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HABITAT DISTRIBUTION AND SURVIVAL IN THE FIELD SPARROW (*SPIZELLA PUSILLA*)

By STEVE FRETWELL

INTRODUCTION

In an earlier paper on the role of territorial behavior in Field Sparrows (Fretwell, ms, b), I found that the nesting success in a densely occupied habitat appeared to be lower than in a sparsely settled area. This implied that many individuals selected an overcrowded habitat to breed. Two explanations seemed plausible: firstly, the birds could be maladapted, and were unable to distribute properly (see Fretwell, ms, a). This explanation seemed reasonable because the habitats studied were pine plantations, habitats to which Field Sparrow populations can not have been long exposed. In developing an alternate explanation, however, it was noted that in 1964-1965 Field Sparrows wintered in the densely occupied habitat (#1) but not in the sparsely occupied one (#2). It was then proposed that breeding in the winter habitat provided an overwinter survival advantage which compensated for the lower nesting success. A study of Wynne-Edwards' ideas (1962) suggested a mechanism involving social behavior by which winter survival could be related to breeding habitat residence. In particular, it was hypothesized that dominance status was a key factor in winter survival, and that the added experience of breeding in the winter habitat increased the winter dominance status of individuals.

The way in which dominance may affect survival is not specified in this hypothesis, yet it is of fundamental concern. Thus, some general consideration of annual survival is needed. The observation was made that Field Sparrows did not "fill up" all available breeding habitats. This suggested that the species population was limited by some resource during the winter season. Lack (1954, 1966) has argued convincingly that food supply is a major factor limiting many bird populations. Thus, it seems reasonable to hypothesize further that the Field Sparrow population is limited by winter food supply, and that the exploitation of this resource is regulated by dominance.

The complete hypothesis to be tested then is:

(1) Field Sparrow populations are limited by winter food supply: some individuals fail to survive because of a shortage of available food.

(2) The exploitation of winter food is controlled by dominance status; dominant birds get more food.

(3) Dominance status in the winter flock is affected by breeding experience; birds which breed in the winter habitats have a higher winter dominance status.

Many aspects of this hypothesis could not be examined in the Field Sparrow which does not lend itself readily to direct dominance studies. Dominance studies have been conducted on the Junco (*Junco hyemalis*), however, by Sabine (1949, 1955, 1956, 1959) and Fretwell (ms, c). Sabine stressed the sociological mechanisms involved in dominance hierarchies in this species, while my previous studies demonstrated that dominance status regulated winter feeding and survival. Sabine (1955) also showed that winter dominance status and breeding residence were related in the Junco in the way presently hypothesized for the Field Sparrow. Thus, the major parts of the hypothesis have been verified for the Junco, a species which, in the winter at least, shows many similarities to the Field Sparrow.

Nevertheless, we need to examine this hypothesis in the Field Sparrow to be sure that the species is not different from the Junco. Because the dominance behavior of the Field Sparrow, although present, is difficult to study, we cannot duplicate that aspect of the Junco work on this species. Verification must employ other pertinent aspects of the species' biology.

The objective of this paper is to first validate the initial observations on the relationship between the habitat density and breeding success. After establishing this, I will then consider some predictions of the hypothesis that can be tested in the Field Sparrow.

HABITAT VARIATION IN BREEDING BIOLOGY

In order to verify the 1964 observations on habitat differences in nesting success, breeding Field Sparrow studies were continued in 1965 and 1966.

Procedure

The 1964 study is described in Fretwell (ms, b).

The 1965 study utilized the same habitats studied in 1964 and largely replicated the pertinent observations made in that year. Density was again determined by spot mapping of males, but in this year territorial males were identified before breeding actually began. Nest success was again estimated, using Mayfield's (1961) estimating approach. Only May nests were included in 1965 however. Clutch size and hatching success estimates were also restricted to May samples.

In 1966 two new fields were studied as well as one of those studied in 1964 and 1965 (#2). One of these new fields (#3) consisted of approximately 10 acres (4.05 ha) and was largely covered by broomsedge (*Andropogon virginicus*) (ca. 70 percent) and wild rose-blackberry tangles. A creek bordered by 10-20 foot deciduous trees ran through the field. This field was evidently ideal wintering habitat, because of its abundance of broomsedge and cover (Quay, 1940).

