## 2024 KENTUCKY WILD TURKEY BROOD SURVEY REPORT

Zak Danks and James Woods, Turkey Program, Kentucky Department of Fish & Wildlife Resources

### SUMMARY

The Kentucky Department of Fish and Wildlife Resources (KDFWR) conducted an annual turkey survey from July 1 through August 31, 2024. Survey participants reported over 2,600 turkey observations across the state, which indicated peak hatching in early to mid June. Survey metrics indicated improved reproductive success in 2024 compared to 2023, including better nesting success (71% vs 64% of hens observed with a brood) and productivity (2.7 vs 2.3 poults per hen). Poults per hen improved more in western counties (3.1 vs 2.6) and eastern counties (2.3 vs 1.8) than central counties, which were unchanged (2.6). Reproductive success has trended upward since 2017. When reproductive success improves, spring hunter harvest increases 2 years later. For more information about the survey, visit the Kentucky Fish and Wildlife *Summer Turkey Brood Survey webpage*, or enter the key words "turkey survey" in the search bar on the agency's website (fw.ky.gov). KDFWR thanks the many participants who made time to report turkeys!

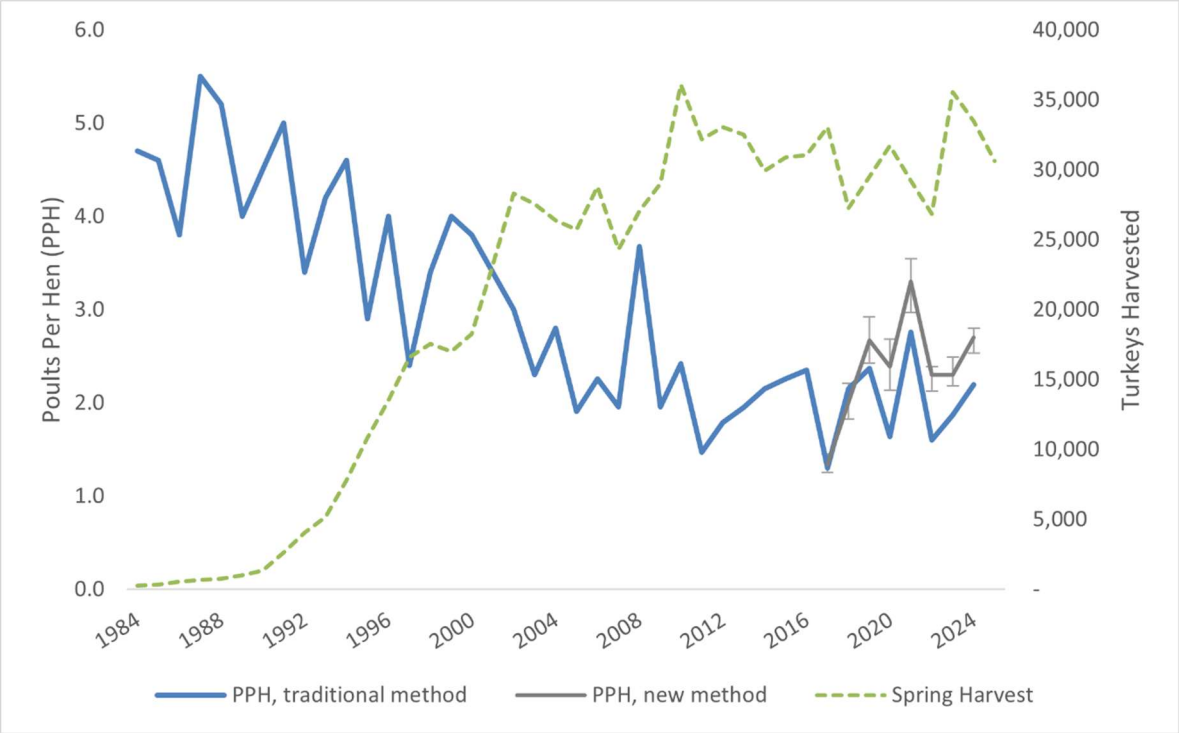


**Figure 1. Long-term trends in turkey reproduction and abundance.** As turkeys were restocked across Kentucky in the 1980s and '90s, the population grew rapidly, indicated by the dashed green line for spring hunter harvest. Conversely, the rate of poult production declined rapidly during this time, indicated by the solid blue line showing the brood survey's poult per hen metric. Compared to the traditional poult per hen calculation method used since 1984, a new method used since 2017 (gray line with vertical error bars) produces slightly higher estimates but indicates statistical measurement uncertainty. Both calculation methods show that over the past 20 to 25 years, better reproductiion leads to more turkeys 2 years later; for example, spikes in poults per hen in 2008 and 2021 were followed by spikes in harvest in 2010 and 2023, respectively.

