AN ABSTRACT OF THE THESIS OF

Dena Kay Podrebarac for the Master of Science

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Title: The distribution of the house finch in Kansas and studies of competition between the house finch and the house sparrow in Kansas during the winter.

Abstract Approved: Elmer J. Finck

The winter distribution of the house finch (Carpodacus mexicanus) in Kansas was reviewed from Christmas bird counts (CBC's) that were published in the Kansas Ornithological Society Bulletin. The house finch entered the state from the southwest and has rapidly expanded across Kansas in a northeasterly direction. The house finch was first recorded on a CBC in 1955 in Clark County. The site that has the longest continuous record of house finch sightings is Morton County/Cimarron National Grasslands in the southwestern corner of the state. In 1990, the number of house finch sightings on the CBC was 2,807 and the number of counts recording house finches was 23, both the largest numbers recorded for the house finch in Kansas. At present, a second population of house finches may be invading Kansas from the east, however, the majority of house finches in Kansas probably came from the southwest.

Competition may occur between the house finch and the house sparrow (Passer domesticus). Analysis of the Kansas Winter Bird Feeder Survey has shown the house finch to outnumber

the house sparrow in five southwestern Kansas counties. To test whether the house finch is having an effect on the house sparrow in Kansas, a study was performed in an aviary with same-sex dyads of house finches and house sparrows under winter conditions. The house finch was the more aggressive of the two, but a large variance occurred within individuals, leaving only threats and attacks by female house finches statistically significant in a nested analysis of variance. Given a choice of food, the house finch preferred thistle seed, and the house sparrow seemed to prefer millet seed.

THE DISTRIBUTION OF THE HOUSE FINCH IN KANSAS AND STUDIES OF COMPETITION BETWEEN THE HOUSE FINCH AND THE HOUSE SPARROW IN KANSAS DURING THE WINTER

A Thesis

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by

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PREFACE

Chapter one was published in the Kansas Ornithological Society Bulletin, therefore it is written in the style of that journal.

Chapter two will be submitted for publication to The Wilson Bulletin, therefore it is written in the style of that journal.

TABLE OF CONTENTS

LIST OF TABLES

Chapter 1

Chapter 2

LIST OF FIGURES

Chapter 1

Chapter 2

THE WINTER DISTRIBUTION OF THE HOUSE FINCH (*Carpodacus mexicanus*) IN KANSAS

Introduction

The house finch (*Carpodacus mexicanus*) is relatively new to eastern Kansas. It existed in extreme southwestern Kansas for many years, but this finch recently began to expand across Kansas in a generally northeast direction, first as winter visitors, then as nesting individuals (Elder 1985).

The former range of the house finch was west of the Great Plains. However, the species was artificially introduced to the East Coast (on Long Island, NY) in 1940, when pet dealers, who had been selling the birds under the name "Hollywood Finch," released them in order to escape prosecution for transportation and possession of a protected species (Elliot and Arbib 1953).

The house finch adapts well to urban areas and will come to feeders, so it began to spread through the eastern United States. An increase in the house finch was documented in Illinois (Robinson 1989), Minnesota (Eckert 1989), and South Dakota (Howitz 1989) on Christmas Bird Counts in the last half of the 1980's. Although unpublished, it has also invaded Iowa and Missouri, (C. Ely pers. comm.). Possibly, an eastern population of the house finch is invading eastern Kansas. The objective of the study is to investigate the expansion of the house finch

across Kansas.

Materials and Methods

Data were collected as sightings on Christmas Bird Counts (CBC's) which are collected from all over the state, and published in the March issues of the Kansas Ornithological Society Bulletin. The first CBC published in the Kansas Ornithological Society Bulletin was for the winter of 1949 (Goodrich 1950).

Results

Although there are records of house finch sightings in Kansas dating back to 1882 (Menke 1894), the first observation on a CBC was in 1955 in Clark County (Baker 1956). Two individuals were seen, but there were no CBC's submitted from Clark County for the years preceding or following.

After another record in 1962 in Ellis County, annual sightings within the state began in 1966. Since that time, the number of CBC's reporting house finches has increased dramatically and spread across the state (Figure 1).

In 1990, 23 counties reported house finches on their CBC's, six of which were first sightings, and three of the six had conducted previous CBC's. The six new counties were Phillips, Seward, Riley, Jefferson, and Pawnee-Rush. The data presented in Figure 1 are somewhat limited since every county does not submit a CBC, but it does show where the highest numbers of house finches are found. The highest numbers from the most recent count are all in western counties, except for Riley County, which had 414 house finches seen (Table 1).

In Figure 2, valleys occur when a county that had house finches previously did not submit a CBC for that year, or, as with the early sightings, a bird that was seen in Ellis County in 1962 was probably a winter visitor, because another one was not seen until 1966.

Figure 1. The number of house finches seen on CBC's in Kansas since 1955, arranged by county.

