The food habits of the species are of interest in that a larger number of minute organisms such as ostracods, copepods and diatoms, are taken, than by most ducks, a result, no doubt, of more thorough sifting of the bottom ooze.

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THE SONG OF THE FIELD SPARROW.

BY ARETAS A. SAUNDERS.

THE song of the Field Sparrow (*Spizella pusilla*) is one which can be studied comparatively easily. The abundance of the species in most parts of its breeding range; the length of the song period; the freedom with which the species sings, the individual repeating its song at short intervals; the clearness of quality, which makes the pitch of the notes easily determined; and the shortness and general simplicity of the song, all are factors which help to bring this about.

The more one studies bird song, the more one attempts to make accurate records of songs, the more he becomes impressed with the fact that in almost all species there is great individual variation. Such variation is the rule, not the exception. Because of this it is difficult to make definite general statements concerning the character of the song of any species. Any such statement must be qualified by the fact that there are often individuals that sing a song entirely different in one or more respects from all others of that species.

The general characteristics of the song of the Field Sparrow, covering the five main factors of variation in bird song, are as follows.

1. Time. The Field Sparrow song is of short duration. The average length of the song, based on the one hundred and forty-nine records I now have, is 2.7 seconds. The longest song of all is 4.6 seconds, and the shortest 1.6 seconds. It is rare to find songs that are longer than 3.2 seconds or shorter than 2.4 seconds. One specific time character, that holds in practically all songs, is

acceleration. The introductory notes are the longest and the terminal notes the shortest of the song, the latter often so rapidly repeated that they cannot be counted and must be recorded as a trill. It seems to me that the trilled notes of Field Sparrow songs are of this character, rather than a trill produced by the repetition of a consonant sound. (Auk, XXXII, p. 174.)

II. Pitch. The pitch of a single song of the Field Sparrow never varies greatly. The amount of variation may be none at at all, or as much as four tones, but songs with a variation of more than two or two and a half tones are rare. The range of pitch for the species as shown by the same one hundred and forty-nine records is exactly one octave, from D'''' to D'''. The great majority of songs range between C'''' and F'''. The greatest range of any single song is four tones, from C'''' to E'''. The variation in pitch of most songs grades evenly up or down the scale. Sudden changes in pitch of more than two tones are rare. The greatest changes in pitch are to be found in slurred notes at the beginning of certain songs.

III. Quality. The quality of the Field Sparrow song is that of a clear sweet whistle. There is no variation in quality noticeable in different parts of the same song, and very little between the songs of different individuals. It is the sweetness of quality that makes the song of this bird so pleasing. In other respects the song is quite simple, and does not show characters that would class the bird among the best singers. I have only one record of a song that varied enough from the usual sweetness of quality to make note of the fact. This song, number 23 in the illustrations, was distinct from others in other respects as well as quality. The voice of the bird was about the quality of that of the Redstart, and was not recognizable as that of a Field Sparrow at all. This song, which I shall mention again, is a good example of the occasional freak song that may occur in any species.

IV. Intensity. The general intensity of the song of the Field Sparrow varies but little. As a rule with most bird music, the higher notes carry farther than the lower ones. There are no markedly accented notes in the song, that is, not accented as far as intensity is concerned. Accent seems, by some writers on bird

song, to be treated as a time factor, that is, notes of longer duration are considered accented. From this standpoint many notes in the Field Sparrow song are accented. But I prefer to consider accent entirely a matter of intensity, an accented note being louder than others, not longer. From this standpoint accent is very slight or unknown in Field Sparrow songs.

I have measured the intensity of only one or two songs. Song number 9 in the illustrations was completely audible from a distance of three hundred and forty feet, on a day when the wind was not blowing. The highest part, the high part of the long trill, was audible from three hundred and eighty feet, under the same conditions. This was on a level, with few trees or other obstructions between my position and that of the bird. Figuring that the intensity of sound varies inversely as the square of the distance from its source, this would make the intensity of the lower notes of this song practically four-fifths of that of the higher notes. Another song, number 2 in the illustrations, was audible from about two hundred and eighty feet, but conditions for determining this were not so good in this case, so that the measure is less reliable.

V. Pronunciation. The song of this species is usually without consonant sounds of any sort. In fact I have not certainly heard such sounds in any song. Certain songs, such as number 10 in the illustrations, having notes with a slight upward slur in them, sound from a distance as tho these notes were not variable in pitch, but were introduced by a sound like the consonant w. That is, the slight slur makes the notes sound like "wee wee wee" instead of "eee eee eee," as they would sound if not slurred.

