EFFECTS OF BIRD REMOVAL ON A WINTER POPULATION OF SPARROWS

By L. Richard Mewaldt

Over a period of seven winters (1954-55 to 1960-61) the mean number of individuals of four species of wintering sparrows captured on a 10,000 square foot suburban lot was 349 (289-411). When, during the 1961-62 winter season (October-April) 492 birds of three of the species were removed from the population, a total of 1096 individuals of the four species was captured. Similarly during the 1962-63 winter season, when 894 birds of three of the species were removed, 1143 individuals were captured. Some consequences of population pressure, after removal of most of the regular winter resident birds from the study area, are reported and discussed.

Reports of studies of repopulation of birds after removal during the winter season to parallel this report seem unavailable. Removals of birds during the breeding season, when most birds are paired and territorial, have yielded results with some similarities to our findings. For example, Stewart and Aldrich (1951) found the number of territorial male birds in a 40-acre tract of Spruce-Fir forest in Maine to be 148 during the period 6-14 June 1949. Birds removed by shooting from 15 June to 8 July totaled 455 (420 adults of both sexes and 35 young). By 24 June the number of territorial males was reduced to approximately 28. This low level was maintained until 8 July by continued collection coupled with the steady influx of new birds. For most species, more than twice as many adult males were collected on the area as were present on June 14. Apparently the carrying capacity of the surrounding forest was not sufficient to accommodate all males present. These surplus males infiltrated the area when territorial males were removed. Very similar results were obtained on the same plot the following year by Hensley and Cope (1951).

Our study was conducted in suburbia, a man-created ecologically important community. Suburbia is becoming an increasingly important factor in the ecology of birds. Smith (1959) recognizes "urban" and "rural" communities as biotic communities of the San Francisco Bay Region. Rather homogeneous but greatly different original habitats, such as forest, swamp, desert or grassland are modified to form suburbia, a rather typical, if complex, ecological type. Plots of closely cropped grass separated by trees, shrubs, flower beds and weed patches are combined with physical barriers such as houses and fences. Water is available to maintain a verdent habitat and to fulfill the needs for surface water. The number and kinds of predators are certainly changed or modified and their impact on avian populations is complex. This community, however complex and little understood biologically, is certainly of sufficient geographical extent and importance to receive attention. Graber and Graber (1963) found in Illinois that the urban habitat, which

occupied slightly over 2 percent of the state's total acreage in 1958, supported about 12 percent of the state's summer avian population. They present no data on winter utilization of the urban habitat.

In much of California, avian population composition and density have been greatly altered in not only the breeding season, but also during the winter season. Among species which breed in Canada and Alaska, winter in central California, and occupy suburbia in substantial numbers are sparrows of the genus *Zonotrichia*. That suburbia, as found in central California, is a satisfactory winter habitat for them is strongly suggested by our findings.

I acknowledge with gratitude the assistance of Bill Mewaldt and Frances Mewaldt who assisted with trapping and recording. Robert J. Newman and Stuart Warter of LSU at Baton Rouge, Louisiana and Chandler S. Robbins and Allen J. Duvall at Laurel, Maryland accepted shipments of birds and released them in appropriate habitats. James P. Heath, James R. King, and Henry G. Weston read the manuscript and provided useful suggestions for its improvement. Other help incident to the removals or with the keeping of records was provided by Mildred Fujimoto, Dennis King, Raymond Marsh, Robert W. Smith and George Tengan. This project was supported in part by Office of Naval Research Contract Nonr (NR301-658) and National Science Foundation Grant 20745.

Figure 1. Banding station is restricted to one suburban lot (indicated by arrow) in east San Jose, California. Aerial photograph was made in November of 1962.

METHODS

We have operated a bird-banding station on a formally planted suburban lot at San Jose, California since October 1954. Although operated in all months of the year, activities were more nearly continuous during the cooler months from October to May. Trapping effort and effectiveness was approximately the same in all years. Baits included chick-scratch, red millet and water. Birds were captured and repeatedly recaptured in wire netting ground traps and Japanese bird nets.

The banding operation reported here was confined to a 10,000 square foot suburban lot (Figure 1) adjacent to a fairway of a golf course. Nearby hillside areas are covered with grass, herbs and woody brush which provide excellent feed and cover. An effort has been made (apparently successfully) to avoid having neighbors involved in feeding birds for such activity might materially affect trapping success at our station.

