Predicting Wild Turkey Harvest Levels

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Abstract: Reliable pre-season predictions for wild turkey harvests can be an important component of management plans where hunter and/or harvest quotas are used. Data collected in Florida from 1983–1989 included 9 demographic and 4 meteorological variables. Using regression analyses we identified those variables which were associated with spring turkey harvest and produced a "best" regression model for making pre-season, spring harvest predictions from data collected during the previous year. Variables identified as most important included: harvest, total number of turkeys observed in late summer surveys, and rainfall during the spring harvest season. The regression model employing these independent variables accounted for 94% of the variation in the following year's harvest. Collection of such data is feasible under state wildlife agency fiscal and manpower constraints. Their use gives biologists additional information upon which to base management decisions.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 45:227–234

The Florida Game and Fresh Water Fish Commission (FGFWFC) serves as lead managing agency for public hunting on 1,654,938 ha in 62 Wildlife Management Areas (WMAs). Spring turkey hunting is conducted on 41 of these WMAs. Harvest or hunter quotas are used to manage hunting pressure on 17 (42%) WMAs. Quotas are normally determined according to area size, historical hunting pressure, and data on turkey population demography, when available. Data consist of harvest, hunting pressure, and population indices derived from annual biological surveys. Hunting pressure and index values, however, rarely account for a significant amount of variation in annual harvest (FGFWFC, unpubl. data). Other factors, such as weather, also may contribute to annual harvest variation (Healy and Nenno 1985).

WMA biologists, however, have limited fiscal and manpower resources with which to collect biological data. If the appropriate variables were identified, a reliable harvest model could be developed without WMA biologists having to greatly

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increase effort or expenditures. The objectives of this study were to: 1) determine if variation in meteorological data contributed significantly to explaining annual variations in turkey harvest, and 2) determine if meteorological and demographic data could be used to reliably predict harvest prior to spring turkey seasons.

This work was funded by the FGFWFC through the Wildlife Management Bureau and Wild Turkey Management Program. C.D. Spivey and numerous wildlife reservists assisted in collection of demographic data. M. Lopez provided meteorological data. We thank N.F. Eichholz, P.D. Doerr, V.J. Heller, T.E. O'Meara, J.C. Peoples, D.E. Runde, R.E. Vanderhoof, D.K. Woodward, and anonymous reviewers for helpful comments on earlier drafts of the manuscript.

Methods

Meteorological and demographic data were collected annually from 1983 through 1989 on Green Swamp Wildlife Management Area (GSWMA). GSWMA, located in Polk, Lake, and Sumter counties, Florida, is owned by the Southwest Florida Water Management District (SWFWMD) and managed as a public hunt area by the FGFWFC. Management efforts on GSWMA have featured the wild turkey since 1978. GSWMA contained 6 habitat types (FGFWFC, unpubl. data) distributed over 19,456 ha. Bald cypress (*Taxodium distichum*) forests were the most extensive cover type, comprising 35% of the area. River swamps containing both hydric and mesic hammocks, and flatwoods comprised 32% and 28% of the area, respectively. The remainder was comprised of slash pine (*Pinus elliottii*) plantations (4.3%), xeric hammocks (0.3%), and improved pastures (0.4%). Florida's spring turkey season begins on the third Saturday in March and continues for 36 days.

Temperature, relative humidity, and precipitation were collected annually from 4 SWFWMD monitoring stations distributed across Green Swamp WMA: Devil's Creek, Providence, Providence Tower, and Rockridge. Data from these stations were averaged annually to represent the entire study area. Variables included in analyses were: mean temperature and humidity, and rainfall during the harvest and incubation periods (Williams and Austin 1988).

Wild turkey demographic data were obtained from population surveys and harvest monitoring. Harvest (turkeys/year) and hunting pressure (man-days/year) were determined at mandatory game check stations located at both entrances to GSWMA. Variables used in analyses included harvest, man-days of hunting pressure, and man-days per harvested turkey. Survey data were collected using the Unbaited Transect Method as described by Cobb (1990*a*). Survey data included in analyses were as follows: number of males, females, poults, and total individuals observed during annual surveys; population poult:hen ratio (i.e., ratio of total poults observed to total hens observed); and individual poult:hen ratio (i.e., mean brood size).

Data were subjected to multiple regression using selected combinations of independent variables to examine variability of annual harvest (dependent variable). Our objective was to produce a regression model for predicting spring turkey harvest

(NHAR) from data collected during the previous year. Correlation and regression analyses were conducted using PC-SAS[R] computer software (SAS Inst. Inc. 1988). Correlation analyses were conducted for all variables. Regression analyses followed techniques described by Rawlings (1988). Full-ranked regression models with all possible variable combinations were compared using R^2_{adj} values, as they facilitate the comparison of models with different numbers of parameters. Models with R^2_{adj} near its maximum were chosen for detailed residual, collinearity, and eigen analyses. Test statistics included: R^2, R^2_{adj}, Durbin-Watson D statistic, eigenvalues, condition numbers, variance decomposition proportions, residual skewness and kurtosis, and the Shapiro-Wilk W statistic. The simplest model satisfying the above diagnostic criteria was chosen as the "best" model.

