# Utilization of a Limited Preferred Food Resource by Blue Jays *(Cyanocitta cristata)*

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## ABSTRACT

The constituency of a Blue Jay *(Cyanocitta cristata)* flock that had learned the filling schedule of a backyard feeder providing a limited daily supply of unshelled peanuts was determined in the winter of 1999/2000. During Dec - Feb, 117 jays (57 hatching-year/second-year and 60 after-hatching-year/after-second-year) were trap-ped at the feeder site in central New Jersey and banded. Eighty-five surveys were conducted during Mar - Jul 2000. During the first 37 surveys (through 13 May), 75 ± 4% of the jays visiting the feeder were banded, and the results from these surveys were used to estimate that 157 ± 9 jays had used the limited resource. The surveys also determined that the jays banded were sedentary residents. This study demonstrated that a limited daily supply of a preferred food was sufficient for sedentary resident Blue Jays to establish a feeding-site fidelity and that the study paradigm may be suitable for other feeder-use evaluations.

## INTRODUCTION

Some Blue Jays *(Cyanocitta cristata)* participate in seasonal migrations, while others remain sedentary and do not stray from their fledging locales (Lincoln 1927, Schorger 1964, Middleton 1974, Leck 1975, Smith 1979, Kennard 1980, Stewart 1982, Graber et al. 1987, Carpenter et al. 1990, Yunick 1995, Walsh et al. 1999). Although the factors influencing these survival strategies are not well defined, food availability is thought to be a factor (Tarvin and Woolfenden 1999). Studies have attempted to correlate Blue Jay migration patterns with fluctuations in food availability, but the findings have been inconclusive (Bock and Lepthien 1976, Racine and Thompson 1983). Although this opportunistic corvid readily discovers and utilizes food sources provided by humans, it remains to be determined what impact, if any, continuously provided food in feeders has on sedentary and/or migratory Blue Jay behavior (Racine and Thompson 1983, Hickey and Brittingham 1991). Interestingly, there have been no studies of Blue Jays that have learned to exploit a favored food that is supplied in a limited quantity, and this study was undertaken to initiate an evaluation of this behavior.

In 1994. a feeder for dispensing peanuts was constructed (Fig. 1) and mounted 2 m above the ground on a mature maple tree in PW's backyard in rural central New Jersey (40° 18' 42.8" N; 74° 46' 57.7" W). The feeder attracted Blue Jays to the yard by providing a limited offering of unshelled peanuts (~125) each morning; and when the peanuts were available, the jays generally ignored the sunflower seed and cracked corn that were provided continuously in other nearby feeders.

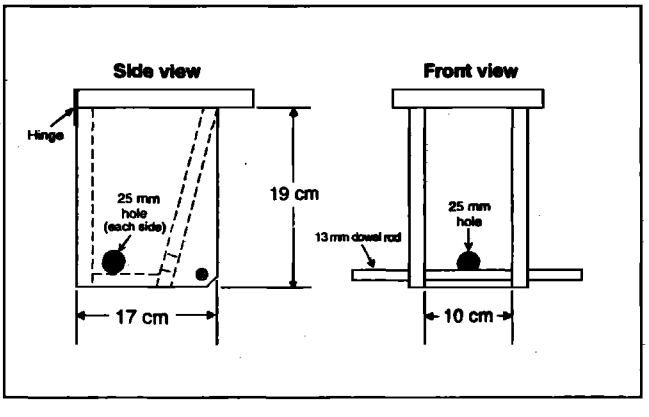


**Fig. 1.** Basic design of a whole-peanut feeder. The location of the perching dowel positioned the Blue Jays for taking peanuts from the side ports.

Blue Jays readily learned to use the peanut feeder; and when not deterred by cats or accipiters, the feeder was usually emptied within 30 min, which suggested that a considerable number of Blue Jays benefitted from this resource. The Blue Jays also learned that once the feeder was emptied, it remained empty for the rest of the day, and jays were seldom seen visiting the empty feeder. Acquiring these behaviors was not unexpected since the ability of jays to learn feeder-filling schedules has been noted previously (Racine and Thompson 1983).