Having considered the general song of the species as a whole, the next point to consider is variation. Variation may be individual, local, or geographical. My records of the song of this species which are made by the graphic method[1] are all from southern New York and Connecticut, and do not show any geographical variation, and only slight local variation. While I have heard the song in other states I have made no records for definite comparison. I

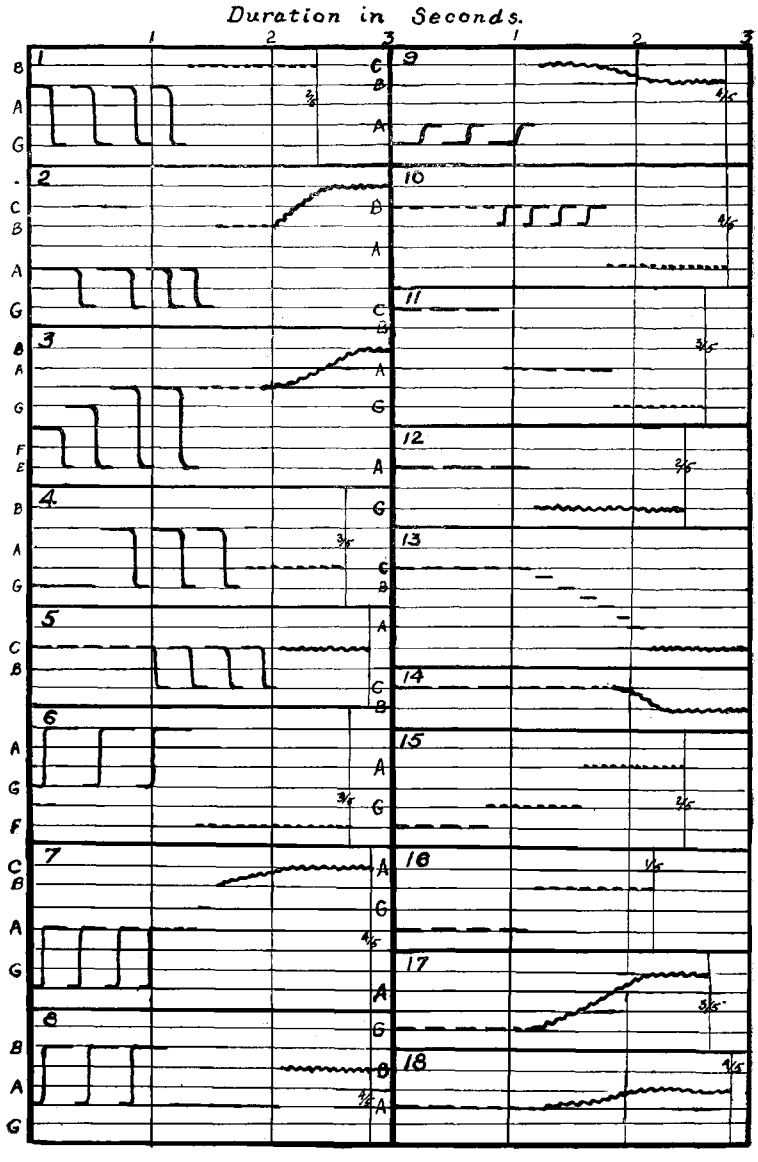
[1] 'Auk' XXXII, pp. 173 – 183.

have no notes or memory of any marked difference between the song in other regions, and that in the region where I have made my records.

Individual variation may be divided into two main kinds. These are variation between the songs of different individuals, and variation in the song of a single individual. The first sort is very common and apparent in the Field Sparrow. Its study is the most interesting part of the study of the song of this species. My records show great variation. Looking them over, there are many that show distinct relationship to each other, and a few that are almost exactly alike. I have divided these songs into seven types. I find that most of my records are easily classed in one of these types, in fact only two of those that are normal songs are not classifiable.