Results and Discussion

Temperature and humidity during the harvest season (MEANTEMP, and MEANHUM) fluctuated widely throughout the sampling period (Fig. 1). Rainfall during the harvest and incubation periods (X_HARAIN, X_INRAIN) also fluctuated (Fig. 1) with notable increases in both variables during 1987. Harvest levels (HARVEST) and man-days of hunting pressure (MANDAYS) fluctuated from 27 to 79 turkeys, and 1,632 to 3,375 man-days, respectively (Fig. 2). Man-days expended per turkey harvested (MD_HAR) ranged from 1 turkey/30 man-days in 1987 to 1 turkey/94 man-days in 1989 (Fig. 2). Trends of males (COUNTMAL), females (COUNTHEN), poults (COUNTPOU), and total individuals (TOTAL) counted during annual surveys (Fig. 3) increased throughout the sampling period, with a notable peak in the number of poults observed in 1986. Annual population poult:hen ratios (OBS_P_H) oscillated throughout the sampling period (Fig. 3), but showed a decreasing trend. Annual individual poult:hen ratios (ACT_P_H) decreased steadily throughout the sampling period except for a notable increase in 1986.

Numerous full-ranked models accounted for >97% of the variation in NHAR. In the simplest model (Equation 1) satisfying all test criteria (i.e., Durbin-Watson D = 1.828; no collinearity; skewness = 0.5667, $0.9 > P > 0.5$; kurtosis = 1.7861, $0.4 > P > 0.2$; Shapiro-Wilk W = 0.9502, $0.9 > P > 0.5$) and meeting all regression assumptions (Madansky 1988, Rawlings 1988), variation in 3 variable values (HARVEST, TOTAL, and X_HARAIN) accounted for 94% of the variation in NHAR ($R^2_{adj} = 0.88$).

$$\text{NHAR} = -4.7779 + \text{HARVEST}\,(-0.1790) + \text{TOTAL}\,(0.3157) + \text{X\_HARAIN}\,(5.3422) \qquad (1)$$

The confidence interval on predictions of NHAR with this model was ± 26 individuals.

None of the correlation coefficients among these 4 variables were statistically significant (Table 1). However, based on our analysis we suggest that several biological relationships were possibly influencing this turkey population. An increase in X_HARAIN during any year should have reduced HARVEST and thereby contrib-

