SOME BIRD BANDING STUDIES AT MICHIGAN STATE COLLEGE FROM 1924-1940 WITH SPECIAL REFERENCE TO THE WHITE-THROATED SPARROW (ZONOTRICHIA ALBICOLLIS) AND THE SLATE-COLORED JUNCO (JUNCO HYEMALIS HYEMALIS)

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Roger Lee Harned

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Roger Lee Harned

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HISTORY OF BIRD BANDING AT MICHIGAN STATE COLLEGE

The bird banding station was first put in operation at Michigan State College on October 12, 1923. On that date Professor J. W. Stack placed the first bird trap in the southeast corner of the Forest Nursery. Two more traps were put in the wild flower garden by him in April, 1924. Three more were set in the Forest Nursery September 30, 1924. Four more were opened in the Forest Nursery and immediate vicinity in October, 1924. Four more were set on the campus during the spring of 1925 and a fifth one in July of the same year.

During the fall term of 1925 Professor Stack and members of his advanced ornithology class operated the traps. Interest was stimulated by giving students an opportunity actually to band and handle living birds and the project proved successful. While variations in the plumage of individual birds of the same species sometimes causes difficulties in identification, constant use of a Barrows key to Michigan birds was urged. Where students were still uncertain of identification they were urged to consult Professor Stack. Operation of the traps became a project of the class and time spent was accredited as a portion of the laboratory work in the course. This method has been followed since 1925.

One advantage gained by having a number of operators is that the traps may be attended more frequently, thereby decreasing the possibility of injuries occurring to entrapped birds.

Until the fall of 1938 the bulk of trapping operations, except for the special projects of individual students, was carried on in the Forest Nursery and in the Beal Botanical Gardens, the traps being almost equally divided between the two areas. During the spring of 1938 sanctuary rights were granted for an inclosed area just west of the old rodent laboratory along the north bank of the Red Cedar River directly south of Wells Hall. In the fall of 1938 the bird traps were shifted to this area and have remained there. It is Professor Stack's intention to keep this site as a permanent bird banding area and to keep the number, type and location of traps constant in order to reduce the variables and to make future data more significant. The area, with its inclosing fence, also will discourage wandering cats and dogs, and eliminate the disturbing influences of a crowded campus.

The type of trap which has proved most successful and which has been used almost exclusively is the modified government sparrow trap described in the "Manual for Bird Banders" by F. C. Lincoln and S. Prentiss Baldwin. It was originally designed, after extensive experimental work, by the late W. I. Lyon of Waukegan, Illinois.

Another highly successful method of catching birds at this station has been by means of Italian bird nets.* Ital-

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* These Bird Trammel Nets are 20' long by 7' high, outside netting 10" square mesh #16 cotton twine; inside netting $\frac{5}{4}$" square mesh #50/2 linen; are hung with #24 twine at top and bottom with small black metal rings $\frac{3}{4}$" in diameter; these are attached to the top with 2" lengths of #12 medium twine. The nets are dyed black, this color being least conspicuous.

BANDING WHITE-THROATED SPARROW

Photographed by Lloyd Hulbert at the Michigan State College Bird Banding Station.

ians made use of these nets in capturing large numbers of birds for food purposes before decreasing numbers prompted the government to put a stop to their slaughter. Dr. O.L. Austin, while visiting in Europe, conceived the idea of using the nets for banding purposes and brought one back to this country for experiment. It proved successful and nets were imported from Italy for use in this country, though at an exorbitant 80% tariff rate, up to the beginning of the present war.

Dr. Austin visited this station some eight years ago. He set one of his nets in the forest nursery for a trial and in less than an hour several birds were caught. Since it was impractical to pay the price of importing nets from Italy, a description of the nets was sent by Professor Stack to the R. J. Ederer Company of Chicago, manufacturer of commercial fish nets. As a result this company has been supplying the nets for the past eight years.

In 1932, as an experiment, four nets dyed green, four nets dyed a gray dust color, and four dyed black were used. All were set under conditions as nearly similar as possible. It was found that the black type of net was most successful. It was also learned at that time that nets soaked in creosote before using and allowed to dry thoroughly had a longer life without in any way presenting a greater risk of injury to birds. These nets have been in operation at this station since 1932 with as many as 24 having been in use at one time.

Several other types of traps have been used, with varying degrees of success. For a period of three years a very elaborate house trap was employed. It proved to be the least successful type of trap used at this station, though at St. Paul, Minnesota, Mr. and Mrs. F.W. Commons report having found it to be very effective. From 1937 to 1940, two duck traps were operated at Lake Lansing, approximately eight miles northeast of East Lansing on State Road # 78. The traps were located on the east side of the lake. During the three years many species and individuals were taken.

An Inland Creeper Trap* has been successful for trapping Downy Woodpeckers, Brown Creepers, Black and White Warblers, and White-breasted Nuthatches. A nest-drop-door trap has been used for capturing the parents of nestlings for banding purposes. Many pairs of Prairie Horned Larks have been banded in this manner as well as parents of Mourning Doves, Robins, and Chipping Sparrows. Bank Swallows have been banded successfully by means of insect nets or Italian bird nets, attached to the ends of bamboo poles, placed over nest entrances. Italian bird nets are particularly useful when several nests occur in banks in a small area. The Cohasset Warbler trap has never been found satisfactory at this station.

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* For descriptions of different types of traps used, see, "Manual For Bird Banders" by F.C. Lincoln and S. Prentiss Baldwin, U.S. Department of Agriculture, Miscellaneous Publication No. 58, November, 1929.

METHODS OF RECORDING DATA

This work is mainly a compilation of data collected by Professor Stack and his advanced ornithology class over a period of 17 years. A description of the records and the method of keeping them is in order.

The first record for each bird is made out by the bander as a field note. This note contains the name of the bander, the time of day, the number of the band placed on the bird's leg, the common name of the bird, whether the capture was made in a net or a trap, and any observations of injury, plumage variations or peculiar behavior. If the bird has previously been banded it is recorded as a Repeat or a Return. A bird is considered a return if a period greater than 6 months has elapsed since the date of the last capture. If the period is less than a half year, the bird is called a repeat.

Back at the station office, where all materials such as banding kits, bait, and a key to Michigan birds may be found, the bander first checks a list posted on the wall containing all the numbers of bands which have been placed on birds since 1923 to determine whether the birds he has captured are repeats or returns. Traps and nets are usually visited every hour to reduce the danger of injury to birds.

Field records are entered chronologically in a journal, a single journal usually containing records for a single migrating season. The band number, the common name, the date of capture, and the name of the bander of each bird are then transferred from the journal to an individual card and placed

in a fireproof metal file in chronological order. In this catalogue species are separated by index cards containing scientific names and the A. O. U. Check-List of North American Birds, (fourth edition). Numbers are kept to facilitate location of species.

A separate file is kept for returns. A notation and reference to "Return File" is made on each original card for which a return has been recorded. Return cards give the dates of returns, the localities, the names and addresses of the persons recovering birds in cases of recoveries at foreign stations, and spaces for remarks on the condition of birds, and the manner taken. Of course, much of the original banding data, such as band number, common name of species, trap number (when known), date of original capture and name of bander is included at the top of each card.

A death and longevity file is also kept in the same manner in which species are separated by index cards containing A. O. U. check list numbers in serial order. Notations on any bird banded here and subsequently found dead or reported dead are entered in this file. This is the only manner known at present by which we may learn anything about how long birds live. To obtain more accurate information on longevity, nestlings have been banded whenever it has been safe to do so.

The number of each species banded is recorded by months on a special form. This form is one of a number of the contributions made by W. I. Lyon as an aid to systematizing station records. It has been used at the Michigan State Col-

lege bird banding station since 1923. Its use has contributed substantially to the information found in this thesis.

WHITE-THROATED SPARROWS

The White-throated Sparrow is one of the most abundant members of its large family. It breeds in Canadian and lower Hudsonian zones, and spends its winters in Missouri, the Ohio Valley, southern Pennsylvania, Connecticut and Massachusetts. It is caught at this station in larger numbers than any other bird, except only the Slate-colored Junco, on its migratory routes between its summer and winter homes.

A total of 4,174 White-throated Sparrows were banded for the years 1924 to 1940, inclusive. Of this number, 2,712 were banded during spring migration periods and 1,462 during fall migrations. These figures are indicative of the variations in spring and fall migrations though it should be noted that no banding was done during the fall of 1930, and that therefore the totals include one more set of spring than fall figures. The actual number banded each spring and fall for the seventeen year period is shown in Table I.

Number Banded Each Season, 1924 to 1940

The mean yearly number of birds banded during fall migration periods was 91.4. The average number banded during spring periods was 159.5. A difference as great as 68.1 would occur by chance about once out of twenty times. Therefore the difference is significant!

In considering this difference some attention might be given to a series of factors that has not been constant during the period. The traps covered in this work have only

TABLE I

NUMBER OF WHITE-THROATED SPARROWS BANDED
BY SPRING AND FALL MIGRATIONS,
1924 TO 1940, INCLUSIVE.

YEAR	SPRING	FALL
1924	75	39
1925	33	91
1926	122	111
1927	203	87
1928	135	164
1929	236	110
1930	136	
1931	86	28
1932	170	168
1933	240	60
1934	204	38
1935	198	30
1936	124	148
1937	180	134
1938	202	104
1939	246	105
1940	122	45
TOTALS	2712	1462

been operated during the school year which varies according to the opening and closing dates of the College; the number of traps operated increased largely during the early years of the study and has since fluctuated for various reasons; several changes in topography and cover of the campus has made it necessary to shift trapping locations in order to obtain the most suitable habitat for trapping. It is conceivable therefore, that considerable variation might occur in the number of birds caught during migration periods.

In order to study further the variation existing between the numbers banded in spring and fall, a mathematical formula has been devised in an attempt to control two of the principal factors which would contribute to the variation. These two factors are: first, the number of traps, and second, the length of time each was operated. This formula is based upon the assumption that the traps were located in equally suitable locations from season to season, and therefore, the number of birds caught would vary in proportion to the number of traps used and the length of time each was in operation during the migration periods. Results are expressed as the average number of birds caught each trap day and are calculated by dividing the total number of birds caught during the migration season by the total number of trap days. For example, in the spring of 1928 twelve traps were operated for a period of nine days and caught 25 birds, 16 other traps were operated by another person for a period of 20 days and caught 46 birds, also 14 more traps were operated for a period of 20 days and caught 64 birds, thus making a total

of 135 birds caught in 708 trap days, or 0.10 birds per trap day. Birds caught per trap day therefore equals the total number of birds caught per migration season divided by the number of traps times the number of days operated.

Table II shows the number of birds caught per trap day for the years 1924-32, inclusive. Records of individual traps were not kept after 1932.

The average number banded per trap day during spring migrations was 0.27 with a standard deviation of 0.20. The average number banded per trap day during a fall migration was 0.15 with a standard deviation of 0.06. The difference between the two averages is significant. It would occur by chance about once out of twenty times.