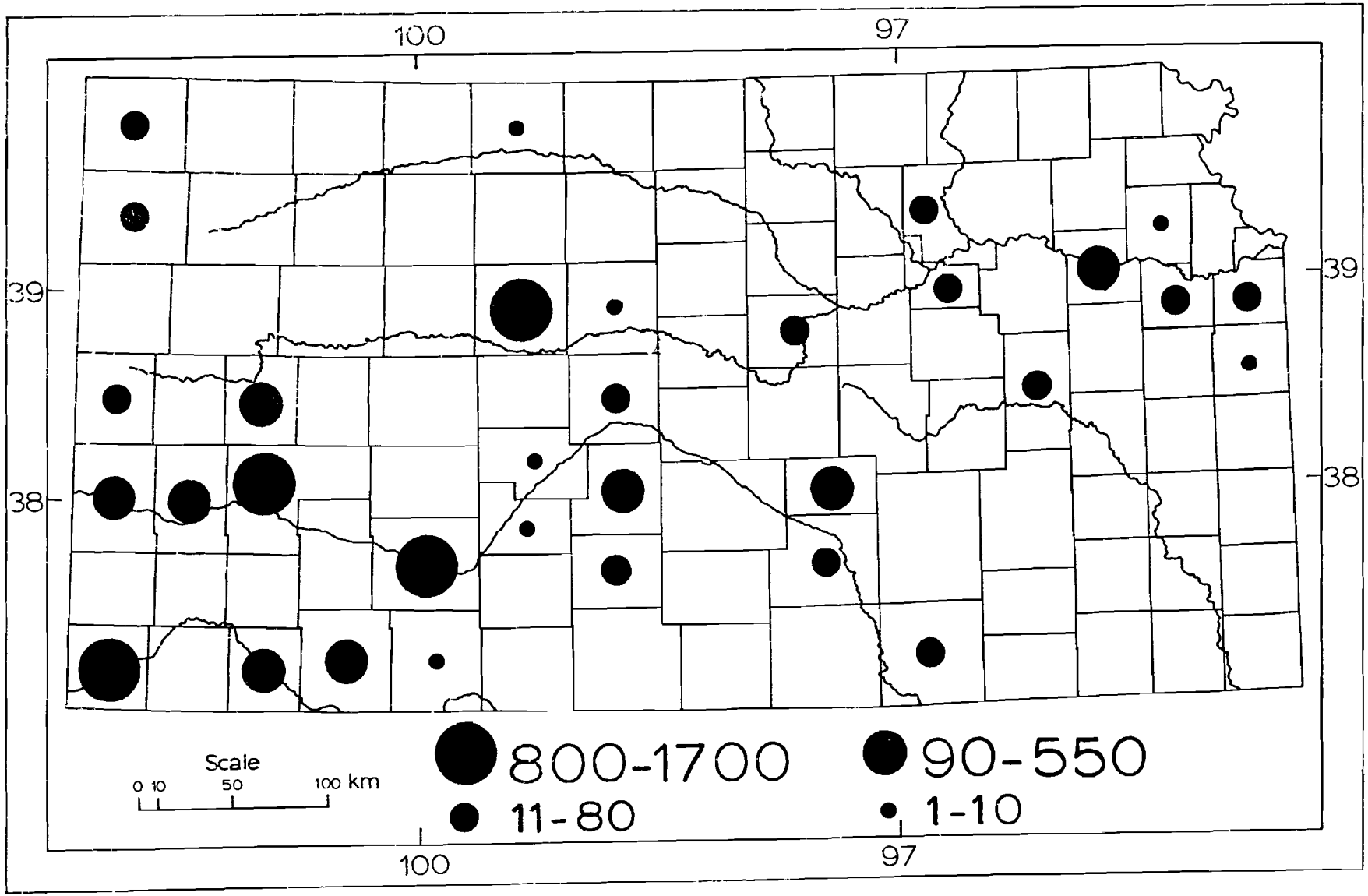

100
97
39
38
Scale
0 10 50 100 km
800-1700
90-550
11-80
1-10

Table 1. The counties from which the four highest numbers of house finches were recorded on the CBC in 1990.

site	county	total
Garden City	Finney	817
Western Stafford	Stafford	543
Manhattan	Riley	414
Cimarron National Grasslands	Morton	245

Figure 2. The number of sites reporting house finches on CBC's in Kansas from 1962 to 1990. The 1955 sighting is not included.

