

BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

Vol. II

OCTOBER, 1931

No. 4

SOME DETAILS OF THE MIGRATION HABITS OF WHITE-THROATED SPARROWS

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GLENOLDEN, eight miles southwest of the Philadelphia City Hall, is two miles from the Delaware River, and just on the edge of the fall line of tributary streams.¹ The river valley south of Philadelphia, with its sheltered location and mild temperature in winter, is a favorite winter resort for a number of species of insectivorous birds. White-throated Sparrows are always found here in winter in varying numbers, though they are more rare and local winter residents north of Philadelphia except in similarly favored regions such as the lower Connecticut Valley. Mr. R. J. Middleton, of Norristown, Pennsylvania, sixteen and two-thirds miles northwest of Glenolden, traps large numbers of White-throats during fall migrations, but he neither traps nor (with one exception to be noted below) sees any during the winter.

For the past five years practically all trapping in Glenolden has been done within a few hundred feet of our house, and for the most part within fifty feet. Directly back of our property a neglected plot, formerly devoted to orchard and truck farming, is choked with weeds whose seeds tempt many birds. The ground beyond this plot gives way precipitously to the winding woodland ravine which follows the course of a small stream. In this ravine there is shelter from the high winds of winter, and along the valley the wintering flocks of birds which visit our feeding and banding station range for at least a quarter of a mile below the station and for probably a half a mile at least above. White-throats banded near the house have been seen frequenting the woods on the farther slope at least a quarter of a mile beyond the ravine. We have hoped in time to be able to assemble data on the distance such winter flocks wander from day to day, since our experience seems at

¹A map of the Glenolden region was shown in *Bird-Banding*, Vol. I, No. 3, July, 1930.

variance with the experience of others, who report that wintering birds do not range more than a few hundred feet from a banding station. This fact is mentioned in spite of the lack of detailed proof because of the bearing it has on a point mentioned below.

Our bird-banding activities in Glenolden started in October, 1922. Therefore we have records of White-throated Sparrows (*Zonotrichia albicollis*) from early fall to late spring during nine winter seasons (excepting the early fall of 1922). Trapping is carried on pretty regularly during the winter season. Traps are usually in operation from dawn until eight A.M., frequently during the entire morning, and many times throughout the day. They are usually operating all Saturday and Sunday. Sometimes during a slack period the traps are removed for a while. On the occasional days of snow every effort is made to carry on trapping as extensively as possible. Therefore the records present regular and complete results throughout the season as a whole.

During the winter of 1928-29 it was not possible to devote any time to banding except in the early morning and on Saturdays and Sundays. Yet the results exceeded those of any other year to date. In 1929-30 far more time was devoted to banding than during any previous year, but only a few White-throats were taken during the entire winter. Therefore it seems that even intermittent banding would fairly represent the winter population, and if any individuals were missed, it would be those passing through and stopping for only short intervals.

We are convinced that practically every White-throat that stays for any length of time in the ravine within a distance of a quarter of a mile at least from our banding station, is trapped and banded. We base this conclusion on the fact that in winter we practically never see unbanded White-throats in the field. We do trap new birds in January, February, and March, but conclude that they are new arrivals at the time of banding. (This point will be discussed later.) Therefore, if a White-throat is not trapped during an interval of six weeks or more when others are continually being trapped, we feel certain that in most cases the individual has left the locality entirely or has met with disaster.

As already mentioned, there is a great quantity of weed seeds available, and the bait of the traps lures the wintering birds only at times. The White-throats are usually found with a winter flock composed of several species which ranges up and down the ravine, perhaps not visiting the trapping

station for days at a time, though individuals may come now and then. A spell of frost, snow, or a decided change in weather brings the assorted birds of this flock quickly to the feeding and banding station, though high wind, even when accompanied by cold weather, keeps birds closely within the shelter of the ravine. At times of extreme weather, newcomers often appear and join the flock, or members of the flock may disappear. The charts show days now and then, or periods of two or three days, when nearly if not all the resident birds show up as if in answer to a roll-call.

As far as our files are concerned, the White-throat records are merely a bulky mass of nearly seven hundred cards, containing detailed information as to plumages, and in some cases tracing plumage-changes and molts in detail. The migration data are there, of course, but are entirely obscured. When these data are assembled and tabulated, one suddenly begins to note the fact that movements appear to be made by groups, and that the migration details vary from season to season for masses, groups, and even for individuals.

FALL MIGRATION

During the second, third, and fourth years of our trapping, we had a series of traps placed over an area of about two acres in the bottomland and on one side of the ravine. Eventually we were obliged to confine trapping almost entirely to stations within sight of the house, both because of vandalism and because of the amount of time and energy required to make hourly visits to the traps. This change apparently affected only the migrants as far as numbers are concerned. The number of wintering birds taken was probably no less in any season, though their repeats might be fewer. During the succeeding years the number of birds taken during times of migration was noticeably smaller. Meanwhile trees and shrubbery have grown appreciably on our property, the orchard that originally lay between us and the woodland has "gone wild," and on the only other property that lay between us and the woods the house was destroyed by fire and the grounds have since been uncared for. Thus the wilderness has come to us slowly, with the result that in the fall of 1930 the number of migrating White-throats caught at home approached the former quantities caught over a much larger area.

It should be noted that, although the records of wintering birds do not suffer seriously if two or three days elapse now and then when no banding is done and if the station territory is restricted; banding during a migration rush to be truly

representative must be pursued continuously and over a considerable area. Mr. Middleton, of Norristown, has records of migrating White-throats that are far more adequate than ours, because his trapping suffers no interruptions, and because he has a series of substations over a territory of several acres.

In considering the data of fall migration, therefore, some of Mr. Middleton's records have been included by way of comparison. Chart No. 1 shows the available data by years at Glenolden. A detached vertical line in the space following the date of a year indicates the day on which the first sight record of a White-throat for the season occurred. These sight records start in 1921, two years before the banding station was established. A horizontal line in the space following a year date indicates the duration of trapping for the fall season. Small vertical lines affixed to these duration lines indicate migration peaks or waves. In 1925, 1927, and the following years, a second space for each year marked "M" shows the duration of the fall banding period for White-throats at Mr. Middleton's station with migration peaks indicated, but does not include the first sight records.

It is interesting to note that prior to the fall of 1928, Mr. Middleton had but one trap in operation, and that he trapped but 81 White-throats in the fall of 1925, his first year, none in the fall of 1926, and 54 in the fall of 1927, as compared with several hundred handled in each succeeding fall. As to the failure to trap in the fall of 1926, Mr. Middleton writes: "From my migration records I find that White-throats were common all through October and present in fair numbers until the middle of November (in 1926). During the summer of 1926 we built a chicken-house with a good-sized run right close to the place where I had my one trap located, and although the trap was fenced in, the chickens could get fairly close to it. I did not move the trap farther back in the woods until most of the birds had passed, and I think this accounts for not taking any. It was not because of their scarcity, as my records show about a normal movement that fall."

