



Changes in Autumn Hawk Migration

Have peak migration dates of BWA and COHA changed significantly in the Northeastern U.S. from 1941-2010?



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ABSTRACT

Studies of the migratory habits of raptors have revealed changes in the timing of spring and fall migrations of both long-distance and short-distance migrants. These changes may be attributed to the increase in mean temperatures caused by climate change. These changes seem to be more pronounced in the short-distance migrants than in long-distance migrants. This may be due to their being close enough to their summer breeding grounds to be able to detect changes in weather patterns, thus signaling them to begin migration. Long-distance species rely on photoperiod cues to begin their migration. Using hawk observation data spanning 67 years from Hawk Mountain Sanctuary in Kempton, PA., I looked for a change in the timing of fall migration of Broad-winged and Cooper's hawks. These species were chosen because they have better defined peak migration windows, and are representative of both short and long-distance migrants. Three metrics (peak passage, 50% passage, and 90% passage) were used in order to gain a broader perspective of migratory patterns. Although an upward spike was noted in the most recent decade in Cooper's hawks, the signal was not strong enough to be considered statically significant. In these two species there is no detectable change in the timing of their fall migration for any of the metrics tested.

OBJECTIVES

The goal of this project is to:

- determine if there is a change in the timing of raptor migration by examining the migration data for selected hawk species [Broad-winged Hawk (*Buteo platypterus*) and the Cooper's Hawk (*Accipiter cooperii*)]
- to determine if there is a change in the frequency of distribution in the count data across the years.
- and if a significant shift in pattern is realized, correlate the count data with climatological data from the same time period

METHODS

Question: Has there been a significant change in the timing of peak autumn migration for COHA or BWA, between 1941 and 2010?

Hypothesis: There has been no significant change in the timing of peak autumn migration for COHA or BWA between 1941 and 2010.

To complete this analysis:

- a linear plot is created showing the trend of the decadal averages for the BWA and COHA

- from this a linear regression t-test is conducted to determine whether the slope of the regression line differs significantly from zero

- the significance level is set at 0.05

To conduct the linear regression t-test:

- the standard error of the slope is determined by the formula:

$$SE = S_{b_1} = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{(n-2)}} / \sqrt{\sum (x_i - \bar{x})^2}$$

- The t-test is then calculated by the formula:

$$t = b_1 / SE \text{ (} b_1 \text{ is the slope of the line being tested.)}$$

Hypotheses:

- H₀: The slope of the regression line is equal to zero.

$$H_0: b_1 = 0$$

- H_a: The slope of the regression line is not equal to zero.

$$H_a: b_1 \neq 0$$

If the slope representing the trends of the dates of peak migration is significant, then the slope will not be equal to zero, and \therefore the null hypothesis will be rejected.



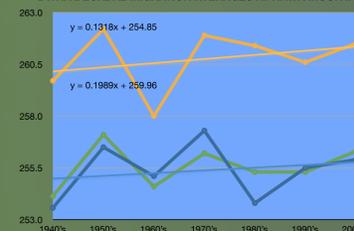
A Kettle of migrating Broad-winged hawks

RESULTS

COHA DECADEAL MIGRATION AVERAGES AT HAWK MOUNTAIN



BWA DECADEAL MIGRATION AVERAGES AT HAWK MOUNTAIN



SUMMARY OF LINEAR REGRESSION ANALYSIS OF HAWK MIGRATION DATA

| SAMPLE | LINEAR EQUATION | b ₁ | SE | T=b ₁ /SE | P |
|----------|------------------|----------------|------|----------------------|--------|
| COHA max | Y=0.6971x+276.42 | 0.6971 | 0.96 | 0.73 | P>0.05 |
| COHA 50% | y=0.45x+277.09 | 0.45 | 0.51 | 0.88 | P>0.05 |
| COHA 90% | Y=0.3039x+293.79 | 0.3039 | 0.88 | 0.34 | P>0.05 |
| BWA MAX | Y=0.1318x+254.85 | 0.1318 | 0.63 | 0.21 | P>0.05 |
| BWA 50% | Y=0.1279x+255.05 | 0.1279 | 0.47 | 0.27 | P>0.05 |
| BWA 90% | Y=0.1989x+259.96 | 0.1989 | 0.67 | 0.30 | P>0.05 |

CONCLUSIONS

The timing of the autumn peak migration of Cooper's and Broad-winged hawks is unchanged in the seven decades from 1941-2010. Although the autumn departure dates for both species show an upward trend, (especially in the last decade 2001-2010). The linear regression t-test shows that the slope is equal to zero, so therefore the H₀ is accepted and the H_a is rejected.

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ACKNOWLEDGEMENTS

The National Science Foundation Grant No. 1101245
Stephen R. Hale PhD, UNH Leitzel Center
Laurie Goodrich PhD, Hawk Mountain Sanctuary