Actual trapping was usually confined to about ten hours a week, mostly on weekends. When not set, the traps were constantly open and held a surplus of feed which the birds utilized heavily. Trapping during the morning hours was most productive. However trapping was frequently done later in the day when the flocks visiting the yard were composed in part of individual birds not seen in the morning hours. It was not uncommon to capture more than 100 birds in an hour's time. Usually, at such times, more than 90 percent of the captures were repeats.

More than 95 percent of the birds trapped in the study area were of four species of ground feeding sparrows. They were the White-crowned Sparrow (*Zonotrichia leucophrys*) of two migratory races (*gambelii* and *pugetensis*), the migratory Golden-crowned Sparrow (*Zonotrichia atricapilla*), the migratory Oregon Junco (*Junco oreganus*) and the non-migratory House Sparrow (*Passer domesticus*). Other species which regularly occupied the same ground and cover space included the Mockingbird (*Mimus polyglottis*), the Brown Towhee (*Pipilo fuscus*), House Finch (*Carpodacus mexicanus*), Brewer Blackbird (*Euphagus cyanocephalus*) and Scrub Jay (*Aphelocoma coerulescens*). Because the numbers and activities of these and a few other species were apparently not materially affected by this study and because their effect on the four major species studied was minor, they will not receive further consideration.

Most *Zonotrichia* removed were shipped by commercial aircraft to Baton Rouge, Louisiana (411 birds) in the 1961-62 winter season (Mewaldt and Newman, manuscript) and to Laurel, Maryland (693 birds) in the 1962-63 winter season. Approximately a dozen *Zonotrichia* died each year between capture and release at the remote station. Deaths were apparently due to failure to learn to eat and drink in captivity. About 50 House Sparrows in 1961-62 and 180 in 1962-63 were permanently removed as experimental birds. An additional thirty-five House Sparrows were banded and released at the banding station late in the 1962-63 season.

TABLE 1. BANDINGS AND RETURNS OF WINTERING *ZONOTRICHIA* AT SAN JOSE CALIFORNIA, 1954-63
(COLUMNS 2-12 ARE WHITE-CROWNED SPARROWS ONLY)

Season	New Bandings*		Number of Year Returned After Banding							Handled		Golden-crowns Handled	Total *Zont.* Handled
(1)	Ad (2)	Year-ling (3)	1 (4)	2 (5)	3 (6)	4 (7)	5 (8)	6 (9)	7 (10)	Ad (11)	Year-ling (12)	(13)	(14)
54-55	50	185								50	185	5	240
55-56	38	254	47							85	254	17	356
56-57	33	179	57	17						107	179	12	298
57-58	31	202	75	36	15					157	202	29	388
58-59	25	167	58	32	11	7				133	167	13	313
59-60	21	229	44	38	14	4	1			112	229	30	371
60-61	31	150	48	15	17	8	3	1		123	150	26	299
61-62	211	472	45	27	12	14	7	3	1	320	472	242	1034
62-63	122	379	97	9	8	2	2	3		243	379	172	794

*Includes banding station fatalities of less than 1%.

RESULTS AND DISCUSSION

The degree of stability of the winter population is reflected by the actual number of captures each season and the number of returns in the following season (Table 1). From 1955 to 1962 twenty-six percent of newly banded White-crowned Sparrows are known to have been alive the next winter season. From 1956 to 1962 fifty-one percent of returns were known to survive the following year. The recapture of this fifty-one percent of returners suggests a minimum annual survival rate of not less than 51 percent among adults in the station population. This is substantially greater than the 43 percent annual survival determined for 198 White-crowned Sparrows of all races recovered at points remote from their station of banding in all parts of North America over a period of forty years (Cortopassi and Mewaldt, manuscript).

The relative stability of the population of the four species of birds from 1954 through mid-1961 (Figure 2) suggests that environmental conditions remained generally constant. Fluctuations from year to year were largely a result of changes in the numbers of White-crowned Sparrows. During this period, Oregon Juncos were frequently seen within 100 yards of the station, but were not trapped in significant numbers after the winter of 1954-55. From 1954 to 1961 about twenty House Sparrows captured were removed from the population each year. The relatively small number of Golden-crowned Sparrows, Juncos and House Sparrows suggest that the White-crowned Sparrows dominated the banding station from 1954 to 1961.