A good many Field Sparrow songs contain slurred notes, most commonly the introductory notes of the song. There are two kinds of slurs, those slurred downward in pitch and those slurred upward. These then are the first two types. Type I, songs numbered 1 to 5 in the illustrations, are those containing notes slurred downward in pitch. Type II, songs are those containing notes slurred upward in pitch, numbers 6 to 10 in the illustrations. The remaining five types are without slurred notes and are as follows: type III, songs descending in pitch toward the termination, such as numbers 11 to 14; type IV, songs ascending in pitch toward the termination, such as numbers 15 to 18; type V, songs first descending, then ascending in pitch, such as numbers 19 and 20; type VI, songs ascending and then descending, such as number 21; and type VII, songs all on one note, without any change in pitch, such as numbers 22 and 23.

Type I is the commonest type of song, at least in the region covered by my observations. Thirty-eight of my records belong to this type, making 26.2% of the one-hundred and forty-five records which I consider normal songs. This type is most commonly introduced by the slurred notes, followed by faster notes or a trill on a higher pitch. Such a song is well illustrated in number 1, which is fairly representative of twenty-one of my records. Song number 2 is distinctive in that the slurred notes are very

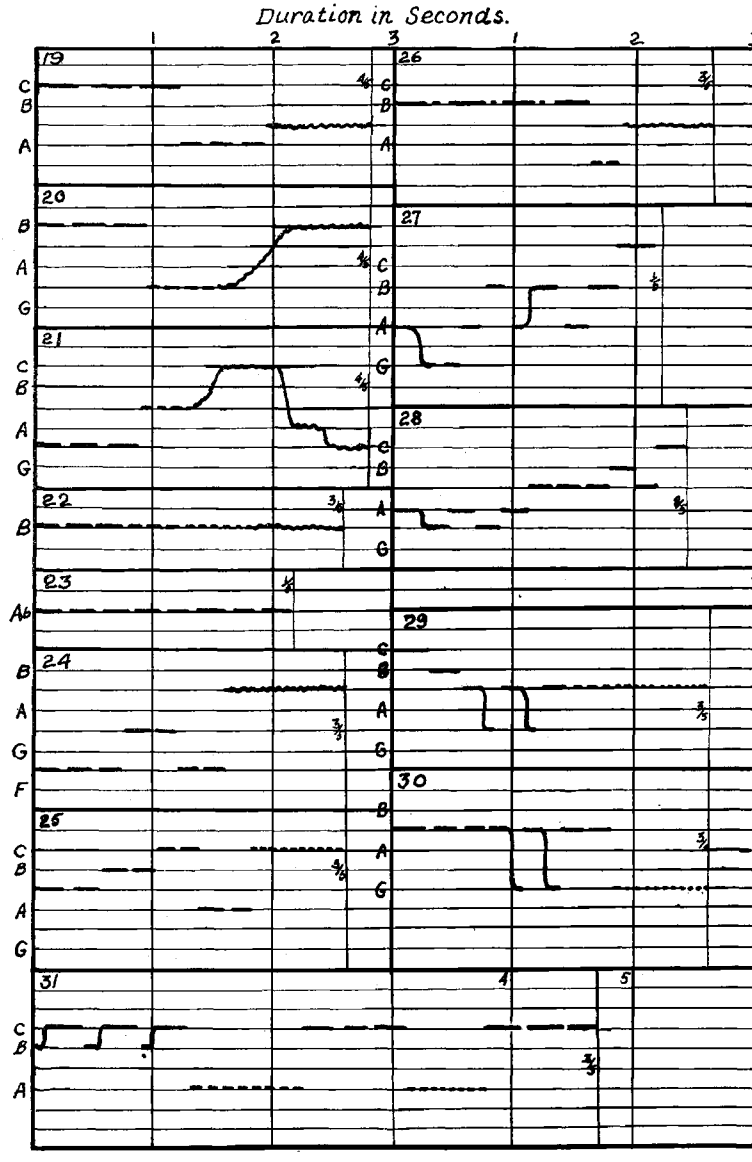


SONGS OF THE FIELD SPARROW.
TYPES I, II, III AND IV.

slow at first, and markedly accelerated as the song continues. I have three such records. Number 3 shows still a different variation, with the slurs ascending in pitch. I have three songs of this sort in my records. Number 4 is typical of four songs, introduced by a single long note, followed by the slurs. Number five is typical of four others where the slurred notes are in the middle of the song, instead of at the beginning. Three other songs of this type are essentially like number 1, but differ in that the termination is lower in pitch than the slurs, rather than higher.

