10-1983

# ADJUSTING BIRD CONTROL APPLICATIONS WITH THEIR OPTIMAL BEHAVIORS IN RED-WINGED BLACKBIRDS

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# ADJUSTING BIRD CONTROL APPLICATIONS WITH THEIR OPTIMAL BEHAVIORS IN RED-WINGED BLACKBIRDS

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## ABSTRACT

In order to improve control methods that imply giving any drug, repellent, or chemosterilant through food, we need to know where and how to offer the feeding opportunities to maximize the number of birds to be treated. Because of heavy snow cover in the winter in Quebec, spring-feeding flocks of red-winged blackbirds are predicted to be more attracted to corn fields than non-corn fields and more attracted to feeding sites where corn stems were left over from the preceding fall or where perches near the feeding stations are available. Multivariate analysis confirmed the trends predicted for 30 feeding sites. Other vegetation or structure parameters as well as feeder types were analyzed to predict higher frequencies of visits and increased numbers of birds at several experimental sites.

## INTRODUCTION

Optimal foraging strategy predicts that animals, at least the survivors, will choose selectively, will optimize their behavior to use a special habitat, a feeding site, a food type, or will perform so as to handle resources most efficiently and thus maximize some currency or energy utilization for better survival (Shoener, 1971; Pyke et al., 1977; Kamil and Sargeant, 1981). The extent to which the predictions of the model are upheld seems to depend partly on the simplicity with which the laboratory or field environment is designed.

Schluter (1981) and Menzel and Wyers (1981) question the validity of the main predictions of the model of optimal foraging, because they have not yet been evaluated in more complex, multifold systems or from a wider array of macroscopic questions and alternatives. Nevertheless, the animals seem to come pretty close to optimal strategies. Assuming the value of this theory, we want to test some predictions in a multifold system to answer the where, when, and what to feed birds to attract them to any treatment made for control or management of so-called pest species.

Chemosterilization in red-winged blackbirds (*Agelaius phoeniceus*) is believed to be a potentially useful tool to control bird populations (Davis, 1961; Mitchell et al., 1969; Guarino and Schaffer, 1975; Stehn and Dolbeer, 1980; Barclay, 1981; 1982; Potvin et al., 1982a,b; Lacombe et Cyr, 1984a,b). Because of the social and flocking behavior of the redwings, the sterilant should be given to the male birds through food offered to spring flocks of migrant birds, mainly monospecies flocks or mixed blackbird flocks, returning to nesting sites. This procedure should maximize the efficiency of a treatment, if the birds can be attracted to the feeders containing treated food. Yet, this last problem of attracting the birds to feeders remains a great challenge for chemosterilization as well as other control methods that involve giving drug through food to the birds.

Thus, we chose to investigate some aspects of the optimal behavior of the redwings in order to obtain methodological cues for application purposes. Let us assume the birds fly. From a distance they will recognize fewer details than when on the ground. Our approach is thus to set predictions at different perception levels of the birds moving from a flight distance to the ground. Our predictions are, firstly, that the number of birds and the frequency of visits increase with the surface ratio of open or cultivated areas over the whole area surrounding the feeders. Secondly, because of heavy snow cover that lasts well into spring in Quebec, we predict that along an artifical gradient, from hay fields or pasture, to corn fields harvested the previous fall, without corn left standing over winter to corn fields harvested the previous fall with several rows of corn left standing over winter, we would get increasing numbers of birds visiting the site and/or the feeders. Finally, based on preliminary trials in indoor aviaries, we predicted that feeders with decoy or living birds nearby would attract more birds more often than feeders without them.

## STUDY AREA AND METHODS

This study took place in the area between Lennoxville, Cookshire, and Waterville in the Eastern Townships, Quebec. The area suffers moderate damage from blackbirds but is very suitable for experiments due to the location of the Federal Agricultural Research Station in Lennoxville. The corn crop suffers the most from blackbird depredation, especially following the large increase (16%) in blackbird populations in Quebec between 1966 and 1981 (Erskine, 1978; Dolbeer and Stehn, 1979).

The experiments consisted of choosing 30 sites divided into three groups, A, B, and C, with 10 sites each. Group A sites had harvested corn with a few 300-feet-long rows of corn left standing the previous fall. Group B, sites were the same as A without rows of corn. Group C were control fields without corn, mostly hay fields or pasture. We set up combinations of two feeder types per site on the corn-field sites, replicating 10 different choices on Group A and B sites. The feeder choices will not be analyzed here. At each site, we presented either no decoy, a metal or stuffed decoy, or a living male redwing in a small cage. Feeders were replenished regularly.