Photo © Sara Watkins

## INTRODUCTION

Each year since 1984, the Kentucky Department of Fish and Wildlife Resources (KDFWR) has conducted a summer survey of wild turkeys. Although commonly referred to as the "brood survey" for continuity and familiarity, survey participants report all turkeys seen, not just hens with poults (females with their young of the year). Hundreds to thousands of turkey observations are summarized to produce metrics indicating the success of "hatch," a commonly used term referring to the success or productivity of the turkey population during its annual spring-through-summer reproductive period. Monitoring reproductive success helps KDFWR manage Kentucky's turkey population through regulations, outreach, and technical guidance to landowners.

Turkey reproductive success is difficult to measure because it varies from year to year and place to place in response to weather conditions, food and cover availability, land management, predator abundance, and disease prevalence. KDFWR is working with researchers at Tennessee Tech University on a 3-year study in Muhlenberg County to better understand the various facets of turkey reproductive ecology, such as nesting success and brood habitat use. The eventual research findings will thoroughly advance our understanding of turkey population dynamics in Kentucky, but will represent a short-duration snapshot from one area of the state.

In contrast, the brood survey provides an assessment of turkey reproductive success each year across the state, which compliments shorter-term research estimates. As a long-term monitoring tool, the Brood Survey would not be nearly as effective without the high level of public involvement seen in recent years. This report presents results of the 2024 Kentucky Wild Turkey Brood Survey. For more information, such as instructions on how to participate or past-year reports, visit *https://fw.ky.gov/Hunt/Pages/TurkeyBroodSurvey.aspx*.

## METHODS

Survey participants submit details about turkeys observed during routine travels across the state in July and August, including the number of turkeys seen (adult females, young poults, adult male

gobblers, and turkeys of indiscernible sex or age), location (the county or exact GPS coordinates), size of any poults seen, and whether they previously saw and reported those specific turkeys. Participants report observations using a Survey 123 website or mobile phone app (ESRI 2025) or a paper form submitted by mail or e-mail.

The primary metric calculated from turkey observations and used to indicate reproductive success is the poults per hen (PPH) ratio. Traditionally, PPH was calculated as a single value across all observations; the total number of poults observed was divided by the total number of hens observed (blue line in Figure 1). In 2017, we adjusted how hens without poults were recorded on the survey reporting form, which allowed us to calculate a PPH value for each observation of at least one individual hen. We then average the individual PPH values as an estimate for the state overall and for each of 3 regions, formed by counties grouped to represent the general west-to-east gradient from open crop to pastureland to mountain forests across Kentucky.

In addition to PPH, the other survey metrics we calculate include a poults per brood ratio (PPB) to indicate brood size or poult survival, the proportion of hens observed with a brood to indicate nesting success (PHWB), and the ratio of male to female turkeys (MF) to indicate gobbler carryover after the spring hunting season.

The new method uses a statistical technique called nonparametric bootstrapping to calculate confidence intervals around the per-observation means for PPH and PPB. This follows a standardized protocol adopted by several states in recent years. We do not calculate confidence intervals for PHWB and MF, which represent aggregations of all observations in regions and the state overall.

**RESULTS**

Survey cooperators recorded a statewide total of 2,625 turkey observations. Most observations were reported using the Survey 123 phone app and website (66%) and most were of turkeys not previously seen and reported by cooperators (80%). Most observations were reported from central counties (54%), reflecting greater survey participation where most people live in the state (Figure 1).

Based on reported observations, we estimated a statewide PPH index of approximately 2.7, which was up from 2.3 in 2023 (Table 1, Figure 3). At the regional scale, PPH improved more in western counties (3.1 vs 2.6) and eastern counties (2.3 vs 1.8) than central counties, which were unchanged (2.6). Statewide and regionally, PPH has trended upward following the historic low point observed in 2017. The PPH in 2024 was not quite as high as in 2021, a year when 17-year periodical cicadas (Brood X) emerged in counties along the Ohio River and in north-central Kentucky.