Type II is also a common one, being represented in my records by thirty-one songs, or 21.4%. These songs are most commonly like numbers 6, 7 or 8 in form. Ten are like number 6 with the terminal portion lower in pitch than the introductory slurs. Six are like number 7, with the terminal trill higher. No less than thirteen are like number 8, the song divisible into three parts, first high pitched slurs, then low pitched single notes, then a terminal trill of medium pitch. This form of song is so distinctive that it might be classed as a separate type. It is commonly quite rhythmic in character, and in the great majority of cases the first and second parts are of three notes each. Dr. Winsor M. Tyler has sent me descriptions of several Field Sparrow songs from Lexington, Mass. One of these is obviously this form of type II song. Song number 9 is distinct and without a second counterpart among my records. While it might be classed with number 7, its great distinction lies in the fact that the first note of the slur is the longer one, rather, than the second. Song number 10 is also the only one of its kind I have recorded, but Dr. Tyler has sent me a description of a similar one from Lexington. A third song he has sent me is also type II, but unlike any in my records. It begins with four slurs, the second, third and fourth each lower in pitch than the preceding one; and ends with a series of rapid notes on the same pitch as the first slur. In a way it is the opposite of a type I song, such as number 3.

Type III is nearly as common as type II. I have thirty records, making 20.7%. Number 11 represents a descending song broken into three distinct parts. I have three such songs. Number 12, broken into two distinct parts, is common and I have seven such



SONGS OF THE FIELD SPARROW

TYPES V, VI AND VII, AND VARIABLE SONGS.

records. But the commonest of type III songs is represented in number 13, where the descent in pitch is gradual. I have fourteen such records. Number 14 is one with a change in pitch of only half a tone. I have six such records. They are interesting in that they grade toward the type VII song. In fact from a distance I have sometimes thought them type VII, and have always made a point not to record songs of such type unless I can hear them closely and distinctly. A recorder without a good musical ear would probably consider them type VII.

Type IV shows practically the same four variations as type III in exactly the reverse. I have twenty-six type IV songs, or 17.9%. Five are similar to number 15, seven to number 16, eleven to number 17, and three to number 18, a song with so slight a change in pitch that it shows intergradation between this type and type VII, and is easily mistaken for the latter. Song number 15 is in a way unusual. It is one of the most perfectly rhythmic Field Sparrow songs I have recorded, being in three parts exactly equal in time, according to the stop watch, and with four notes in the first part, eight in the second and twelve in the third.

Type V is rarer than the preceding types. I have only eight such songs making 5.5%. Five of these songs are similar to number 19 but the other three are rather irregular and more similar to number 20. The songs like number 19 show a strong relationship to type II songs such as number 8. In fact they are the same, save that the first notes are not slurred.

Type VI is a rare one. I rather hesitated about including it as a type, for the three songs I have are irregular and not much alike save in a general way. They are only 2.1% of the whole. Number 21 is an example, a unique song, but as representative as any of the type. The bird that sang this song occasionally dropped off the terminal trill, leaving nothing but a simple type IV song, so that possibly the evolution of such a song was from type IV.

Type VII is represented by seven records or 4.8%. I also have one record of this type from Mr. Tyler. Six of my seven records are like number 22, differing from each other only in pitch and in length. The seventh, number 23, is unique in two respects,

and to be regarded as a freak song. It shows none of the acceleration, which seems to be a general characteristic of Field Sparrow songs, and, as I have already mentioned, its quality was not that of the usual Field Sparrow song, so that when I first heard it I thought it some warbler with which I was not familiar, and was much surprised when I identified it. This bird was found in Norwalk in May 1917, and again in the same place in May 1918, but in 1919 it was not found.

Unusual songs, not belonging to any type, are represented in numbers 24 and 25. These are the only normal songs I have that are not classifiable in one of the seven types. Dr. Tyler, who has described only songs that seemed to him unusual, describes one beginning with four notes alternating on two different pitches followed by a descending trill. In general it is like a type III song, but differs enough at the beginning to be not classifiable. My own records that do not belong to any type are 1.4% of my normal records.