It was impossible to treat the entire banding data by the trap-day method because records of the exact number of traps used and the number of birds caught by individual traps were kept only from 1924 to 1932.

The above data raises an interesting question in measuring migration intensity. Is there always a definite relationship between the number of birds caught and the number of trap days? It is apparent from the facts given that usually a relation does exist, but at the same time it is not evident that an absolute correlation can always be relied upon. For example, in the fall of 1926, 117 birds were caught in 690 trap days, whereas in 1927 only 83 birds were caught in 841 trap days. In other words, in the fall of 1926 more birds were caught in fewer trap days than in 1927. The correlation over a period of eight years, however, was found to be 0.64.

TABLE II

NUMBER OF WHITE-THROATED SPARROWS CAUGHT PER TRAP DAY DURING SPRING AND FALL MIGRATIONS

YEAR	SPRING	FALL
1924	0.81	0.15
1925	0.09	0.15
1926	0.16	0.17
1927	0.23	0.10
1928	0.19	0.21
1929	0.30	0.20
1930	0.23	
1931	0.14	0.08
1932	0.29	0.16

The total number banded in spring was found both in total figures and trap day calculations, to be significantly greater than the total number banded during fall migration periods.

It might be expected that greater numbers would be banded during the fall because that period would include not only the mature birds but also the young of the year. Then too it has been shown that the fall migration period is more leisurely, that is, it extends over a longer period of time. The average spring migration period is about one week shorter than the average fall period. Therefore it might seem that this would increase the chances for each bird to be captured and as a result the total catch would be greater during the fall.

It is evident that the above statement presents only one side of the question and that the following factors should be considered.

First, since natural food for ground feeding species, such as the White-throated Sparrow, is more abundant during the fall migration season it seems natural to expect that fewer birds would be attracted to artificial baits during that period. Therefore it is probable that a greater catch would be realized during the spring period which usually begins around April 20 and ends about May 20.

Second, contrary to popular opinion all birds do not seem to follow the same migration routes from year to year or even the same routes in spring and fall. Especially does this seem to be true for the White-throated Sparrow. According to all information at hand, at stations between win-

ter and summer homes, local return records for White-throated Sparrows are rare. Mr. F. C. Lincoln[2] of the Fish and Wildlife Service, 1935, makes the following statement about this:

> "The White-throated Sparrow is a common migrant in many sections. Since it is a ground-feeding bird and is readily attracted to the vicinity of dwellings, it has been banded in large numbers, the total to February 1, 1935, being nearly 100,000. It would be expected that these would yield a comparable number of return records, and that the facts would furnish basic data relative to the migrations of the species. Such, however, is not the case. Banded White-throated Sparrows are rarely recaptured at stations between the breeding and the wintering grounds. Operators of stations in the winter area, as Thomasville, Georgia, (S. Prentiss Baldwin) and Summerville, South Carolina, have obtained return records showing that these birds do come back to the exact winter quarters occupied in previous seasons. The fact that they do not again visit banding stations on their migration routes indicated some unusual aspects of their travels, which it is hoped will eventually be discovered by banding studies. Problems of this type constitute definite challanges to the student of bird migration."

Mr. Lincoln[2] also says: "The White-throated Sparrow, a bird that apparently breeds and winters each year in the same areas, either travels by different routes, or at least does not make the same stops while on migration."

The only information which has been obtained about a bird of this species banded at this station came from Eldorado, Arkansas. This bird was banded here April 27, 1927, and was shot by T. Mooty at Eldarado in November, 1929. This bird was evidently shot while on migration or at its winter home.

Third, it is possible that in some years we do not get the earlier days of fall migrations since the date of opening the trapping station depends upon the opening dates of school.

Fourth, light days are somewhat longer during spring migration. Whether this difference is great enough to cause an appreciable difference between the numbers banded during the two seasons is questionable but it might be considered as a contributing factor.

Something more should be said, however, concerning the variations which occur in the numbers banded within the same season from year to year. These differences are due to a combination of several factors which may be summarized as follows:

First, that White-throated Sparrows do not follow the same migration routes from year to year, or at least do not make the same stops.

Second, is the effect of variations in climatic conditions. Mr. Lincoln[6] has said that the migration of birds has so evolved that in general they synchronize with average climatic conditions. Also, birds pause during migration and allow the spring season to advance, and then by rapid travel again overtake, and sometimes even overlap it. Possibly great flocks sometimes congregate in a locality until favorable conditions prevail and then by non-stop flying pass over many localities along their migratory route. Perhaps this partially explains why White-throated Sparrows do not make the same stops from season to season.

Third, according to Bradt[7] there seem to be differences in trap-shyness among individuals. He observed that within the same species certain flocks were readily attracted to the vicinity of traps and were caught with regularity, whereas

other flocks seemed to be more wary and therefore were seldom caught. But, of course, this theory involves bird psychology, a field in which little is known and about which little can be said in this work.

Fourth, it has been shown that there is a positive correlation between the number of trap days and the number of birds caught. Therefore, the variation from year to year would depend on the number of traps used and the number of days they were operated.

Record of Repeats

A bird which is recaptured at the same station within a period of six months after the date of the last previous capture is called a repeat. This terminology is based on the theory that if only a short period of time elapses between captures it is probable that the bird has remained relatively close to the station between captures. The period of six months has been fixed arbitrarily to correspond with the length of the migrating season. If a period of time greater than six months elapses between catches, the bird is classified as a local return.

A great many things may be learned from studying the repeats of birds. The length of stop-over periods along the migration route, the tendancy of species to form the trap-habit method of feeding, the length of time elapsing between repeats, the relation of frequency of repeats to weather conditions, and the comparison between the repeat records of different species and between individuals of the same species,

are all problems which may be studied from repeat records. The White-throated Sparrow acquires the trap-habit readily and repeats with regularity. One White-throated Sparrow repeated 55 times in 38 days.

The average percent of repeats during spring migrations, as determined from Table III, is 24.6 with a standard deviation of 14.5. The corresponding average for fall migrations will be found to be 63.3 percent with a standard deviation of 15.6. The difference between the two averages is significant. This difference would occur due to chance about one time out of twenty.

Bradt[7], whose results were based on banding results for only one year, did not find a significant difference between the number of repeats in spring and fall.

The difference shown in this work from records over a period of ten years, is probably due in part to the fact that migration in the fall is more leisurely. Assuming birds do remain in one locality for a longer period of time in the fall than in the spring, it would be expected that they would be taken a greater number of times in the fall.

According to Rowan[3] a greater speed of migration in the spring is due to a strong urge for mating and reproduction. This urge, not being present in the fall, would cause migration to be less rapid.

It might be thought that since natural food is more abundant during the fall period, fewer birds would be inclined to form the trap-habit. This does not hold true for repeating White-throated Sparrows at this station.

TABLE III

NUMBER AND PERCENT OF REPEATS
FOR WHITE-THROATED SPARROWS
DURING SPRING AND FALL MIGRATIONS

YEAR	SPRING			FALL		
	Number Banded	Number Repeats	Percent Repeats	Number Banded	Number Repeats	Percent Repeats
1924	75	10	7.5	39	28	71.8
1925	33	10	3.3	91	48	52.8
1926	122	23	18.8	111	74	66.6
1927	203	83	40.8	87	37	42.5
1928	135	37	27.4	164	122	74.4
1929	236	117	49.6	110	75	68.1
1930	136	22	16.2			
1931	86	37	43.0	28	26	92.9
1932	170	48	28.2	168	63	37.5
1933	240	26	10.8			

Table IV shows the average length of stop-overs in days for birds that repeated during spring and fall migration periods. Period of repeats in days as used in this table is defined to mean the average number of days which elapsed from the first day a bird was taken to the last day it was taken, inclusive.

The average days in this locality for birds which repeated during spring migrations was found to be 4.5 days, with a standard deviation of 1.57. The average for fall migration was 10.67 days, with a standard deviation of 2.56. The difference between the two averages is significant. This difference would occur by chance about once out of twenty times. Bradt[7] found evidence which indicated a more leisurely passage south in the fall but did not prove it definitely due to insufficient data.

These results seem to substantiate the hypothesis stated before, that a greater number of repeat records should be expected during a fall migration period because during that period White-throated Sparrows remain in this locality for a greater length of time.

In order to compare the length of time between individual repeats during the two seasons a formula has been devised. The average length of stop-overs when divided by the average number of repeats for that season equals the average time between repeats during that particular season. For example, in the spring of 1924, the average stop-over period was 3.2 days. The average number of repeats for that sea-

TABLE IV

AVERAGE PERIOD OF REPEATS IN DAYS

FOR WHITE-THROATED SPARROWS

YEAR	SPRING	FALL
1924	3.2	13.2
1925	3.0	12.5
1926	4.4	11.2
1927	4.8	6.4
1928	4.1	7.5
1929	6.9	8.9
1930	3.4	
1931	8.4	13.8
1932	5.2	11.9
1933	4.3	

son was 2.3 times. The quotient is therefore found to be 1.39 days. In other words, for White-throated Sparrows that repeated, an average time of 1.39 days elapsed between recaptures. Table V shows the results of these calculations.

The average time between repeats during spring migrations was 1.94 days, with a standard deviation of 0.50. The average for fall migrations was 1.70 days with a standard deviation of 0.24. The actual difference between the averages was therefore 0.24 days. This was found to be only 0.7 times the standard error of difference between the two means and is therefore insignificant. It is probably due to chance alone.

These results seem to indicate that: (1) the inclination to repeat is equally great in spring and fall; (2) seasonal difference in food conditions is a relatively unimportant factor influencing the number of repeats; and (3) the greater number of repeats in the fall is chiefly due to the longer stay in the locality during that migration period.

Migration Peaks

It is difficult to say that a migration reaches its greatest intensity on any one specific day because the numbers caught on succeeding days may vary greatly. In order to show a somewhat smoother migration curve and still give the impression of the fluctuating tendancy it seems better for all practical purposes to group the number of birds banded in two or three days. For this work a three day period has been

TABLE V

MEAN LENGTHS OF TIME BETWEEN REPEATS, IN DAYS, FOR WHITE-THROATED SPARROWS

YEAR	SPRING	FALL
1924	1.39	1.50
1925	2.31	1.64
1926	1.83	1.67
1927	1.85	1.83
1928	1.78	1.92
1929	2.15	1.24
1930	1.36	
1931	1.35	1.68
1932	2.48	2.09
1933	2.87	

adopted. Bradt[7] used a fifteen day period.