Like PPH, PHWB improved across the state compared to last year: 79% vs 67% in the west, 70% vs 67% in central counties, and 64% vs 58% in the east (Figure 3). Trends in PHWB since 2017 indicate that nest success has improved in western and central Kentucky but been stable in Eastern Kentucky. In contrast, PPB did not differ significantly from last year: 3.9 in the west, 3.8 in central, and from 3.1 to 3.5 in the east). Longer-term trends in PPB indicate that brood size or poult survival has been more stable than PPH or PHWB. The MF ratio decreased from last year in central and eastern counties but was unchanged in the west, and it has trended downward in western and central counties but been stable in eastern counties. The MF is negatively related to PPH (Figure 4).

**Table 1.** Summary statistics for the 2024 Kentucky Wild Turkey Brood Survey. Poults per hen = PPH, poults per brood = PPB. Calculations based on NWTF Technical Committee standardized protocol.

| Region[a] | PPH (95% CIs, n)[b] | PPB (95% CIs, n) | % of Hens With a Brood (n)[c] | Male:Female (n)[d] |
|---|---|---|---|---|
| Western | 3.1 (2.8-3.4, 357) | 3.9 (3.7-4.2, 282) | 81.4 (357) | 0.32 (396) |
| Central | 2.6 (2.4-2.8, 788) | 3.8 (3.6-4.0, 551) | 68.4 (788) | 0.32 (875) |
| Eastern | 2.3 (2.0-2.5, 309) | 3.5 (3.2-3.8, 198) | 60.1 (309) | 0.50 (365) |
| Unknown | 3.2 (2.0-4.4, 19) | 4.3 (3.1-5.7, 14) | 73.5 (19) | 0.67 (20) |
| Statewide | 2.7 (2.5-2.8, 1473) | 3.8 (3.6-3.9, 1045) | 70.2 (1473) | 0.36 (1656) |

[a] "Unknown" indicates observations for which a location could not be determined

[b] 95% bootstrap confidence intervals; n = number of observations used in calculation

[c] Percentage of hens observed with at least 1 poult

[d] Total number of males observed divided by total number of hens observed

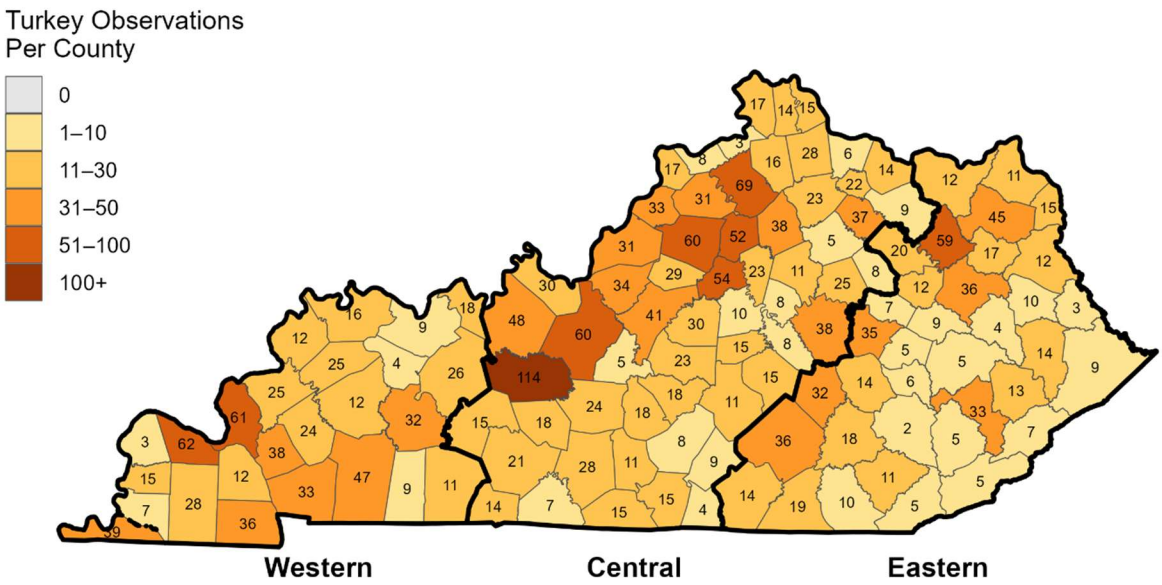


**Figure 2.** Turkey observations per county for the 2024 Kentucky Wild Turkey Brood Survey. Counties are grouped into 3 survey regions reflecting general landscape differences.