The next point to consider is variation within the individual. This variation consists of three kinds. First, slight variation of a single song; second, possession of two or more distinct normal songs; third, certain peculiar seasonal variations that are evidently abnormal. The first of these is a common form of variation, tho apparently not found in all individuals. It may be often observed by watching and listening to a single bird for a short period of time. The bird may vary its song by changing the number of introductory notes or slurs, by slightly varying the pitch of the terminal notes, by cutting the length of the terminal trill short, or in type I and II songs by substituting one or more single notes for slurs. Thus I have recorded from a single bird in the course of half an hour seven songs that were all slightly different, yet all of the same type and same general characteristics. Some individuals, however, never show any such variation, but sing their song over and over exactly the same. This was true of the bird singing the distinctive song, number 9. The bird was observed singing in the same place on many different days for more than a month, but there was never the slightest change in the song in form, pitch or time.

The second sort of variation, the possession of two or more

distinct songs by a single individual, seems to be a rare phenomenon in the Field Sparrow. I have only one case on record, that of a single bird that I observed in the same place several different days singing first a type I song, than after a short time changing to a type II. The type I song was distinctly lower in pitch than the type II. Once the bird sang the two songs consecutively, without a pause between them, first the type II song, followed immediately by the type I. In the spring and summer of 1920, I had some forty different individual Field Sparrows under more or less constant observation from day to day. Yet this was the only case where a bird was found to possess two different types of song, a strong contrast to the Song Sparrow, each normal individual of which has several different songs. I have one case on record of a Song Sparrow with twenty-four totally different songs. Such variation is so obvious in that species, that it seems as if more of it would show in the Field Sparrow if possessed in any marked degree.

The last kind of individual variation is a peculiar sort that seems to be common to a number of different species of birds. As late summer approaches and the period of song draws near its close, with the approach of the postnuptial moult, birds begin to vary their songs in many peculiar ways. The songs numbered 26, 27, 28, and 31 are examples of peculiarities of this sort. At this time all general rules for the song of the species seem to be broken, and in Field Sparrows, songs are decidedly irregular in both pitch and time characters, though they are usually of the same sweet quality as before. Intensity is also sometimes varied, and the songs become soft and inaudible from any great distance. For this sort of variation I propose the term postnuptial variation, because it comes with the approach of the postnuptial moult, at the season when nesting duties are completed.

One might suspect that these peculiar songs are those of young birds of the year, just learning to sing. In order to be sure of this point I have carefully examined several birds singing such songs, and always found them adults without any sign of the streaked breast which young would have at this time. When one considers the physiological cause of bird song, it would seem

impossible that any young bird would sing in the year it is born, or, at any rate, before the post-juvenal molt.

The examples of postnuptial variation I have given are the only ones I have on record, though I have often heard others. They are heard less frequently than normal songs and are therefore less easily recorded. Number 26 is believed to be from the same bird that sang song number 8 as its normal one. It was in the same locality, and there are similarities in pitch and arrangement of the two songs, tho not so much so in time. Numbers 27 and 28 are two from another bird, and a bird who normally sang a type I song very similar to song number 1. The bird was heard singing the normal song, and both these variations, together with some others I was unable to record, on July 25, 1920, about a week before the song period of this species began to show signs of diminishing. Number 31 is a song from a bird I could not identify with any whose normal songs were on record, though I should suspect that its normal song was type II. It is the longest Field Sparrow song I have on record.

The Song period of the Field Sparrow, in Connecticut at least, begins with the arrival of the birds in spring, about the first of April, and lasts till August. The average date of first song heard in eleven years' records is March 26. The earliest date is March 12, 1921. This date and two others, March 14, 1902, and March 13, 1915, are probably those of birds that had wintered in the vicinity. The latest date for the beginning of song is April 16, 1916, a year in which the species arrived April 2, but was not heard singing till later. Dates when the song period ceases are more difficult to obtain. Summers have frequently been spent in other localities, out of the range of the Field Sparrow, and in early years no summer records were kept. The average date of the last song heard in five years' observations is August 18, the earliest being August 7, 1920, and the latest August 26, 1918. One still later date, that I did not average in with others because from a different locality, is September 2, 1907, at Milford, Pike County, Pennsylvania.

There is no regular period of song in the fall for this species. Whether occasional birds sing at this season I am not sure. Trust-

ing memory I should say that I had heard the song in the fall, but my notes covering ten years in which I was in the range of this species at this season, do not mention a single instance. During these years I kept daily records of birds heard singing. I have frequent notes on the fall singing of many other species, so I feel justified in stating that fall singing on the part of the Field Sparrow is a rare occurrence.