In general the peak of spring migration was found to fall somewhere between the first and ninth of May, and most frequently between the first and third. During five periods the peak occurred from the first to the third, for four years the pinnacle was reached from the fourth to the sixth, during three seasons the period of maximum intensity came between the seventh and ninth, in one period the peak fell from May tenth to twelfth, during one year it occurred from May thirteenth to fifteenth; and for one period the peak was from the twenty-eighth to the thirtieth of April. The spring peak for 1933 could not be included in the above classification because that was an exceptional year having two peaks. Sixty three birds were banded from the twenty-eighth to the thirtieth of April and sixty-three were also banded from the seventh to the ninth of May. Between these two peaks, May the first to sixth, nine birds were banded. This example clearly illustrates an extreme fluctuation. Such fluctuations may be due to changing climatic conditions, variations in temperature and the occurrance of local storms.[4]

In general the peak of fall migration was found to occur from the first to the sixth of October, inclusive, and most frequently from the first to the third. During three years the peak occurred from the first to the third of October, for two seasons the pinnacle was reached between the fourth and the sixth of October, in two fall migrations the period of maximum intensity came from the seventh to the ninth of October, and in two periods the time of maximum banding activi-

ty was between the tenth and the twelfth of October. For the years 1926, 1932, 1934, and 1936 it was impossible to determine single three day periods in which the greatest numbers of birds were banded.

For all years, with the exception of perhaps 1931, migration did not reach a peak before banding operations began. Therefore, the relatively late dates for the opening of college did not prevent us from determining the period of maximum migration.

Graph I presents the spring and fall migration curves for White-throated Sparrows. Each point on the curves is the average number of birds banded on three successive days over a period of sixteen years. These curves may be used in the future as standards for comparison with curves for individual years.

An inspection of these graphs leads to the following general conclusions concerning spring and fall migrations of White-throated Sparrows:

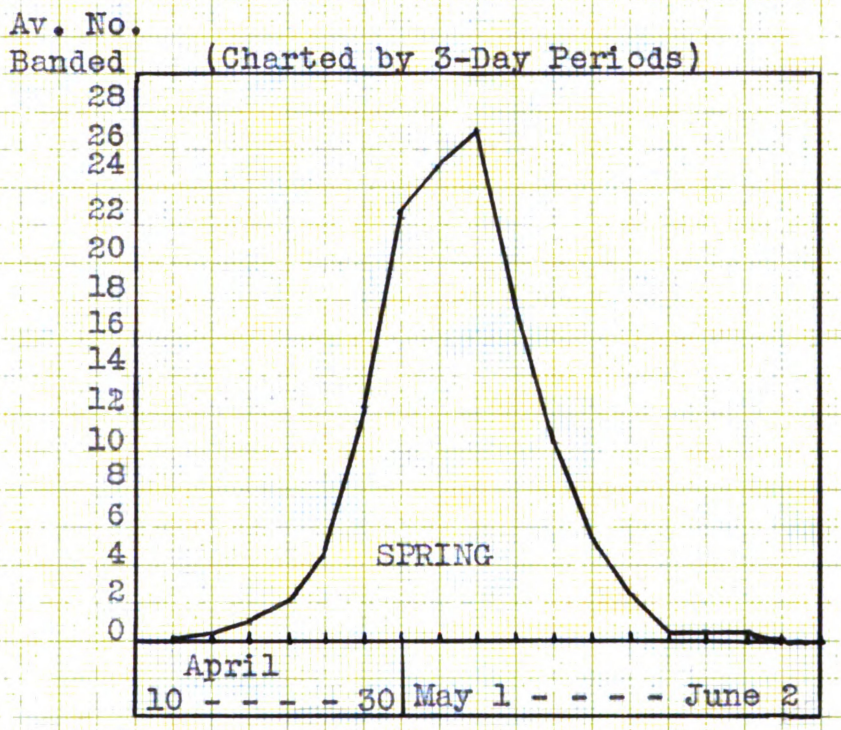
1. The bulk of spring migration occurs between the ninteenth and twenty-first of April and the ninteenth and twenty-first of May, a period of thirty-three days.
2. The bulk of fall migration comes between the twenty-sixth and twenty-seventh of September and the twenty-fifth and twenty-seventh of October, a period of thirty-three days.
3. The average spring migration peak falls between the seventh and ninth of May, inclusive.

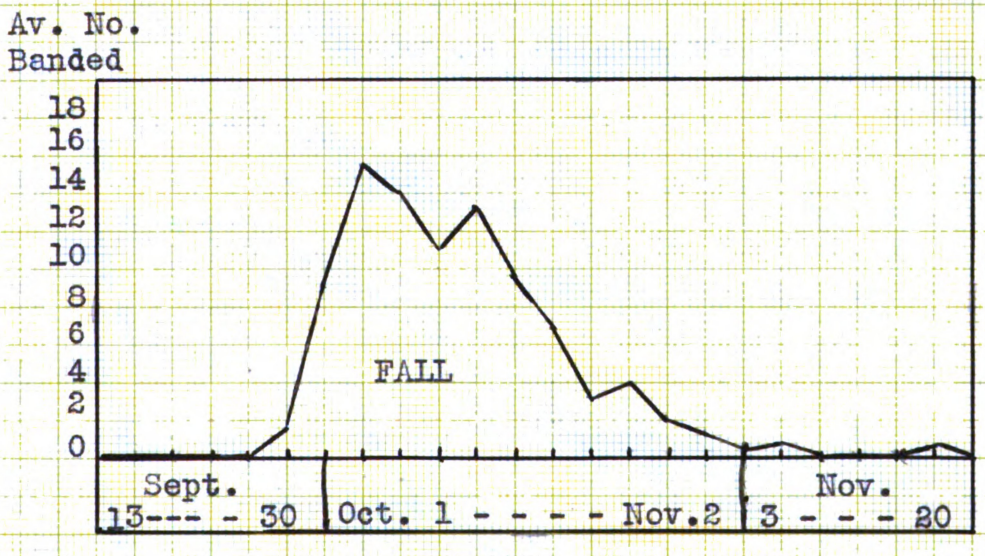
GRAPH I

AVERAGE SPRING AND FALL MIGRATION CURVES

FOR WHITE THROATED SPARROWS

(1924 to 1939)





4. The average fall migration peak occurs between the first and third of October, inclusive.
5. After migration begins the peak is reached in less time and is more abrupt in the fall than in the spring. After the peak is reached, migration terminates in less time and the slope is more abrupt during the spring migration. This further supports the theory that there is a definite urge in the spring to reach breeding grounds. This urge is nonexistant in the fall and migration is more straggling and leisurely.
6. The difference between the average numbers banded in the spring and in the fall is clearly shown.

Records of First And Last Captures

The first and last captures of birds for both spring and fall migration seasons are of particular interest for several reasons. The first arrival of birds in the early months of the year, for example, is always welcomed because of their association with approaching spring. Likewise, it is always with regret that we record their departure in the fall as a warning that winter is on the way.

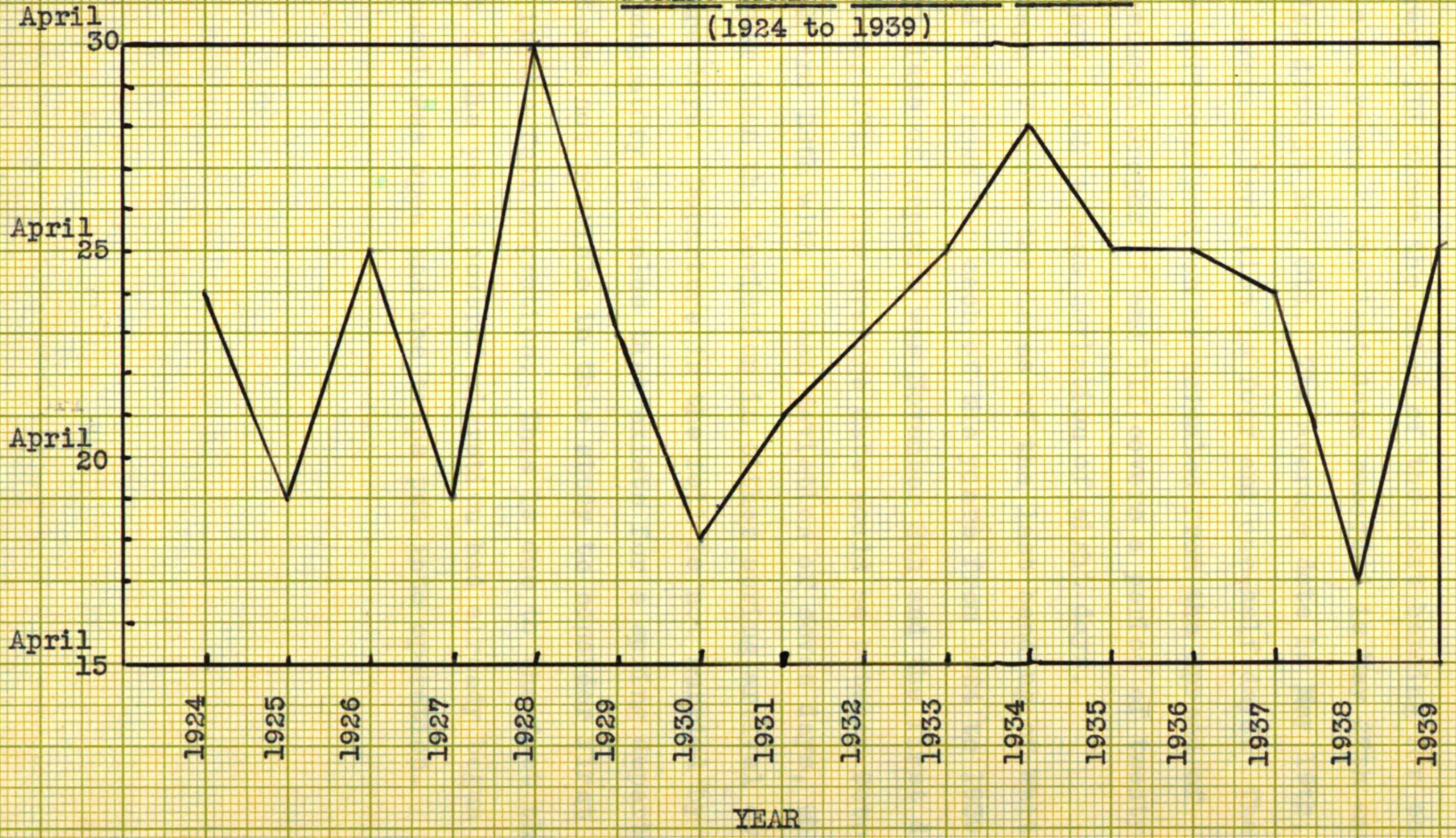
Graph II shows the dates of the first banding of White-throated Sparrows for each of the years from 1924 to 1939. The earliest date recorded is April 17th and the latest is April 30th. The average date is April 23rd and the average deviation would be approximately three and one-half days. It

GRAPH II

FIRST BANDING RECORDS FOR WHITE-THROATED SPARROWS

DURING SPRING MIGRATION PERIODS

(1924 to 1939)



is interesting to note, over a period of sixteen years, that this deviation is no greater.