The other new field (#4) consisted of about 25 acres (10.1 ha), and was largely covered by mixed herbaceous vegetation, wild rose and blackberry tangles, small cedars, and small deciduous scrub growth. Broomsedge covered less than 20 percent of the total area. This habitat was known to be occasionally occupied by Field Sparrows in winter, but also often unoccupied, especially in hard weather. Habitat #2 was still altogether unsuitable for wintering Field Sparrows.

In 1966, male density, clutch size of early broods, brood size of early broods, nest success, and early production of fledgings were observed. These measurements were made in all three habitats. In this year, nest success was estimated as the percent of nests found in construction which later fledged young. This estimate is considerably easier to make than Mayfield's (only three visits to the nests are necessary), and has fewer theoretical objections, but wastes data (nests found after the first egg has been laid are not considered). It was used in 1966 in order to provide a check on the previous year's comparisons.

The behavioral observations on most pairs were complete enough in 1966 that I was able to state which had successfully fledged young and which had not, despite the fact that some successful, and many unsuccessful nests were never found. The biggest bias in this estimate comes from young which fledge but do not survive the first 48 hours. Each of the fields was carefully examined every three or four days, but such young may fledge and disappear between visits. Therefore, the estimates may underestimate actual values. The study was terminated on June 29:

TABLE 1. HABITAT DIFFERENCES IN BREEDING BIOLOGY OF FIELD SPARROWS

Winter suitability		Null		Low		High	
1964	density	10.1 ha	138.4♂♂/100 ha			5.74 ha	397.8♂♂/100 ha
	nest mort.	172 nd[1]	.029 failures/nd			333 nd	.073 failures/nd
	clutch size	10 n(ests)	3.56 eggs/n			17 n	3.43 eggs/n
	egg mort.	10 n	0.0 failing eggs/n			17 n	.7 failing eggs/n
1965	density	14.2 ha	170.5♂♂/100 ha			5.74 ha	397.8♂♂/100 ha
	nest mort.	109 nd	.028 failures/nd			160 nd	.056 failures/nd
	clutch size	8 n	3.88 eggs/n			11 n	3.35 eggs/n
	egg mort.	5 n	.2 failing eggs/n			7 n	.28 failing eggs/n
(May only)	fledging wt.	5 n	9.9 gm/yng			5 n	9.6 gm/yng
1966	density	16.2 ha	74.1♂♂/100 ha	10.1 ha	217.5♂♂/100 ha	4.05 ha	321.2♂♂/100 ha
	nest mort.	15 n	.67 failures/n	17 n	.70 failures/n	10 n	.80 failures/n
	clutch size*	8 n	3.88 eggs/n	12 n	3.92 eggs/n	8 n	3.12 eggs/n
(May-June)	brood size**	5 n	3.5 yng/n	5 n	3.2 yng/n	4 n	3.0 yng/n
	broods/pair	9 pairs	.89 broods/pair	19.5 pairs	.54 broods/pair	12.5 pairs	.44 broods/pair

*first nestings — **successful nestings — [1]nd is nest days the number of successful nestings per pair was estimated up to that date.

Statistical tests were run within years on several of the measurements, but closest attention was given to consistency in trends between years. As in the 1964 study, rates and proportions were treated as if they arose from a binomial population. All means (including proportions) were assumed to be normally distributed and habitats compared in analysis of variance.

In 1966, two males sang in one habitat while their mates nested in another. Density figures assumed the male to be a resident of his singing habitat, but nests were assigned to the habitat in which they were found. In calculating broods per pair, one of these pairs was divided between the habitats, the other was considered wholly a part of just one habitat. This was based on the habitat choice of the female, which in one case was divided, in another was not.