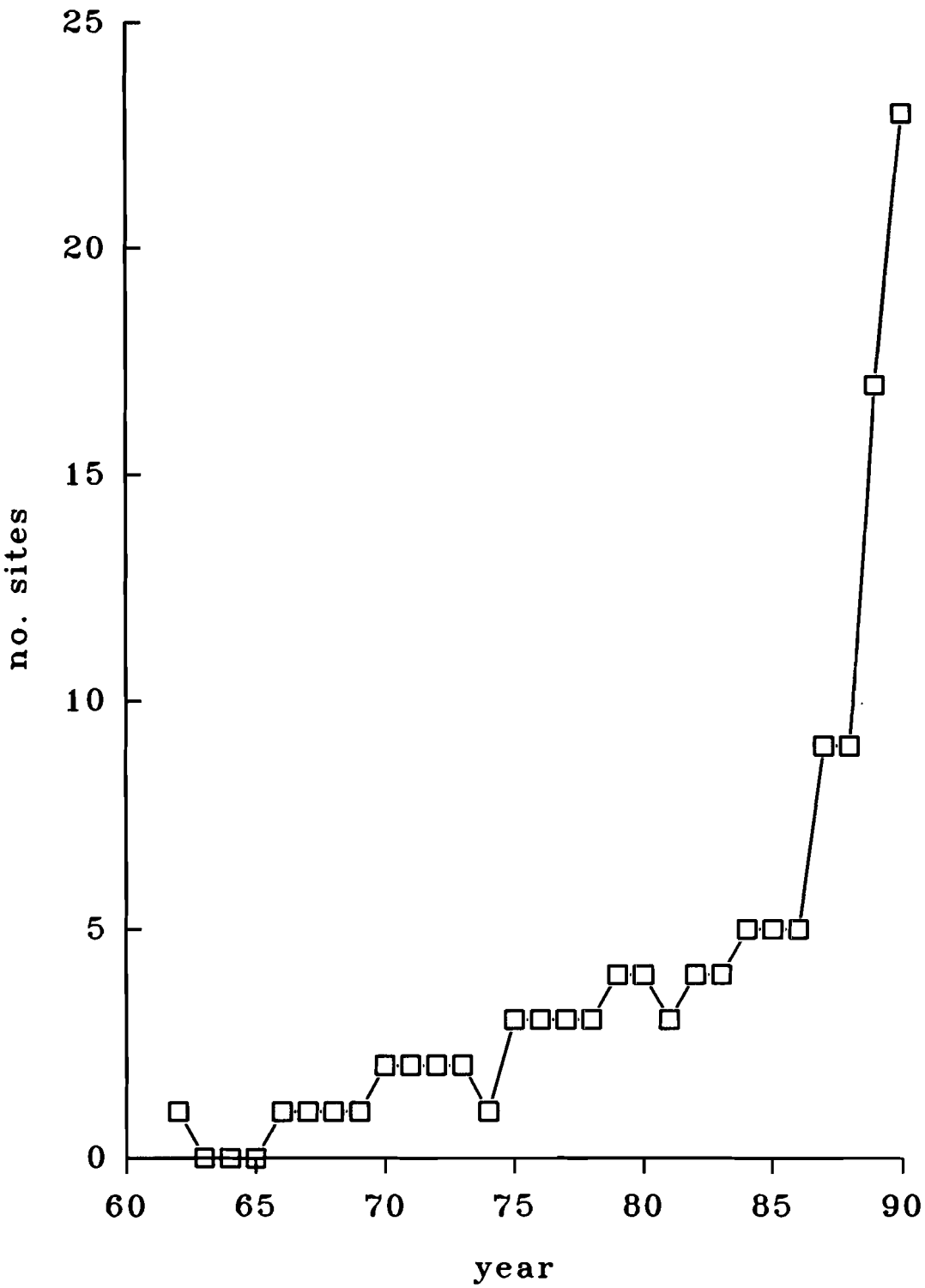
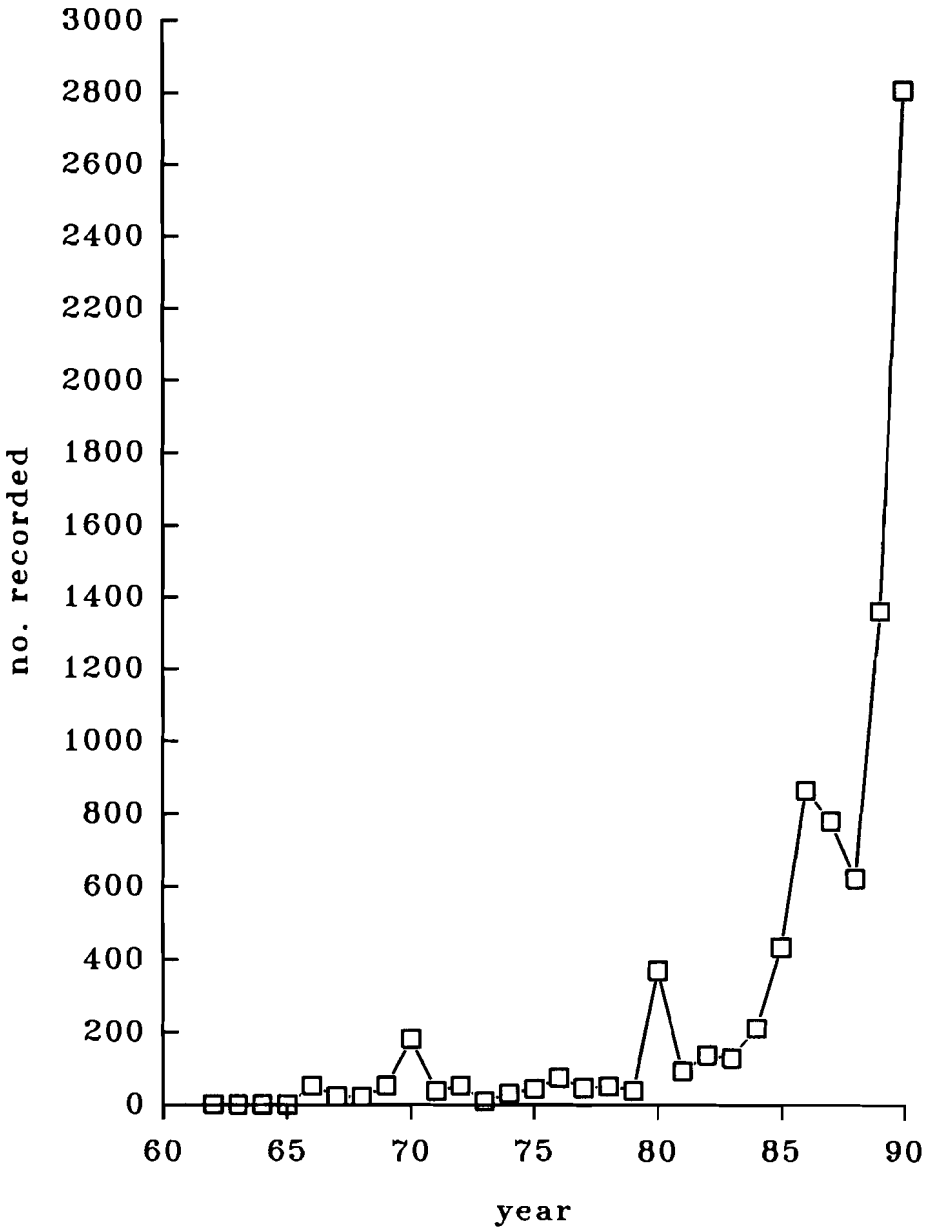

25
20
15
10
5
0
no. sites
60
65
70
75
80
85
90
year

Figure 3 has several peaks which can be explained. The peak in 1970 occurred when 176 house finches were sighted in Ford County, compared to 52 the year before and 18 the year after. Again Ford County has a peak in 1980 with 332 birds compared to seven the previous year. No CBC was submitted the following year. In 1987, Hays dropped from 462 to 63, which accounts for the valley, although four new counties reported house finches that year. In 1989 and 1990 the number of house finches seen on CBC's has increased abruptly, due to large increases in the number of house finches seen in counties which previously counted the bird, and the addition of new counties. In 1990, 2,807 house finches were seen on CBC's in Kansas.