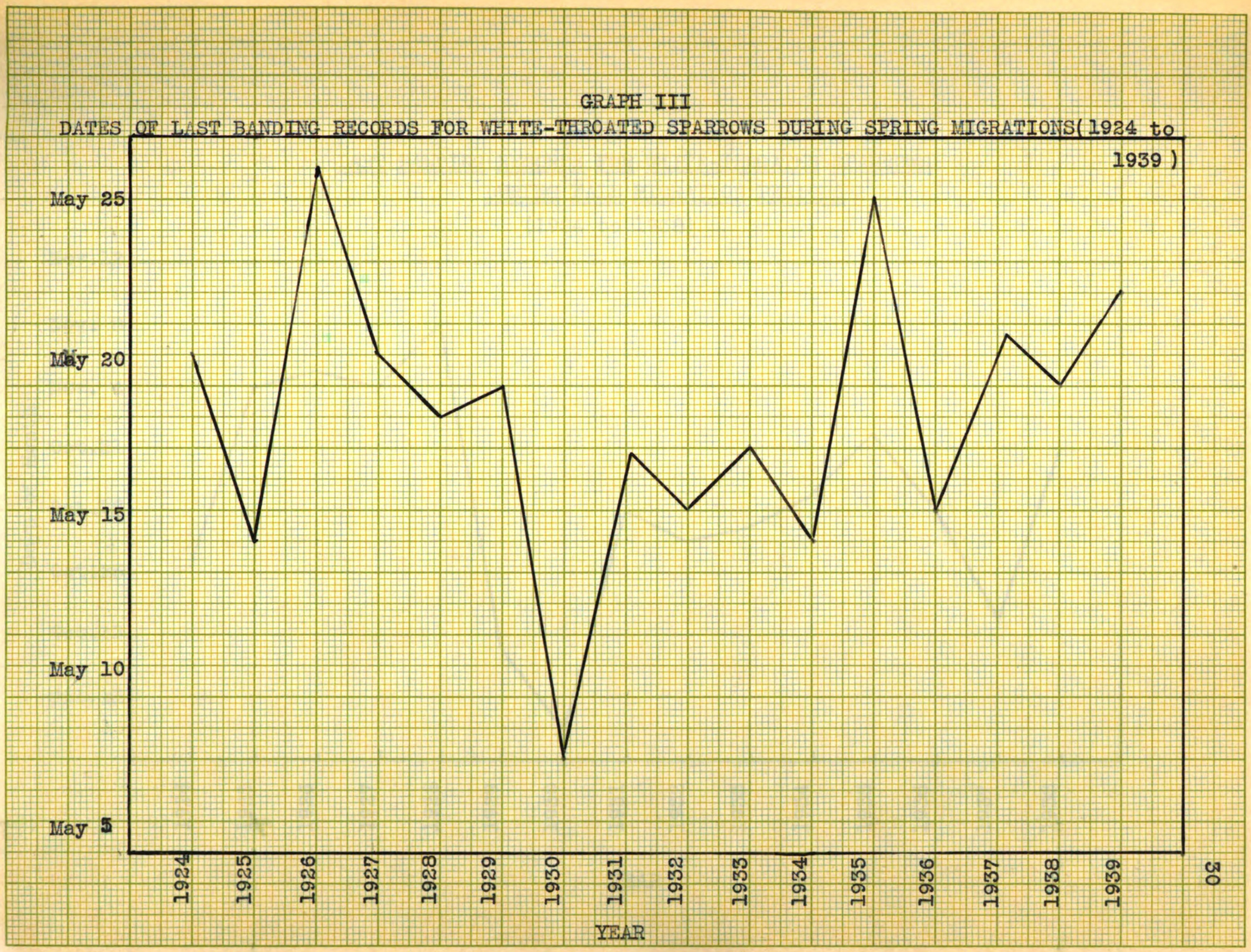
Graph III shows the dates of the last banding for each of the same years. The last date recorded is May 27th and the first date is May 8th. The average date is May 19th, and the average deviation is four and one-half days. The average spring migration as revealed from the spread of dates between Graphs II and III covers a period of twenty-seven days, with a mean deviation of eight days.

Graph IV shows the dates of the last banding of White-throated Sparrows for each of the years from 1924 to 1939. The last date of capture was November 8th and the first date was October 13th. The average date would be between October 27th and 28th with a mean deviation of seven days, which is greater than the deviation in either spring arrival or departure days. Departure in the fall is not hurried by the strong migratory stimulus that exists for a spring departure.

It was not possible in this study to consider first arrivals in the fall migration. This is due to the fact that in most of the years covered migration had already begun before school was open and the traps put into operation.

GRAPH III

DATES OF LAST BANDING RECORDS FOR WHITE-THROATED SPARROWS DURING SPRING MIGRATIONS(1924 to 1939)



GRAPH IV

LAST BANDING RECORDS FOR WHITE-THROATED SPARROWS

DURING FALL MIGRATION PERIODS

(1924 to 1938)

SLATE-COLORED JUNCOS

The Slate-colored Junco is a small, plump, bird commonly known as the "snow bird". It comes at a time when most of the other birds have left for their winter homes in the south, and usually remains until late in the fall. It breeds in the Hudsonian and Canadian zones in northwestern Alaska, northern Mackenzie (the tree-limit of North America, northern Manitoba, central Quebec, the base of the Alaskan peninsula, southern Yukon, central Alberta, northern Minnesota, central Michigan, Ontario, and the mountains of New York, Pennsylvania, and Massachusetts. Its winters are spent in the eastern United States, southern Ontario, and south to the Gulf Coast. These birds are banded at this station in greater numbers than any other species. They are taken almost entirely during their migratory periods since relatively few remain in this locality throughout the winter months. For the period of 1924 to 1940, inclusive, 5349 were banded. If the total number of repeats were added to this, the total number of catches would approximate 12,000.

Number Banded Each Season 1924-40

Of the total number banded, 2236 were banded during spring migrations and 3133 during fall migrations. In Table VI the numbers are shown both by years and seasons.

The mean number banded during spring migrations is 131.5 with a standard deviation of 86.6. The average number in the corresponding fall migrations is 195.8 and the standard de-

TABLE VI

NUMBER OF SLATE-COLORED JUNCOS
BANDED DURING SPRING AND FALL MIGRATIONS,
1924 to 1940, INCLUSIVE.

YEAR	SPRING	FALL
1924	6	153
1925	7	199
1926	88	330
1927	52	151
1928	280	285
1929	119	335
1930	151	
1931	17	78
1932	223	368
1933	146	155
1934	249	155
1935	252	215
1936	105	71
1937	137	131
1938	318	266
1939	146	185
1940	43	36

viation is 100. The difference between the means, 64.3, is not significant since it would occur through chance about one in five times.

One explanation for this dissimilarity is that in some years spring migration begins before the traps are opened. The beginning of spring trapping operations at this station corresponds roughly to the opening date of the spring term. The trapping station has therefore started from April 4th to April 16th during the past sixteen years. This variation would make a considerable difference in the number captured, since the maximum migration period often falls in the period of April 7th to April 12th. Also it is difficult to determine the actual start of migration at this station because occasionally individuals do winter in this area. Journals from students doing special problems during the winter terms show records of a few Slate-colored Juncos caught throughout the winter months. Bradt[7] found spring migration beginning on April 9th.

Another probable theory to account for the difference is as follows. It has been shown that spring migration is usually more rapid than fall migration. This difference has been said to be due to the presence of the strong urge in the spring for mating and reproduction. This urge is associated with the growth and development of gonads in the spring, initiated by increasingly longer light days and a greater amount of activity. It might be that when favorable weather prevails in the spring, birds make a series of extremely long,

non-stop, flights until they reach their destinations in the north. Since this is not present in the fall, migration may be less rapid and stop-overs made oftener and for greater periods of time. If this is true, it would seem partially to account for the smaller number banded in the spring.

An examination of Table VI reveals an interesting point. The total number of Juncos caught during spring and fall migration before 1932 is almost equal. The total for fall migration is 1214 and the corresponding total for spring migration is 1293. It is evident that the difference is not significant. Then why is there a difference since 1932? It is noteworthy that bird trammel nets were first employed as a supplementary method of capturing birds in 1933. It may be that this factor has played an as yet unrevealed influence in the change. A more likely reason, however, would seem to be that captures of Slate-colored Juncos have always been relatively heavy in the fall.

Record of Repeats

Several interesting things about the behavior of Slate-colored Juncos in migration can be learned from a study of their repeating habits. The repeats of these birds, that is, their recaptures within a period of six months after original captures, show the length of their stop-overs, the tendency to form the trap habit method of feeding, and the length of time elapsing between their repeats. The number and percentage of repeats in comparison to the total number banded is

shown for both spring and fall for the years 1924 to 1933 in Table VII.

The average percent of repeats during spring migrations was found to be 29.57 with a standard deviation of 16.5. The average for fall migrations was 42.6, with a standard deviation of 19.4. The difference between these two averages (13.1) is not significant. A difference as great as 13.1 would occur through chance approximately once in three times so this difference may be due to chance.

The percent of spring repeats for Slate-colored Juncos (29.5) is slightly greater than spring repeats for White-throated Sparrows (24.6) but the difference is not significant. The percent of fall repeats for White-throated Sparrows (63.3) was found to be significantly greater than the percent of fall repeats for Slate-colored Juncos (42.6). The difference (10.7) would arise from chance once in twenty times. This indicates a greater tendency for White-throated Sparrows to form the trap habit during the fall migration.

In Table VIII the period of repeats in days is defined to mean the average number of days which elapsed from the first day a bird was taken to the last day it was taken, inclusive. The table shows the repeat periods for both spring and fall seasons from 1924 to 1933.

Let us look at these repeat periods, compare them for spring and fall, and see what they mean. The repeat periods for spring vary from a minimum of five days in 1933 to a maximum of sixteen days in 1927. The average period was 9.7 days with a standard deviation of 3.1. The repeat periods for fall

TABLE VII

NUMBER AND PERCENT OF REPEATS FOR SLATE-COLORED JUNCOS DURING SPRING AND FALL MIGRATIONS; 1924 - 1933 INCLUSIVE

YEAR	SPRING			FALL		
	Number Banded	Number Repeats	Percent Repeats	Number Banded	Number Repeats	Percent Repeats
1924	6	2	33.0	153	28	18.3
1925	7	0	0.0	199	83	41.7
1926	88	26	29.5	330	119	36.0
1927	52	28	53.8	151	73	48.3
1928	280	100	35.7	285	84	29.5
1929	119	36	30.2	335	187	55.8
1930	151	71	47.0	0	0	0.0
1931	17	0	0.0	78	68	87.0
1932	223	68	30.5	368	88	23.9
1933	146	52	35.6			

TABLE VIII

AVERAGE PERIOD OF REPEATS IN DAYS,

1924 - 1933, INCLUSIVE

YEAR	SPRING	FALL
1924	6.0	10.3
1925		17.9
1926	9.8	12.5
1927	16.0	18.8
1928	9.2	14.3
1929	11.4	9.3
1930	10.5	
1931		11.2
1932	9.6	14.2
1933	5.0	

run from a minimum of 9.3 days in 1929 to a maximum of 18.8 days in 1927. The average was 13.6 days with a standard deviation of 3.2. It will be seen that the repeat periods for fall are considerably longer than those for spring. The difference between the two averages, 4.9, would occur through chance only once in twenty times and is therefore considered significant. It is particularly significant in this instance. Since the time covered by the average period of repeats is a relative indication of the length of time birds remain in a locality, it would mean that birds remained at the college banding station for a greater number of days in spring than in fall migrations. In other words, migration during the fall is more leisurely than during the spring.