Results

The results of the three years' study are given in Table 1. Provided are sample sizes and means. Clearly, the suitable winter habitats are occupied by breeding birds at a higher density. Also there is a correlation between factors affecting birth rate and breeding habitat. Nest survival and clutch size generally decrease with increasing habitat winter suitability. These trends are consistent between years. Combined data on daily nest mortality rates in 1964 and 1965 show a significant difference between habitats #1 and #2 ($t = 2.3$, $p < .01$). Also, clutches were significantly lower in the winter habitat in 1965 ($t = 2.3$, $df = 17$) and again in 1966 ($F = 18.4$, $df = 2,28$).

These results uniformly confirm the 1964 findings, thus satisfying the first objective of this paper. Let us now consider the hypothesis formulated above.

PREDICTIONS OF THE HYPOTHESIS

I. Winter habitat residence

Implicit in the hypothesis is the idea that birds which breed and winter in the same habitat compete in winter with birds that breed in inferior winter habitats. This is probably true if the two groups occupy the same winter habitat for at least part of the winter season. We should note, however, that this is a sufficient but not a necessary condition. The birds which breed outside the wintering habitats might find the cost of migrating to distant wintering grounds less than the cost of a disadvantaged direct competition in nearby wintering grounds. They would be expected to migrate then, and although the competition exists as an ultimate or selective factor that has affected the evolution of the population, it rarely *directly* influences a present individual's survival. However, if the individuals directly interact, then they probably compete, and the effects of the competition should be observable. It is of interest then to consider where members of the different local populations winter.

Procedure and results

In the winter of 1964-1965, Field Sparrows were not found in the low density breeding habitat #2 but were abundant in #1 (ca. 8 birds/acre). That winter 178 different individuals were caught and color banded. Of these, 27 (15 percent) were recaptured breeding the following summer in habitats #1 or #2. The recaptured birds were evidently all males (behavioral sexing of Field Sparrows is sometimes not certain). Of 23 males breeding in #1 that summer, 14 (60 percent) were banded; of 24 males breeding in #2, 13 (54 percent) were banded. Thus, about equal proportions of the breeding males in the two habitats spent some of the winter in the same habitat (#1). Therefore it can be reasonably assumed that they compete with one another for winter resources. This is not necessarily true for females, which evidently migrated. Nor is it necessarily true that all the males from both habitats spent all the winter together.

Discussion

There was evidently a considerable amount of dispersion from field to field in the winter. Although there were not more than 120 birds in habitat #1 at any one time in the winter, 178 were handled over all, and in most of the net samples less than 40 percent of the birds caught were banded. The great amount of movement was probably due in part to netting activities, since baited and trapped populations are quite stable (unpublished observation: also Fretwell, ms, d). This dispersion probably involved mostly first year birds and possibly adult migrants.

These results indicate that habitat #1 males compete with habitat #2 males during at least some of the winter. It also indicates that #1 and #2 females migrate and either do not compete with each other at all in the winter or compete in another region.

II. Winter fat class and habitat of breeding

The hypothesis states that competition among wintering Field Sparrows is over food supply and that birds with breeding experience in the wintering habitat do better in this competition. In the Junco study mentioned above (Fretwell, ms, c) fat classifications were used in order to assess the status of an individual's food supply. The results of that study confirmed the validity of the approach.

Food-dependent survival is probably related not to how much food is available, but to what risks the individual must take in order to obtain the food. Except for the days near the end of the winter, the available food must be in temporary abundance. No more is produced between these days and the end of the winter, and the available food is sufficient for much of the population to survive the many days to winter's end. Then, during the course of the winter, the population can be envisioned as living on a diminishing heap of food. In the Junco study however, it appeared that subdominant individuals could be forced to feed on unsatisfactory (sparse?) food sources (e.g. in woodlands), or in a dangerous way (e.g. solitarily) on the usual food sources. In either case, all individuals are probably exposed to a sufficient food supply. But the cost, or risk, to subdominant birds of obtaining that food is so high that we may assume that these subdominant individuals are not able to maintain the fat reserves that dominant birds maintain.

These remarks and the stated hypothesis lead us to predict that Field Sparrows which wintered in #1 and bred in #2 should be lower in fat class than those which both wintered and bred in #1.