It must be remembered that at Norristown fall migration of White-throats definitely ends, and (with one exception) no more White-throats are seen until spring, while at Glenolden there is merely a cessation of the migration rush, and new individuals appear now and then throughout the winter. All birds trapped in Glenolden after the final fall-migration date as given on the chart, are included in the series of winter-residence charts.

In considering the data on fall migration, we first notice

that there seems to be a fairly constant lapse between the date on which the first sight record is made and the date when trapping begins. In 1923, 1924, and 1925 there is a lapse of but two to four days. In those three years trapping was done over a large area, as before stated. In the five following years there is a lapse of from ten to twelve days between the day when the first sight record was made and the day on which the first bird was trapped. This is what might be expected at the more restricted detached banding station.

When we compare the dates of duration of fall migration in Glenolden and Norristown, we note that the first birds are taken at Norristown ten to fifteen days earlier than the first birds at Glenolden. (This is not true for the fall of 1925, but the fact that Mr. Middleton was just starting his banding operations is sufficient explanation of this exception.) While we would expect the birds to reach the more northern point first, and while we realize that in Glenolden a few days of possible trapping are lost because of the restricted area of trapping, nevertheless it is evident that the flocks are moving very slowly, probably indicating that the migration speed slackens more and more as the flocks approach the territory of winter residence. In 1929 and 1930 Mr. Middleton was trapping White-throats several days before the first straggler was seen in the Glenolden region.

Further comparison of the records indicates that there is no particular relation between the migration peaks of the two stations, though definite conclusions of this sort must be based on careful data for many more years than are here included. However, the lack of correlation between migration peaks in the two localities indicates that the general migration is not a regular movement of so many miles each twenty-four hours with definite stop-overs. The route in this region may be definite and unchanged (and further proof of this will be offered) but the places and durations of stop-overs vary. A migration peak at Norristown one day is no indication that Glenolden will see one that same day, or a given number of days later, though such may frequently be the case.

It is also evident that there is no ratio agreement between the number of White-throats banded in Norristown and the number banded in Glenolden in any given year. This fact lends further weight to the tentative conclusion that though a definite route is followed, the places and durations of stop-overs vary.

There is, of course, no indication whatever that Norristown

lies on the same migration route as Glenolden. Geographically it might seem that such would be the case, since Norristown lies on the Schuylkill River, which flows into the Delaware a few miles north of Glenolden. Although north-and-south river valleys indicate the possibility of concentrated migration-routes, and although greater numbers of birds in general seem to be found in river valleys, nevertheless there is other evidence indicating overland routes. Mr. Middleton has never taken a bird of any species banded by us, nor have we ever taken one of his. Also the river-valley route south from Norristown is rather circuitous. But these considerations need not stand in the way of comparing results between the two stations, since large migration movements are known to occur over many miles of territory simultaneously.

A study of adequate data such as Mr. Middleton's, with due consideration of all the details of atmospheric conditions, should yield illuminating results as to the effect of weather on migration, though I suspect that it might be necessary to know more about the origin and destination of the flocks, and about the exact course of the migration-route all along the line, so that the consecutive and cumulative effects of the weather might be taken into consideration. It is easier to interpret winter movements as influenced by weather conditions with a knowledge of local weather only.

We can, however, in the case of the dates of the first sight records at Glenolden, show conclusively the effect of the weather. In 1921, 1922, and 1924, September 24th was the date of the first sight record; in 1926, September 27th; in 1928, September 25th; and in 1929, September 26th. These dates may be considered about normal, and it happened that the weather in late September was normal in those years. In 1923, the first sight date was September 29th, and we note that the preceding days were unusually warm. In 1925 the first date was September 22d, occurring during a noticeably cold snap. In 1927, late September was very warm, and on October 1st the mercury stood at ninety degrees. Cool weather came on October 4th, and the first White-throats were seen on October 5th. In 1930, late September was warm and humid, and the first White-throats were seen on September 28th.

A further example of the effect of atmospheric conditions on migration is shown by Mr. Middleton's records for the fall of 1928. Never, in any other year, has he trapped or observed White-throats later than November. Occasionally there were one or two stray individuals taken after the regular migration

period noted on the chart. In 1927, one White-throat was taken on November 14th, and one on the 21st, though the migration period had apparently ended on October 30th. But in 1928 White-throats were taken in numbers up to November 11th. One was taken on the 13th, one on the 14th, two on the 16th, one on the 19th, one on the 20th, one on the 21st, one on December 12th, and one on December 13th. Furthermore, two White-throats remained through December, one of which was first banded on November 10th, and the other first banded on October 28th. Mr. Middleton considered this a unique occurrence. The late fall and early winter of 1928 were, however, very mild.

MIGRATING RETURNS

A return,² as used in this paper, is a bird taken at or in the near vicinity of the original banding station after a period of migration. Since White-throats are taken at Glenolden during migration periods and during their period of winter residence, there is a possibility of taking *two kinds of returns*: migrating returns and winter-resident returns. Furthermore, the migrating returns may be and have been taken while going south in the fall and again on the northward journey in the spring, or either in the fall, or in the spring of successive years.

Recoveries are defined as banded birds retaken away from the vicinity of the original banding station. No White-throats banded at Glenolden have ever been recovered elsewhere.

The term Migrating Returns is therefore applied to those White-throats taken during one migration season and not retaken for a period of about three months. Since the winter residents, as will be shown in further detail, repeat at intervals during their season of residence, it seems quite certain that these migrating returns were taken both on their way south in the fall, and then on their way north in the spring, and have wintered farther south in the intervening interval. One or two such occurrences might be regarded as exceptional instances of wintering individuals that simply did not repeat during the season of residence, but there are too many records of this kind to permit such an improbable explanation. Furthermore, wintering birds inevitably repeat at times of storm and severe weather. Undoubtedly there are more migrating returns than are included in Chart No. 2, but no birds have been so designated unless an interval of more than three months has elapsed between the fall and spring captures.

²See *Bird-Banding*, Vol. I, No. 1, Jan., 1930. "Suggestions for a Revised Bird-Banding Terminology."