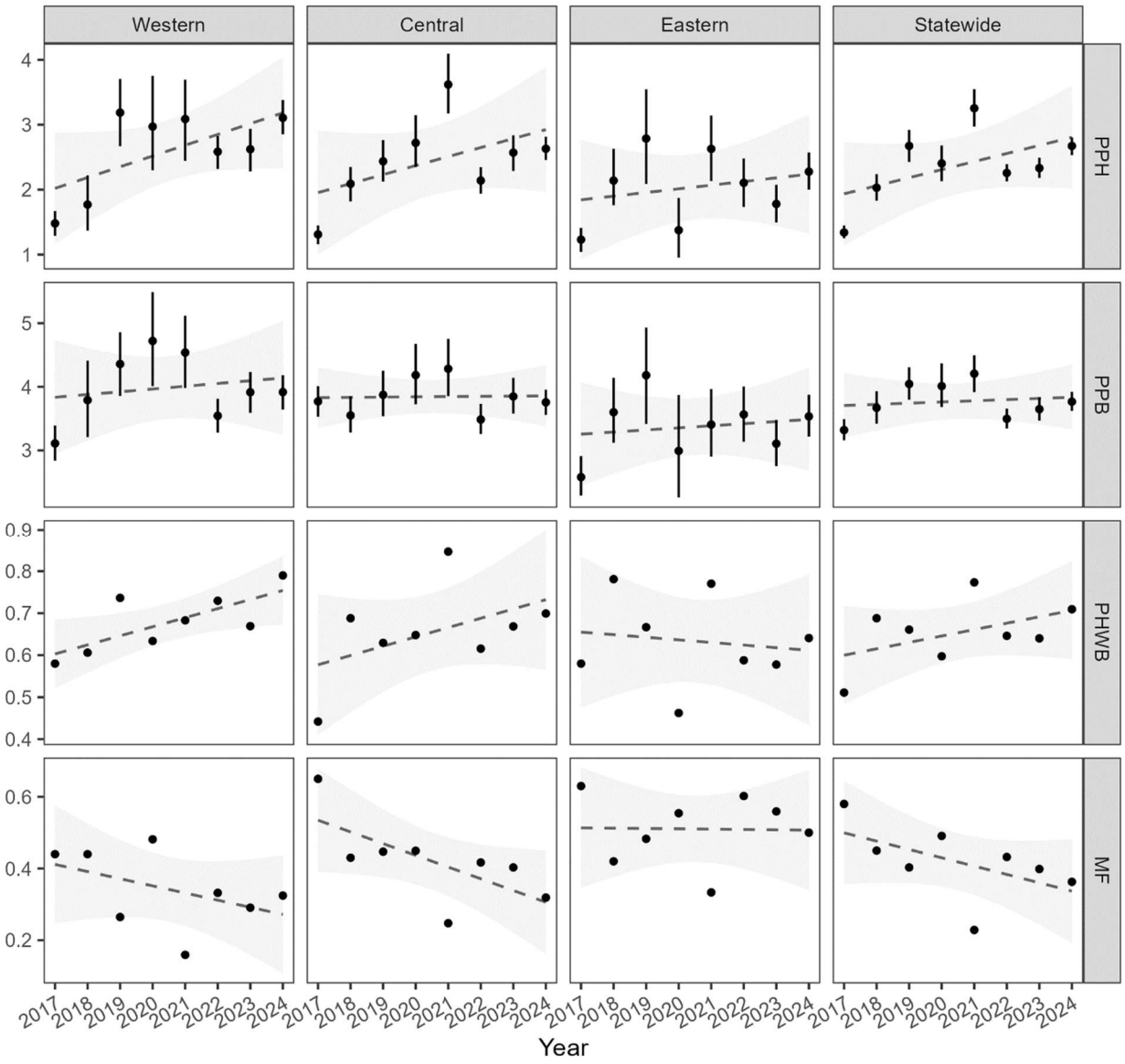


**Figure 3.** Trends in metrics of wild turkey reproductive success from the Kentucky Wild Turkey Brood Survey, 2017-2024. For each subplot, horizontal x-axis shows years and vertical y-axes show values for the other metrics, each within a row. Regions are oriented vertically in columns. Points show annual averages for each metric. Averages for Poults Per Hen (PPH) and Poults Per Brood (PPB) include 95% confidence intervals to indicate estimation uncertainty, where as the Proportion of Hens With a Brood (PHWB) and the Male:Female ratio (MF) are single values across all observations. Dashed lines show locally-smoothed trend lines across years. Gray ribbons show 95% confidence interval for trends.