We are mainly concerned with the influence of breeding in #1 on later winter survival. The available data reflect the reverse however; the recaptured birds were first banded in the winter and scored for breeding habitat the following spring. Some, perhaps most, of the breeding banded individuals were in fact older adults which had bred in the same habitat the previous year. Others, however, may well have been immatures of no breeding experience whatsoever. The hypothesis does not and can not specify what the competitive status of immatures will be, on the basis of their habitat of later breeding. Thus, it seems best to exclude these first year birds from the analysis, insofar as this is possible.

These groups may be separated on the following reasoning. Let us suppose that the first year birds (immatures) were in fact a part of the highly dispersive element noted above in the banded winter population. In support of this supposition is the observation that of 100 fledglings banded in 1964, one was recovered in spring, 1965, nesting about one-half mile from his hatching site. One other was recovered the intervening winter, but not seen again. Thus the fledglings showed a very high (98 percent) disappearance rate. Some of this could be attributed to mortality, but some must also be attributed to dispersiveness.

Given that the dispersive element was composed of first year birds and not older residents, then it is evident that the earlier in the winter a subsequently breeding bird was caught, the more likely it is that the individual was an older bird. First-year birds caught in December, for example, would probably have dispersed from the area by February when breeding territories are set up. On the other hand, subsequently breeding birds caught for the first time late in the winter were probably mostly first-year birds, since the extensive netting effort made throughout the winter would have caught most older, resident individuals that were to be caught at all. This distinction is obviously not clear-cut and exceptions might well be expected in both directions. However, the netting took place in December and February, and so the above method of separating the age classes was applied. Only breeding birds handled in December were considered in the habitat comparison of fat class.

It should be noted that if this method of separation is *not* valid, applying it does not add any bias to the results. The only effect is a reduction of sample size by the exclusion of February birds and therefore, a smaller chance of detecting a significant difference statistically. However, if the method *is* valid, there may well be an increased probability of detecting the predicted difference, if it exists, since any bias or error due to the effects of immatures will be reduced or avoided. Therefore, it is safer to make the comparison with the separation than without it.

The prediction is thus refined to the following: Field Sparrows caught in December which later bred in the wintering habitat would generally have a higher fat class than those caught in the same month but which later bred elsewhere. The fat class of an individual was corrected for time of day, date, and observer bias by taking the sign of the deviation of that individual's fat class from the mean of the group in which it was caught. Thus, each bird was compared to the other birds caught and handled at the same time as it. A sign test was conducted to test for a difference between populations.

Procedure and results

Twelve of the 14 males which bred in #1 were caught in December. Of these 12, 9 (75 percent) were higher in fat class than the average of the group in which they were caught. Seven of the 13 recaptured males which bred in #2 were caught in December. Of these 7, one (14 percent) was higher in fat class than the average of the group in which it was caught. A sign test applied to this data (Steel and Torrie, 1960) is significant at the 1 percent level verifying the prediction in the hypothesis.

Part of the basic hypothesis is the idea that winter survival is ultimately associated with food supply. This does not mean that starvation is the usual direct cause of mortality. As mentioned above, it is not how much food is available, but the cost of obtaining that food that is critical. Therefore, we expect that reasonably fat birds may still be stressed for food, and that food-dependent mortality may be reflected in higher mortality rates in slightly less fat birds. Only if this expectation is valid however does the habitat comparison mean anything. Thus, it is important to verify that fatter birds have a higher winter survival.

III. Survival and fat class

Part of the basic hypothesis predicts that birds with a greater fat class have a higher probability of surviving. This is clearly expected to be an intrapopulation phenomenon; if residents and migrants occur together, residents with fat class higher than other residents should more probably survive, and migrants with more fat than other migrants should also have a higher survival rate. But residents cannot be compared to migrants.