The most illustrative data were from 16 sites that had at least one CBC before the first house finch record, and have had continuous sightings since, without discontinuing the CBC. This showed more accurately when the house finch reached an area.

Figure 3. The total number of house finches recorded in Kansas on CBC's from 1962-1990.


3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
no. recorded
60
65
70
75
80
85
90
year

Discussion

There are several limiting factors to the accuracy of the CBC data. In 1990, 35 counts were submitted (Zimmerman 1991), representing 32 Kansas counties. This left 76 counties unaccounted. Only three sites have submitted a count every year (two of which were from the same county). Thirteen counties reported house finches on their first CBC, so we do not know when the birds first appeared in those counties. Concerning the CBC itself, party hours (hours x observers) spent and habitat covered could well affect the count. The sudden increase in sightings could also be attributed to an increased awareness of the house finch in the last few years.

According to the 1991 Kansas Winter Bird Feeder Survey, the house finch was the tenth most abundant bird at backyard feeders (Chapter 2). In this survey, participants observe their bird feeders for two consecutive days in January and record the highest number seen at one time for each species.

The eastern population of the house finch has probably reached Kansas, which could account for the sudden rise in extreme eastern Kansas sightings. A genetic study of the eastern and western populations could determine the origin of the eastern Kansas birds, and if any genetic differences had arisen during their separation.

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THE DISTRIBUTION OF THE HOUSE FINCH AND THE HOUSE SPARROW IN KANSAS DURING THE WINTER AND OBSERVATIONS OF COMPETITION IN AN AVIARY

ABSTRACT.--Several observers suggest that competition occurs between the House Finch (Carpodacus mexicanus) and the House Sparrow (Passer domesticus), and propose several hypotheses as to which species is dominant and why. Analysis of the Kansas Winter Bird Feeder Survey shows the House Finch to outnumber the House Sparrow in five southwestern Kansas counties. To test whether the House Finch is having an effect on the House Sparrow in Kansas, an aviary study was performed with same-sex dyads of House Finches and House Sparrows under winter conditions, using time budget analysis. The House Finch was the more aggressive of the two, but a large variance occurred among trials within individuals, leaving only threats and attacks by female House Finches statistically significant in a nested analysis of variance. Given a choice of food, the House Finch preferred thistle seed, and the House Sparrow seemed to prefer millet seed.

Competition between the House Finch Carpodacus mexicanus and the House Sparrow Passer domesticus may be occurring in the eastern United States, resulting in the decline of the House Sparrow (Wootton 1987). The House Finch is dominant in competition between the Purple Finch (Carpodacus purpureus) and the House Finch (Shedd 1990). In laboratory conditions, Kalinoski (1975) determined the House Sparrow to be almost completely dominant over the House Finch, while his outdoor observations showed the House Sparrow only slightly dominant. He speculated that his laboratory results were due to long, continuous contact between individuals. In 1951, eleven years following the introduction of the eastern population of the House Finch, Elliot and Arbib (1953) made a personal observation that the House Finch was dominant and aggressive over the House Sparrow at feeders. Thompson (1960) suggested that observations in Berkeley, California indicated that the House Sparrow was winning fights.

Wootton (1987) analyzed Breeding Bird Surveys (BBS) and Christmas Bird Counts (CBC's) in the eastern United States to determine the densities of the two species. While the House Finch increased exponentially, there was a significant decline in the density of House Sparrows. After ruling out habitat change, weather, and presence versus absence of the House Finch, Wootton concluded that competition is occurring due to similar habitat use and diet.

Conflicting findings among these studies may be due to differences in aggressiveness between the eastern and western populations. Kalinoski and Thompson's studies took place in New Mexico and California respectively, the original range of the House Finch. Wootton's study and Elliot and Arbib's observations were of the eastern population. Possibly, the eastern population of the House Finch is more aggressive. Podrebarac and Finck (1991) concluded that most of the Kansas population is from the expansion of the original range, but speculated that the east and west populations may have reached a contact zone in eastern Kansas.

The House Finch and House Sparrow diets consist mainly of vegetable matter (96.7% and 96.6%, respectively), mostly seeds (Wootton 1987). Both species live in areas of human habitation. They nest on buildings and come to backyard feeders (Kalinoski 1975, Wootton 1987). A preliminary survey among Emporia, Kansas residents who had bird feeders revealed that competition was occurring between the two species, but was inconclusive as to which was dominating. The survey also suggested that both species preferred sunflower seeds.

To test whether the House Finch is having an effect on the House Sparrow in Kansas, the 1991 Kansas Winter Bird feeder survey was analyzed to determine the densities of the two species by county. In addition, an aviary study was

performed, in which winter conditions were simulated and interactions of dyads of House Finches and House Sparrows were observed. I predicted that the House Finch would be aggressive toward the House Sparrow, causing the House Sparrow to avoid the House Finch and to defer from its supposed preferred food, sunflower seeds. I also predicted that the House Finch would displace the House Sparrow in southwestern Kansas, where the House Finch first arrived and is in greatest abundance.

METHODS

Bird Feeder Survey

The Kansas Winter Bird Feeder Survey, which began in 1988, is conducted by the Kansas Department of Wildlife and Parks and the Kansas Ornithological Society, and funded by the Chickadee Check-off. Participants observe their bird feeders for two consecutive days in January and record the largest number of individuals observed at one time for each species. The 1991 survey was analyzed by county, to determine the distribution of the House Finch and the House Sparrow. Eighty-seven of 105 Kansas counties were represented.

Aviary Study

The birds for the study were captured from late January to early February, 1992. House Finches were captured at a roosting site in Emporia, Kansas. House Sparrows were captured at a backyard feeder in Emporia, Kansas. Mist nets were used to capture the birds as they approached the roost or feeder. Mist netting continued until at least ten individuals of each species survived in captivity.