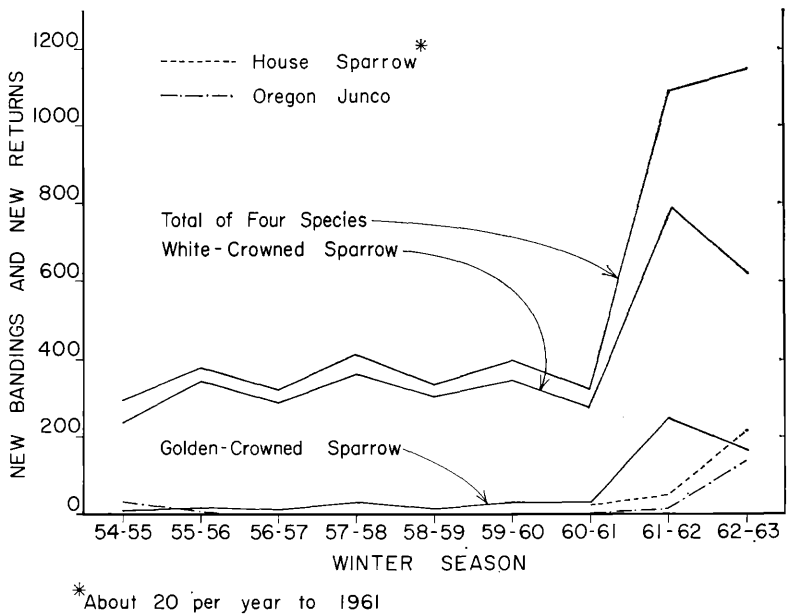

Figure 2. Numbers of four species of sparrows handled each season from 1954-1963.

Once established in the early months of the winter, the individual White-crowned Sparrows making up the population did not change materially the balance of the winter (Figure 3). After December, few additional new birds were captured, and most of these few were apparently from flocks whose flock range did not regularly include the station.

It is significant to observe that the first birds captured in September and October remained the entire winter. There was no evidence of transients in the fall and of only a few in the spring. This is made especially clear (Figure 3) by the paucity of new birds captured during spring migratory period in early April. This is similar to the situation Sabine (1956) described in a winter study of Slate-colored Juncos (*Junco hyemalis*) in which fall migrants did not visit the feeding station even though spring migrants did so. It is my opinion, based upon repeat records, and upon the obvious paucity of unbanded birds in spring, that less than five percent of the total captured at our station each year were transients.

It was apparent that three or four flocks of White-crowned Sparrows included the station in their regular feeding circuit at least part of the time. The structure of these flocks resembled very closely the structure of flocks of Juncos (*Junco oreganus*) described by Sabine (1955 and 1959), and Golden-crowned Sparrows described by Robertson (1957).

From 1954 through 1961, the White-crowned Sparrows of the race *pugetensis* outnumbered birds of the race *gambelii* about five to one. This changed to nearly a one to one ratio in 1961-62 and 1962-63. Although some flocks in this region are composed entirely of one

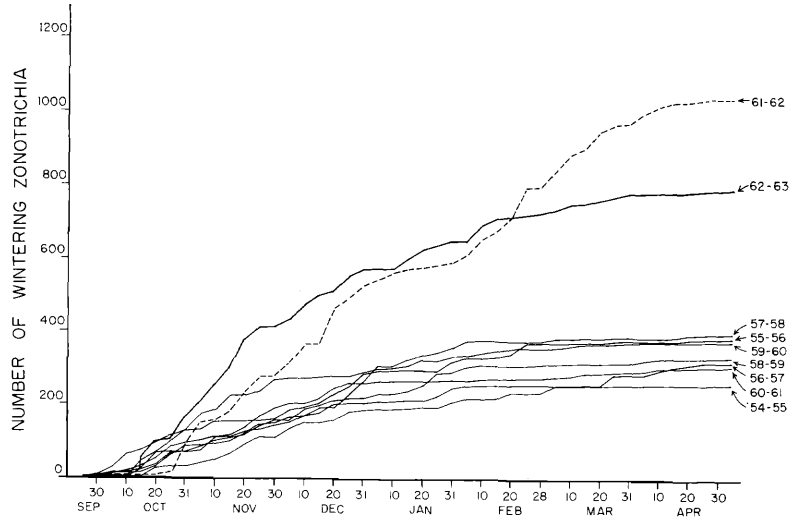

Figure 3. Cumulative totals of *Zonotrichia* as initially captured each season from 1954 to 1963. Initial captures each season include unbanded birds and birds returning from previous seasons.

race or the other, most birds occur in mixed flocks. We have been unable to detect habitat preferences for these two races on the winter range in central California (Mewaldt and Woon, 1959). All flocks in the immediate vicinity of the station were composed of birds from both races. Until late in 1961 Golden-crowned Sparrows did not appear at the station in separate flocks. They usually appeared as individuals in flocks of White-crowned Sparrows.