The observations took place between mid-March and early May, one hour daily at each site, and were made from a distance to avoid disturbing the visiting birds. The sequences of the daily visits were chosen randomly between 0700 and 1700. The data recorded at each site included the presence of the birds, the travel distance (if seen flying), the habitat features, the feeders, and the field used.

We also measured several parameters associated with the corn left in the experimental rows of Group A sites, namely the number of rows of corn stems, the number of stems, the number of ears per stem, the percentage of corn stems standing or lying on the ground, etc. The habitat evaluation included the measurements of the area of each habitat type from aerial photographs, measurements in the field of habitat structures and distances between them and the experimental field and feeder.

Data were always checked for normality with the Saphira-Wilk test before performing further analyses to evaluate the predicted trends. Multivariate analysis included BMDP-discriminant analysis, principal component and factor analysis to evaluate the parameters accounted for in an *a posteriori* grouping of our sites.

## RESULTS

Our results were analyzed from different bird perception levels. The first question is related to the size of the target to be reached from a distance (Menzel and Wyers, 1981). Our first prediction deals with surface ratio of habitat coverage. The bird should respond firstly to the relative surface of the different patches of gross habitat types it perceives. From Table 1, we see that hay fields are a dominant feature of the area, with 45.7% of all sites, followed by wooded areas with 26.5%, and cultivated areas with

18.1%. Thus, depending on the attractiveness of a site as a potential resource for the birds, we expect a bird or a flock of birds to choose landing in any area which presents, at first sight, enough of the resource habitat.

A discriminant analysis was performed to determine how well the sites are group specific. The result is a very good classification of the sites (Table 2). Since each group of sites seems to have its own characteristics, a Principal Component Analysis (PCA) was performed to see how, by their features alone, the habitats segregate from each other and which features explain this segregation. Only two factors accounted for 82.4% of the total variance. The first one separated the coverage from open to closed habitats along the first axis, while the second sorted out the cultivated areas from the non-cultivated open areas. Plotting the transformed data for each site into factor scores shows that sites in groups A and B occupy a more central place on the graph, and the control group C sites occupy the central right portion of it (Fig. 1).

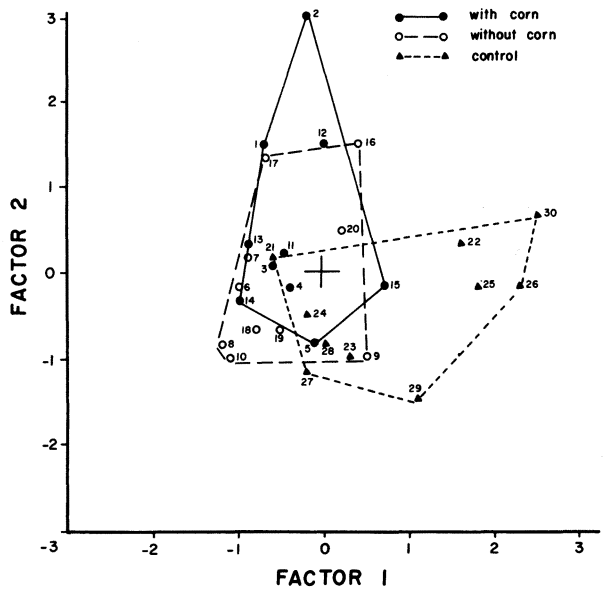


**FIGURE 1. Position of each site along factor score 1 and 2 of a principal component analysis.**

Table 3 gives the sites arranged in decreasing order of number of birds (N), as well as the frequency of visits (F), and the ratio of these two values. We rearranged the sites in decreasing order of their N/F ratio and calculated successive means of the corresponding factor scores for five adjacent sites from this rank order. We plotted these values on a graph (Fig. 2) that fits the Figure 1 coordinates. Three groups of sites showed up. They include mainly A sites in the upper left hand corner, B sites in the lower left, and C sites at the right side of the graph. The overlapping of Figures 1 and 2 reveals that birds show site selectively in agreement with site features alone. Thus group A sites were visited more than group B, and group B more than group C sites.