Winter conditions (approximately 2°C, 8 hours light and 16 hours dark) were simulated in a climate controlled room. Individuals were housed in separate cages when experimentation was not taking place. Within the cages, each bird was given a dish of mixed seeds every evening just before the lights went off, so that they would not be

disturbed the following morning. Water was provided ad libitum. The individuals were visually, but not acoustically isolated (Hill 1990). The birds were given two weeks to adapt to captivity (Espaillat and Mason 1990).

An aviary measuring approximately 2.3 x 1.4 x 1.8 m was constructed in the climate controlled room, fashioned after Sherry (1984) (Figure 1). The birds were observed through a 1.3 x 0.7 m window draped with camouflage netting. The experimental habitat consisted of a tree in a metal stand (Sherry 1984) for perching, four feeders along one wall, and a water dish on the floor (Figure 2). The type of food in each feeder was rotated periodically.

The selection process for dyads was stratified random, so that all individuals would be utilized. The dyads were not given food the evening previous to being in the aviary. Birds were released into the aviary through a small hatch, within 30 minutes of the lights coming on, and allowed to acclimate for five minutes. Observation periods lasted 45 minutes. A second observation period occurred either one or two hours after the birds were released into the aviary. Following the observation periods, the birds were captured with a net and returned to their individual cages.

Table 1 lists the activities and interactions which were recorded for each bird. Time budget analysis was used to record activities every 10 seconds (Wiens et al. 1970). Interactions were recorded whenever they occurred, as

Figure 1. Diagram of the aviary.

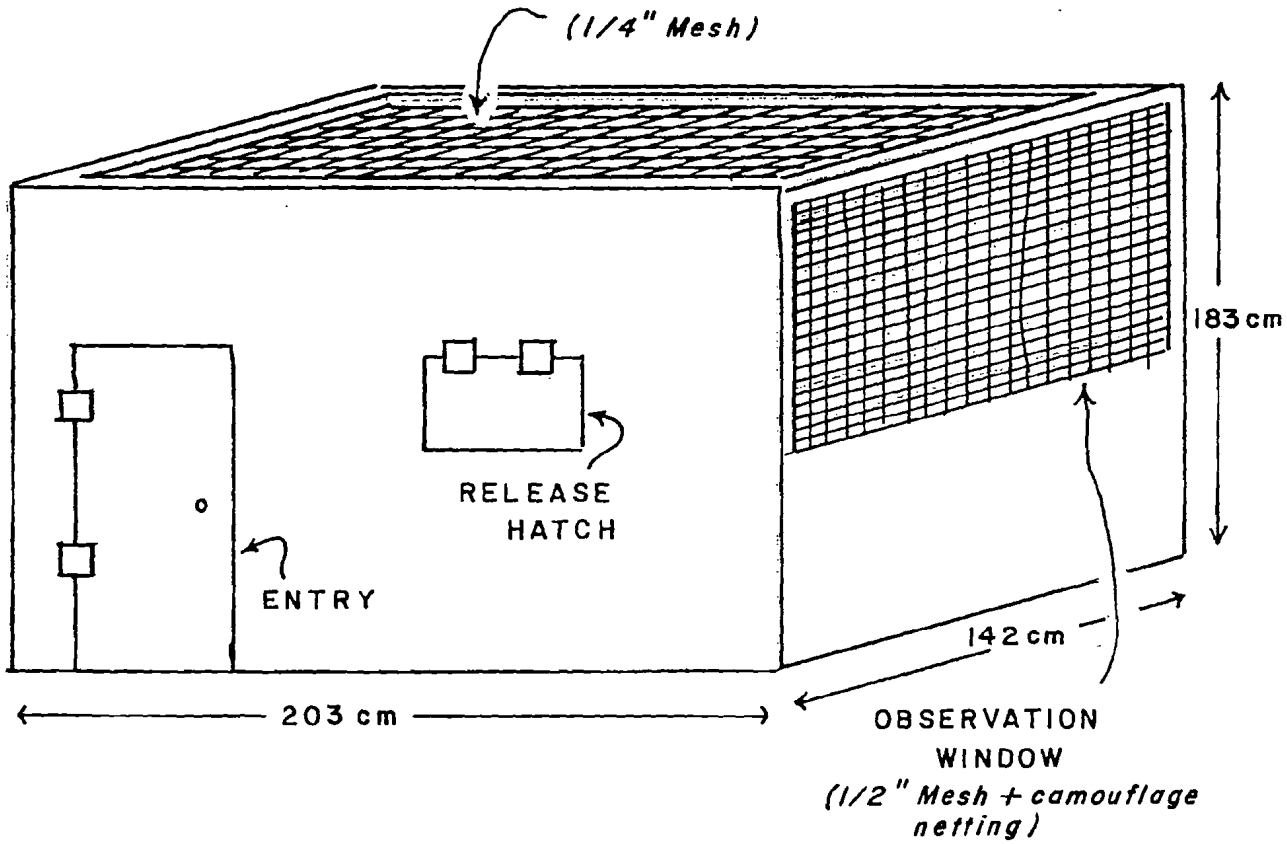

(1/4" Mesh)
183 cm
RELEASE
HATCH
ENTRY
142 cm
203 cm
OBSERVATION
WINDOW
(1/2" Mesh + camouflage
netting)

Figure 2. View of the aviary from the observation window. Dots represent feeder positions.