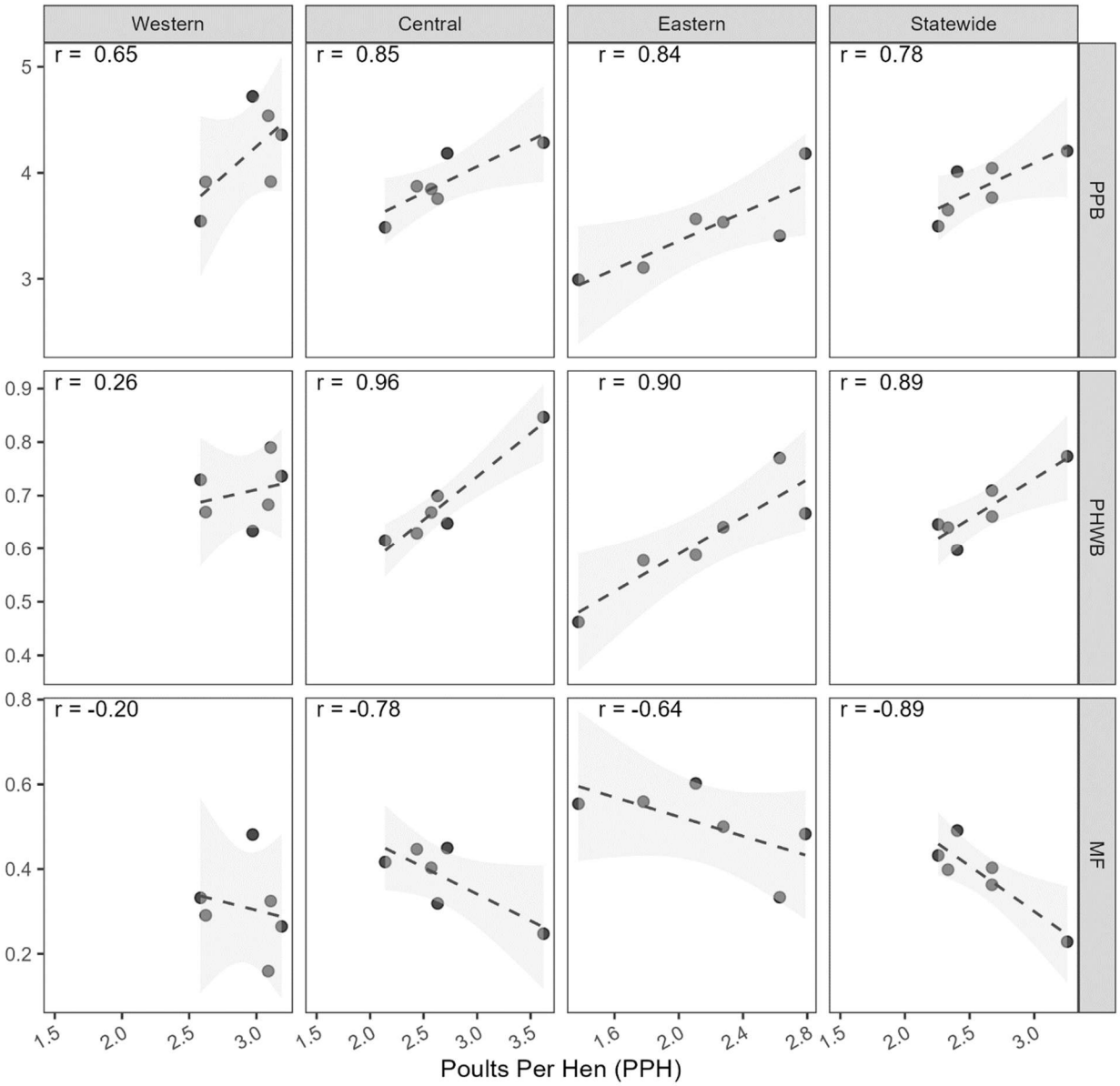


**Figure 4.** Relationships (statistical correlations) between poults per hen (PPH) and the 3 other metrics of turkey reproductive success from the Kentucky Wild Turkey Brood Survey, 2017-2024. PPB = poults per brood, PHWB = proportion of hens with a brood, MF = male:female ratio of observations. For each subplot, horizontal x-axis shows the PPH value and vertical y-axes show values for the other metric in each row. Regions are oriented vertically in columns. Points show yearly values for PPH and the other metric. Dashed lines and r values show Pearson's correlation coefficients. Gray ribbons show 95% confidence intervals for correlations.

