

# MIGRATION OF FALL WARBLERS IN PENNYPACK PARK A FIVE-YEAR STUDY

FRANK WINDFELDER

## INTRODUCTION

The main intent of this article is to document the fall migration of warblers through the Pennypack Park area of Philadelphia. To this end, I have completed five years of field work in the area. I hope this will be a contribution to our knowledge of fall warbler migration in the region as a whole. At the end of the article, I will draw conclusions based upon my data and make suggestions for further study.

## HISTORY

Pennypack Park, created by City Ordinance in 1905, is located along the Pennypack Creek in Northeast Philadelphia. The creek itself runs generally in a southeasterly direction. It enters the city from Montgomery County at Pine Road and meanders through the Northeast until it empties into the Delaware River just south of Pennypack Avenue. The Park was enlarged over time as sections were acquired from private interests, but since World War II there has been unremitting encroachment, mainly from the construction of housing subdivisions.

The primeval habitat of the Pennypack Valley was much different in pre-Columbian times than it is today. Much of the original eastern deciduous forest was cleared for farming by the Delaware Indians and later by Swedish and English pioneers.

In modern times, according to John T. McNeill, Jr. (1941), at least three pairs of Upland Sandpipers nested in the fields between Verree Road and Pine Road, north of the Pennypack Creek. He listed such open-area species as Bobolinks, Eastern Bluebirds, Red-headed Woodpeckers, and Savannah, Grasshopper and Vesper Sparrows as summer residents.

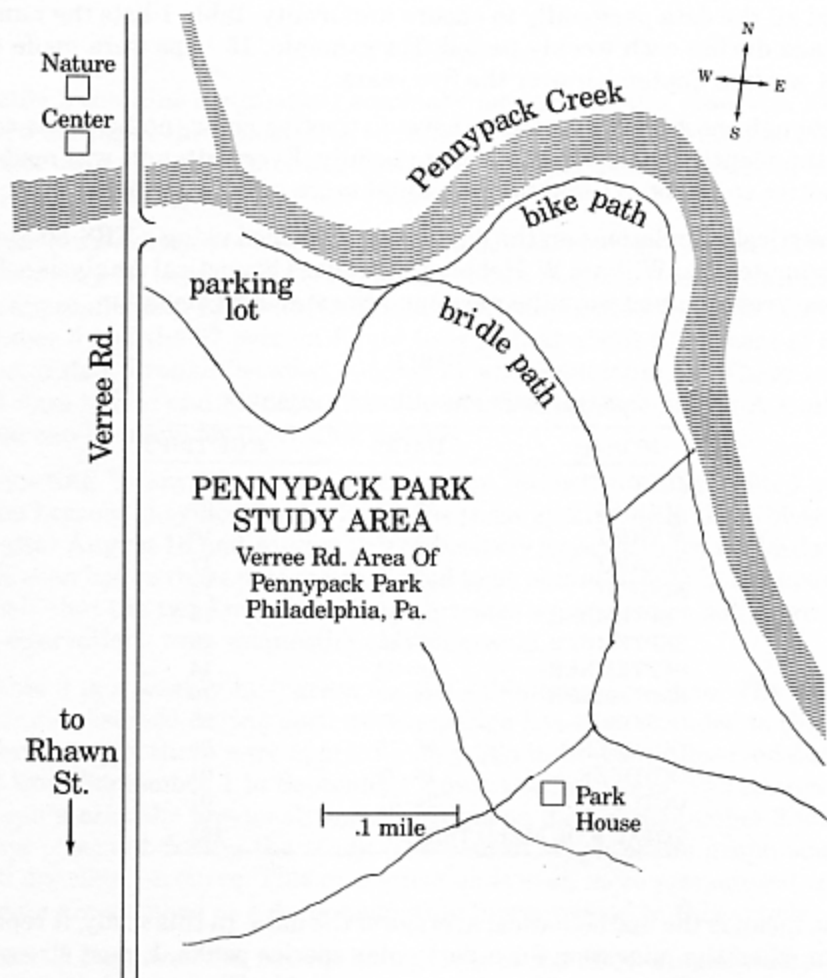
In the woodlands, McNeill recorded Kentucky Warblers and Louisiana Waterthrushes nesting, and Ovenbirds were particularly common. Blue-winged Warblers occupied the edges. Brushy areas contained Yellow Warblers, Common Yellowthroats, and Yellow-breasted Chats. Black-and-white and Chestnut-sided Warblers were irregular breeders.