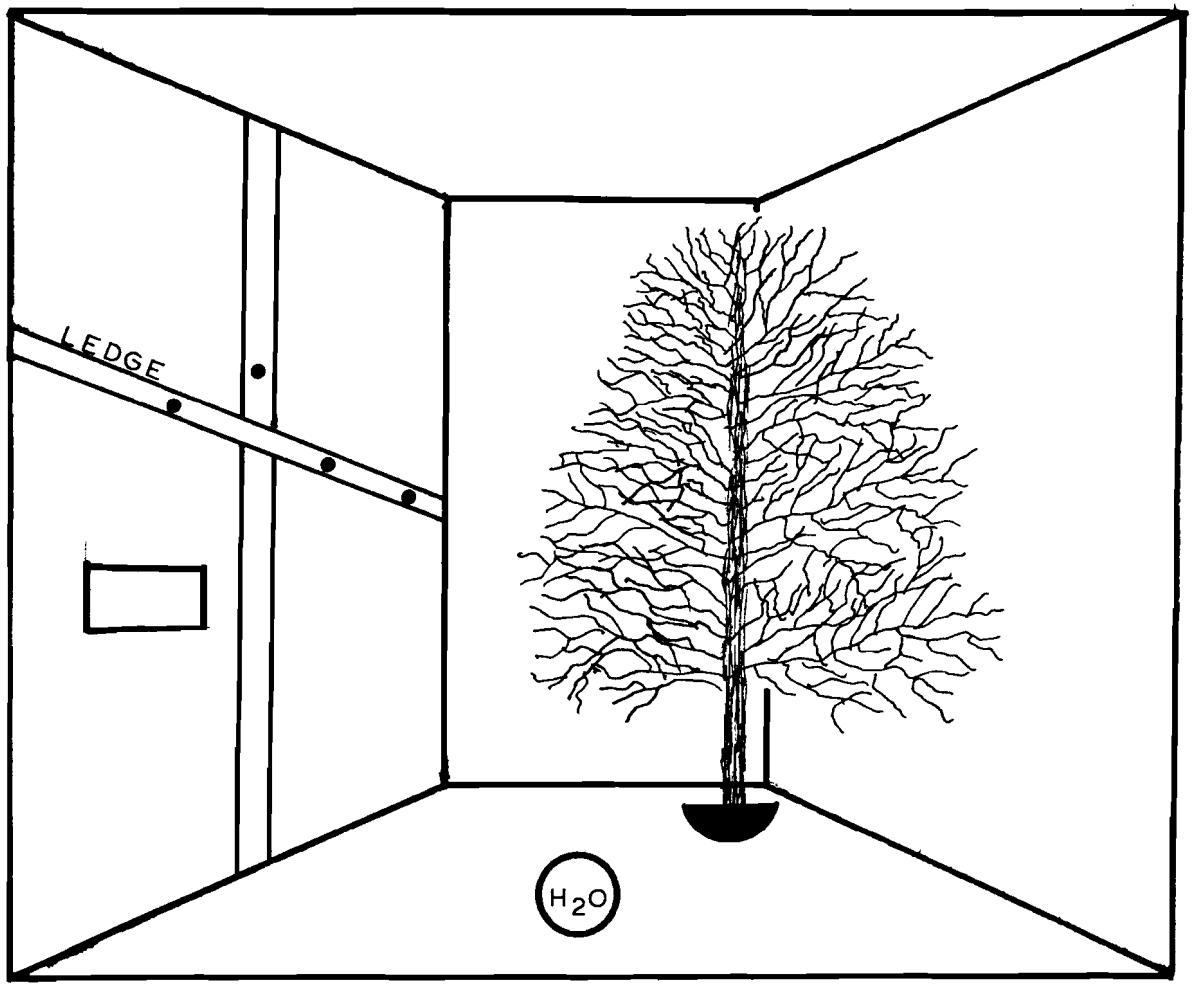

LEDGE
H2O

TABLE 1.

BEHAVIORS, WHICH WERE RECORDED EVERY 10 SECONDS, AND INTERACTIONS, WHICH WERE RECORDED AS THEY OCCURRED, THAT WERE OBSERVED IN THE AVIARY.

Activities	Abbreviation
Behaviors	
Flying	Fl
Foraging on ground	Fo
Sunflower seed feeder	Sf
Sunflower chips feeder	Sc
Millet feeder	M
Thistle feeder	Th
Perching	P
Preening	Pr
Calling	C
Standing on ground	S
Out of sight	O
Interactions	
Simple avoidance	Av
Supplanting attack	At
Chase	Ch
Threat display	T
Combat	Co

opposed to only on the ten second mark. Each of the four feeders contained a different food, striped sunflower seeds, sunflower chips, millet, and thistle. Therefore, in addition to interactions, food preference could be observed. The study was conducted for twenty observation days.

A modified version of the agonistic encounters described by Thompson (1960) was used, including: (1) simple avoidance behavior - an individual leaves at the approach of another individual, (2) supplanting attack - an individual flies or jumps at another individual with feet and bill, (3) chasing - an individual follows the retreating individual to attack again, (4) head-forward threat display - an individual bears its bill and often widens it's wings toward another individual, (5) combat - both individuals fight with bills and feet, calling loudly.

Results were calculated as percentages to present in table form. A nested analysis of variance (ANOVA) was used to test for differences among the means of each variable between House Finches and House Sparrows. The two trials for each bird were nested within each individual.

RESULTS AND DISCUSSION

Bird Feeder Survey

The bird observed in greatest numbers on the survey was the House Sparrow. The House Finch rounded out the top ten (Table 2). In five southwestern counties (Ford, Haskell, Kearny, Meade, and Scott), the House Finch observations outnumbered the House Sparrow observations (Figure 3). The House Finch first entered Kansas from the southwest, therefore, if a decline of the House Sparrow is beginning to occur, it would logically occur in the southwest first. Figure 3 also shows that the House Finch now occurs across the state of Kansas.