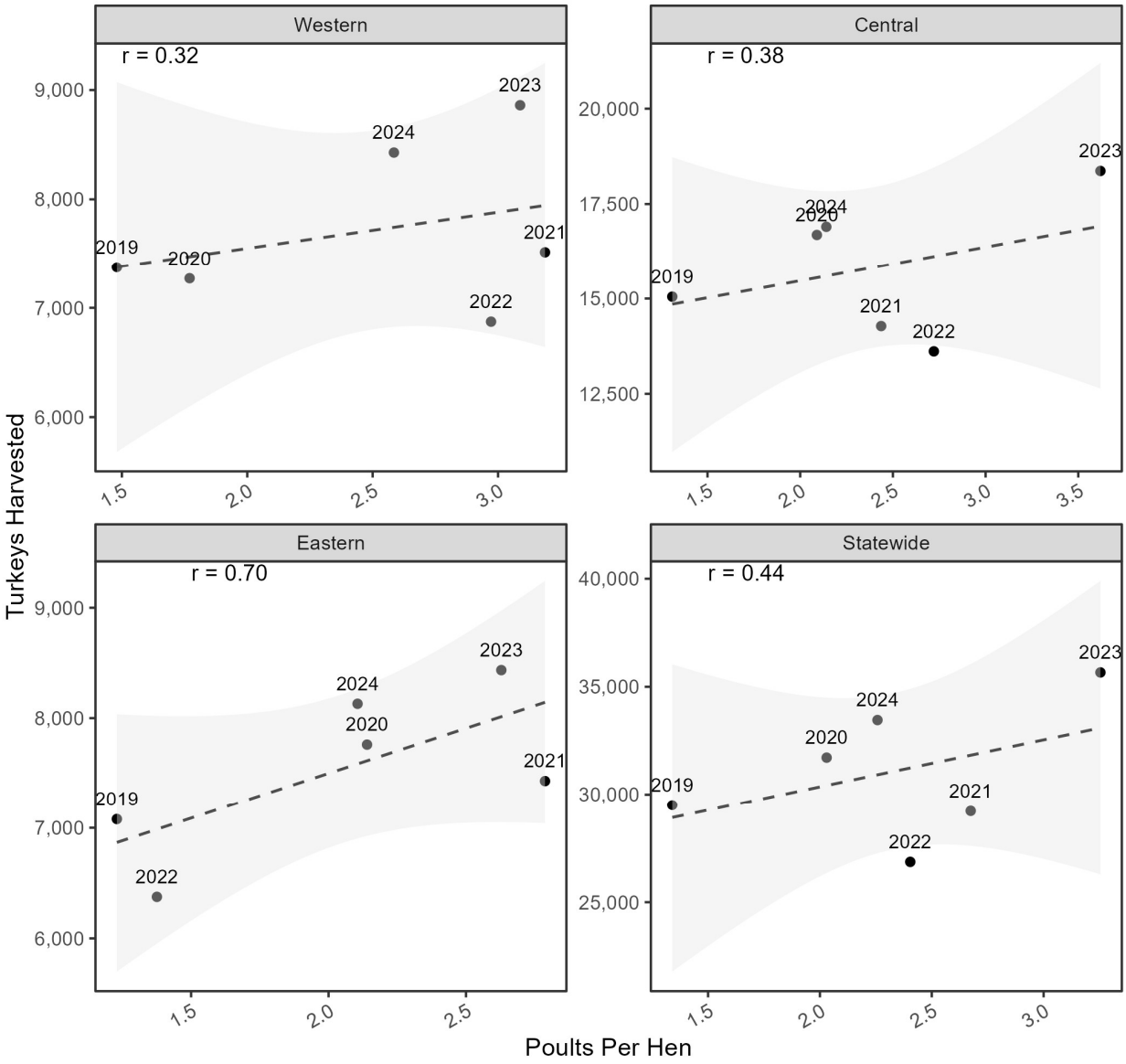


**Figure 5.** Relationships (statistical correlations) between poults per hen (PPH) from the Kentucky Wild Turkey Brood Survey with spring turkey hunter harvest from the KDFWR Telecheck database, 2017-2024. For each subplot, horizontal x-axis shows the PPH value and vertical y-axis shows the number of turkeys harvested. Points are labeled with the year of harvest, but the PPH value is for 2 years prior when poults were produced. Dashed lines and r values show Pearson's correlation coefficients. Gray ribbons show 95% confidence intervals for correlations.