During the five years prior to initiating this study, the regularity of this behavior suggested that the Blue Jays using this feeder were probably sedentary residents because latitudinal migrants would have little opportunity to learn of this food source; i.e., the peanut supply was depleted quickly each morning by the "feeder-user" jays. However, there remained the possibility that two different Blue Jay groups (ie., "winter" and "summer" migrant populations) were exploiting this food source (Tarvin and Woolfenden 1999). To evaluate this possibility, it was deemed necessary to identify the Blue Jays using the feeder and to determine if there were any changes in the constituency of the feeder-user jays over time. To accomplish this goal, we trapped and banded Blue Jays visiting the feeder site and then conducted feeder surveys at the end of the banding period. Trapping and banding were accomplished in the winter when no latitudinal Blue Jay migration was occurring in New Jersey and after local hatching-year (HY) jays had either dispersed or become feeder users. The results of the 1999/2000 winter assessment of the feeder-user jays are presented in this report.

## METHODS

***Capture/Banding Protocol*** — Blue Jays were captured Dec 1999 through Feb 2000 using a four-cell Potter trap. The trap was located 3 m from the peanut feeder and was baited with a portion of the unshelled peanuts (~10/chamber) that would normally be placed in the feeder. On non-trapping days the trap served as an adjunct peanut feeder, and the peanuts usually placed in the feeder were allocated between the feeder and the trap (~10/chamber). Trapping sessions were for five hours (beginning at dawn) on 1-2 days/week. After the last banding session, the trap was removed from the yard and all of the peanuts were placed in the feeder. Numbered aluminum bands (Bird Banding Laboratory, U.S. Fish and Wildlife Service, Laurel, MD) were placed on the left leg. The jays were aged via criteria listed by Pyle (1997). Morphologies, measurements, body weights, and assessments of body fat were recorded. Prior to initiating this study, no banded Blue Jay had ever been observed visiting the peanut feeder or yard.

Color-banding individual Blue Jays was considered inappropriate for this study. Pre-study observations of jays using the feeder indicated that it would not be possible to determine color-band sequences accurately because: 1) visits frequently lasted for <2 seconds, 2) it was common for several jays to visit the feeder simultaneously, and 3) ambient light levels were insufficient for identifying band colors at dawn when the surveys were initiated. Therefore, it was decided to forego individual color marking in this study.

***Feeder Survey Procedure*** — For this study, 85 feeder surveys were conducted 28 Mar through 15 Jul 2000. Surveys were initiated by filling the feeder at dawn and then observing the feeder until it was empty or for 45 min (timed from when the first jay came to the feeder). Observations were made at a distance of 12 m (from within the house) using a 9.5X binocular. Each Blue Jay visiting the feeder was tallied as either wearing a band or not, and for each survey the percentage of Blue Jays visiting the feeder with bands (i.e., relative distribution) was calculated based on the recorded total number of banded and unbanded jays. The competitors visiting the feeder were also documented. It is recognized that proportionality data could have been obtained via surveys on non-trapping days during the three-month banding period, but such data could have been biased by trap-wary jays; therefore, we elected to keep the banding and surveying periods separate.

***Population Estimation Method*** — The Petersen mark-recapture method (Krebs 1994) was adapted for calculating an estimate of the number of feeder-user jays. This method is based on capturing and marking a portion of a target population followed by determining the proportion of marked individuals in the population via random samplings.

## RESULTS

***Blue Jays Banded*** — During seven trapping sessions, 117 Blue Jays (57 HY/second-year [SY] and 60 after-hatching-year [AHY]/after-second-year [ASY]) were caught and banded. (One jay was banded inadvertently on the right leg.) Not all of the jays coming to the feeder site were captured. Adipose tissue deposits in the furculum were minimal or absent, which is typical for birds that winter in central New Jersey (Suthers 1988). Twenty-four percent (16 HY/SY; 12 AHY/ASY) of the Blue Jays banded were recaptured; four of these jays (3 SY; 1 AHY) were recaptured twice.