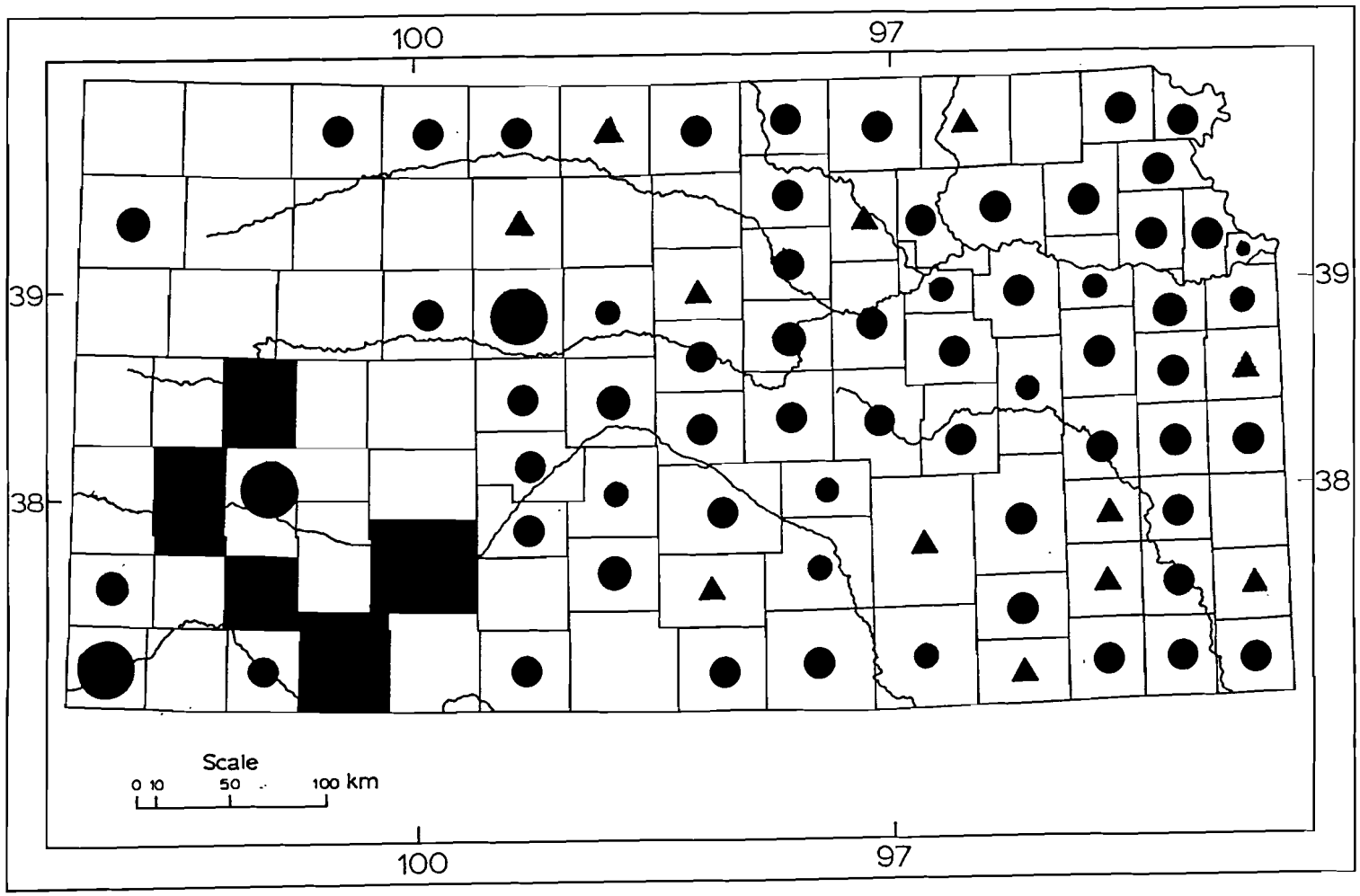
The analysis of the Kansas Winter Bird Feeder Survey seems to indicate that the House Finch in southwestern Kansas is out-competing the House Sparrow, which supports the findings of Wootton (1987). It will be interesting to see what happens in eastern Kansas in the coming years, since the density of the House Sparrow is higher there than in western Kansas (J. Schulenberg, pers. comm.). Both species prefer urban areas, so the real story will be told in the more populated areas to the east.

TABLE 2.

THE TOP TEN SPECIES SEEN ON THE KANSAS WINTER BIRD FEEDER SURVEY THAT WAS CONDUCTED 10-13 JANUARY 1991.

Species		Day 1	Day 2	Total
1.	House Sparrow	14969	14895	29864
2.	Dark-eyed Junco (all races)	8953	8551	17504
3.	American Goldfinch	7898	7978	15876
4.	Northern Cardinal	7100	6938	14038
5.	European Starling	6748	6631	13379
6.	American Tree Sparrow	3787	3937	7724
7.	Blue Jay	3408	3530	6938
8.	Black-capped Chickadee	3258	3214	6472
9.	Harris' Sparrow	3045	3110	6155
10.	House Finch	2683	2679	5362

Figure 3. The sightings of House Finches and House Sparrows at bird feeders on the Kansas Winter Bird Feeder Survey, 1991, arranged by county. The shaded counties indicate where the House Finch out-numbered the House Sparrow. Circles indicate counties in which both species were observed. Triangles indicate counties in which House Sparrows were observed, but House Finches were not.


100
97
39
38
Scale
0 10 50 100 km

Aviary study

The aviary study began with eight House Sparrows (5 males and 3 females) and ten House Finches (5 males and 5 females). The study ran from 19 February to 20 March 1992. The birds were released 24 March. Male dyads were observed a total of 15 hours. Female dyads were observed a total of 6.75 hours.

