift off of the WMA in spring and summer by gobblers was reflected in the mortality locations of the instrumented gobblers. Only 6 (26.1%) of the 23 harvested gobblers were killed on the WMA. The best way to increase the number of gobblers on the WMA during spring would be to provide for the full spectrum of habitat needs, including nesting and brood-rearing habitat to attract and hold hens and subsequently gobblers (Speake et al. 1975). Williams and Austin (1988:165–166) concluded "(o)nly minimal seasonal movement would be expected when all necessary habitat components are available in a very small area," and "(m)aximum turkey population densities will be achieved when all the landscape is used, more or less, year-round."

The biggest obstacle to manipulation of habitat evenly across the entire WMA

is the size, shape, and arrangement of the property. Almost all of the habitat manipulations (specifically, prescribed burning and plantings) occurred on the main peninsula of the WMA. The remainder of the WMA was narrow strips of land bordering the lake. Moving equipment and supplies to these areas from the main peninsula was time-consuming and inefficient. Also, activities such as planting food plots off of the main peninsula tended to benefit the hunters of adjacent private land more than the WMA hunters.

Although annual mortality of instrumented gobblers was high (1989–1990 average = 56%), the harvest was concentrated primarily on adults. The age structure of the WMA harvest also favored adult gobblers. The lower harvest rate of juvenile gobblers would benefit recruitment into the adult age classes, possibly increasing the harvest quality. However, the age of harvested gobblers on the study area rarely exceeded 2 years. Thus the opportunity to kill a very large bird with long spurs (i.e., a "trophy" gobbler) was almost non-existent. Hunting pressure throughout the study area, and the tendency for 2-year-old gobblers to be more heavily harvested, precludes a high percentage of those trophy gobblers from occurring in the population. The survival of approximately 63% of the juvenile gobblers will at least provide a substantial number of 2-year-old gobblers to hunt in the following spring, provided population levels and production do not decline.

Habitat management on the WMA should be directed toward meeting needs of turkeys throughout the entire year. However, turkey populations can only be increased to a point and this may not be adequate to maintain or increase harvest levels, increase hunter success rates, or provide older gobblers. A hunter quota system may be necessary. Additionally, control of human disturbance outside of the turkey season, particularly on certain sections of the WMA, also may benefit turkey hunting.

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