As a result of my current work on the Pennsylvania Breeding Bird Atlas Project, I found that today in Pennypack Park only Yellow Warblers and Common Yellowthroats regularly breed. Louisiana Waterthrushes rarely nest in the Park now.

Ironically, this paucity of nesting Parulinae makes the Park ideal for a migration study. Almost all late season warblers are migrants.

## THE STUDY AREA

The section of Pennypack Park just east of Verree Road and south of the Pennypack Creek was chosen as the study area. This section is about a mile from the western terminus of the Park at Pine Road. The area is easily found by consulting a street map of Philadelphia. A trail map has been included in this article.



In the study area, the habitat is about 85 percent mature deciduous woodland, with oak, beech, and tulip trees predominating. There are a couple of very small swampy areas. Near the Park House, there are a number of Eastern White and Virginia Pines and a rather large ornamental Austrian Pine. The remaining habitat consists of overgrown fields containing Multiflora Rose and various saplings.

It is well-known that weather conditions influence the migration of warblers. Fall weather patterns in the Philadelphia area vary widely from one year to the next. This study was done over a period of five years so that the data would not be biased as a result of variable weather within a given year or two.

One hundred and twenty three field trips were made to the study area between 1982 and 1986. The average length of the trips was about two hours. I collected all the data personally to ensure uniformity. Table 1 lists the number of trips made during each weekly period. For example, 15 trips were made during the first week in September over the five years.

Although most warbler species have distinctive chips, no bird was counted unless the identification was confirmed visually. Every attempt was made to be conservative so as not to count an individual twice on a single field trip.

Statistical calculations on the data were performed using a TRS-80 Model III Microcomputer and William W. Hebbler's Advanced Statistical Analysis software. Two measures obtained were the mean and the standard deviation.

TABLE 1  
FALL VISIT FREQUENCY (1982-1986)

MONTH	DATES	# OF TRIPS
JULY	24-31	02
AUGUST	01-07	07
AUGUST	08-15	16
AUGUST	16-23	17
AUGUST	24-31	14
SEPTEMBER	01-07	15
SEPTEMBER	08-15	16
SEPTEMBER	16-23	14
SEPTEMBER	24-30	10
OCTOBER	01-07	05
OCTOBER	08-15	05
OCTOBER	16-23	01
OCTOBER	24-31	01
TOTAL # OF FIELD TRIPS		123

The mean is the mathematical average of the data. In this study, it represents the date when the migration for a particular species peaks. I must stress that a mean based upon few observations is not very reliable. The more observations, the closer the mean in the Table should be to the actual mean in the field. The standard deviation is a measure of how spread-out the data are or, conversely, how closely packed the data are about the mean. Hence, standard deviation represents the length in days of the main migration period for a given species. The larger the number, the more spread-out is the migration.

Data accumulated from the observation of natural occurrences frequently graph as a normal distribution (bell) curve. In a normal distribution, approx-

imately 68 percent of the data would fall within one standard deviation of the mean. If this number is approached for the distribution of a given species, it is a clue that the migration pattern for that species is that of a normal distribution. A normal distribution, however, is not a necessary conclusion. For example, the fall migration pattern of Bald Eagles along the Kittatinny Ridge of Pennsylvania, as reported in the Hawk Mountain News, 1977 to 1983, is definitely not a normal distribution. For this species, there are two peaks, a large one early and a smaller one late.

#### THE DATA

Table 2 contains a statistical summary for each species observed. The table has been arranged chronologically, so that the mean dates are later as one moves down the table. For example, the Tennessee Warbler is listed later in the table since it is a later migrant than the Canada Warbler.

Here is an example of how the standard deviation ( $\sigma$ ) can be used. The statistical summary for the subfamily Parulinae shows that the overall standard deviation is approximately 13. Using this number in conjunction with the mean date of September 3 and the 67 percent figure tells us that about 67 percent of the warblers migrated through between August 21 and September 16. These two dates are 13 days before and 13 days after the mean date respectively. A similar calculation can be made for individual species.

Counting Yellow Warblers and Common Yellowthroats presented a special problem because they nest in the Park. For these species, only those observations made after August 10 and August 21 respectively were included in the data. Individuals seen before these dates were judged to be non-migrants. It is impossible to know whether the two Louisiana Waterthrushes were, or were not, migrants. All other observations were unquestionably migrants.