Agonistic encounters were found to be initiated by both sexes of the House Finch (Table 3). Often this was when the House Sparrow ventured close to the House Finch while perching in the tree. Occasionally, the House Finch seemed to attack when unprovoked. In addition, there were times when the House Finch tolerated the House Sparrow sitting at its side, but then would suddenly attack or threaten. Thompson (1960) found this to be true during the spring. He also described the territorial behavior of the House Finch as variable, and depending on "mood" or the circumstances. Among agonistic encounters (Table 3), the attacks and threats by female House Finches against female House Sparrows were significantly greater ($\underline{P} < 0.05$). While the differences in percentages between the species are large for the other encounters, large variances within individuals resulted in the differences being non-significant. Avoidances by male House Finches against male House Sparrows appear to be greater (although not significantly). It is hypothesized that this occurred because the House Sparrow

TABLE 3.

PERCENTAGE OF TIME THAT A SPECIES INITIATED A PARTICULAR AGONISTIC ENCOUNTER IN SAME-SEX, DIFFERENT SPECIES COUPLETS.

Encounter	Males		Females	
	Finch	Sparrow	Finch	Sparrow
Avoidance	65.22	34.78	20.00	80.00
Attack	88.10	11.90	98.08	1.92*
Chase	100.00	0.00	100.00	0.00
Threaten	100.00	0.00	94.44	5.56*
Combat	50.00	50.00	50.00	50.00

* = species different, $\underline{P} < 0.05$

was often very "flighty," occasionally catching a preening or perching House Finch off guard. Thompson (1960) described this as a fright response. This did not occur among the females. Combats appear to be equal because both individuals are involved. Only three combats occurred, with the House Sparrow displaced each time. Analysis of variance could not be performed on some groups due to a very small number of occurrences.

By breaking down the encounters into how often a species was the aggressor or how often a species was displaced, the greater displacements of female House Sparrows by female House Finches were significant (Table 4). Thompson (1960) described a behavior which was seen quite often in this study; when a House Finch was eating at a feeder, the House Sparrow would fly over and perch close by without actually trying to eat. Thompson described this as a type of avoidance of a superior. It is interesting to note that encounters by the House Finch (males) occurred significantly more often in the tree rather than at the feeders, as originally hypothesized. Overall, 87.30% of the encounters took place in the tree for the males, and 91.78% for the females. Thompson (1960) reported that agonistic behavior among wild House Finches occurs at resting or roost sites throughout the year. Only one encounter occurred at the water. In this encounter, a male House Finch displaced a male House Sparrow.

TABLE 4.

PERCENTAGE OF TIME THAT A SPECIES INITIATED A PARTICULAR ENCOUNTER, AND WHERE IT OCCURRED IN SAME-SEX, DIFFERENT SPECIES COUPLETS.

Results	Males		Females	
	Finch	Sparrow	Finch	Sparrow
Aggressor	88.89	11.11	95.89	4.11
Displaced	4.76	76.19	1.37	90.41*
Not displaced	3.18	15.87	2.74	5.48
In tree	94.44	5.56*	96.67	3.03
At feeder	57.14	42.86	100.00	0.00
At water	100.00	0.00	0.00	0.00

* = species different, $\underline{P} < 0.05$

The results of the food preference analysis (Table 5) showed the male House Finches spend significantly more time eating sunflower chips than the male House Sparrows. Thistle seed was preferred significantly by both male and female House Finches. Although not significant, the House Sparrows seemed to prefer millet seed and foraging on the ground. A few observations were made of same-sex same-species dyads, in which the House Sparrow still preferred millet seed, therefore the House Sparrow was not deferring to millet seed as a result of House Finch presence. The time spent at the sunflower seed feeder by the House Sparrows is misleading, since the House Sparrows rarely cracked open a sunflower seed. Most of the time was spent rooting through the feeder for other morsels. The House Finches spent more time feeding overall, and had longer stints at a feeder, while the House Sparrows darted back and forth to feeders, often staying only long enough to grab a seed and fly back to a perch. These observations are similar to those observed by Kalinoski (1975).

Considering that the aviary study showed a lack of significant overlap in food resources for the two species, and that encounters occurred away from the feeders, aggression during the spring while establishing territories and nesting should be studied. Numerous House Sparrows once nested on the Science Hall at Emporia State University, but after the House Finch arrived in Emporia in 1989 (Zimmerman

TABLE 5.

PERCENTAGE OF TIME SPENT EATING AT FEEDING STATIONS AND FORAGING ON THE GROUND IN THE AVIARY, IN SAME-SEX, DIFFERENT SPECIES COUPLETS.

Station	Males		Females	
	Finch	Sparrow	Finch	Sparrow
Foraging	2.96	38.27	7.71	18.60
Sunflower	9.07	14.26	4.86	31.78
Sunflower chips	11.74	1.62*	3.14	3.10
Millet	8.28	35.02	8.29	42.64
Thistle	67.95	10.83*	76.00	3.88*

* = species different, $\underline{P} < 0.05$

1990), the Science Hall became populated by nesting House Finches (pers. obs.).

Individuals within the aviary always had access to four full feeders of the four types of food previously described. When in the individual cages, the birds were fed every evening, and only deprived of food the evening before placement into the aviary.

A possible bias in this study was the location of the aviary in the same room with the individual cages. Subjects in the aviary could hear the calling and singing of individuals in the cages. Occasionally, an individual seemed to notice outside sounds, but often they continued to feed, perch quietly or preen when sounds came from the cages. Future studies should separate the experimental subjects from such interferences.

CONCLUSION

Competition does appear to occur between the House Finch and House Sparrow during the winter, if they are confined in an aviary, but not at feeding stations as was hypothesized. The prediction that the House Finch is aggressive toward the House Sparrow was supported, while the prediction that this aggression occurs at the feeder and results in the House Sparrow deferring to another food was disproved. If the hypothesis is true that the eastern population of the House Finch is more aggressive, then the eastern population has presumably reached Kansas and was used in this study, which supports the speculation of Podrebarac and Finck (1991). Loss of nesting sites to aggressive House Finches in the spring has been suggested as a possible reason for the decline of the House Sparrow (Brown and Brown 1988, Bennett 1990) and needs to be further studied.

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Title of Thesis

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