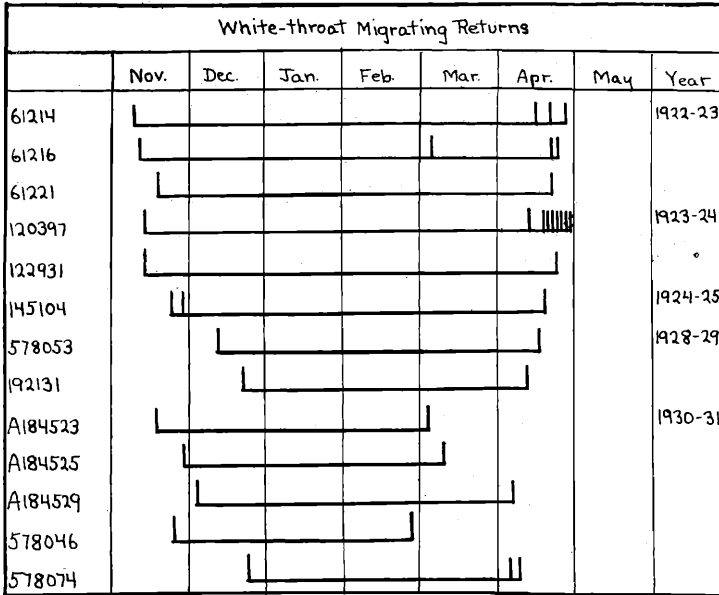


Chart 2. Migrating Returns.

Vertical lines in the space following a band number indicate the times the bird wearing the band with that number was trapped. Small horizontal cross bars on the vertical lines indicate second or third trappings on a given day.

In several cases an individual that has spent one entire winter season at Glenolden, repeating often, will be taken only during migration times in a succeeding year. Examples are numbers 192959 and 578074. Still oftener it is the case that an individual repeats several times during one winter season and is taken only in the fall or only in the spring of a succeeding season, and some individuals have even skipped a year entirely. This indicates, as will be shown later, varying habits for different seasons; but the point to be observed here is that it is all the more clearly demonstrated that we have migrating returns because of these individuals that have been traced through one season by trapping, and then are trapped only at the migration time another year. If such birds were

present throughout the entire winter, they would surely be trapped as they were in past seasons.

Mr. William I. Lyon, of Waukegan, Illinois, has trapped thousands of White-throated Sparrows during migration-times, and has never, so far as the writer has been able to ascertain, had any returns as above defined; and other bird-banders, including Mr. Middleton, with an occasional exception, have failed to get returns from this species when taken during migrations.¹

It seems that the chances of taking such migrating returns in many localities must be exceedingly slight. On the other hand, from a comparatively small number of White-throats trapped at Glenolden, an appreciable number of migrating returns have been taken. Mr. F. C. Lincoln (unpublished correspondence) says, "The indication is that these birds [White-throats] return to their winter quarters of former years, but that they either follow a different migration-route, or that they make different migration stops while *en route* between summer and winter quarters." A consideration of the records here presented indicates that the latter alternative is the more probable, and that in any case there are undoubtedly banded migrating White-throats passing by stations that are never retaken.

As already suggested, when birds stay but a short time in a territory of several acres, they may or may not visit the vicinity of the traps, and likewise they may or may not be caught even if near the traps. The fact that as many migrating returns as are listed have been taken at Glenolden is a great argument in favor of the probability of a very definite migration-route followed both in fall and in spring, at least through the lower Delaware Valley. (Further arguments to this end will be forthcoming). If the migration-route is definitely followed, the stop-over for Glenolden may be but for a night, or may even be omitted and made elsewhere, depending on weather conditions, etc.

It seems also as if the data, or lack of it, concerning migrating returns, might indicate a certain habit of migration. We have already noticed that the first date of trapping White-throats in the fall is from one to two weeks later in Glenolden than in Norristown, which is but sixteen and two-thirds miles northwest. As the flocks come nearer to the general area of

¹Mr. Middleton has had one return and one recovery from a grand total of 1483 White-throats: A115136, banded Oct. 26, 1928, returned Oct. 10, 1929, and A100232, banded Oct. 8, 1928, recovered April 29, 1930, Manchester, N. H.

winter residence, it seems that they move more and more slowly. This would entail longer stop-overs, with more chances of trapping migrating returns. Such a theory would offer an explanation of the fact that at Glenolden, which is just within the usual northern limits of the area of winter residence, we have succeeded in taking migrating returns, while other operators farther north, who have banded far greater numbers of White-throats during migrations, have failed to take returns.

That some White-throats do linger for some time during migration periods is shown both by Mr. Middleton's records and by ours. A good number of fall migrants repeat, though these repeats, for the most part, are included within a week's time or less, a period that indicates the average duration of the migration halt. But there are a smaller number of White-throats that linger from two weeks to a month, which may be referred to as leisurely migrants.

Striking examples are the individuals lingering late into December at Mr. Middleton's station in 1928. At Glenolden we find individuals not only remaining for some time in the fall, but appearing early in the spring and then lingering a while, and also individuals that are appearing and disappearing throughout the winter. These leisurely migrants may be considered better after we have dealt with the features of the period of winter residence.

PERIOD OF WINTER RESIDENCE

In the light of the preceding paragraph it appears that it would be inaccurate to refer to all birds taken during the

Complete Known History of Whitethroat No. 120388								
	Oct	Nov.	Dec	Jan	Feb.	Mar.	April	May
1923-24								
1924-25								
1925-26								
1926-27								
1927-28								

Chart 3. Complete Known History of White-throat No. 120388.
Vertical lines indicate times of trapping.

interval between the migration periods of fall and spring as winter residents. Some of them do spend the entire winter season in Glenolden, and others apparently come and go. Therefore we must refer to all birds trapped between migration periods as those taken during the period of winter residence.

We are apt to think of the winter territory of birds as possessing a definiteness similar to that of nesting territory; and, indeed, such observations as have been made by Mr. S. Prentiss Baldwin and his associates at Thomasville, Georgia, and by bird-banders in other regions, indicate that such is frequently the case.²

That definiteness of territory does not prevail among the White-throats at Glenolden is indicated by the records of returns, where it is shown that the history of any individual is apt to vary radically from year to year. No. 120388, for instance, spent the entire winter at Glenolden from November through April the first year, never appeared the next year, was taken in January, February, and March the third year, was taken twice in January the fourth year, and but once in March the fifth year. An interesting detail of this bird's history is the fact that in March of the fifth year, the bird was taken during a late spring snowstorm which had the effect of rounding up a large number of birds that otherwise might never have been taken. Had there been such a snowstorm at the psychological moment during the second year, we should undoubtedly have taken the bird then.

Other returns show similar variety in winter history. Therefore it seems that an important point to be noted in studying White-throat migrations at Glenolden is the definiteness of the migration-route, whereas the actual halting-points or the duration of the stop-over may vary. This theory is also upheld by records already considered.

Mr. Middleton's experience, however, has been similar to that of Mr. Baldwin and Mr. Musselman. As before mentioned, he has never trapped White-throats later than December, and he reports that White-throats do not winter in Norristown as a rule. In 1928-29, already described as a mild winter, there was an exception to this rule. Mr.

²"Among the migrants, the White-throated Sparrows make up the most interesting group, and I have long ago decided that this is a definite neighborhood group, coming here each winter, since I first found them in 1915, always at Station A."—S. P. Baldwin, "Adventures in Bird Banding in 1921," *The Auk*, Vol. XXXIX, No. 2, April, 1922, p. 216.