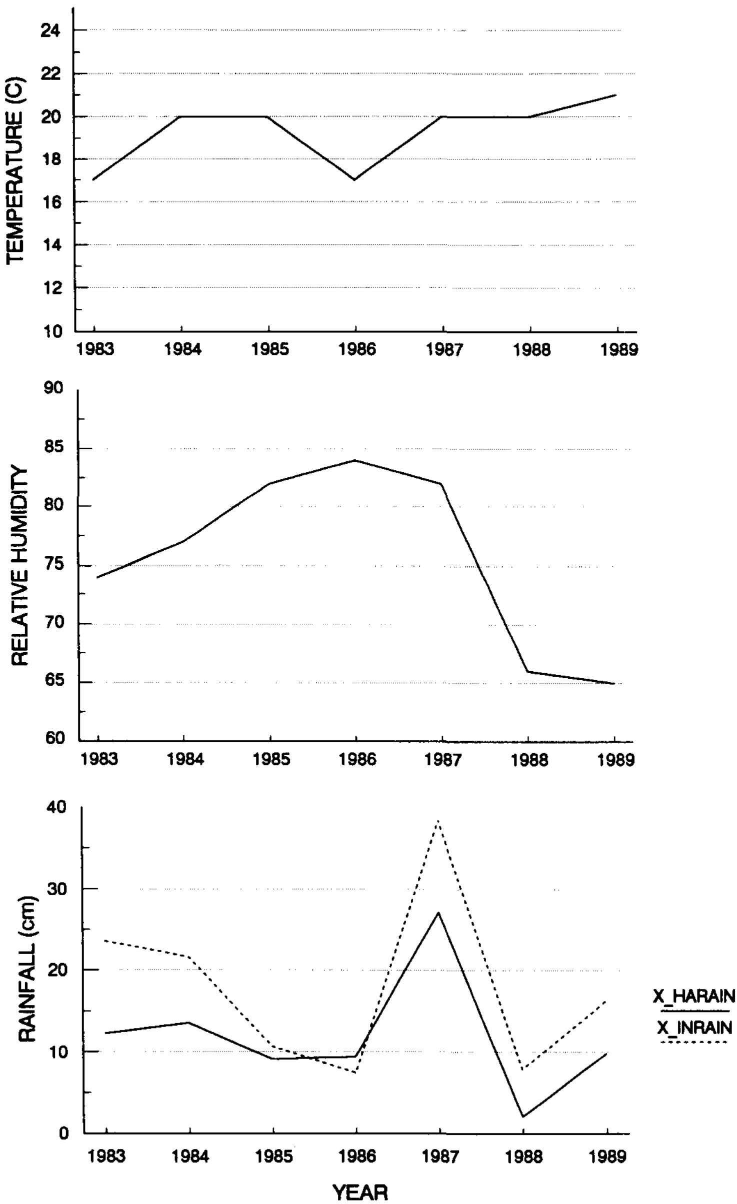

Figure 1. Temperature, humidity, and rainfall during the spring turkey harvest and incubation periods on Green Swamp Wildlife Management Area, Florida, 1983–1989.

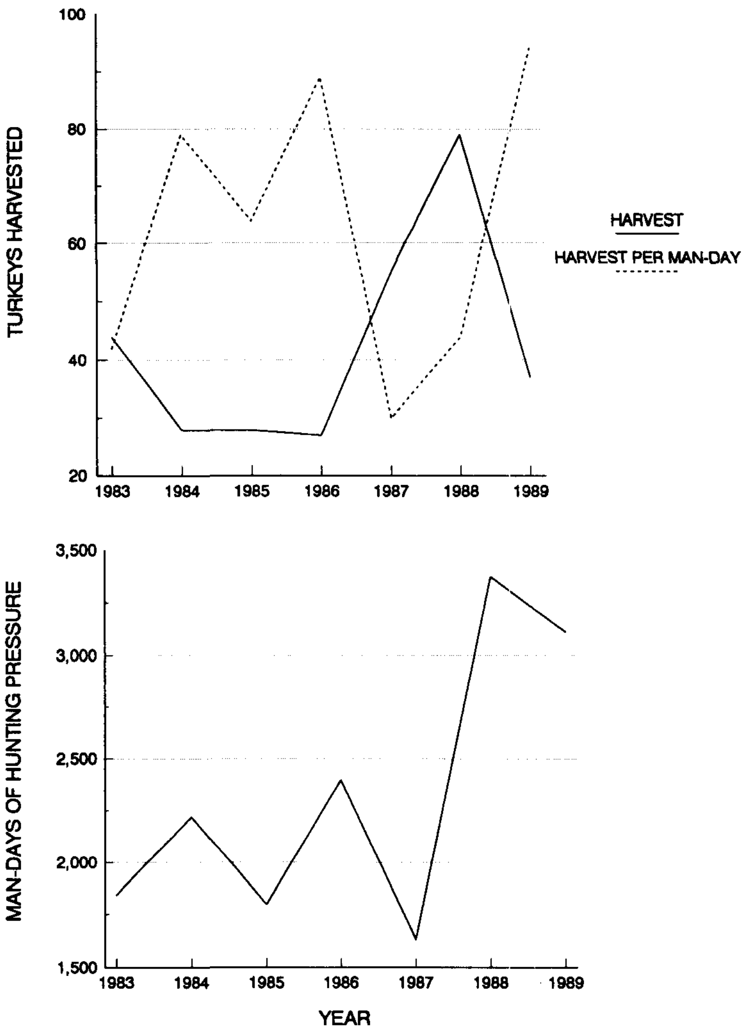

Figure 2. Spring turkey harvest (HARVEST), hunter success (HARVEST PER MAN_DAY), and man-days of hunting pressure (MAN-DAYS) during spring turkey seasons on Green Swamp Wildlife Management Area, Florida, 1983–1989.

uted to increases in NHAR during the following year. Likewise, an increase in TOTAL would have reflected an overall increase in the wild turkey resource, an increase which should be reflected in an increase in NHAR during the following year's spring harvest season. Wunz and Shope (1980) and Weinrich *et al.* (1985) found that census counts and turkey harvest levels were highly correlated in Pennsylvania and Michigan, respectively. While harvest and demographic parameters are