Table 3 is a weekly histogram for the subfamily Parulinae. The number of individuals observed during each weekly period has been rounded to the nearest five. For example, there were approximately 365 individuals observed during the period from September 1 to September 7 over the five years. The narrow bar on the graph marks the previously mentioned mean date of September 3 for all the warblers observed during the study. The overall shape of the graph suggests a normal distribution curve. This configuration is even more pronounced when the same data are graphed as a daily histogram (not provided in this article).

Table 4 compares the weekly histograms of the Blue-winged and Magnolia Warblers. Their mean dates were August 27 and September 10 respectively, which is a difference of two weeks. This indicates that Blue-winged Warblers were considerably earlier fall migrants through Pennypack Park than were Magnolia Warblers. Note also that the standard deviations are about the same. For each species, most individuals migrated through in about a five-week period.

Table 5 compares the weekly histograms of the Chestnut-sided and Black-and-white Warblers. In this case, the mean dates differ by only one day. However, the Black-and-white Warbler has a much higher standard deviation. Their histo-

grams illustrate this difference. The bulk of the Chestnut-sided's migration was concentrated in a four-week period, whereas the Black-and-white's migration period was more protracted.

Table 6 compares the line graphs of a number of species for which I had sufficient data to generate reliable curves.

TABLE 2

SPECIES	n	$\bar{X}$	$\sigma$	%	EARLY	LATE
LOUISIANA WATERTHRUSH (#) <i>Seiurus motacilla</i>	2	8/12	1.00	100	8/11	8/13
YELLOW WARBLER(*) <i>Dendroica petechia</i>	9	8/15	4.03	67	8/10	8/24
HOODED WARBLER <i>Wilsonia citrina</i>	2	8/17	4.00	100	8/13	8/21
CERULEAN WARBLER <i>Dendroica cerulea</i>	2	8/20	8.50	100	8/11	8/28
WORM-EATING WARBLER <i>Helmitheros vermivorus</i>	10	8/22	8.27	60	8/13	9/09
GOLDEN-WINGED WARBLER <i>Vermivora chrysoptera</i>	9	8/24	14.92	89	8/10	10/02
MOURNING WARBLER <i>Oporornis philadelphia</i>	4	8/25	2.35	75	8/23	8/29
NORTHERN WATERTHRUSH <i>Seiurus noveboracensis</i>	28	8/26	13.43	57	7/28	9/18
BLUE-WINGED WARBLER <i>Vermivora pinus</i>	84	8/27	9.51	73	8/08	9/23
CANADA WARBLER <i>Wilsonia canadensis</i>	187	8/28	9.13	69	8/04	9/25
AMERICAN REDSTART <i>Setophaga ruticilla</i>	309	8/29	11.97	67	8/04	10/07
BLACKBURNIAN WARBLER <i>Dendroica fusca</i>	92	8/29	8.82	73	8/08	9/18
OVENBIRD <i>Seiurus aurocapillus</i>	34	8/29	11.58	65	8/13	9/13
CHESTNUT-SIDED WARBLER <i>Dendroica pensylvanica</i>	132	8/31	8.79	64	8/10	9/28
BLACK-AND-WHITE WARBLER <i>Mniotilta varia</i>	179	9/01	14.19	64	8/04	9/30
NASHVILLE WARBLER <i>Vermivora ruficapilla</i>	10	9/05	9.33	70	8/26	9/28
BAY-BREASTED WARBLER <i>Dendroica castanea</i>	78	9/07	7.27	74	8/23	9/30
BLACK-THR. GREEN WARBLER <i>Dendroica virens</i>	41	9/07	10.58	83	8/20	10/08
TENNESSEE WARBLER <i>Vermivora peregrina</i>	93	9/07	9.69	66	8/22	10/02
CAPE MAY WARBLER <i>Dendroica tigrina</i>	17	9/09	8.89	59	8/29	9/28
MAGNOLIA WARBLER <i>Dendroica magnolia</i>	125	9/10	10.87	63	8/21	10/08
BLACKPOLL WARBLER <i>Dendroica striata</i>	18	9/11	10.49	61	8/22	9/28
WILSON'S WARBLER <i>Wilsonia pusilla</i>	2	9/13	0.50	100	9/12	9/13
BLACK-THR. BLUE WARBLER <i>Dendroica caerulescens</i>	70	9/13	14.57	47	8/23	10/10
COMMON YELLOWTHROAT(*) <i>Geothlypis trichas</i>	172	9/15	12.55	65	8/21	10/14
NORTHERN PARULA <i>Parula americana</i>	27	9/16	7.85	67	8/29	9/28
CONNECTICUT WARBLER <i>Oporornis agilis</i>	1	9/21	0.00	100	9/21	9/21
YELLOW-RUMPED WARBLER <i>Dendroica coronata</i>	3	10/06	8.16	33	9/26	10/16
SUBFAMILY PARULINAE	1740	9/03	12.91	67	7/28	10/16