The bander can study survival by analyzing recapture rates. In this case, 67 Field Sparrows handled between 20 December 1964 and 2 January 1965 (winter residents) were divided into two groups. Birds in group 1 were greater than average in fat class; those in group 2 were less. The proportion of survivors recaptured after 2 February 1965 was calculated for each group, and the difference in proportion tested using a normal approximation to the binomial distribution. The proportion of survivors in Group 1 later recaptured was .67 (21 of 33); in Group 2 only .32 (11 of 34) were recaptured. These proportions are significantly different ($t = 2.8$, 66 df, $p < .01$). The study was repeated on a smaller scale in 1965-66. Eighteen birds were obtained between 24 December and 30 December and divided into two groups. Group 1 (high fat) contained 10 birds; Group 2 (low fat) contained 8 birds. Six recaptures were made in February 1966, 4 in Group 1 (40 percent) and 2 in Group 2 (24 percent). In both years the proportion of high-fat birds which survived and were recaptured was about twice the proportion of low-fat birds. Thus, if fat class is independent of recaptureability (including non-dispersion), then it is not independent of survival, and fat birds (residents) survive better. If fat class does depend on food availability, these results confirm this aspect of the basic hypothesis.

IV Survival and habitat of breeding

At this point, we have demonstrated that birds which breed in the winter habitat compete in winter with those that breed elsewhere. We have also shown that breeding in the winter habitat leads to higher fat in winter, and that higher fat is associated with higher winter survival. This implies that breeding in the winter habitat enhances winter survival, as hypothesized above. We should like more direct evidence of this enhanced survival, and the following studies are intended to provide such evidence.

A. The ratio of first year birds in the breeding population

As was mentioned earlier, in the banding activities of 1964-65, a considerable amount of dispersion was noted. This dispersion was attributed mainly to first-year birds, since more experienced birds are more likely to have set up residence. On the basis of this distinction between first year and older birds, the captured sample was divided into those caught before 2 January (early caught) and those caught after 2 February (late caught). It was assumed that most, if not all of the early caught individuals which stayed in the immediate area to breed were adults. It was conversely assumed that those late-caught individuals which stayed to breed were largely immatures. This assumption was originally used to refine the fat-habitat comparison. However, the percent of first-year breeding birds in an area is an estimate of the adult mortality in that area because first-year birds in general only replace dead adults. Therefore, by comparing the percent of late-caught breeding birds in the two habitats, some measure or index of the difference in annual adult survival can be obtained. There may well be biases in these measures in that some old birds might be caught late or some first-year birds early. These biases are of little concern unless they differ between the groups that we wish to compare. We will assume that there is no difference, bearing in mind that the validity of the comparison depends upon this assumption. Then we can compare the percent of late-caught (supposedly first year) breeding birds in the two habitats. The hypothesis predicts that since adult mortality is lower in the winter habitat, the proportion of first-year breeding birds will also be lower.

Results

Of the 14 banded males found breeding in the winter habitat, 2 (14 percent) were late caught. Of the 13 banded males found breeding in the non-winter habitat, 6 (45 percent) were late caught. The difference between these proportions is statistically significant ($t = 1.83$, $df = 25$) only if a one-tailed test is employed. This is perhaps justified since the sign of the difference is predicted by the hypothesis. However, the main value of these proportions is they give preliminary estimates of the adult mortality rates in the two habitats. Survival in #1 is estimated to be 86 percent; in #2, to be 55 percent. Consistent with the hypothesis, survival in #1 is estimated to be higher.

B. Rates of return to territory

The above estimates are based on some rather uncertain assumptions and a more direct method would be desirable. In the spring of 1966, a substantial number of breeding males in areas #2, #3, and #4 were banded with the intent of measuring their rate of return to territory the winter of 1966-67. This method is a fairly reliable one for estimating adult mortality (Nice, 1943; Coulson, 1956), since even migrants find their way back to their previous year's territory. Preliminary banding data on the Field Sparrows at Raleigh showed that the males do return to their territories. Walkinshaw (1945) has shown this to be true also for migrants nesting in Michigan. However, although the estimates may be reliable, the winter of 1966-67 presented some complexities which must affect the interpretation of the hypothesis. We must consider these before looking at the results.