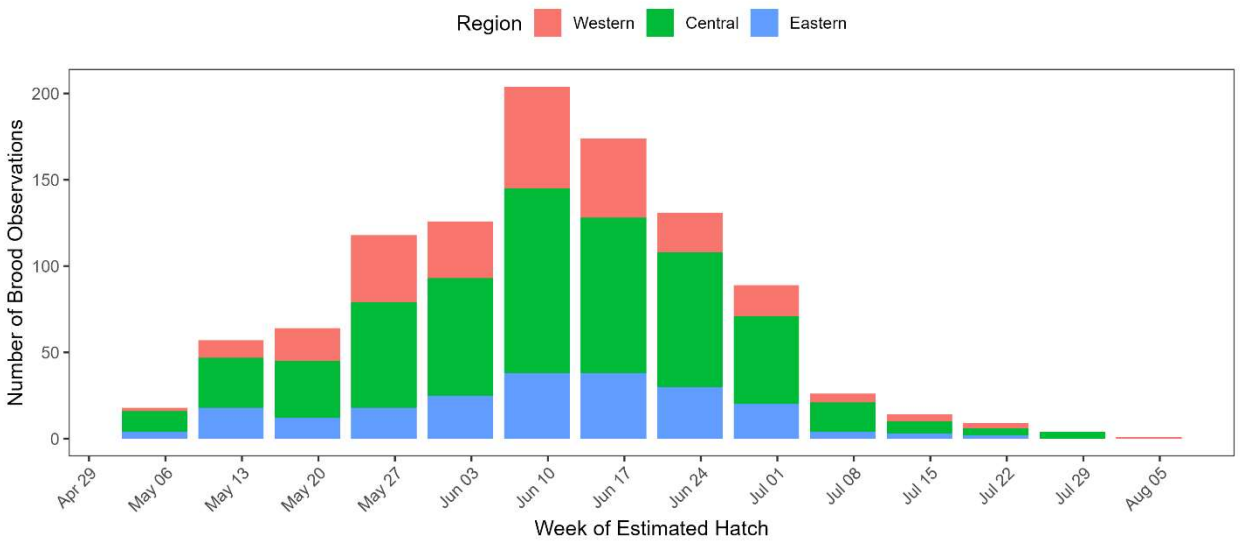


**Figure 6.** Estimated hatch dates of poults based on brood observations reported in the Kentucky Wild Turkey Brood Survey, 2024. Dates were derived from back-dating the date poults were observed based on the size of poults estimated by observers. Observers were provided the following poult size comparisons to other bird species: sparrow size (<2 weeks), robin size (2 weeks), quail size (3 weeks), pigeon size (4 weeks), grouse size (6 weeks), pheasant size or larger (8+ weeks).

Poults per hen is generally correlated with the other brood survey metrics, evidenced by relatively high correlation coefficients (r values above .5) for statewide values and some regional values (Figure 4). The correlation of PPH with both PPB and PHWB are positive, suggesting the three metrics provide similar, redundant inference for reproductive success. The correlation of PPH with MF is generally negative, suggesting that in better production years, fewer males are observed. This may be due to older (larger) poults getting mistaken for adult hens, which pushes the MF ratio towards females.

The correlation between PPH and spring harvest was positive but less strong, indicating that other factors explain a large proportion of the unexplained variation in the number of turkeys harvested each spring (Figure 5). This should not be surprising, as harvest totals are a product of weather conditions hunters face along with the actual number of turkeys on the landscape. Similarly, harvest is only a crude indicator of population size. Further analysis that incorporates weather and land cover variables would be needed for a clearer picture of the relationship.

Based on reported poult sizes, we estimated a peak in hatching in early to mid June. This corresponds fairly well with preliminary research findings at our western Kentucky field sites, suggesting a useful measure, at least for 2024.

## DISCUSSION

Kentucky 2024's brood survey data suggest that turkey reproductive success improved compared to 2023. In fact, the trend has been positive since 2017, the lowest production level on record. That low point in reproductive success likely depressed short-term turkey abundance and led to the

increasing number of calls to the Turkey Program in subsequent years from hunters and landowners who reported seeing fewer turkeys. It stands to reason that in low production years, fewer turkeys get added to the population, meaning fewer hens available to nest and rear broods to maintain or grow the population. Our male-to-female ratios show a population skewed toward males in 2017 but a shift toward females since then.

The effect of reproductive success in any given year, good or bad, is reflected in the spring harvest 2 years later (Figures 1 and 5). Inexperienced 2-year-old male turkeys are desirable to hunters in terms of behavior (gobbling, strutting) and physical characteristics (long beard, full tail fan), explaining why they are more vulnerable to hunters' calls compared to older gobblers that have been exposed to hunting pressure in previous seasons. Banding data collected since 2022 show much higher harvest rates for 2-year-olds than older gobblers.