n = number of individuals observed

 $\bar{X}$  = mean date $\sigma$  = standard deviation in days

% of population within one standard deviation of mean

EARLY = earliest date observed

LATE = latest date observed

(\*) = nesting species

# = rare nester

TABLE 3  
WEEKLY HISTOGRAM

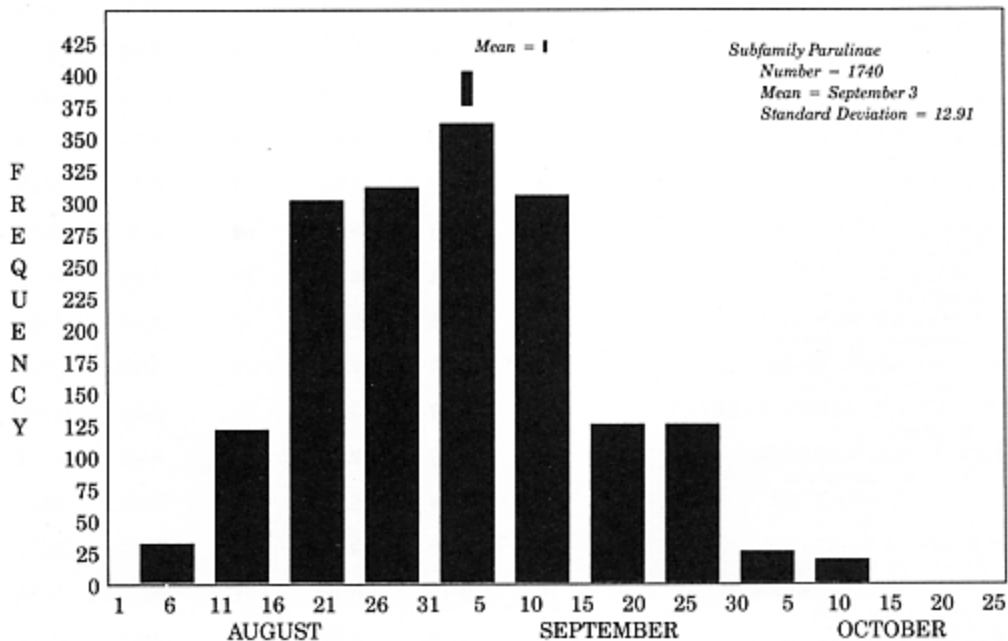