At times when birds of the four principal species were observed feeding together they appeared integrated as a single flock. Crowned Sparrows, however, as indicated by their aggressive behavior, were usually dominant at the traps and feeding areas.

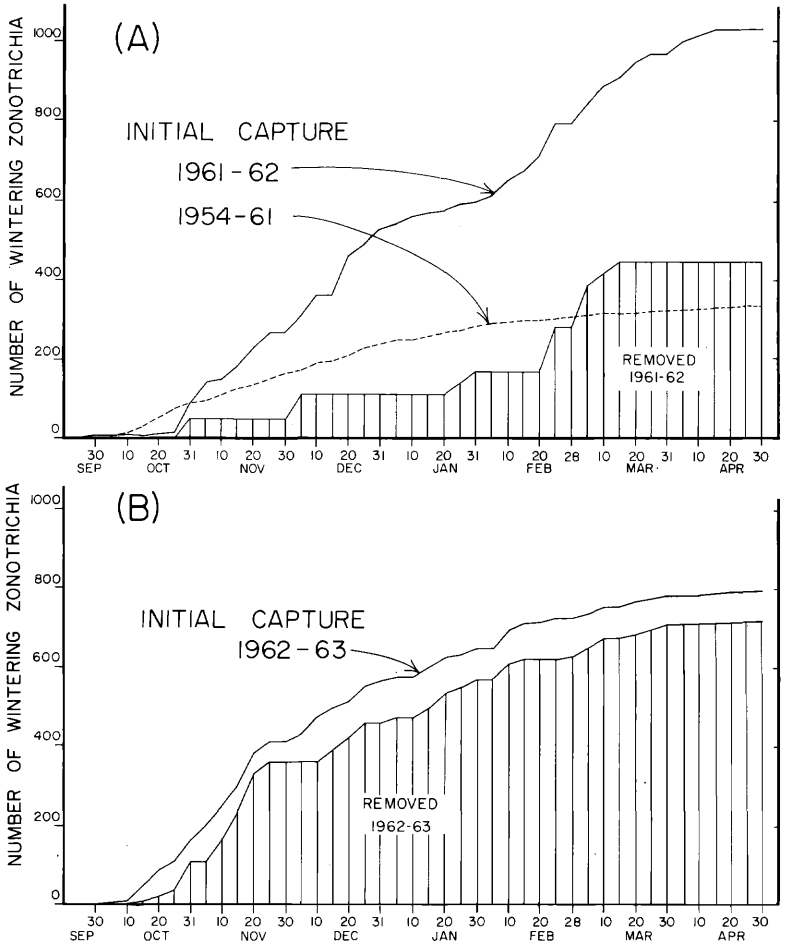

Figure 4. Cumulative total of initial captures of *Zonotrichia* as related to cumulative total of removals of *Zonotrichia* in the 1961-62 winter season (A) and the 1962-63 winter season (B).

Increases in 1961-62. The better than three-fold increase in birds captured in the 1961-62 winter season was composed chiefly of White-crowned and Golden-crowned Sparrows (Figure 2). White-crowned Sparrows captured increased from a 7-year (1954-61) mean of 305 (235-359) to 792 in 1961-62, an increase of 160 percent. Golden-crowned Sparrows increased from a 7-year mean of 19 (5 to 30) to 242, an increase of more than 1100 percent.

Infiltration of new birds onto the station grounds seemed to intensify after each removal of established birds (Figure 4). The highest number of *Zonotrichia* handled in any one season prior to 1961-62 was 388 in 1957-58. The mean number for the seven seasons prior to 1961-62 was 324. In spite of these maxima, we removed 442 *Zonotrichia* during the 1961-62 season — more than had been present in any of the seven preceding seasons. In addition, another 592 *Zonotrichia* were captured, banded and released at the station. So far as I can find such over-infiltration is previously unreported.