"I believe that Mr. Baldwin's conclusions that the White-throats at Thomasville are very local in distribution and in their activities are fully warranted. In fact nearly all of the birds captured at this banding station showed a tendency to feed chiefly in one locality."—T. E. Musselman, "Bird Banding at Thomasville, Ga., 1923." *The Auk*, Vol. XL, No. 3, July 1923, p. 448.

Middleton writes: "In reference to the White-throats wintering during 1928-29, there were five to ten here all winter and they were settled in a weed-and-briar patch about one hundred feet from my nearest group of traps. Three of these birds repeated during December, and one of these was killed by a rat while in a sparrow-trap on December 30th. After this happened they came near the traps at times but did not enter. There were plenty of weed seeds where they were located, and that may have had something to do with their not entering the traps. However, one of those that was taken during December did repeat on April 15th in the same group of traps near the spot where they were all winter."

This incident adds to the data upholding the theory of varying winter histories, since the members of this group did not winter at Norristown during other winters. However, it is additional proof of the tendency of White-throats to settle for the winter in small groups within a very limited area, and, as already stated, the groups of White-throats are not thus confined in Glenolden. Perhaps the extent of winter-areas during a period of residence is conditioned by the lay of the land.

The accompanying group of charts, numbers 4-12, shows the local White-throat population-status for each entire winter season, October to May, with the exception of the casual migrants of fall and spring. Short vertical lines in the space following a band-number indicate each time the bird wearing that band was trapped (repeats and returns), while the connecting horizontal line indicates the duration of the bird's known history. In the case of returning birds, this horizontal line must be followed from chart to chart, or noted on another chart featuring returns only. The letter R at the left-hand end of a horizontal line indicates that the individual returned after having been first banded during a previous season. The letter R at the right-hand end of a horizontal line indicates that the individual returned during a subsequent season. A small horizontal mark on a short vertical line indicates a second trapping for the individual on a given date. In a very general manner local weather conditions have been noted on the charts, initials being used:—C for cold, R for rain, S for snow and W for warm. These weather descriptions are given only when they show a definite connection between the weather and the contemporary trapping, and in no way present a complete picture of the season. However, snowfalls are infrequent during most winters, and snowfalls of any extent invariably affect trapping and are therefore noted.

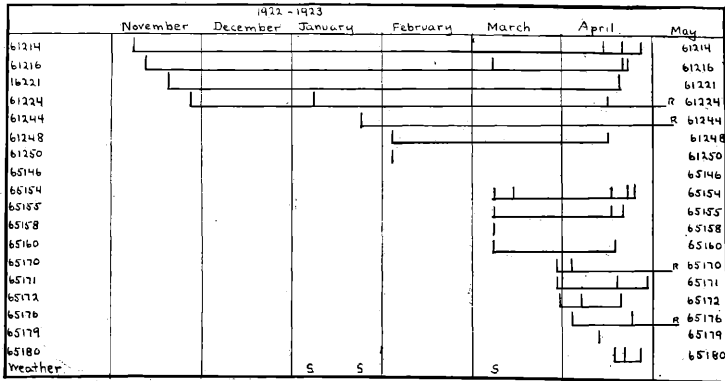


Chart 4. Local White-throat Population Status for 1922-1923.

It has been impossible to go more fully into a study of the effect of weather-conditions on trapping and bird migration, but in general it is safe to say that during any considerable period when the trapping is very slack, the weather has been mild or at least has not been subject to sudden or severe changes. An example of this is shown in February, 1925, when few birds were taken and when the weather was uniformly mild. According to our field notes, banded White-throats were seen throughout the month, although the chart indicates that none was present.

The duration of the winter season includes nearly the entire period when White-throats are to be found in Glenolden, since some winter residents stay from early October until late April or even early May. In order to keep the charts from being obscured by too much detail, it has seemed best to exclude the mass of fall and spring migrants. This has necessitated the arbitrary setting of dates that end the time of fall migration and begin the period of spring migration, though the arbitrariness seems justified when the records themselves suggest such dates. The records thus excluded deal entirely with individuals handled but once, or whose repeats occur within a period of a week or two. There are also individuals that are handled but once, or within a few days' time between the limiting dates of the two large seasonal migrations, but their records are shown on the charts. In many cases, birds first appearing in the height of the migration rush have stayed throughout the winter, while the majority of birds taken at about the same

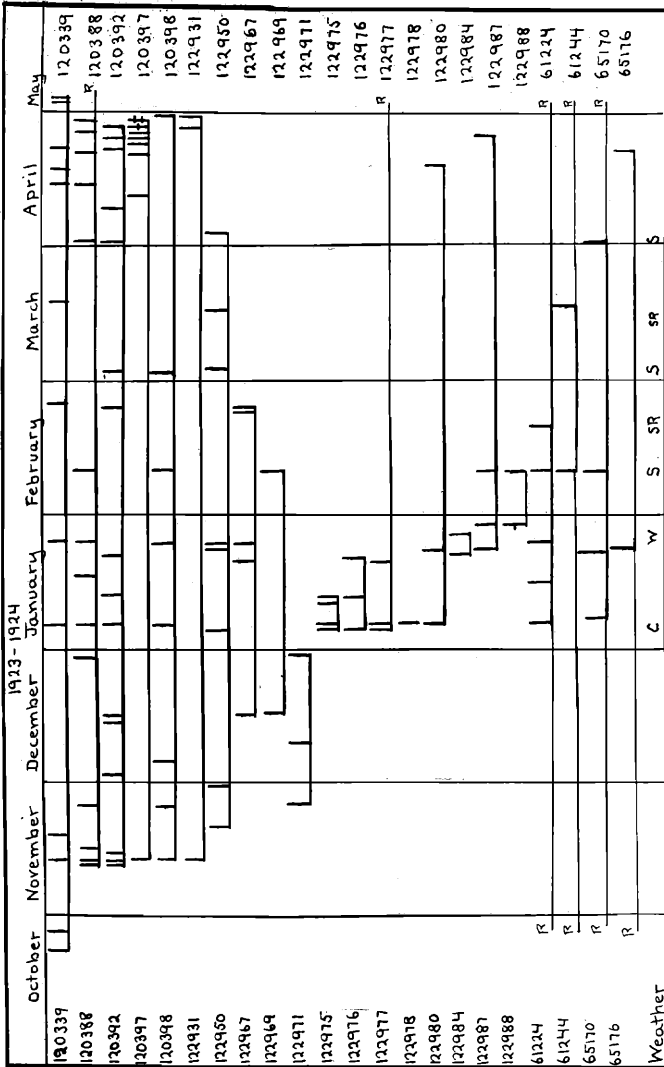


Chart 5. 1923-1924.