From our second prediction, redwings should be more attracted to corn fields with corn left standing the previous fall. Figure 3 shows the number of birds in relation to the frequency of visits at each site. We notice, at first glance, a difference between the three groups of sites. A site which is visited more frequently is also usually visited by more birds; bigger flocks tend to show site fidelity in their foraging patterns. Conversely, a site infrequently visited by few birds suggest that it is not suitable to attract big flocks.

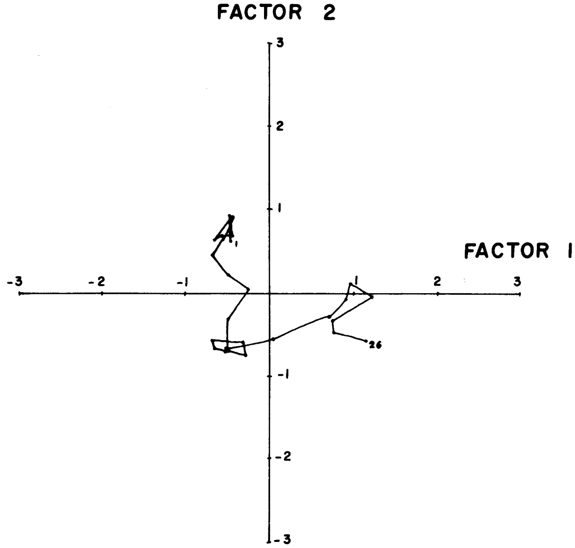


**FIGURE 2.** **Successive factor score means (1 to 26) corresponding to five adjacent sites arranged in rank order of decreasing value of their ratio N/F (see Table 3 and text).**

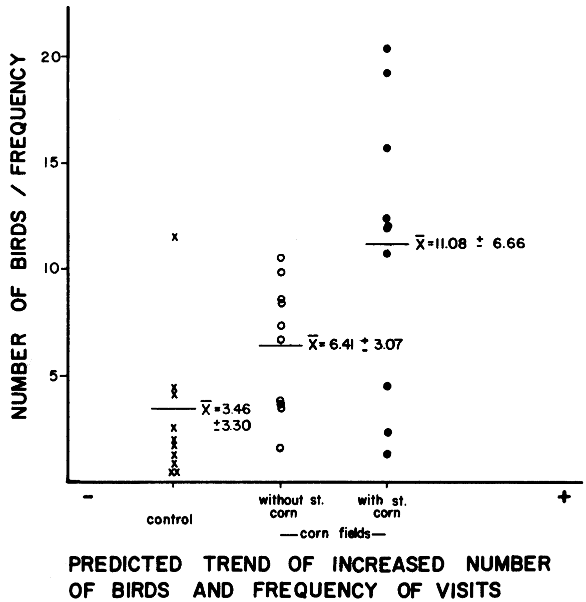


**FIGURE 3.** **Number of birds plotted against frequency of visits for three groups of sites.**

We plotted the N/F ratio (Table 3) against the predicted trend of increased numbers and visits of birds from group sites C to A. The expected trend shows up very well, with significant correlation (r = 0.603, $P < 0.01$). One might question the position of the three groups of sites along the X axis. Indeed, this is not a natural gradient. If we transform the scale to extremes, such as a log one or an exponential one, we would still get a significant correlation coefficient of r = 0.590, $P < 0.01$ for the log scale, or r = 0.595, $P < 0.01$ for the exponential one. These two extreme cases mean graphically that either groups A and B both lie very far apart from C along the X axis or that groups C and B are grouped far apart from A. Neither makes sense, though, if we look at the following results.

We performed a discriminant analysis with several variables to classify the 30 sites without *a priori* grouping. The only bird variables that discriminated the sites were the number of birds and frequency of visits. The mean value of these variables for each group of sites is given in Table 4. An *a posteriori* classification yielded 80, 80, and 70% of correct grouping into control fields (C), corn fields without standing corn (B), and corn fields with standing corn left over winter (A), respectively.

Among the sites that were wrongly classified, field no. 21 was located near a corn field which was harvested the previous fall. Yet, it remains unclear why this site was not classified as belonging to group B instead of A. The nearby corn field brought birds to the site that might not otherwise have shown up. The three wrongly classified group A sites had the lowest percentage of their surroundings cultivated as compared to the mean surface coverage for their group; moreover, the farmer had left the standing corn rows along the edge of a wood in two out of these three cases, rendering it less attractive. Further analysis below will throw more light on the reason for this *a posteriori* wrong classification of some A sites. We could not find good field evidence to explain the wrong classification of two sites of group B. The absence of perches near the feeding site may have been important for this event in both cases.