TABLE 4  
WEEKLY HISTOGRAMS

F  
R  
E  
Q  
U  
E  
N  
C  
Y

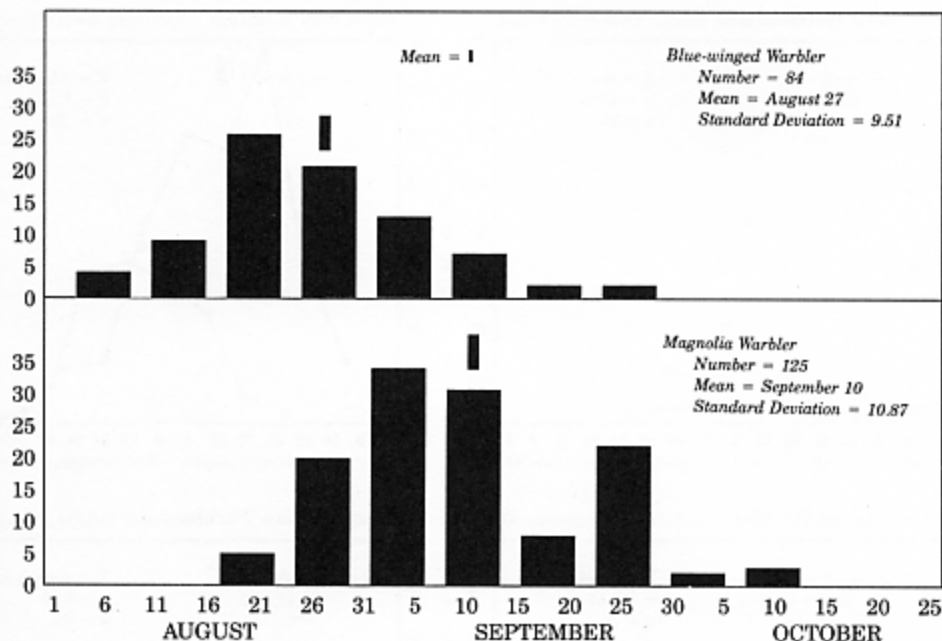


TABLE 5  
WEEKLY HISTOGRAMS

F  
R  
E  
Q  
U  
E  
N  
C  
Y

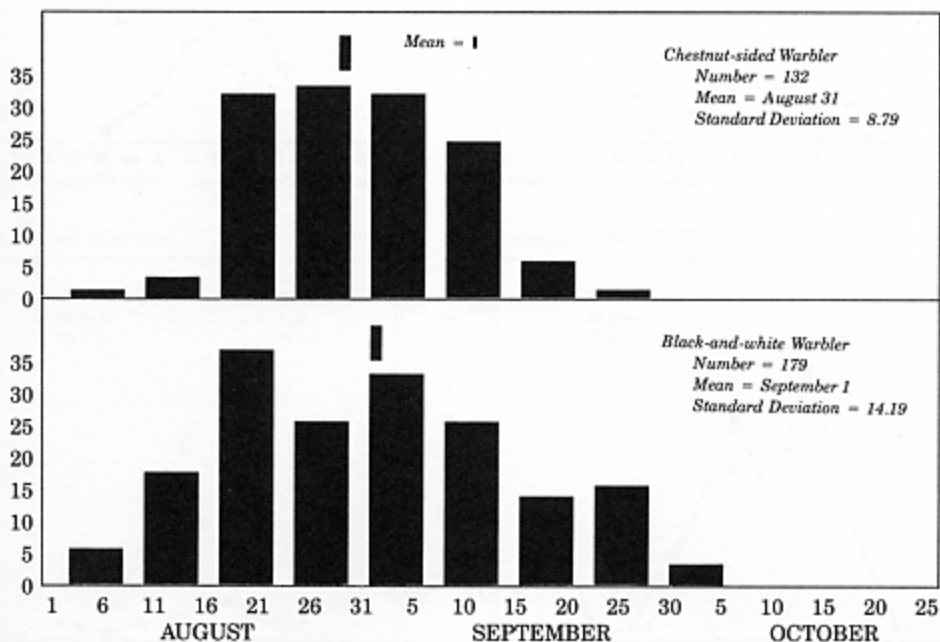
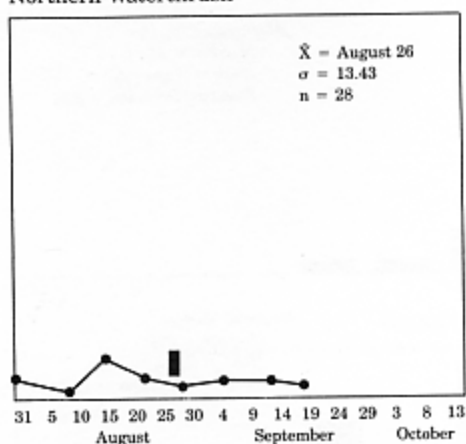
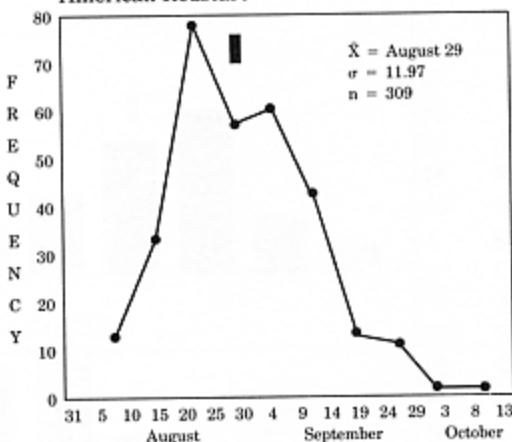