The complexities were 1) Field Sparrows did not overwinter in any of the breeding habitats in 1966-67 and 2) Field Sparrows did overwinter in habitats totally unoccupied in the breeding season. I could find no evidence however that the breeding individuals from fields #2, #3, and #4 stayed in the Raleigh area during the winter of 1966-67. The Field Sparrows present in other nearby habitats (Sorghum-Digitaria) were carefully examined for color bands; few were banded at all, and those observed with bands were not locally-breeding birds but returns from previous winters. Thus, it is probable that the breeding birds at Raleigh migrated to other areas and that the Field Sparrows at Raleigh that winter were migrants. It is possible then that the breeding residents of the studied habitats chose broomsedge habitats in other locations, and that the experience of breeding in one broomsedge field enhances survival in the winter in all broomsedge fields. If so, then the prediction of the hypothesis is expected in this population in spite of its migration. If not, then the hypothesis is not applicable to migrants and the year 1966-67 is not suitable for testing.

We hope of course that the hypothesis will hold for migrants as well as residents, since this will greatly extend its range of generality. It would apply, for example, to the Field Sparrow females which share the males' breeding distribution and biology, but which evidently regularly migrate.

The birds were recaptured the spring of 1967 with one of two possibilities expected. One, the hypothesis is valid in spite of the complexities in which case the return to territory will be highest in #3, the previously defined best winter habitat type, and lowest in #2, the habitat type unoccupied in winter. Habitat #4 should be intermediate. The other possibility is that the complexities negate the hypothesis in which case the rates of return to territory may well be about equal in all three habitats. This case should lead to shifts of breeding density: the habitats with higher birth rates (especially #2) should increase in density relative to those with low birth rates (#3).

Results

The results are presented in Table 2. They show clearly and significantly ($F = 3.84$; $df = 2,39$) that birds in the preferred winter habitats survive better, supporting the prediction of the hypothesis in spite of the migration of the population.

TABLE 2. SURVIVAL OF WINTERING FIELD SPARROWS

Habitat	#3	#4	#2
Color marked in 1966	13	16	7
Recaptured in 1967	10	11	2
Percent	76.9	68.8	28.6

Discussion

In Figure 1, both these and the preliminary estimates of survival are plotted versus density in breeding habitat. The homogeneous trend is striking as is the agreement between the two types of estimates. This suggests that density on the breeding grounds may be a causal factor affecting overwinter survival. It may be that social experience in the breeding season increases the winter survival rate, and that social experience increases with breeding density. Then one would note a correlation between breeding density and winter survival, even if none of the habitats was a winter type. If this were the case however, one might expect the Field Sparrow to be colonial, which it is not.

At the start of this study, an alternate explanation for the breeding differences was proposed. It was thought that perhaps the birds were maladapted, and that the breeding difference was a new selection pressure to which the population was presently evolving. The new data are not consistent with this explanation, since there is now no evidence that any overall differences in production exists between residents of the different habitats. The differences in breeding rate are evidently balanced by reverse differences in survival rates. Whether the balance is complete depends on the survival of fledglings on which I have no data. If it is balanced, then the habitat distribution of breeding Field Sparrows would be ideal free (Fretwell, ms, a) despite some varia-