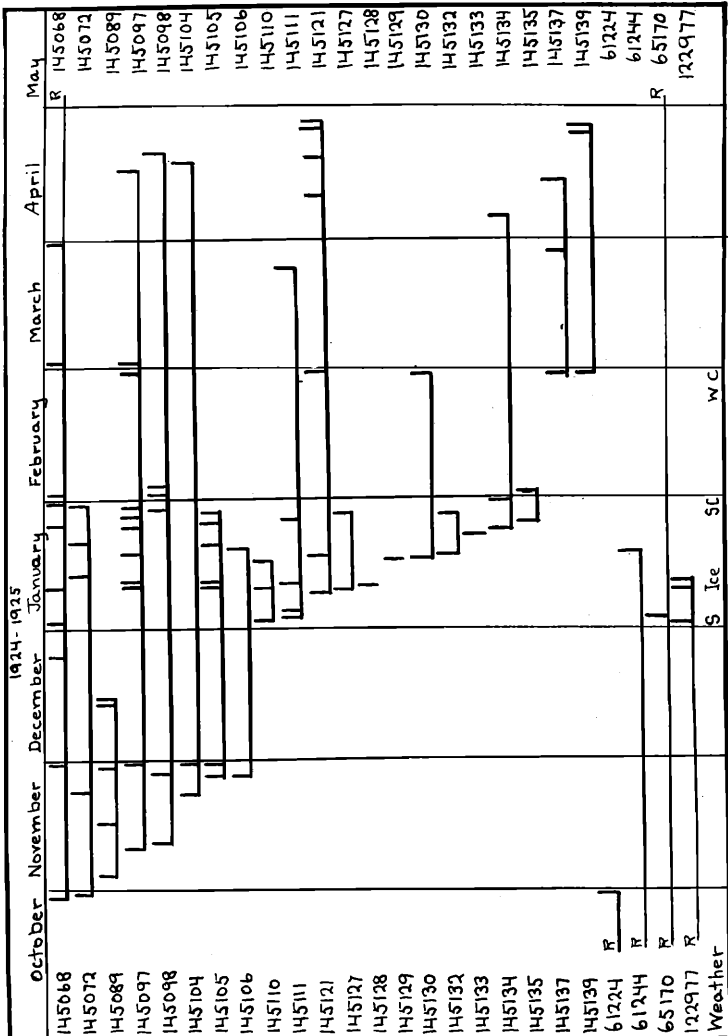


Chart 6. 1924-1925.

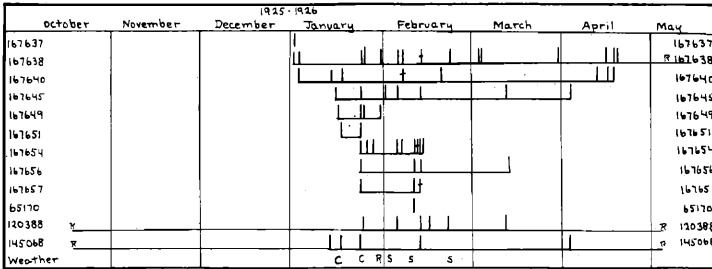


Chart 7. 1925-1926.

time have soon passed on. In order to clarify this complication, the inclusive dates for fall and spring migrations have been indicated on the Fall and Spring Migration Charts (Nos. 1 and 14). Of all the birds trapped before the final date allowed for the fall-migration period, or after the first date of the stated spring-migration period, only those repeating through the winter or subsequently returning are included on the Winter Season Charts.

In studying these charts, the indication of small group movements is striking. In many cases three, four, or more birds appear for the first time within a few days of one another, sometimes all on the same day. They frequently repeat together subsequently during the season, and then simultaneously terminate their histories for the season. There are, for example, 192065, -66, -67, -68 and 167638, apparently late

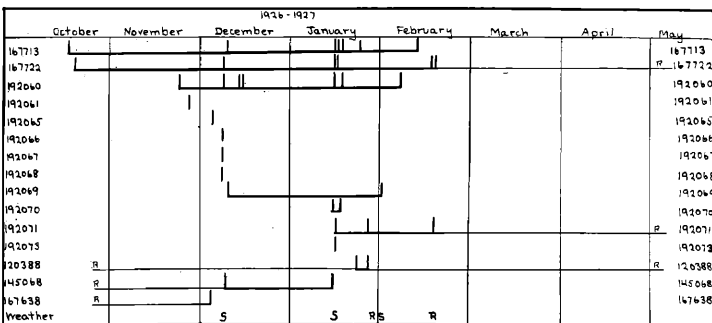


Chart 8. 1926-1927.

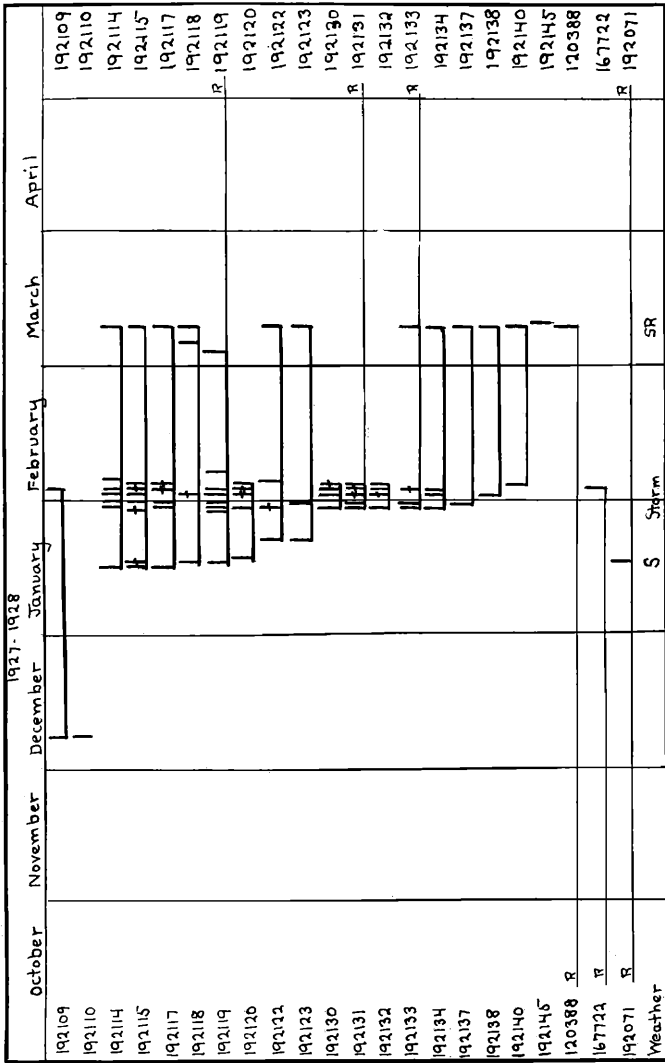


Chart 9. 1927-1928.