While these notes pertain to the song period of the species, the period for the individual is quite another matter. Those who have tried going out in the height of the migration in May, to see how many species could be recorded in a single day, have probably noted that few Field Sparrows are in song at that season, though they were singing abundantly a week or so before. I have noted this fact for a number of years, and sometimes found it difficult to find Field Sparrows in the third week in May, simply because so few of them were singing. But it was not until this year that I realized that many individual Field Sparrows are silent for much longer periods than a week, even right in the midst of the song period.

My notes are insufficient at the present time to report as fully as I should like upon this phenomenon. In general, the facts seem to be, that the majority of birds cease singing about the middle of May, and that a good many individuals do not resume again for a month or more. When they do, it may be to sing for only a few days when they cease again for the remainder of the season, or it may be to sing regularly from then until August. I can only guess at the cause of these phenomena. I believe that a successfully mated male bird ceases to sing as soon as incubation of the eggs begins, and that he does not sing again until the young have left the nest, and it is time to start a second brood. The few birds singing in mid-May are then, either birds that are unmated, or birds that have not started to nest at the normal time for the species. Those that resume singing in late May are those whose nests were broken up for some reason. The resumption of song in late June comes when the first brood is out of the nest and the second brood is beginning. Those birds who do not mate successfully for a second brood continue singing for the rest of

the song period. If these are the facts, it is a strong proof that song, in this species, not only originated by sexual selection, but is still mainly useful to obtain a mate. I hope for the opportunity to continue study on this problem, and to be able to make more positive statements later.

One more fact remains to be mentioned concerning the song of this species, a fact that produces some difficulty in tracing individuals, but is otherwise of considerable interest. It is not uncommon to find birds that are near neighbors singing exactly or approximately the same song. I have never found more than two such birds in a locality but it is possible that three or more may occur. I first noticed this fact at West Haven in 1915, when two birds, with a type III song similar to number 13 in the illustrations, sang the song exactly alike as clearly as my ear could distinguish. The birds alternated with each other from points about seventy-five yards apart. I have since found two other cases of type III songs that were alike, and one of type IV. Other types are not so simple and seem less likely to be exactly alike. I have found both type I and II songs sung by two birds in hearing of each other, the songs similar, but not quite alike. In one locality were two type I singers with songs both showing the peculiarities of number 2 in the illustrations, the songs only slightly different from each other. In another case two birds sang type II songs similar to number 8. Numbers 29 and 30 in the illustrations are introduced to show another case of this sort. The resemblance between these songs was more marked than the records show, for while the number 29 song was usually as it is recorded, the bird occasionally, varied it by dropping the final trill to G, exactly as number 30 sang it. These observations show that it is not always possible to be sure of an individual because of the peculiarities of its song alone, but careful observation throughout the season will generally show whether there are in the same locality, two or more individuals having the same type of song.

This phenomenon may be considered support for the theory that individual birds learn to sing by imitating other individuals. If young birds learn to sing from listening to parents, then two birds singing similar songs may be related by blood, either parent

and offspring or both offspring of the same male parent. Possibly they are not related, but sing alike because the younger bird learned its song from the older, or both learned to sing from the same individual.

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THE BREEDING HABITS OF THE NORTHERN RAVEN IN PENNSYLVANIA

BY RICHARD C. HARLOW.

BORDERING on extinction as a Pennsylvania bird, a few widely scattered pairs of Northern Ravens still exist in the mountains of Snyder, Mifflin, Center, Blair, Clinton, Union, Juniata, Lycoming and Huntingdon Counties (definite breeding records.) It is highly probable that a few still linger in the wildest sections of Luzerne, Columbia, Montour, Northumberland, Wyoming, Sullivan, Bedford and Fulton Counties. I have obtained reliable information of the breeding of these birds in Wyoming and Sullivan Counties during the last ten years and have seen birds taken there, while on April 18, 1919, I saw an adult bird with food in its beak and closely pursued by Crows in Luzerne County. It is probable that there are more pairs left in Center County than elsewhere within the state with Huntingdon, Mifflin and Clinton Counties following closely.

As late as 1900 it was still a fairly common breeding bird in many of the counties named but the decrease during the last ten years has been very marked and unless rigid steps are taken for its preservation, it will be but a very few years before it follows the Wild Pigeon into the list of extinct Pennsylvania species.

The Raven is naturally a very shy species and will not stand the encroachment of civilization and in a number of instances I have known them to leave nests which had been used for generations, as soon as heavy lumbering took place in close proximity to them. In 1917 out of five previously used nests, only one