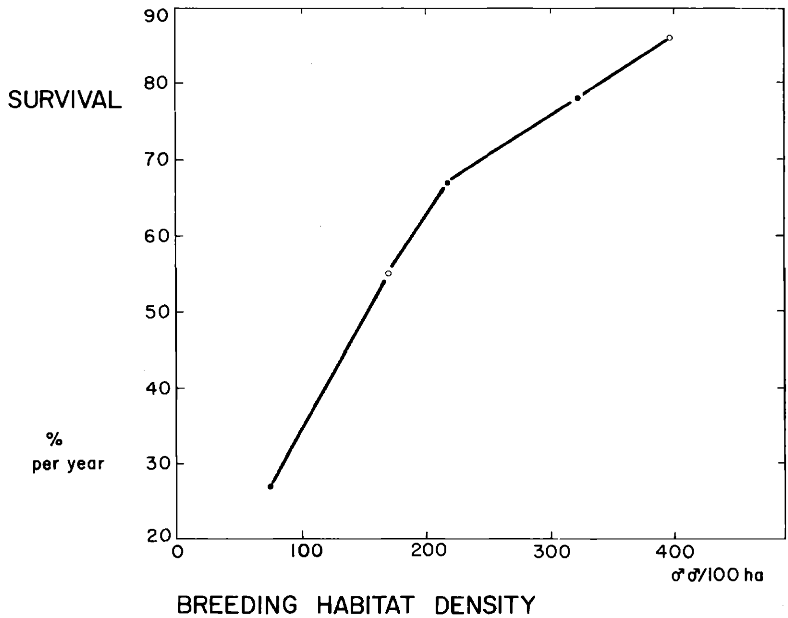

Figure 1. Survival and breeding habitat density. Open circles (o) represent estimates obtained by comparing the proportion of breeding residents which were winter residents. Closed circles (●) represent percent return to territory. All estimates are confined to males.

tion in densities, and some evident density dependent effects (Table 1). This suggests that Field Sparrows can assess density levels, presumably by the use of territorial behavior. Thus, we need to modify the tentative conclusion reached earlier (Fretwell, ms, b) that Field Sparrows used territorial behavior only to space individuals; it appears that the behavior could well regulate density as well.

There still remains some uncertainty about what has ultimately caused the difference in survival rates in Table 2. Differences in dominance status are the hypothesized cause, and I have observed Field Sparrows fighting in the fall, sometimes over food. But no decisive studies of dominance in this species are available. Also, an important relationship between breeding habitat experience and winter dominance in a migratory population is at best improbable, all the more so when the species shows flexibility of winter-habitat distribution. In any case, these studies provide some verification of the hypothesis as it applies to Raleigh Field Sparrows. Future papers will deal with the effect of this theory on the geographic breeding distribution of Field Sparrows.

SUMMARY

On the basis of preliminary observations on habitat differences in breeding success in Field Sparrows, it was hypothesized that

1) Field Sparrow populations are limited by winter food supply; some individuals fail to survive because of a shortage of available food.
2) The exploitation of winter food is controlled by dominance status; dominant birds get more food.
3) Dominance status in the winter flock is affected by breeding experience; birds which breed in the winter habitats have a higher winter dominance status.

Data are presented which support the original observation, confirming that Field Sparrows breed in the wintering habitat at a higher density than elsewhere, but raise fewer young per year per pair there. Several studies were then presented supporting the developed hypothesis. In particular, it was noted that male Field Sparrows which breed in wintering habitats do in fact sometimes winter there with birds that do not breed in a wintering habitat. It was then shown that birds which bred in the wintering habitat had more fat in winter and that fatter birds were more likely to survive to be recaptured. Evidence was then presented suggesting that the proportion of first year birds was higher in nonwintering, breeding habitats which means that the survival rate of adults is lower in these habitats. Actual habitat comparisons of survival rates further verified the result that Field Sparrows which breed in the wintering habitat type survive better. This conclusion applies to migrant as well as resident populations. In conjunction with another paper on dominance and winter survival in Juncos (Fretwell, ms, c), these results confirm the basic dominance-food-survival hypothesis.

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INCURSIONS OF THE EVENING GROSBEAK IN NORTHEASTERN OHIO, 1860-1967[1]

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The Evening Grosbeak (*Hesperiphona vespertina*) was not listed by Kirtland (1838 and 1839) in his *Report on the Zoology of Ohio.* Neither was it mentioned by him in his list of the fauna found in the Cleveland area (1852), although other winter visitors are listed based on ten years of observations. Kirtland reported the Evening Grosbeak for the first time in 1860 in the *Ohio Farmer* (Kirtland, 1860). In 1882 Wheaton wrote that this was the only record for Ohio. Williams (1950) reviewed all published and unpublished records of the Evening Grosbeak up to that time in his *Birds of the Cleveland Region.* He characterized this species as a rare and irregular winter visitor.

Beginning with 1954 I have issued annual reports on the Evening Grosbeak in northeastern Ohio, comprising 14 counties (Dexter

[1]Read at the 47th Annual Meeting of the Wilson Ornithological Society held at Pennsylvania State University, University Park, on 28 April 1966.