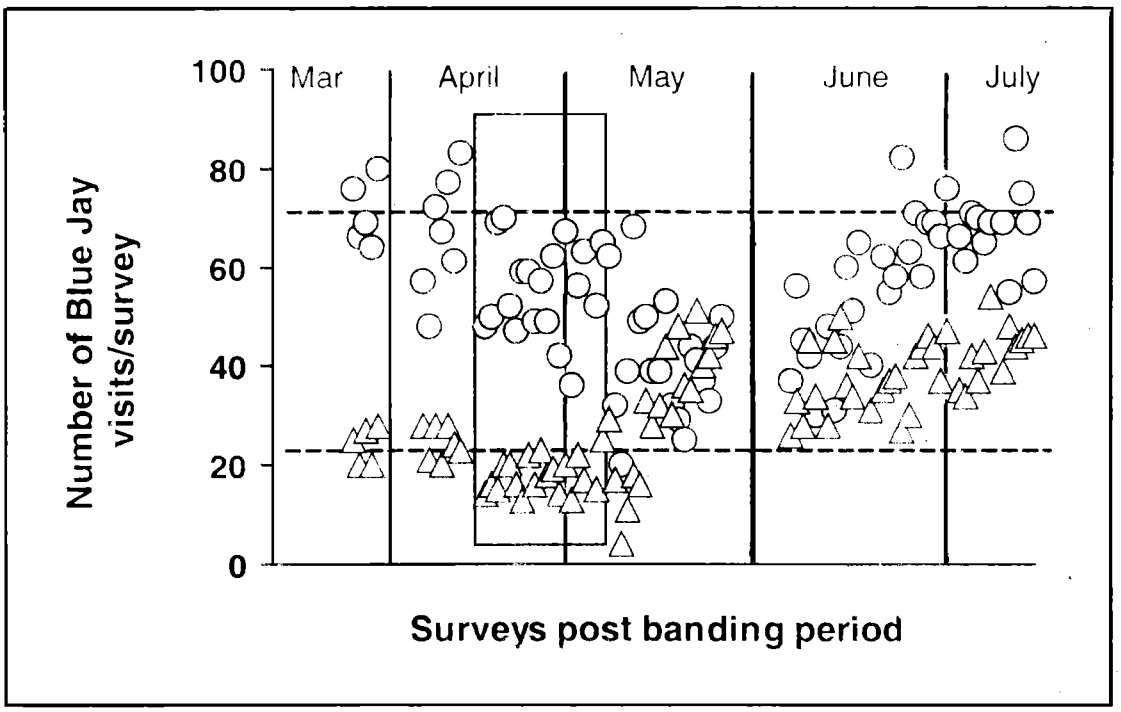


**Fig. 2.** Blue Jay visitation: Number of banded ( circles) and unbanded ( triangles) jay visits to the peanut feeder during the 85 surveys conducted 28 Mar - 15 Jul. The baselines (shown as horizontal intermittent lines) indicate the mean number of banded and unbanded jays observed visiting the feeder during the first 5 surveys conducted (28 Mar - 1 Apr). Baselines are provided for evaluating the visitation data over the survey interval; regression analyses of the data sets used to generate the baselines confirmed their appropriateness (banded jays: $y = 0.0079x + 70.8$, $r = 0.017$; unbanded jays: $y = 0.0079x + 23.8$, $r = 0.028$). The rectangular box indicates the interval when Blue Jays were observed migrating through the study area. The vertical lines identify the surveys conducted during each month. (Space limitations prevent listing the dates for each survey but are available upon request.)

***Peanut Feeder Surveys*** — A total of 7340 Blue Jay visits (4728 banded jays and 2612 unbanded jays) were recorded visiting the feeder during the 85 surveys. The number of banded and unbanded jay visits to the feeder during each survey are plotted in Fig. 2. The feeder was totally emptied during 60 of the surveys (and mostly emptied during the other 25 surveys). Note: Prior to initiating the study, it had been noted that the jays generally emptied the feeder within 30 min; therefore, 45 min was selected as the survey interval in the belief that the feeder would be emptied totally within the time limit. In some instances, however, 45 min was not sufficient for the feeder to be emptied completely, but it was sufficient for determining the relative distribution of the banded jays visiting the feeder.