We also examined the structure of rows of corn left standing in group A sites. We performed a PCA to find out which parameters explain the observed pattern of bird visits. This analysis reveals that three factors explain 80.4% of the total variance. Along the first axis, we find at one end the number of ears on the ground and at the other the number of ears on the stems and the number of stems per 25 m. The second axis is represented by the relative percentage of stems standing and lying. These parameters are not correlated to the ones above. The third axis is explained by the total length of the rows and their width and number. From the above analysis, we found that the factor scores sorted out sites 14 and 15, one having the lowest value along the second factor score axis and the other the lowest value along the first one.

This enhances the explanation for low attractiveness of these sites and the wrong classification among group A sites in the previous analysis. Site 5 is also located on the periphery of the cloud of points in the factor score plot. These three sites attracted fewer birds in the spring for reasons associated with the general surroundings (surface coverage of habitat), the proximate surroundings (localization of standing rows of corn), and the structure of rows of corn after the winter.

Our third prediction deals with decoys. Table 5 summarizes the data set used for the analysis. Only the first 20 sites, groups A and B sites, were used for this analysis. The first two variables in the table show the mean attractiveness of each group of sites, although this does not mean that the birds will also be attracted to the feeding trays, where we expect to feed them eventually with treated corn. The other variables in the table relate to the feeding trays associated or not to a decoy, and the results are self explanatory. An *a posteriori* classification with a discriminant analysis yielded 75% correct classification with stuffed or metal decoys and 100% correct classification without decoy or with a caged living bird.

A living bird in a cage should thus attract roughly 50% more birds at the feeder and possibly 500% more as compared to sites with stuffed or metal decoys or sites without any. The problem remaining to be solved is attracting to the feeders more than 20% of all the birds landing on the site surrounding a feeder.

## DISCUSSION

MacArthur and Pianka (1966) and Wiens (1976) demonstrated the capacity of organisms to recognize and respond to environmental patchiness. This is the first step toward access to a potential food source by an animal. The problem that we face is to make the birds fly down to whichever food we offer them in order to administer a treatment or drug through the food for management purposes. In the spring, especially in Quebec, the soil is mostly covered with snow, often until early April. Only then does it begin to show as the snow melts. Since food sources are hard to find in the winter, the main cues or search images the bird might use from a distance in flight are the size of each patch in the general surroundings.

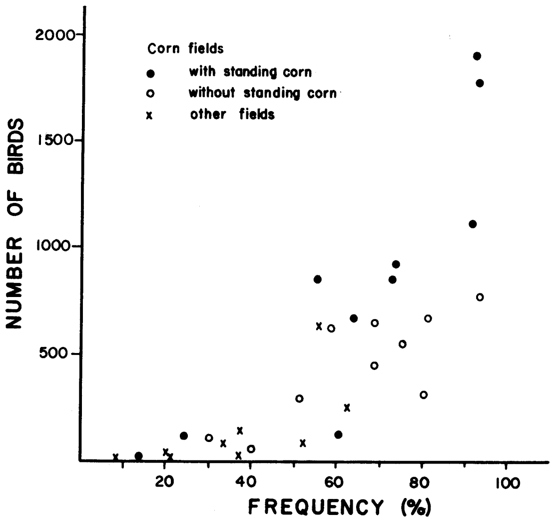


**FIGURE 4. Ratio of number of birds over frequency of visits plotted against the predicted trend of site choice.**

In our analysis, we did not separate the data into periods with complete snow cover and bare soil, due to fluctuations in snow coverage until late April. It indeed fluctuates much from year to year and within March and April. There are several unpredictably spaced snowfalls until the end of April which, at times, re-cover soil that was completely exposed for the birds to search for food. Thus, our first analysis does not demonstrate satisfactorily as yet the choice of an environmental patch. The present evidence allows good predictions on which sites might attract the birds more easily; further testing might improve the evidence. Corn fields surrounded with wooded areas at too close a distance do not render the sites interesting for the birds to land on.