In Table VIII we studied the length of time spent in this locality by migrating Slate-colored Juncos in spring and fall. We are now prepared to study the number of times repeating birds are caught. Is the number related to seasons? In Table IX the average number of days that individuals repeated is shown by years and by seasons from 1924 to 1933.

The number of repeat days in spring migrations vary from a minimum of 1.00 in 1924 to a maximum of 4.21 in 1927. The average is 2.9 with a standard deviation of 0.98. Repeat days in fall vary from a minimum of 1.89 in 1924 to a maximum of 4.24 in 1925. The mean is 3.1 repeat days with a standard deviation of 0.75. The difference between these two means is not significant. We may then conclude that there is no significant relation between the number of repeat days and seasons.

TABLE IX

AVERAGE NUMBER OF REPEAT DAYS PER INDIVIDUAL
DURING SPRING AND FALL MIGRATIONS,
1924 - 1933, INCLUSIVE

YEAR	SPRING	FALL
1924	1.00	1.89
1925		4.24
1926	2.19	2.64
1927	4.21	4.09
1928	3.20	3.02
1929	4.19	3.43
1930	3.07	
1931		2.97
1932	2.81	2.45
1933	2.50	

Record of Returns

The question of whether or not birds follow the same migration routes in different seasons has been long debated. The chance that the same bird will return to exactly the same banding station on its migratory route, usually hundreds of miles in length, seems to be extremely small. Fourteen return records have been recorded for Slate-colored Juncos banded at this station. These records furnish the only evidence that these birds follow the same migratory routes during different seasons.

Table X is a record of returns. It shows the number of the band on the bird's leg, the dates of original capture, and the dates of recovery for the fourteen birds. It may be noted that nine of the records are of birds banded originally during fall migrations. All were recaptured during the succeeding spring migrations. Only one of the birds, Number B 19,537, returned in any subsequent migrations. This bird returned twice and is the only Slate-colored Junco coming back more than once to this station! The records of birds bearing bands numbered 34-6962, 34-6963, and 34-6964 and birds bearing band numbers H 90,910 and H 19,537 are particularly interesting. Birds with the first three band numbers were caught on the same day, October 24, 1936. Two of the three were retaken again the following spring on the same day, April 14, 1937. The third was recaptured two days earlier, April 12. Birds with band numbers H 90,903 and H 90,910 were both originally caught October 30, 1934 and both returned the

TABLE X

RETURN RECORDS FOR SLATE-COLORED JUNCOS

BANDED AT THIS STATION

(1924 - 1939)

BAND NUMBER	ORIGINAL CAPTURE	RETURN
34-6962	October 24, 1936	April 14, 1937.
34-6963	October 24, 1936	April 14, 1937
34-6964	October 24, 1936	April 12, 1937
C 30,343	October 5, 1932	April 19, 1933
F 78,312	October 14, 1932	April 11, 1933
F 79,290	October 19, 1937	April 8, 1938
H 90,903	October 30, 1934	April 6, 1935
H 90,910	October 30, 1934	April 6, 1935
B 19,537	October 2, 1929	March 27, 1930 April 18, 1931
A 89,923	April 6, 1927	November 11, 1927
B 19,302	April 27 1928	November 4, 1928
C 30,207	October 27, 1929	October 6, 1932
A 92,232	October 9, 1928	October 3, 1929
B 20,662	April 15, 1928	April 12, 1929

same day, April 6, the following spring. These examples are noteworthy because they raise an interesting question. Do Slate-colored Juncos remain in flocks throughout the winter? It is indicated from the records that they do remain united throughout the winter. This is even more amazing when one thinks of the many hazards of migration. It is not evident whether or not this is a rule or an exception.

Two birds were banded while traveling north in spring migrations and returned to our station the following fall during their flight south. The greatest period of time elapsing between captures for returned birds is approximately one year. Four such records are shown in Table X.

The two most salient points shown by these return records are : (1) No return records for this species have been recorded in which the length of time between date of capture records is greater than one year; and (2), an indication of a flocking tendency is shown.

MIGRATION PEAKS

Considerable time has been devoted to the study of migration curves for Slate-colored Juncos at Mighigan State College. These birds attracted early attention at the banding station because of their arrival in large numbers and because of their unusual spring and fall migration habits. The records of bandings cover the years 1924 to 1939 for both spring and fall, and form the basis for a study of migration peaks as well as the duration of the migrating seasons.

Graphs V to XV show the curves of spring migration for ten years, charted by three-day periods. While the larger number of the graphs show a clearly defined migration peak, it should be noted that some of them illustrate the fact that migration was already in progress at the time the collection of data was begun. From these latter graphs it would be difficult to determine whether or not the peak of migration was reached before or after the beginning of trapping operations. For some of the years, 1924, 1925, 1926, 1927, and 1931, the number of birds banded was small, definite curves were not shown, and therefore graphs are not included.

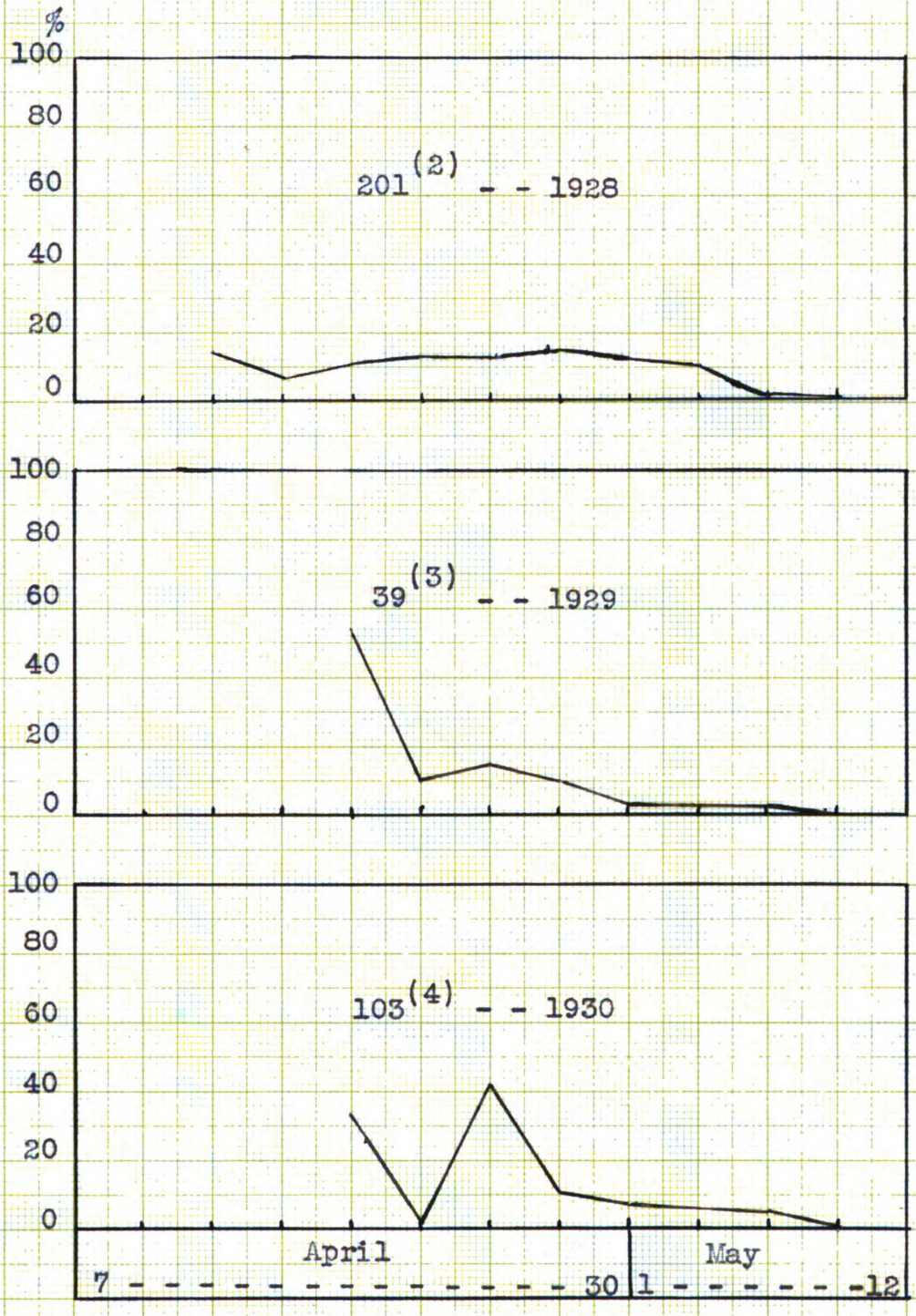
Graphs for 1928, 1929, 1930, 1938 and 1939 are those for the years in which spring migration was already in progress at the time the collection of data was begun. It is probable, therefore, that the peak of migration may have occurred before the traps were opened, or at least was occurring during the period in which they were opened. During the years 1932, 1933, 1934, 1935, 1936 and 1937 definite peaks appear some

GRAPHS V, VI & VII

SPRING MIGRATION CURVES CHARTED BY

THE PERCENT OF TOTAL NUMBER BANDED IN 3-DAY PERIODS(1)

(1928, 1929, and 1930)