Adult White-crowned Sparrows infiltrated the banding station as readily as yearlings. The 40 percent adults in the 1961-62 winter population compares favorably with the 37 percent median (range 21 to 45) of adults present in the seven previous winter seasons (1954-61). Population pressure thus did not appear to exert a greater effect on yearlings, birds which might presumably show less attachment to a specific winter home during their first winter season.

From none (4 seasons) to three (2 seasons) Juncos were captured from 1955 to 1961, but in 1961-62 twelve were taken late in the season. Also, approximately 50 House Sparrows were taken, in contrast to the usual 20. All House Sparrows were permanently removed.

Increases in 1962-63. In spite of even greater removals of birds in the 1962-63 season, numbers of White-crowned and Golden-crowned Sparrows captured were somewhat smaller (Figure 3). The sum of 622 White-crowns handled in 1962-63 was 170 below the 1961-62 total but represented again a greater than 100 percent increase over the mean (305) for the years 1954-61. Similarly the 1962-63 catch of 172 Golden-crowns was 70 below the 1961-62 catch, but 900 percent higher than the mean (19) for the years 1954-61.

Numbers of Juncos increased from 12 in the 1961-62 season to 134 in the 1962-63 season. House Sparrows increased from about 50 (removed) in 1961-62 to 215 (180 removed and 35 banded and released late in the season) in 1962-63.

None of the 411 birds displaced to Baton Rouge or the 693 removed to Laurel returned during the same season. However of 2,133 White-crowned Sparrows handled from 1954 to mid-1961 (Table 1), 647 or 30 percent returned the following season. Thus, of 411 displaced in 1961-62 plus 31 which died or were otherwise removed (total 442), 133 would have been expected to return the following winter (1962-63) if they had not been removed. The fact that only 26 (6 percent) were known to return from Baton Rouge means that the population was already about 100 *Zonotrichia* short (133 expected survival and return, less the 26 which actually returned) at the onset of the 1962-63 winter season.

TABLE 2. NUMBERS OF BIRDS OF FOUR SPECIES IN SIX SAN FRANCISCO BAY AREA CHRISTMAS BIRD COUNTS*
1957 to 1962

Year	Party Hours**	White-crowned Sparrows		Golden-crowned Sparrows		Oregon Juncos		House Sparrows	
		Counted	Per ten Party Hours	Counted	Per ten Party Hours	Counted	Per ten Party Hours	Counted	Per ten Party Hours
1957	588	19,246	327	3781	64	7199	122	8610	146
1958	545	23,486	431	5200	95	4623	85	6812	125
1959	678	23,633	349	6020	89	4840	71	4144	61
1960	610	14,936	245	4723	77	7289	120	5026	82
1961	660	20,502	311	6797	103	8381	127	7729	117
1962	682	12,037	176	3601	53	3373	50	5963	87

*Contra Costa County, Crystal Springs, Oakland, Sacramento, San Francisco and San Jose.
**On foot and by car.

The total of 794 *Zonotrichia* handled at the station in 1962-63 was 240 birds less than the total of 1034 handled in 1961-62 in the presence of undiminished trapping effort. As noted in the preceding paragraph, the removals of the 1961-62 season can account for only about half of this decrease. It is therefore reasonable to assume that the overall population in the vicinity of the station was smaller in the 1962-63 season than in the 1961-62 season. This seems to be confirmed (Table 2) by the numbers of each of the migratory species counted in San Francisco Bay Area Christmas Bird Counts (*Audubon Field Notes*, 1957-62). Each was counted in substantially smaller numbers in 1962 (1962-63 season) than in 1961 (1961-62 season). Numbers were, in fact, smaller than in any of the five preceding years. Cooperators of the National Audubon Society and U. S. Fish and Wildlife Service reported numbers of White-crowned Sparrows were generally lower than usual in the 1962-63 season in the lowland sections of the Middle Pacific Coast Region (*Audubon Field Notes* **17**: 356).

In addition to 442 *Zonotrichia* removed in the 1961-62 season, another 592 *Zonotrichia* were handled (trapped, banded, and released) at the banding station (Figure 4). Each of these totals is greater than the maximum number (388) handled in any previous season. In view of the findings of Stewart and Aldrich (1951) with breeding bird populations, it is not surprising that infiltration bolstered the station population to allow removal of 442 birds.