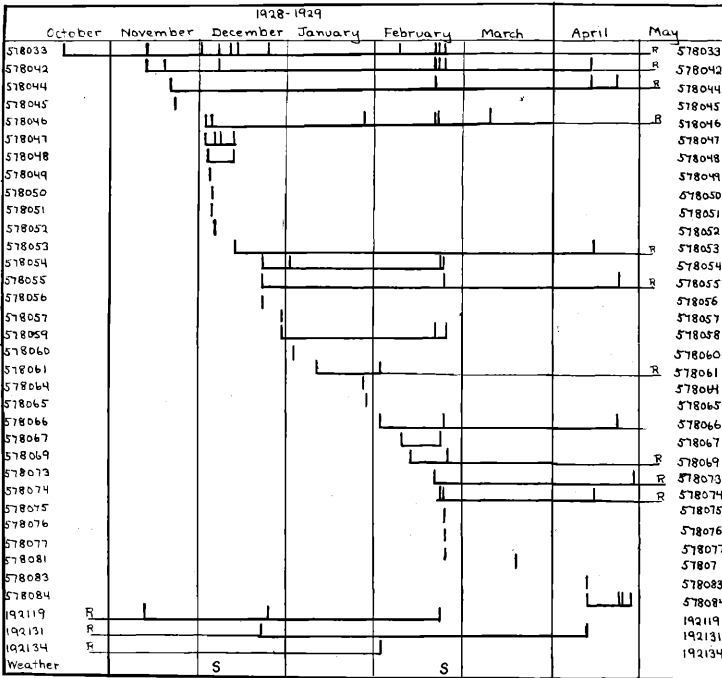


Chart 10. 1928-1929

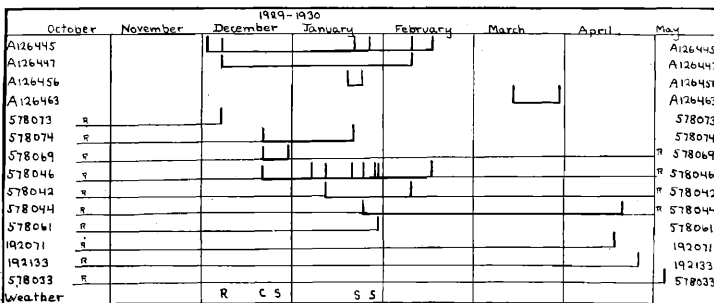


Chart 11. 1929-1930

migrants in December, 1926. 65154, -55, -58, -60 in March, 1923, and 65170, -71, -72, -76 in April, 1923, are two groups of leisurely spring migrants. 120388, -92, -98 wintered through 1923-24, and 120397 and 122931 are both migrating returns in the same winter season. It might seem from a glance at the chart as if these five individuals belonged together, but it must be remembered that up to about the middle of November only wintering and returning individuals are noted on the chart. It happened that on November 10th and 11th, the dates when these five birds were first taken, the fall migration reached its final peak, and many White-throats were taken only once. Each of the groups above indicated may have included other individuals that met with disaster before their movements could again be recorded. This would be particularly true in a group of migrating returns.

Nos. 122975, -76, -77, -78, -80, 61224, and 65170 arrived together in January, 1924, during a cold spell. Two of these repeated (or returned¹) in April, three returned another year, and two were returns from a previous year. In 1926, 167637, -38, and -40 arrived together; then 167645, -49, -51, and 145068; and later 167654, -56, -57, and 120388 arrived together. The chart (No. 9) for 1927-28 needs no comment in this respect, since the groupings are striking. In early December, 1928, a group appears, another in late December, and one in late February, when inclement weather drove all the wintering birds to the traps. The stragglers of January may be a group that lingered for a short time, or may be members of several groups passing quickly through, whose other members were not trapped.

The chart for 1929-30 shows a rather unusual state of affairs. Of ten wintering birds seven were returns. Three of the ten appeared early in December, three more on December 22d, and four in January. One of the first three did not repeat, but it is well to bear in mind that the final record of a bird may easily be misinterpreted. Possibly this bird met with an accident instead of moving farther south. There is one straggler in March, and three more returns at the time of the spring-migration rush.

Not only do we notice these groups of birds appearing and disappearing at various times during the winter, but sometimes in late February, in March, and in early April, before

¹These were probably additional examples of migrating returns, but since the absence interval of about three months has been somewhat arbitrarily chosen to determine the status of migrating returns in order to lend greater credence to the theory, these two cannot be so considered in this paper.

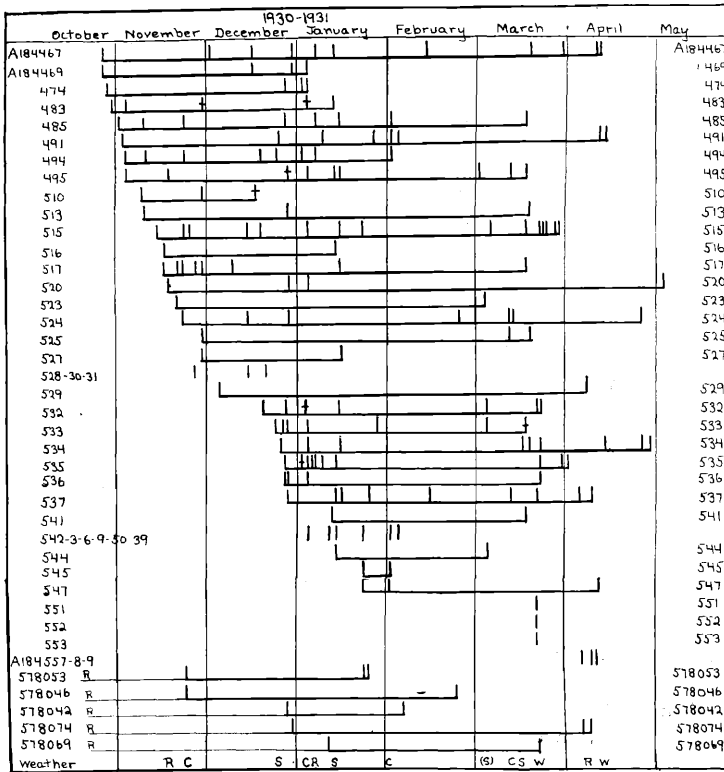


Chart 12. 1930-1931

the main spring-migration, there are indications of group movements. New groups appear, or groups that so far have wintered disappear. Such birds are comparable to the leisurely fall migrants already noted which are not included on the winter charts. The early-spring birds, however, are quite definitely associated in groups. They are mentioned here instead of being included under the heading of Spring Migration because the phenomenon of their appearance is undoubtedly due to the same causes that have created groups throughout the main period of winter.

These group-separations become most noticeable when migration is leisurely or tends to halt during the winter. They are less striking when they occur during the height of the

migration rush, though the two groups of birds already noted, first banded on November 10th and 11th, 1923, have dissociated themselves from the many passing individuals trapped at the same time. There may most likely be similar group-divisions not now discernible within the large aggregations of migration rushes.