In early spring, the foraging space availability is reduced and thus should restrict the birds in their use of space. Clark and Potvin (pers. comm.) as well as our personal observations led to testing rows of corn relative to attracting redwings. The predictions were met with greater verification than expected. Rows of corn left standing will indeed attract the birds more readily, because they show above the spring snow cover. Unexpected variation remains in the attractiveness value of these rows, however. They can be preyed upon by small mammals over winter and crows or other blackbirds in the spring. This will be more so if, due to wind and heavy snow, the stems fall down to the ground, rendering the corn available to microtine mammals.

We did find variation in the quality of the rows of corn left standing and might expect this to reduce to some extent the value of our predictions. Other tests will be done to evaluate the potential attractiveness of these rows, with measurements being made over the snow in early March.

Although we could attract more birds to the feeders if there was a living caged bird nearby, the total number of birds seen at the feeders was relatively small. One problem thus remains, namely, to set up a type of feeder or a combination of feeders and food to which the birds might react more readily. Any treatment would be more efficient if we could get the bird to reach the feeder and stay long enough to eat the required amount of food in order to be affected by the chemical.

Preliminary tests were made with color, shape, and area of feeders. They are as yet inconclusive, because the sample sizes are too small. Yet, we should not underestimate the analytical capacities of animals. Maybe it is not that the behaviors are unpredictable, but we fall short of guessing which actions are indicative. (Menzel and Wyers, 1981).

From Bent (1965) and personal observations, we noticed that the blackbirds exploit the fields in the spring in a rolling fashion. Each bird stays no more than 90 to 120 seconds on the ground, then moves over its colleagues to the front of the bird wave. The wave itself is a wide front of birds exploiting a field systematically. We believe that it is possible to use this bird behavior in offering rows of feeders. Each bird "rolling" from one feeder to the next would thus get the minimum amount of chemical it needs to be affected more quickly.

With the above experiments, we sought to understand how the blackbirds work in their selection of a feeding site. Although the problem the birds are facing is concurrently and not sequentially multifold, we still needed to distinguish different cognitive perceptions of the birds. The first problem the bird faces from the air is where to land. We were able to predict quite accurately, for field situations, which general surroundings they prefer: sites with standing corn left over winter and feeders near a living bird in a cage.

Optimally speaking, the birds seem obviously able to make choices, although we were not able to measure if the same birds or the same flocks evaluated the different possibilities before making their choice. An experiment in the field is not comparable to controlled laboratory experiments as done by Krebs (1980) and others. The system we chose to look at is as complex as it is, because we cannot manage most of the factors. Yet, it is obvious that some choices did take place, be it before our experiments or during them. Birds' decisions seem to be oriented partly toward what to choose in order to get to the food. The conclusions reached show some promise if we dare look at the bird's point of view. When it gets closer to the ground, its perception level necessarily changes as much as the cues it uses to select one or the other parameters. Taking Rotterman and Monnet's comments into account, our study is preliminary; our conclusion are not final. Variation needs to be considered, as corn growers do not grow corn in the same field every year, even if they do grow it each year. Hence the study plot cannot be the same every year. The yearly variation estimates need to be looked at between and not within habitats.

As pointed out by Weatherhead and Bider (1979 and pers. comm.), the sterilization method is limited by our capacity to get the chemical to the birds. Asking the birds to tell us where and how to put it is probably our best bet for an answer. The next step will be to establish a strong collaboration between pest managers and growers to have the latter spend 20 to 30 dollars in rows of corn left standing over winter to attract birds in the spring. This would ease testing the application of a sterilant or any drug, depending on the treatment foreseen.

## ACKNOWLEDGEMENTS

We are very grateful to Yves Cuerrier, Sylvain Guilbert, Victor Hellebuyck, Luce Langlois, Jocelyn Lavertu, Christian St-Cyr, and Jean-Pierre Vitiuk for field assistance. Louis-Marie Thēriault deserves credit for the drawings; Nicole Vanasse, for typing the manuscript. Funding for this study was provided by Conseil de Recherche et Services Agricoles du Quēbec of Quebec Agricultural Ministry and by Fond FCAC of Quebec Education Ministry.