TABLE 6  
WARBLER MIGRATION IN PENNYPACK PARK

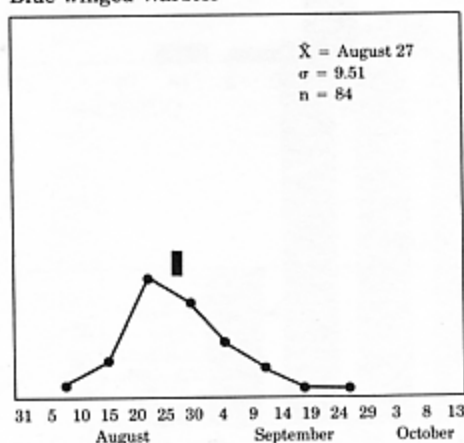
Northern Waterthrush



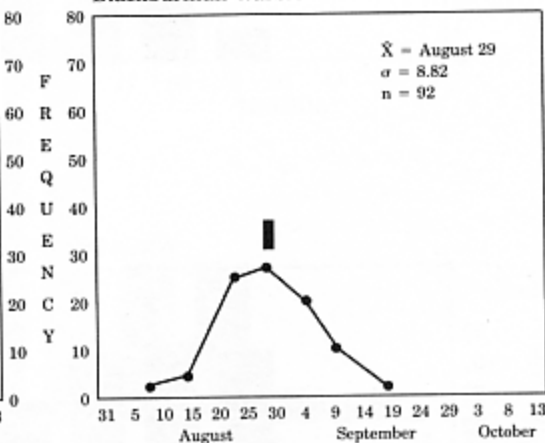
American Redstart



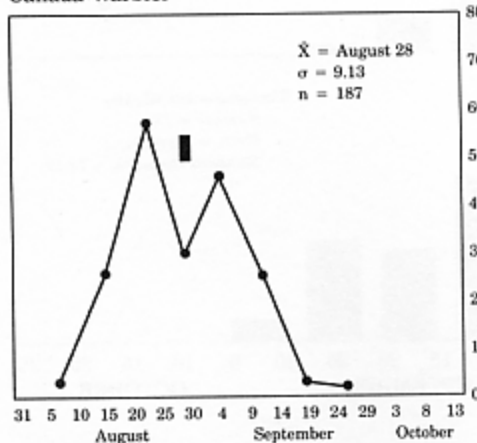
Blue-winged Warbler



Blackburnian Warbler



Canada Warbler



Ovenbird

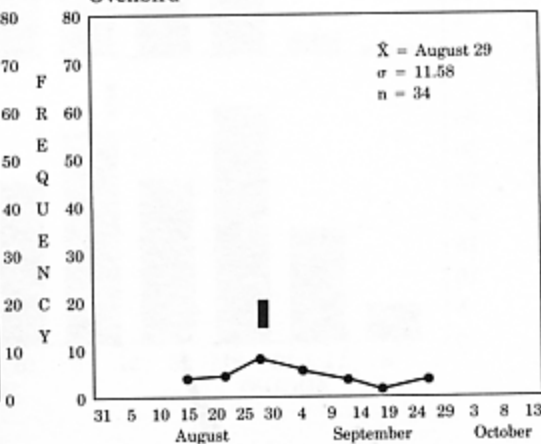
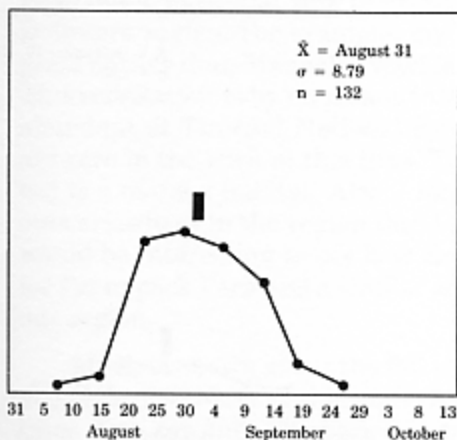
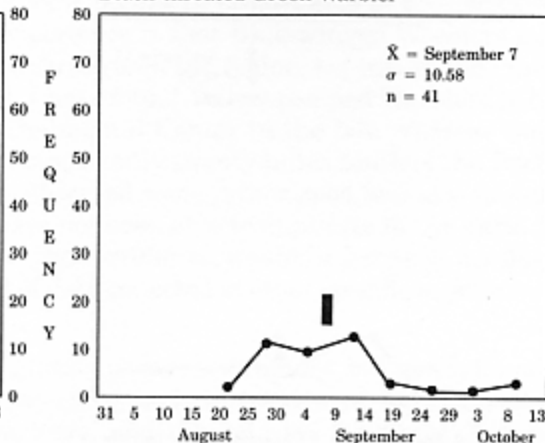