We have already noted that of various birds appearing at different times and in various groups during one season some which appear the following winter have rearranged their travelling schedules and have joined new groups. (See Chart 13). It is fairly well established that many species return, so far as possible, to the same locality each breeding-season. Therefore, taking as an example the returns of 1929-30, we may feel sure that, even though ten individuals appear at different times and in different groupings during two seasons, yet they probably all came each fall from a definite breeding-locality. Until these birds are trapped in their breeding-range we cannot know definitely the reasons for the smaller sub-groups, but do they not very definitely suggest family groups which would, of course, vary in personnel from year to year, and which might often, after accident had removed some of their members, be diminished to two or three survivors each? According to Forbush, *Birds of Massachusetts and other New England States*, the White-throated Sparrow has two broods yearly, with four or five young to a brood. This would give an average of nine fledglings to a pair yearly. According to the theory that nature tends to keep the population stationary, there would, in the course of a year's time, be a mortality of nine out of every eleven birds. Thus it will be seen that family groups might easily consist of but two or three birds. Forbush also writes, "When the last brood has been reared, when the August molt is done, the families, which by this time have assembled in straggling flocks, begin to move southward." It is entirely possible that the family group is a more definite entity than the migrating flock.²

If this theory of the family group is to hold, it must follow that any given group would originally be composed of one adult male, one adult female, and a number of immature birds. The more we have observed White-throat plumages, the more we feel the difficulty of determining sex superficially, except in the case of very bright males two or more years old, or of very dull, large females. Therefore any conclusions as to sex

²See C. L. Whittle "Some Aspects of the Group Habit Among Birds," *The Auk*, Vol. XL, 1923, pp. 224-240.

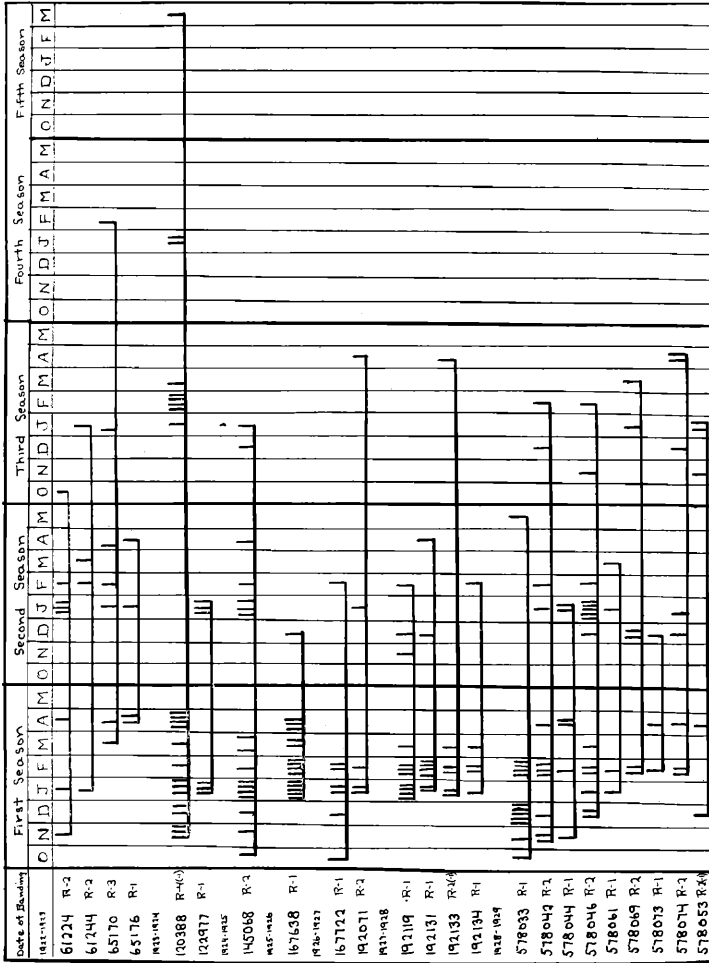


Chart 13. Seasonal Returns.

Short vertical lines indicate each time of trapping. Connecting horizontal lines indicate duration of known history. R with a succeeding digit after the band number indicates the number of returns, viz. — R-3 indicates that the individual was banded in one season and returned during three consecutive seasons.

are, at best, but guesses. The following tables give the serial numbers of certain rather definite groups with the possible sex of each individual.

192133	im. male	192130	im. fem.
192134	ad. male	192131	im. male
192137	im. fem.	192132	im. fem.
192138	ad. male	167722	ad. male
192140	ad. male		
122975	ad. fem.	192114	ad. male
122976	im. ?	192115	im. male
122977	ad. fem.	192117	im. male
122978	ad. ?	192118	im. fem.
122980	ad. fem.	192122	im. fem.
61224	ad. male	192123	im. male
65170	ad. fem.		
		167654	ad. male
167637	im. fem.	167656	ad. fem.
167638	im. male	167657	im. male
167640	im. male	120388	ad. male
		65170	im. fem.
167645	im. fem.	65171	im. ?
167649	ad. male	65172	im. ?
167651	ad. fem.	65176	ad. ?
145068	ad. male		

A preponderance of adult birds noted, particularly males, stands in the way of the family-group theory. But there is a great deal about migration habits that is not known, and there may be more than one plausible explanation of the abundance of adults. It is conceivable that a lone bird, whose family has all perished, would attach itself, temporarily at least, to a neighboring group. It is known that mortality is highest among immature birds and decreases inversely in proportion to the bird's age.³

Attention has already been called to the fact that the winter history of a returning bird varies from year to year. This may be due to some extent to the eccentricities of groups or leaders, and somewhat to weather and other allied causes. An attempt has been made to indicate extremes and severities of weather on the winter charts, but they are only occasional and local. Any study of the effect of atmospheric conditions on bird movements to be adequate must consider the conditions all along the line of possible travel as well as cumulative effects. However, the fact remains, to whatever causes it may be due, that regularity of winter residence such as has

³Mr. S. P. Baldwin, in the quotation given above, refers to the White-throats wintering at Thomasville as "a definite neighborhood group."

	Spring Migration																	Total No. Banded				
	April									May								G	M			
	9	11	13	15	17	19	21	23	25	27	29	1	3	5	7	9	11	13	15	17		
1923																					9	
1924																					31	
1925																					9	
1926																					9	6
1927																					0	
1928																					7	5
1929																					10	39
1930																					32	26
1931																					9	16

Chart 14. Spring Migration.

Short vertical lines indicate trapping of a bird, connecting horizontal lines indicate repeated trappings for an individual. Since band numbers are omitted, each detached vertical line indicates an individual. Totals for the spring migration season of each year are given under G (Gillespie) and M (Middleton).

been noted at Thomasville does not obtain here. May it not be the case that we are witnessing the slow experimental change of the range of a species? White-throats returning to points much farther south than Glenolden may there locate themselves definitely for each winter, while others of the species that seek winter territories along the northern limits of the winter range may be in the process of extending or curtailing these limits. Thus, influenced by weather, food-supply, or companions, some may spend an entire winter (from October to April) in Glenolden one season, or again may sojourn only for the coldest months another year, or still again may merely pass through with the migration rush for a point farther south.