It is necessary, however, to explain the infiltration of 592 *Zonotrichia* (over the 442 removed) to the limited area of the banding station. This exceeds by nearly 250 birds the mean number (324) of *Zonotrichia* recorded annually at the station 1954-61. When the 3 or 4 dominant flocks (those which included the station in their flock range) were dissipated, or even effectively removed, this left a roughly circular area of removal. Infiltrating flocks of birds were observed to approach the station from all directions (Figure 1) except from over the open golf course. It is likely that the number of such flocks, whose flock ranges touched the periphery of this area of removal, was greater than the number of flocks (3 or 4) regularly occupying the area. Because there was no dominant flock left at the station, peripheral flocks invaded the area with impunity. Because the station area was peripheral to each of their own flock ranges, it is unlikely that birds in these flocks exerted effective dominance in the station area.

Although similar and even more drastic removals were made in the 1962-63 winter season, the winter population in the region was substantially lower than in the 1961-62 season. Thus in the 1962-63 season, the relatively small number (80) of *Zonotrichia* handled in excess of those removed (714) may be attributed to decreased population pressure. This paucity of the dominant *Zonotrichia* in 1962-63 allowed substantial infiltration of the less aggressive *Junco* from only 12 in 1961-62 to 134 in 1962-63. This increase in Juncos was realized in spite of an apparent decrease in the 1962-63 winter population of Juncos (Table 2). It would follow that the increase in *Passer* from 50 in 1961-62 to 235 in 1962-63 should also be at-

tributed to the paucity of *Zonotrichia* in 1962-63 inasmuch as *Passer* were removed both years. It should be noted that this latter non-migratory species did not show a substantial reduction during the 1962-63 winter season.

SUMMARY

A wintering population of sparrows was baited, trapped and retrapped on a 10,000 square foot residential lot in San Jose, California during nine winter seasons from 1954 to 1963. Trapping effort and effectiveness was approximately the same in all years. During the first seven winters the mean number of birds of the four species included in the study was 349 (289-411). The most common of the four, the White-crowned Sparrow (*Zonotrichia leucophrys*), accounted for 305 (235-359) of this mean total. Other species included were the Golden-crowned Sparrow (*Z. atricapilla*), Oregon Junco (*Junco oreganus*) and House Sparrow (*Passer domesticus*). Of White-crowned Sparrows banded each year 26 percent were known alive the following year, while of banded birds which returned at least once, 51 percent were known alive the following year.

When in the 1961-62 season 492 birds (442 *Zonotrichia* and 50 *Passer*) were removed (October to March) a total of 1096 birds of the four species was captured. Likewise in the 1962-63 season when 894 birds (714 *Zonotrichia* and 180 *Passer*) were removed, a total of 1143 birds was captured. Numbers of White-crowned Sparrows increased from 305 (mean 1954-61) to 792 (1961-62) and 622 (1962-63), Golden-crowned Sparrows increased from 19 (mean 1954-61) to 242 (1961-62) and 172 (1962-63), Oregon Juncos increased from 5 (mean 1954-61) to 12 (1961-62) and 134 (1962-63), and House Sparrows increased from 20 (mean 1954-61) to 50 (1961-62) and 215 (1962-63).

Removal of the *Zonotrichia* which dominated the banding station allowed infiltration from substantial peripheral flocks. In 1961-62 most infiltration was by *Zonotrichia*. Population pressure was sufficiently great to allow removal (492) of more birds than had been handled (411) in any previous year and to permit the handling of another 604 infiltrators (592 *Zonotrichia* and 12 *Junco*). This high number of infiltrators apparently came from several flocks whose flock ranges did not regularly include the banding station.

However in 1962-63 when San Francisco Bay area *Zonotrichia* population was at its lowest in several years, *Junco* and *Passer* infiltrated the banding station grounds in substantial numbers. In spite of the removal of 894 birds of three of the species only 249 additional infiltrators (of all four species) were handled. The banding station population of sparrows was comparatively low from February to April, and during this period most of the *Junco* and *Passer* were captured. These two taxa apparently responded to the paucity of the domineering *Zonotrichia* at the banding station by infiltrating in substantial numbers during the spring of 1963.

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Received January, 1964