TABLE 6  
WARBLER MIGRATION IN PENNYPACK PARK (Continued)

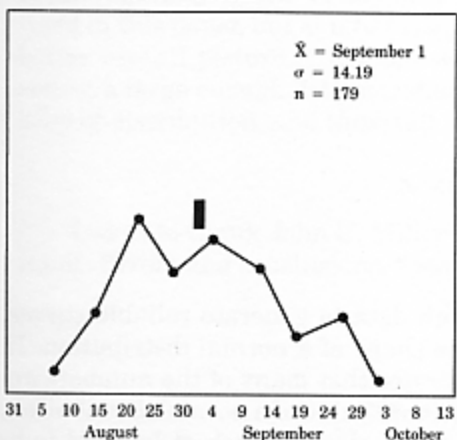
Chestnut-sided Warbler



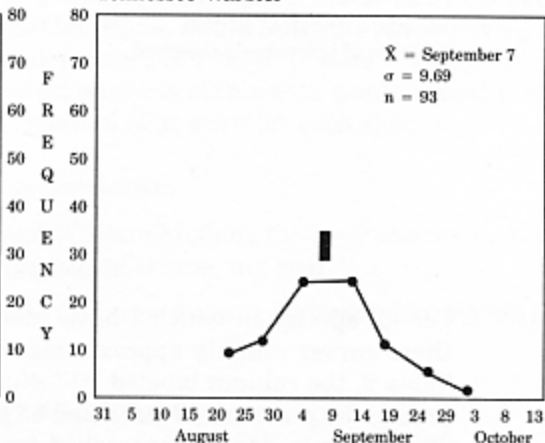
Black-throated Green Warbler



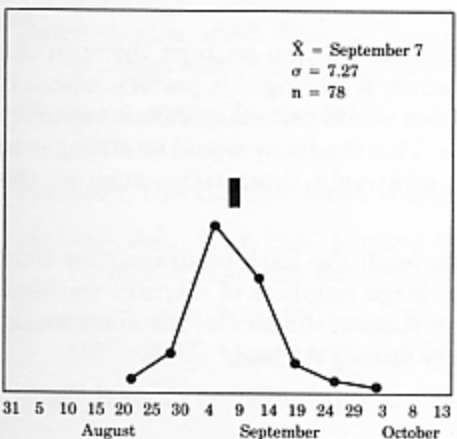
Black-and-white Warbler



Tennessee Warbler



Bay-breasted Warbler



Magnolia Warbler

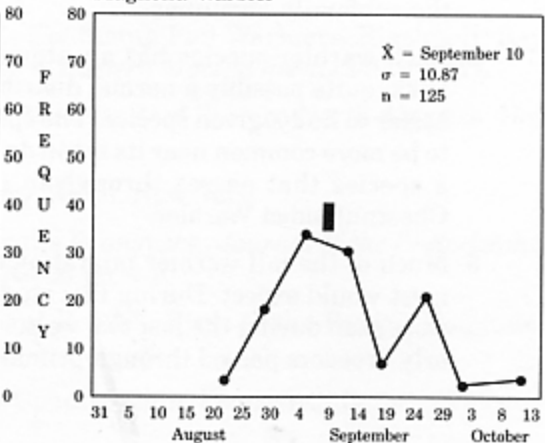
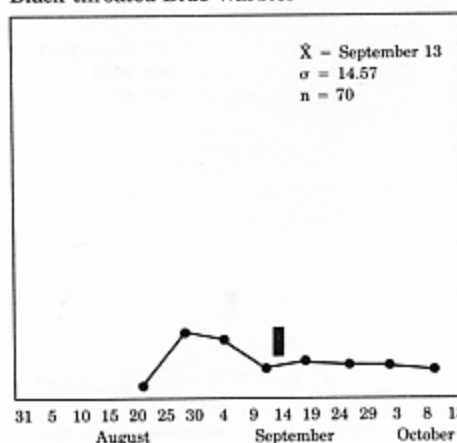
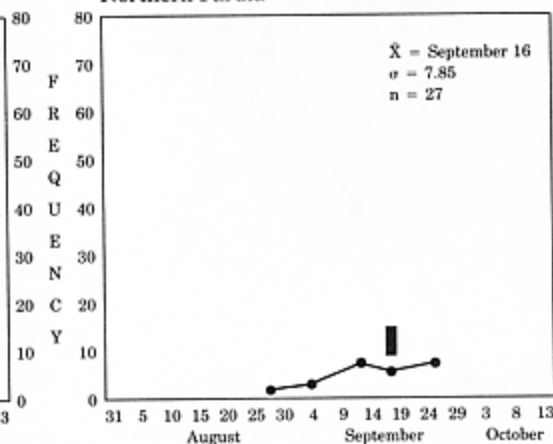