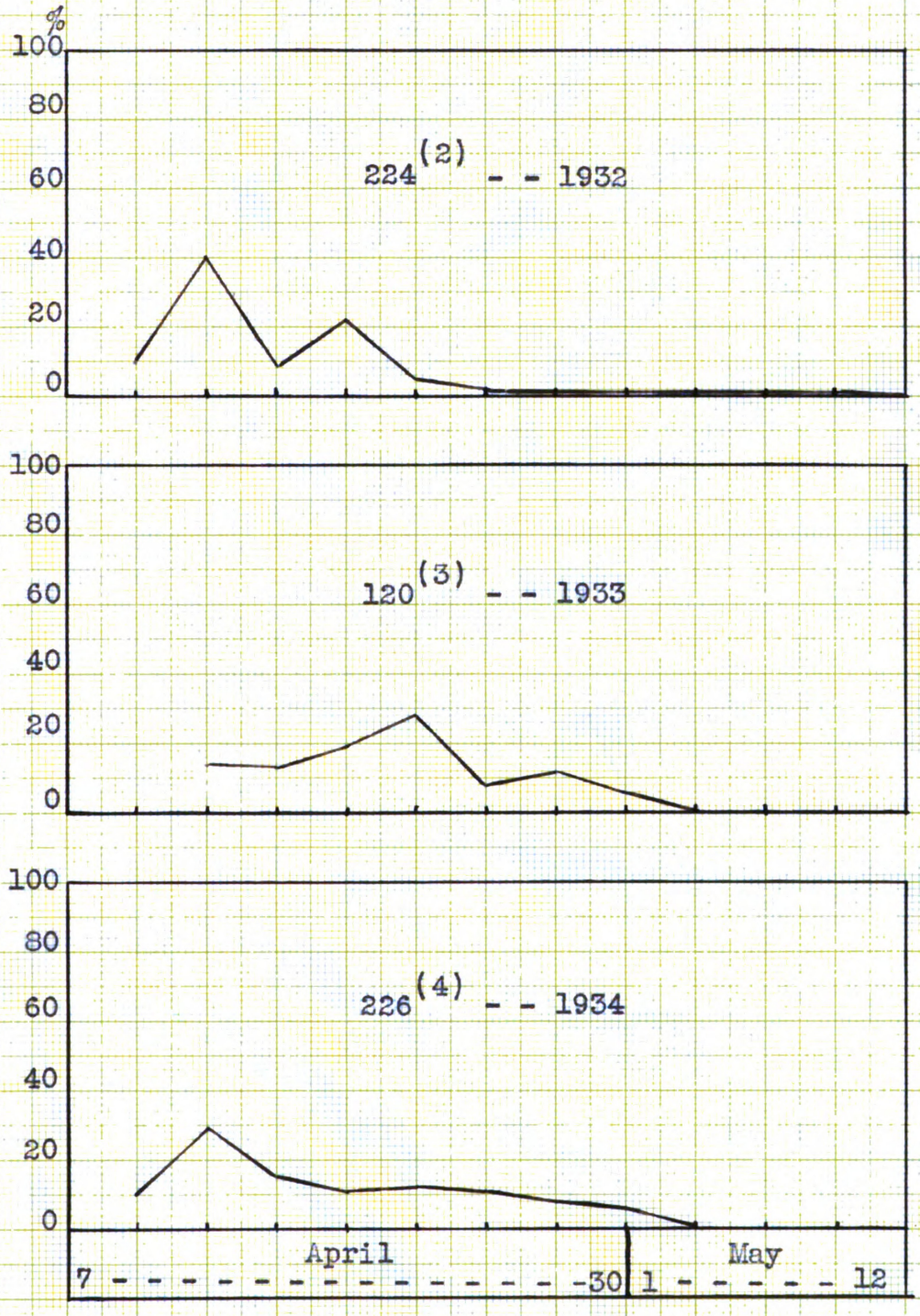


(1) Curves begin at opening dates of trapping station. They do not begin at Zero since Slate-colored Juncos are usually banded during the first day traps are open. (2), (3) and (4) are the total number banded during the period considered by the graphs.

GRAPHS VIII, IX AND X
SPRING MIGRATION CURVES CHARTED BY

THE PERCENT OF TOTAL NUMBER BANDED IN 3-DAY PERIODS(1)

(1932, 1933 and 1934)

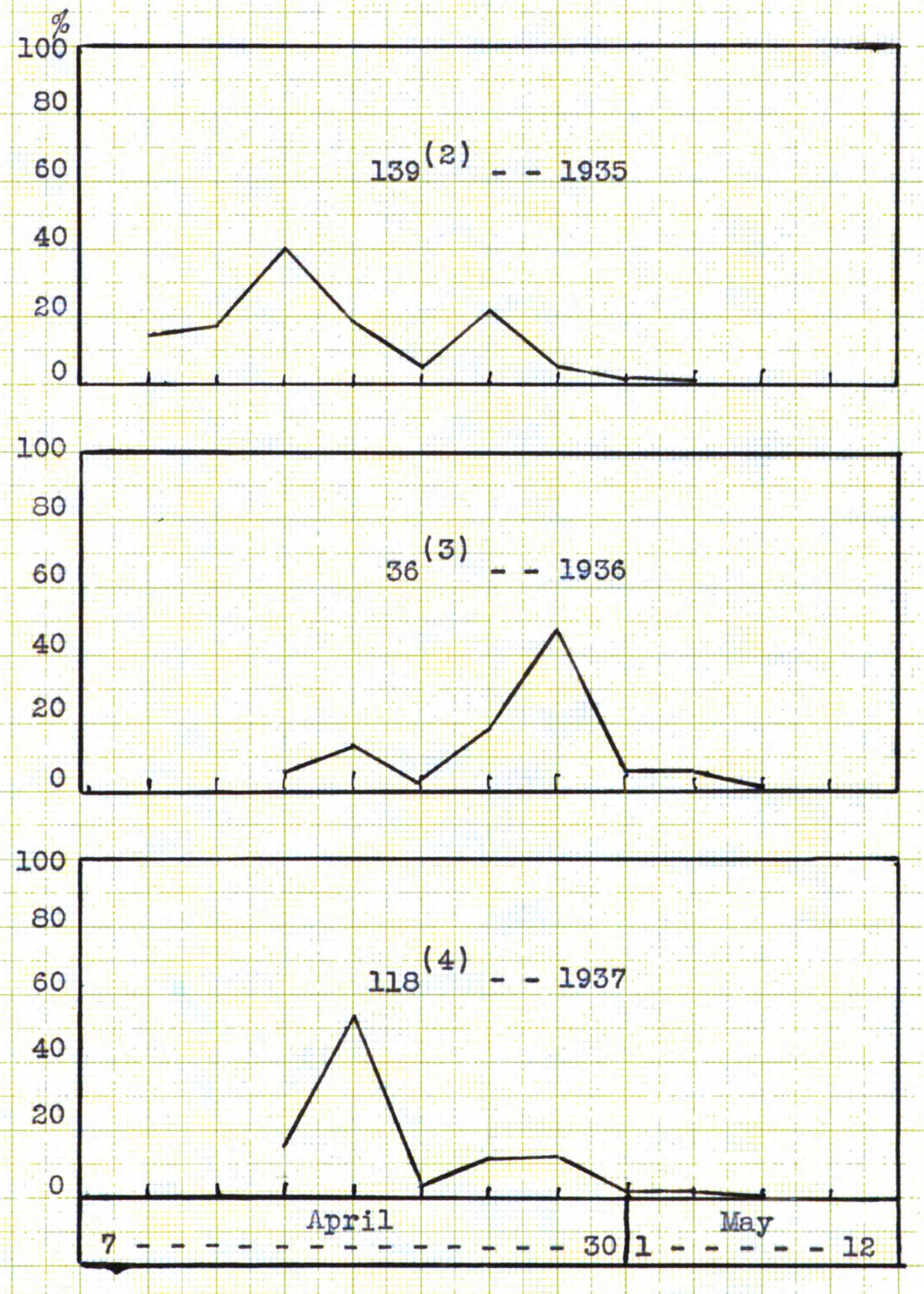


(1) Curves begin at opening dates of trapping station. They do not begin at zero since Slate-colored Juncos are usually banded during the first day traps are open. (2), (3) and (4) are the total number banded during the period considered by the graphs.

GRAPHS XI, XII, & XIII
SPRING MIGRATION CURVES CHARTED BY

THE PERCENT OF TOTAL NUMBER BANDED IN 3-DAY PERIODS(1)

(1935, 1936 and 1937)



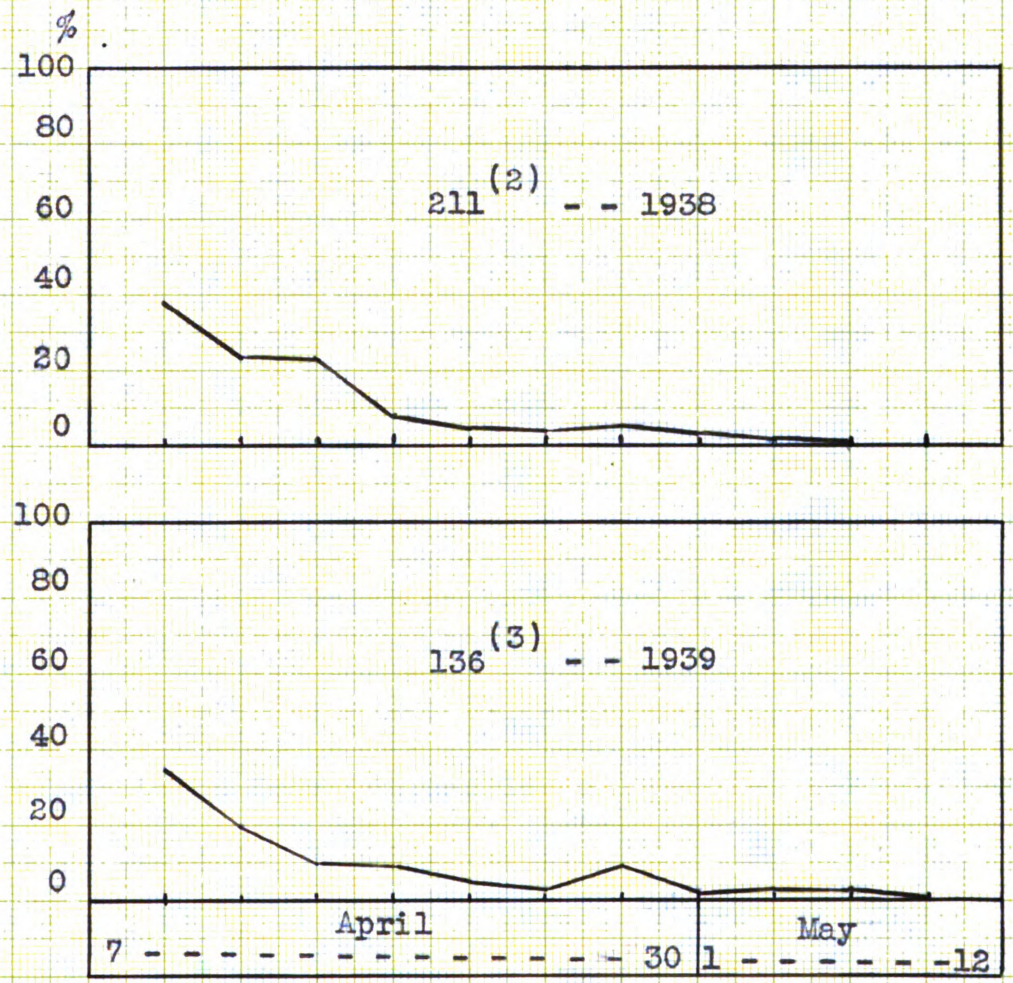
(1) Curves begin at opening dates of trapping station. They do not begin at zero since Slate-colored Juncos are usually banded during the first day traps are open. (2), (3) and (4) are the total number banded during the period considered by the graphs.

GRAPHS XIV & XV

SPRING MIGRATION CURVES CHARTED BY

THE PERCENT OF TOTAL NUMBER BANDED IN 3-DAY PERIODS(1)

(1938 and 1939)



(1) Curves begin at opening dates of trapping station. They do not begin at zero since Slate-colored Juncos are usually banded during the first day traps are open.