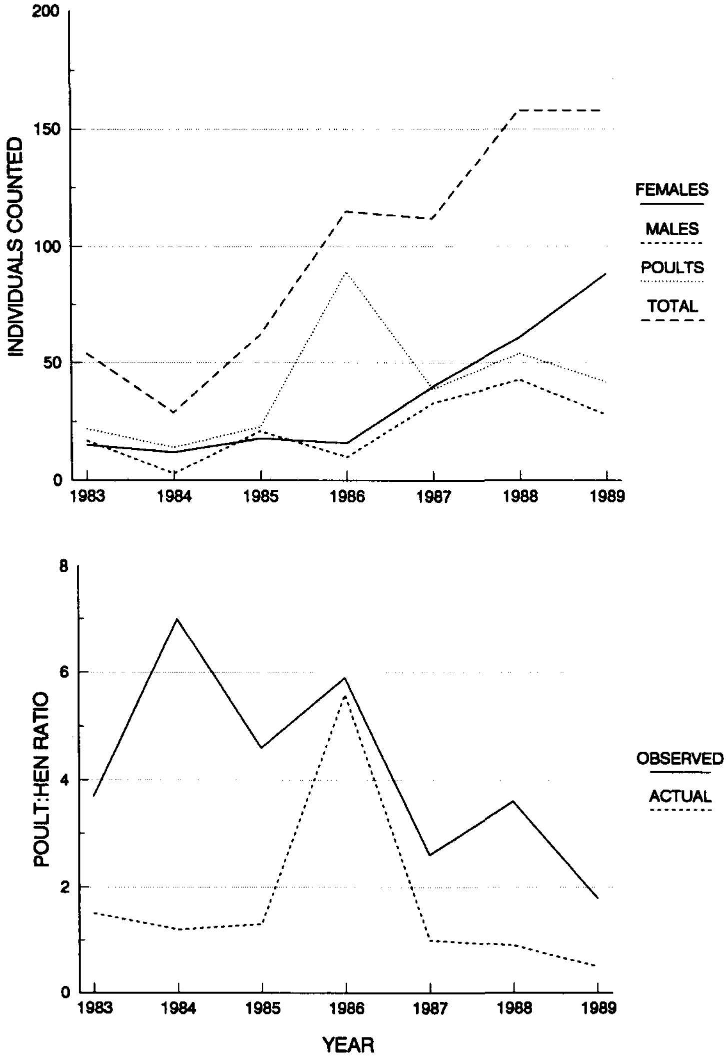

Figure 3. Number of adult males (MALES), adult females (FEMALES), poults (POULTS), and total individuals (TOTAL) counted during annual surveys; and observed and actual poult:hen ratios (OBSERVED, ACTUAL) from Green Swamp Wildlife Management Area, Florida, 1983–1989.

Table 1. Pearson correlation coefficients (Prob > R under H_0:Rho=0) for variables in "best" regression model from analysis of demographic and meteorological data from Green Swamp WMA, 1983–1989 (d.f. = 6).

	Variable			
Variable	HARVEST	TOTAL	X_HARAIN	NHAR
HARVEST	1.0 (0.0)	0.5519 (0.1990)	−0.1121 (0.8108)	0.1901 (0.6830)
TOTAL	0.5519 (0.1990)	1.0 (0.0)	−0.2462 (0.5946)	0.5304 (0.2205)
X_HARAIN	−0.1121 (0.8108)	−0.2462 (0.5946)	1.0 (0.0)	0.6435 (0.1189)
NHAR	0.1901 (0.6830)	0.5305 (0.2205)	0.6435 (0.1189)	1.0 (0.0)

undoubtedly important in predicting harvest levels in this turkey population, the importance of meteorological factors should not be underestimated. For example, there was an inverse relationship between X_HARAIN and TOTAL. In Florida, turkeys usually begin nesting during the harvest season (Williams and Austin 1988). With the negligible topographic relief in peninsular Florida, increases in rainfall during the nesting period could create quasi-flood conditions which can reduce nesting success and poult survival in turkey populations (Kennamer et al. 1975, Kimmel and Zwank 1985, Cobb 1990*b*). These biological scenarios are presented only as possibilities. Because data collection from GSWMA and the regression analysis reported herein were not designed to test for cause-effect relationships and due to our sample size (i.e., d.f. = 6) caution should be taken to avoid spurious conclusions based on the results of our regression analyses.

Our objective was to identify data which can be collected under typical state wildlife agency fiscal and manpower constraints that could be used to predict turkey harvest levels. Based on this analysis, we suggest that such data might include: harvest data collected at mandatory check stations, population survey data requiring only 5–10 man-days, and meteorological data usually available from numerous state or federal agencies. However, data from individual WMAs or management units should be analyzed separately as the variance contribution of individual variables may differ somewhat between areas. Assumptions inherent in using this regression approach for predicting harvest are that predictions fall within the X-space of the analyzed data and that the regression equation accurately models population processes. To address these assumptions, the database used in the analysis will be supplemented, the analysis repeated, and the regression model validated annually. Based on annual analyses, the model may be fine-tuned to maintain its predictive ability. The types of data appropriate for predictive regression analyses are normally available to state agency biologists. Expensive, long-term research is not always required. Under some conditions, annual monitoring will suffice. Using approaches like the regression analysis reported herein, biologists can better manage turkey populations by basing management decisions on sound scientific analyses of biological data.

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