We may apply this same theory in explanation of group movements during any given winter season, and also in explanation of the leisurely movements of late fall and early spring. They are all, undoubtedly, various manifestations of the regular phenomenon of variation of winter-range extent. Apart from the regular rushes of fall and spring migration, flexible group movements are occurring throughout the entire time between early fall and late spring. During one season some birds may winter from October to April, and others may appear (usually in definite groups) at subsequent intervals. In some seasons no wintering birds have appeared until January. In general it seems that such leisurely movements, occurring in small groups, depend mainly on the weather. In a mild winter a group may linger farther north than it would during a cold winter, but at any time a spell of severe weather may start it southward. The group of White-throats mentioned by Mr. Middleton as wintering near his station during the mild winter of 1928-29 may be an illustration of this.

At this point I wish to quote Forbush again: "Mrs. Mary E. Hubbard of New Haven, Conn., banded a White-throated Sparrow there in December, 1925, that came to the station again in December and January, and to a near-by station in April, 1926, but the same bird was taken in North Carolina on March 5, 1927, indicating that while it probably spent the winter of 1925-26 in Connecticut, it may have passed the next winter in the South." The facts already mentioned in this paper suggest a further interpretation of this bird's known history. May it not have journeyed south in 1926 between January and April, not necessarily going as far as North Carolina? In southern New England the late fall and early winter of 1925-26 were moderate, with normal precipitation but no snow. In late January and through February there

were a number of snowstorms. In the winter of 1926-27 there was snow in early December ushering in a white winter, and there were marked flights of Snowy Owls and Goshawks. The later winter was mild, but the earlier winter severity would have already driven birds to the south. About Washington, D. C., February and March were reported moderately cool, and if, as is more than likely, the same weather conditions obtained for North Carolina, it is easy to understand why this White-throated Sparrow was taken there in March.

SPRING MIGRATION

The spring migration of White-throats is an elusive and seemingly erratic occurrence from the standpoint of banding data. There are several weeks in the spring when White-throat songs are heard persistently along the Glenolden ravine, and now and then comes a period of two or three days when there are remarkable numbers of White-throats about. At such times the masses of birds are apt to be very local in distribution. In the spring of 1930 they settled down for three days about our house, and were as thickly massed over the lawn and under the shrubbery as a flock of grackles. In the spring of 1931, when migration dates for many species were remarkably late, a large flock settled down in the woods a quarter of a mile northeast on the western slope of the ravine on May 17th, but there was none near the house on that date and consequently none was trapped.

Trapping of White-throats is far less successful in the spring than in the fall. It might seem that there would be a more limited supply of weed seeds in the spring, especially since birds have been feeding on them all winter, but the birds seem to find enough food in the dead leaves underfoot. Perhaps they seek a larger proportion of animal diet at this time when warmer weather favors insect development. It might seem that the greater number of White-throats trapped in the fall could be explained by the inexperience of immature birds, but it happens that a fair proportion of adults are trapped along with the immature birds.

A more plausible reason for the small amount of spring trapping is the general wariness of birds at mating time. It is also true that the total number of spring migrants must be considerably less than the total number of fall migrants, since disasters occur throughout the winter months and the ranks are not replenished by breeding until summer. It would be impossible to say to what extent the reduction of ranks would

reduce trapping possibilities in any given locality, since it cannot be conclusively shown that migration-routes are the same for the two seasons, and particularly since it is strongly indicated that locations and durations of stop-overs vary.

Chart No. 14 shows the total number of birds handled each spring, including all not noted on the winter charts, also the dates on which the birds were trapped. Each short vertical line indicates the trapping of a bird, while a connecting horizontal line indicates repeated trapping for an individual. In order to make the chart more graphic and concise, band-numbers have been omitted, and each detached vertical line represents an individual.

The total number of birds banded during a season is given in a column at the right under G, and by way of comparison Mr. Middleton's totals are given in the column headed M. Mr. Middleton operates his trapping stations just as regularly in the spring as in the fall, yet in 1929, 1930, and 1931, the years when his trapping operations were most extensive, his totals of White-throats have not been appreciably larger than ours in the spring, though far overshadowing ours in the fall.

In 1923, 1924, and 1925 our traps were spread over a considerable extent of the ravine-slope as already explained. But the resulting totals for the spring season are not any greater than those obtained in 1929, 1930, and 1931, when the traps were all near the house. Therefore in spring the banding results are not necessarily indicative of the large migration waves, but only of those groups that settle down for a day or two directly at the trapping station.

SUMMARY

1. Data secured by intermittent trapping give a fair survey of winter residents. A representative survey of fall migrants can be secured only through steady and extensive trapping. Data obtained by trapping are too meager to be representative of spring migrations, or indicative of spring-migration tendencies.

2. The data of fall migration indicate that

a. Weather conditions are undoubtedly a great factor in determining stop-overs and forward movements.

b. There are definite migration-routes but varying stop-overs.

c. The length of time of stop-overs increases as the season advances and as the flocks reach the northern limits of the area of winter territory.

3. The data of the period of winter residence indicate that
 - a. Snowfalls and extreme or sudden changes of weather bring to the traps almost all the resident birds as well as new arrivals.
 - b. The migration-route is fixed and definite.
 - c. There are small group movements in addition to the regular migrations of large flocks, suggestive of family groups.
 - d. Habits of groups and individuals vary from year to year.
 - e. There is lacking a definiteness of wintering-areas from year to year, and such wintering-areas as are noted (in Glenolden) are not narrowly restricted.
 - f. Since wintering-areas seem to be restricted in other regions, differences in restriction may depend on the lay of the land.
 - g. Migration movement continues throughout the winter period, even though some groups stay the entire season.
 - h. The habits of White-throats during the winter period at Glenolden suggest evidence of a possible extension or curtailment of the northern limits of the winter range.
4. The existence of migrating returns and of leisurely migrants adds credibility to a number of the above suggested theories.

ACKNOWLEDGMENTS

The banding data at Glenolden have been obtained by Mr. John A. Gillespie and the author, working both coöperatively and independently. The author wishes to acknowledge Mr. Gillespie's courtesy in allowing her to make use of the total results, and also his critical reading of the manuscript.

The author wishes to acknowledge the courtesy of Mr. Raymond J. Middleton, both in furnishing her with valuable data from his banding records and also in allowing her to incorporate them in this paper.

The graphical method used has been adapted from the similar method used by Rudyard Boulton and John T. Nichols in "A Method of Analysing Bird-Banding Data," *Bulletin of the Eastern Bird-Banding Association*, No. 2, October, 1925.