(2) and (3) are the total number banded during the period considered by the graphs.

time after the opening dates. These peak dates range from the earliest, April 10 to 12, in 1932 and 1934, to the latest, April 25 to 27 in 1936. The only period in which two peaks occur is April 10 to 12. Graph XVIII shows the average percent of the total number banded for these years in which a definite peak is shown after the traps were opened, i.e., 1932, 1933, 1934, 1935, 1936 and 1937. It may be seen from this curve that for these years, the only ones for which complete data is available, the average peak is April 10 to 12.

Graph XVI is a comprehensive graph of all data available on Slate-colored Juncos banded during spring migrations. This includes not only the data collected in regular studies at the College Banding Station but also considerable information collected by students engaged in special studies during winter and spring terms at times when the regular traps were not open.

The maximum period of fall migration was most frequently found to be from October 16 to 18. The peak was October 7 to 9 during the years of 1924, 1929, and 1930. For the two years 1927 and 1928 the period of maximum movement occurred from October 10 to 12. In the five years 1926, 1932, 1935, 1936, and 1939 (33% of the total years) the pinnacle came from October 16 to 18. The peak for 1933 was reached between October 19 and October 21. In the fall of 1937 the period of greatest intensity was from October 22 to 24; and the peaks in 1925 and 1934 fell from October 28 to 30.

The number of birds banded throughout the first three-day period is rarely more than two or three. This indicates

that the onset of fall migration is closely correlated with the beginning of banding operations in the fall term. We are therefore fortunate in having almost complete fall migration records for this species.

Graphs XVI and XVII, together, present the spring and fall migration curves for Slate-colored Juncos. Each point on these curves is the average number of birds banded on three successive days over a period of sixteen years. These curves may be used in the future as standards for comparison with curves for individual years. It must be borne in mind however that these are average curves constructed from records over a period of sixteen years and curves for individual years may vary considerably.

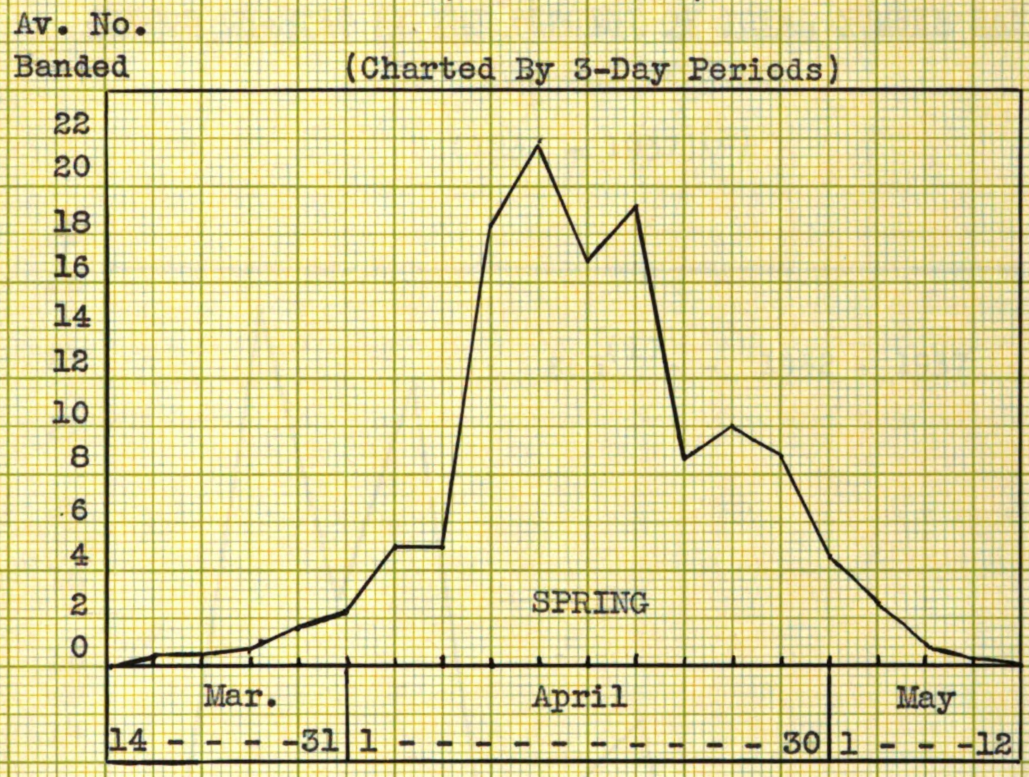
Inspection of these curves leads to the following general conclusions concerning the spring and fall migrations for Slate-colored Juncos:

1. The fall migration lasts longer than the spring. This difference is primarily due to a more leisurely passage in fall than in spring.
2. The period of maximum intensity is much longer in the fall than in the spring. The peak of maximum intensity is higher, however, in the spring than in the fall.
3. Some birds spend their entire winters in this area. This is indicated by the fact that some birds are captured as long as the traps are operated in the fall and is further supported by records of students conducting special banding studies in the win-

ter term.

4. There is a greater tendency to show a definite peak in the spring than in the fall. This sharp rise to a peak is characteristic of spring migrations in general, but here it is partially due to the lateness in opening the traps in the spring.
5. The curves are very irregular. This is probably due to the relatively irregular migratory habits of this species.

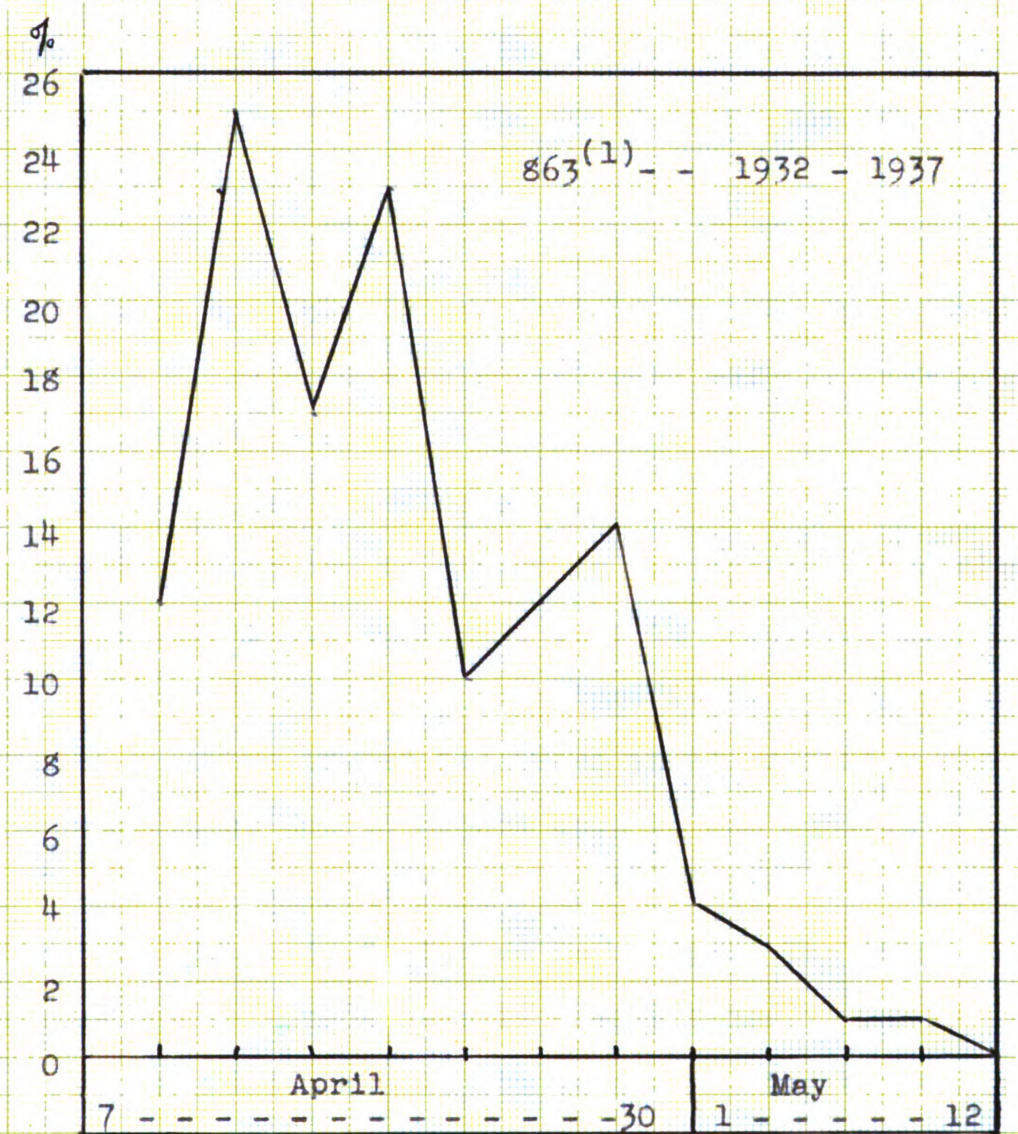
GRAPHS XVI & XVII
AVERAGE SPRING AND FALL MIGRATION CURVES FOR SLATE-COLORED JUNCOS
(1924 to 1939)



Graph XVIII

AVERAGE SPRING MIGRATION CURVE FOR SLATE-COLORED JUNCOS CHARTED BY THE PERCENT OF TOTAL NUMBER BANDED[1] IN THREE-DAY PERIODS

(1932 - 1937)[2]



(1) Total number banded is 863.
(2) These years are the only ones for which complete information is available.

COMPARISON OF MIGRATION RECORDS

1. A significantly greater number of White-throated Sparrows are banded in the spring than in the fall. This difference would be due to chance once in twenty times.

2. A greater number of Slate-colored Juncos are banded during the fall than during the spring. A difference as great as the one found would occur due to chance once in five times.

3. A significantly greater percent of repeats for White-throated Sparrows occurs in fall than in spring. This difference would be due to chance considerably less than once in one hundred times.

4. There is a greater percent of repeats for Slate-colored Juncos in the fall than in the spring. The difference would occur due to chance once in three times.

5. Stop-over periods are significantly longer for White-throated Sparrows in the fall than in the spring. The difference would be due to chance once in one hundred times.

6. Stop-over periods for Slate-colored Juncos are significantly longer in fall than in spring. The difference would be due to chance once in twenty times.

7. The difference in the length of time between repeats in spring and fall is insignificant for both White-throated Sparrows and Slate-colored Juncos.

8. For Slate-colored Juncos the tendency to form the trap habit is equally great in fall and spring.

9. The average peak of spring migration for White-throated Sparrows falls between May 7 and May 9.

10. The average peak of fall migrations for White-throated Sparrows was from October 1 to 3.

11. The period of greatest banding activity for Slate-colored Juncos during the spring is April 10 to 12.

12. The average fall migration curve for Slate-colored Juncos does not show a definite three-day peak. Over a period of sixteen years maximum numbers have been banded mainly during the periods of October 16 to 18, 17 to 19, 20 to 22, and 28 to 30. This is due to a more leisurely migration in the fall than in the spring.