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**TABLE 1. Mean (in %) and standard deviation of coverage of each habitat type.**

| Habitat type | Group A With standing corn | Group B Without standing corn | Group C Control |
|---|---|---|---|
| Experimental fields | 9.4 ± 5.3 | 7.6 ± 4.7 | 8.3 ± 4.4 |
| Cultivated fields | 31.7 ± 16.3 | 20.8 ± 12.2 | 6.2 ± 7.8 |
| Hay fields | 50.3 ± 10.6 | 60.5 ± 17.1 | 38.0 ± 20.0 |
| Abandoned fields | 0 | 0.8 ± 1.8 | 5.6 ± 7.7 |
| Woods | 18.2 ± 17.2 | 17.9 ± 17.2 | 50.2 ± 19.9 |

**TABLE 2. Discriminant analysis on surface coverage of each habitat type.**

| N/Case = 10 From fields of | % of observations classified into fields of Group A | Group B | Group C |
|---|---|---|---|
| Group A | 80.0 | 20.0 | 0.0 |
| Group B | 20.0 | 70.0 | 10.0 |
| Group C | 10.0 | 10.0 | 80.0 |
| Total % | 36.67 | 33.3 | 30.0 |

**TABLE 3. Number (N) of birds, frequency (F) observation and ratio N/F for each site.**

| Site | Group | Number (N) of red-winged blackbirds | Frequency (F) of observation (%) | Ratio N/F |
|---|---|---|---|---|
| 12 | A | 1906 | 92.6 | 20.58 |
| 1 | A | 1793 | 93.1 | 19.26 |
| 4 | A | 1106 | 92.0 | 12.02 |
| 11 | A | 917 | 73.9 | 12.41 |
| 2 | A | 879 | 73.3 | 11.99 |
| 3 | A | 868 | 55.2 | 15.72 |
| 17 | B | 791 | 93.1 | 8.50 |
| 8 | B | 689 | 81.5 | 8.45 |
| 13 | A | 680 | 63.0 | 10.79 |
| 16 | B | 668 | 68.0 | 9.82 |
| 21 | C | 648 | 56.5 | 11.48 |
| 6 | B | 614 | 58.1 | 10.57 |
| 19 | B | 560 | 75.0 | 7.47 |
| 9 | B | 459 | 68.0 | 6.75 |
| 7 | B | 305 | 80.6 | 3.78 |
| 10 | B | 299 | 51.6 | 3.71 |
| 27 | C | 258 | 62.5 | 4.13 |
| 24 | C | 156 | 37.5 | 4.16 |
| 5 | A | 133 | 60.7 | 2.19 |
| 14 | A | 110 | 24.1 | 4.56 |
| 18 | B | 105 | 30.8 | 3.41 |
| 22 | C | 97 | 52.2 | 1.86 |
| 23 | C | 84 | 33.3 | 2.52 |
| 20 | B | 65 | 40.0 | 1.63 |
| 30 | C | 39 | 20.0 | 1.95 |
| 28 | C | 34 | 37.0 | 0.92 |
| 15 | A | 18 | 13.8 | 1.30 |
| 25 | C | 10 | 21.7 | 0.46 |
| 26 | C | 10 | 21.7 | 0.46 |
| 29 | C | 9 | 8.0 | 1.13 |

**TABLE 4. Number of birds and frequency of visits in three experimental groups of sites.**

| Fields | Number of birds | Frequency of visit |
|---|---|---|
| GROUP A With standing corn | 841.0 ± 654.69 | 64.2 ± 27.56 |
| GROUP B Without standing corn | 455.5 ± 251.83 | 64.8 ± 19.57 |
| GROUP C Control | 135.8 ± 196.68 | 35.8 ± 17.84 |

**TABLE 5. Number of birds at sites with or without decoy or living bird in a cage.**

| Number of blackbirds (X ± SD) | Without decoy | With decoy | With living bird |
|---|---|---|---|
| Total on the site | 261.0 ± 261.1 | 1028.0 ± 955.9 | 575.5 ± 309.6 |
| Mean per day on the site | 13.0 ± 9.5 | 18.75 ± 8.5 | 20.0 ± 2.5 |
| Mean per day on red feeders | 3.0 ± 2.94 | 1.25 ± 0.5 | 5.0 ± 4.8 |
| Mean per day on yellow/green feeders | 2.5 ± 2 | 1.25 ± 0.96 | 5.5 ± 4.1 |
| Total on red feeders | 8.5 ± 8.7 | 21.0 ± 22.7 | 114.0 ± 119.9 |
| Total on yellow/green feeders | 17.3 ± 17.7 | 31.0 ± 32.7 | 54.0 ± 59.9 |