TABLE 6  
WARBLER MIGRATION IN PENNYPACK PARK (Concluded)

Black-throated Blue Warbler



Northern Parula



Key:  $\bar{X}$  = mean date  
 $\sigma$  = standard deviation in days  
n = number of individuals observed

CONCLUSIONS

1. For all species in which I have enough data to generate reliable curves, these curves roughly approximate the shape of a normal distribution. In Table 2, the column labeled "%" illustrates that many of the numbers approach the previously mentioned 68 percent value of a normal distribution. This value is closely approached for all species in which at least 34 individuals were observed. Note in particular the 67 percent in this column for the subfamily Parulinae.
2. Each warbler species has a unique fall migration pattern through the Park, quite possibly a normal distribution. Knowing this pattern makes it easier to find a given species. The species would certainly show a tendency to be more common near its mean date. This tendency would be stronger in a species that passes through in a relatively short time, such as the Chestnut-sided Warbler.
3. Much of the fall warbler migration through the Park occurs earlier than most would expect. During this study, large numbers of migrant warblers were seen during the last two weeks in August. As a rule, the more southerly breeders passed through primarily during August.

## SUGGESTIONS FOR FURTHER STUDY

There seems to be a correlation between the fall migration of warblers in Pennypack Park and this migration as it occurs in other parts of the Hudson-Delaware region. For example, my experience is that Blue-winged Warblers migrate earlier than Magnolia Warblers throughout the region, not just in the Park. This correlation is by no means total. I have found Yellow-rumped Warblers to be abundant at Tinicum National Environmental Center in the fall, whereas they are rare in the Park at this time. Tinicum is only twenty miles south of the Park, but is a marshy habitat. Also, I have observed some rather good late-season fall-outs elsewhere in the region that I have not been able to duplicate in the Park. It would be interesting to see how close the correlation would be between my data for Pennypack Park and a similar set of data collected at other specific locations in our region.

Much is known about the fall migration patterns of raptors, but less is known about the southerly movements of passerines, including warblers. My study contains data for only 28 species of warblers, and the data set for many of these species is rather scanty. Much more data are needed for those species that do not occur regularly in the Pennypack. Systematic study using the techniques outlined in this paper, but at other regional locations, would be helpful in acquiring a better overall picture of the fall warbler migration here. If such a study could collect a large enough data set, statistical analysis of this data would reveal what kind of distribution, and thus, fall migration, is at work for each species.

## ACKNOWLEDGMENTS

I want to thank John C. Miller and William Murphy for their comments and input. Errors and conclusions, however, are, of course, my own.

—9233 Convent Avenue, Philadelphia, PA 19114

## SELECTED BIBLIOGRAPHY

- Aaronson, Stephen, et al. 1969. Old Northeast Philadelphia County 1609-1854. Northeast High School. Philadelphia, Pa.
- Baird, James. 1986. Tips for Tyros—Confusing Fall Warblers: Blackpoll, Bay-breasted and Pine. *Bird Observer of Eastern Massachusetts* 14(4), p. 171.
- Chapman, Frank M. Second Rev. Ed., 1937. *Birds of Eastern North America*. New York.
- Harrison, Hal H. 1984. *Wood Warblers' World*. New York.
- McNeill, John T. Jr. 1941. Birding Up the Pennypack. *Journal of the Philadelphia Council of Amateur Scientists*, (No. 2) pp. 4-10.
- Street, Phillips B. & Wiltraut, Richard E. 1985. Birds of the Pocono Mountains (1975-1985). *Cassinia* 61, pp. 3-19.
- Stull, Jean, et al. 1985. *Birds of Erie County*. Elgin, Pennsylvania.