13. The average spring migratory period for White-throated Sparrows is April 23 ±4 days, to May 19 ±4.5 days, or a period of 27 ±8.5 days.

14. It was impossible to determine average first capture dates in the fall for White-throated Sparrows since migration usually begins before traps are opened. The average date of last capture in the fall for this species was found to be between October 27 and 28 ±7 days. First banding records at this station range from September 16 to 30. Using September 23 as a median date, fall migration lasts a minimum of 35 days.

15. It was impossible to determine exact beginning dates for spring migrations or closing dates of corresponding fall periods for Slate-colored Juncos. Migration usually begins in the spring before traps are opened. The minimum date for first records at this station is approximately April 9. The average date for last records in the spring is approximately April 30. The minimum spring period is there-

fore 21 days.

6. The termination of fall migration is not well defined for Slate-colored Juncos since a few are taken as long as traps are open in the winter. These birds evidently winter in this region. Migration begins at about October 1 and appears to be over at approximately November 20. Thus the period of fall migration is about 50 days.

17. In general fall migration covers a greater period of days and is less regular than the corresponding spring period. This is true for both Slate-colored Juncos and White-throated Sparrows.

STUDY OF BAIT PREFERENCES

Method of Procedure

A bait study experiment was set up in 1927 and 1928 under Professor Stack's guidance and conducted by L.C. Stegeman, now affiliated with the Roosevelt Wildlife Experiment Station at Syracuse, New York. The object of this experiment was to study the food habits of birds caught with relation to habitat.

Two batteries of eight traps each were placed in different habitats. Habitat I was located in an open field about mid-way along, and adjacent to, the south side of a fence enclosing a beech-maple woodlot, known as College River Woodlot. Habitat II was placed on the south side of a clump of shrubs in an otherwise open field just south of the aforementioned woodlot. The two habitats were approximately ninty feet apart. Traps were placed side by side, six feet from one another in each habitat and the traps of each battery were placed to face in the same direction. Each trap was supplied with a different bait, although the same ones were used in both batteries. The baits were millet, wheat, hemp, cracked corn, buckwheat, sunflower seed, and suet. The traps of both habitats were operated for the same period of time, from September 26, 1927 to April 17, 1928. The birds caught, therefore, were mainly fall migrants and winter residents, with a few early spring migrants.

Statement of Results

In Habitat I 181 birds, representing 13 species, were caught a total of 563 times. In Habitat II 224 birds, 16 species, were captured 505 times. The average number of catches per individual in Habitat I was 3.11 and the average in Habitat II was 2.25. This difference was not considered to be significant but probably was due to chance. The samples were too small for statistical comparison.

Species caught in Habitat II and not in Habitat I were the Olive-backed Thrush, Brown Thrasher, Hermit Thrush, and Mourning Dove. All species with the exception of Downy Woodpeckers were caught in Habitat II.

The following were caught in both habitats: 2 (7%) Tree Sparrows, 4 (21%) Towhees, 8 (40%) Juncos, 2 (28%) Nuthatches, 2 (40%) Tufted Titmice, 2 (28%) Cardinals, and 1 (33%) Blue Jays.

It is interesting to note that of 32 White-throated Sparrows that were caught 87 times, not a single individual was caught in both habitats. This suggests that even though large numbers of this species may be in a locality, the number of catches may be very small. It has been noticed that during the earlier part of a White-throated Sparrow's migration period, sight records may be numerous and still catches be very infrequent, even though the traps are located in an area where later they are seen and caught in large numbers. These evidences seem to indicate that movements during migrations in search of food are limited to small areas and that stop-overs

are more for short periods of rest.

It was found that the variations which occurred in the number of catches with different baits could not have arisen due to chance alone. In other words definite preferences are shown for certain baits. The following preferences were determined: (Tables XIII to XXIII)

1. a. In Habitat I Song Sparrows showed a significant preference for millet over the bait with the second most catches, buckwheat.
   a. In Habitat II Song Sparrows did not show a significant preference between any of the baits.
2. a. In Habitat I Juncos showed a significant preference for millet over the bait with the second most catches, hemp.
   b. In Habitat II Juncos did not show a significant preference.
3. In Habitat I and Habitat II Chickadees showed a significant preference for sunflower seed over the bait with the second most catches, suet.
4. a. In Habitat I Tree Sparrows showed a significant preference for millet over the bait with the second most catches, hemp.
   b. In Habitat II Tree Sparrows showed a significant preference for millet over the bait with the second most catches, corn.

5. In Habitat I Quail did not show a significant preferemce at the five percent level. In other words, the difference between first and second choices would be due to chance once in twenty times. At the seven percent level however they did show a significant preference for hemp over the bait with the second most catches, wheat. In Habitat II the number of catches was not large enough to make a statistical analysis.

6. In both habitats Towhees did not show a signi- preference.

It is somewhat difficult to understand why any species would show a preference for a particular bait in one habitat and not in the other. It seems improbable that the two habitats were dissimilar enough to produce this result even though the differance was shown to be significant statistically. What is probably more important is the preferences for bait shown in Tables XXIV and XXV. These show a significant liking on the part of the six species caught in largest numbers in both habitats for millet, with hemp as their second choice.

One of the most interesting things shown by this study is the preference for suet and sunflower seed by the Chickadee, a bird that is caught mainly during the winter months as contrasted with the other birds which are caught mainly during the warmer periods of the year. This would indicate a need for a heat producing diet. The correlation of a preference with the need has, to the knowledge of the author, never been

proven. The possibility of using this approach to the solution of problems concerning physiological needs might well be further investigated.

NUMBERS OF CATCHES CHARTED BY SPECIES AND BAITS

Table XI, (Habitat I)

SPECIES	C	M	H	B	W	SF	S	A	TOTAL	NO.BIRDS
1	1	22	4	5	0	2	0	0	34	10
2	10	92	56	22	2	6	10	4	202	66
3	1	1	6	1	0	22	10	0	41	15
4	3	53	0	15	6	2	1	0	80	30
5	9	44	14	3	1	6	1	1	70	16
6	2	2	19	6	9	0	0	0	38	9
7	11	0	1	13	2	3	2	1	33	13
8	1	0	2	0	0	12	14	0	29	5
9	0	0	2	0	0	6	3	0	11	5
10	0	3	1	2	1	0	0	0	7	6
11	0	0	0	0	0	1	0	0	1	1
12	0	0	2	1	0	1	1	1	6	3
13	0	0	0	0	0	1	1	0	2	2
	38	217	107	68	221	62	43	7	563	181

Table XII, (Habitat II)

SPECIES	C	M	H	B	W	SF	S	A	TOTAL	NO.BIRDS
1	15	17	14	14	3	8	1	2	74	21
2	34	47	38	38	20	9	2	3	192	112
3	2	1	1	1	1	37	4	0	47	13
4	0	3	2	0	1	0	1	0	7	2
5	15	48	12	7	5	6	1	0	94	22
6	1	2	11	2	2	1	1	0	20	10
7	13	0	5	4	3	0	0	0	25	10
8	2	0	2	0	0	2	1	0	7	4
9	0	0	0	0	0	2	3	0	5	2
10	0	0	4	0	0	0	0	0	4	4
11	1	0	0	0	2	3	0	0	6	3
12	1	1	4	0	0	1	0	0	7	6
13	1	0	0	1	0	0	0	0	2	2
14	0	0	0	0	0	0	1	1	2	2
15	1	1	0	0	0	6	0	1	9	8
16	0	0	1	0	3	0	0	0	4	3
	86	120	94	68	40	75	15	7	505	224

LEGEND

SPECIES

1. Song Sparrow
2. Junco
3. Chickadee
4. White-throated Sparrow
5. Tree Sparrow
6. Quail
7. Towhee
8. White-breasted Nuthatch
9. Tufted Titmouse
10. Fox Sparrow
11. Blue Jay
12. Cardinal
13. Downy Woodpecker
14. Olive-Backed Thrush
15. Brown Thrasher
16. Hermit Thrush
17. Mourning Dove

BAITS

C. Corn
H. Hemp
M. Millet
B. Buckwheat
S. Suet
A. Apple
SF. Sunflower seed

TESTS FOR SIGNIFICANCE BETWEEN FIRST AND SECOND MOST POPULAR BAITS BY SPECIES

Table XIII, Song Sparrow (Habitat I)

	M	B
Observed	22	5
Expected	13.5	13.5
Deviation	7.5	7.5
x^2	8.34	

Table XIV, Song Sparrow (Habitat II)

	M	C
Observed	17	15
Expected	16	16
Deviation	1	1
x^2	0.12	

Table XX, Slate Colored Junco (Habitat I)

	M	H
Observed	92	56
Expected	74	74
Deviation	18	18
x^2	8.8	

Table XVI, Slate-Colored Junco (Habitat II)

	M	B
Observed	47	38
Expected	42.5	42.5
Deviation	4.5	4.5
x^2	0.94	

Table XVII, Chickadee (Habitat I)

	SF	S
Observed	22	10
Expected	16	16
Deviation	6	6
x^2	4.5	

Table XVIII, Chickadee (Habitat II)

	SF	S
Observed	37	4
Expected	20.5	20.5
Deviation	16.5	16.5
x^2	26.4	

Table XIX, Tree Sparrow (Habitat I)

	M	H
Observed	44	14
Expected	29	29
Deviation	15	15
x^2	15.4	

Table XX, Tree Sparrow (Habitat II)

	M	C
Observed	48	15
Expected	31.5	31.5
Deviation	16.5	16.5
x^2	17.2	

Table XXI, Quail (Habitat I)

	H	W
Observed	19.9	9
Expected	14	14
Deviation	5	5
x^2	3.6	

Insufficient number of Quail caught in Habitat Two for statistical analysis.

Table XXII, Towhee (Habitat I)

	B	C
Observed	5	13
Expected	9	9
Deviation	4	4
x^2	3.54	

Table XXIII, Towhee (Habitat II)

	H	C
Observed	13	11
Expected	12	12
Deviation	1	1
x^2	0.16	

Legend: Baits, H, hemp; M, millet; C, corn; W, wheat; B, buckwheat; SF, sunflower seed; S, suet.
x^2, Chi Square.[5]

TESTS FOR SIGNIFICANCE BETWEEN FIRST AND SECOND MOST POPULAR BAITS FOR SIX SPECIES

Table XXIV, All Six Species (Habitat I)

	M	H
Observed	214	100
Expected	157	157
Deviation	57	57
x^2	41.4	

Table XXV, All Six Species (Habitat II)

	M	H
Observed	118	83
Expected	100.5	100.5
Deviation	17.5	17.5
x^2	6.1	

Legend: Baits, H, hemp; M, millet; C, corn; W, wheat; B, buckwheat; SF, sunflower seed; S, suet.
x^2, Chi Square.[5]

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