When KDFWR began tracking the PPH index in the 1980s, PPH values were high, reflecting high population growth rates following the restocking of over 6,000 turkeys across the Commonwealth between 1978 and 1997. However, as the turkey population expanded across the state, growth rates, as measured by PPH, declined until the mid-2000s, then leveled off, generally around 2.0 PPH, which has since been considered a "break-even" level of production for population sustainability. The decline in productivity during a period of population growth may seem counterintuitive but is well documented in wildlife population biology. It may indicate that the turkey population grew until it reached the landscape's capacity to support it (Byrne et al. 2015).

In recent years, state wildlife agency biologists have begun standardizing brood survey data collection and analysis to improve monitoring for long-term sustainability of turkey populations. This standardization prompted the refinement in how we calculate PPH. An artifact of the calculation change has been that PPH estimates are systematically higher (by ~0.5 PPH) under the new method. For wildlife population monitoring, an exact figure can be less important than a trend across years. Also, sound inference should involve measures of statistical uncertainty to help gauge the reliability of our estimates (confidence intervals under the new approach), a more rigorous and transparent approach.

Regardless of how you figure it, the story is the same: over the past 20 to 25 years, turkey abundance and harvest have depended on reproductive success. Turkey populations are dynamic, sometimes fluctuating considerably from year to year (Healy and Powell 1999). This should not be surprising considering the hurdles turkeys face: high predator densities, ill-timed spring rains and flooding during nesting and brood-rearing periods, poor nesting and brood-rearing habitat throughout the state, and counter-productive land management practices ranging from recreational mowing to intensive agriculture and poor forest management. Diseases and pathogens may play a role as well.

Upticks in the turkey populations have been linked to the emergence of periodical cicadas. In 2008, the Brood XIV 17-year cicadas provided a readily available, nutritious food source for turkeys and an alternative prey source for predators. That same brood of cicadas is scheduled to emerge again next year, in 2025, so we are hopeful for another turkey population response in 2027 and beyond. An emergence of a different set of periodical cicadas (Brood X) probably contributed to higher PPH values in 2021. In 2024, Brood XIX 13-year cicadas emerged in parts of western Kentucky and likely contributed to notable improvements in turkey reproductive success documented by our Tennessee Tech University research collaborators. Compared to last year (2023), PhD student Sara

Watkins documented a 50% increase in nest success, a 176% increase in renesting rate, a 30% increase in brood success, a 63% increase in poults per hen, and a 113% increase in the percentage of nests that produced a successful brood. Although these (preliminary) results are not directly comparable with our statewide brood survey results, their general alignment shows the great value of the survey.

In closing, we suggest that the cicadas point to something that hunters and landowners interested in helping wild turkeys should consider: providing areas of lush herbaceous vegetation that support "bugging areas" for broods. Doing our best to promote successful reproduction can guard against the factors that are difficult or impossible to control: predators, disease, and weather. Quail, rabbits, deer, and songbirds will also benefit. KDFWR biologists are available to provide free technical advice and links to financial assistance. Contact KDFWR for more information on turkey habitat improvement; see the following web link: (*https://fw.ky.gov/More/Documents/privatelands_biologists.pdf*.

## REFERENCES

Byrne, M. E., M. J. Chamberlain, and B. A. Collier. 2015. Potential density dependence in wild turkey productivitiy in the southeastern United States. Proceedings of the National Wild Turkey Symposium 11:329-351.

Environmental Systems Research Institute (ESRI) 2025. ArcGIS Survey123 mobile data collection application. https://survey123.arcgis.com.

Healy, W. M., and S. M. Powell. 1999. Wild turkey harvest management: biology, strategies, and techniques. U. S. Fish and Wildlife Biological Technical Publication BTP-R5001-1999. U. S. Fish and Wildlife Service, Washington, D. C.

## ACKNOWLEDGMENTS

We thank the many survey participants who took the time to report turkey observations, which have helped us better understand and manage the wild turkey resource. Also, we thank supporting KDFWR staff who developed the reporting app and website (Geographic Information Systems Program) and produced the messaging to advertise this survey (Information and Education Division). Finally, we thank hunters for funding this work through the sale of Kentucky hunting licenses and matching federal funds derived from excise taxes on hunting equipment (the US Fish and Wildlife Service's Wildlife Restoration Program, first authorized by the Pittman-Robertson Act of 1937).