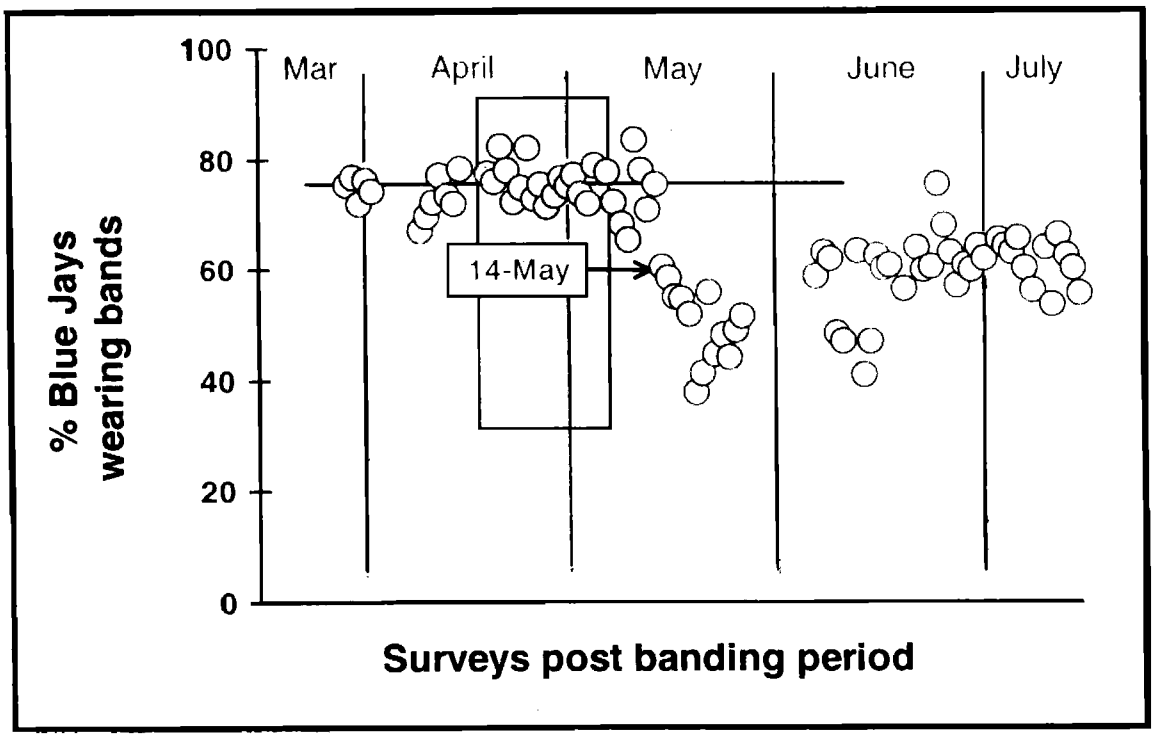


**Fig. 3.** Relative distribution: Percent of Blue Jays visiting the feeder during each survey ([number of banded jays/total number of jays] x100). The horizontal line indicates the mean relative distribution (75%) for the 37 surveys conducted 28 Mar through 13 May (regression analysis results: y = 0.0087x+74.2, $r$ = 0.030). The survey when the relative distribution data first indicated that the feeder-user constituency had changed (14 May) is identified. The rectangular box identifies the interval when Blue Jays were observed migrating through the study area. The vertical lines separate the relative distributions by month.

The relative distributions based on the number of visits made by banded and unbanded jays to the feeder during the surveys are presented in Fig. 3. The relative distributions were found to be remarkably uniform (75 ± 4%) during the first 37 surveys conducted (28 Mar -13 May) even though the numbers of both banded and unbanded jays visiting the feeder began to decrease beginning in mid-Apr (Fig. 2). The decreases in the number of visits made by jays to the feeder may be related to the onset of breeding activities (mid-Apr - May) and/or from increased competition for the peanuts by other species (particularly in May and Jun). Fig. 3 also shows the significant change (i.e., decrease) in the relative distributions that began on 14 May ($p<0.01$, Mann-Whitney U-test, Goldstein 1964), which reflects the increase in the number of unbanded jays that began to visit the feeder (see Fig. 2). However, during mid-June and July, the relative distributions had stabilized at 62 ± 4% (Fig. 3).

In June, the number of banded jays visiting the feeder also began to increase; and by the end of June, the number of visits made by banded jays to the feeder had returned to baseline (i.e., the mean number of visits recorded during the first five surveys - Fig. 2).

***Feeder-user Population Estimates*** — The calculated population estimates of feeder-user Blue Jays are based on the 37 surveys conducted through 13 May and are plotted in Fig. 4 Regression analysis of these population estimates indicated that the feeder-user population had remained relatively constant through 13 May ( y = -0.0571x + 160.7, $r$ = 0.089). The mean number of Blue Jays using the feeder (based on the calculated estimates presented in Fig. 4) was 157 with a standard deviation (S.D.) of nine jays.

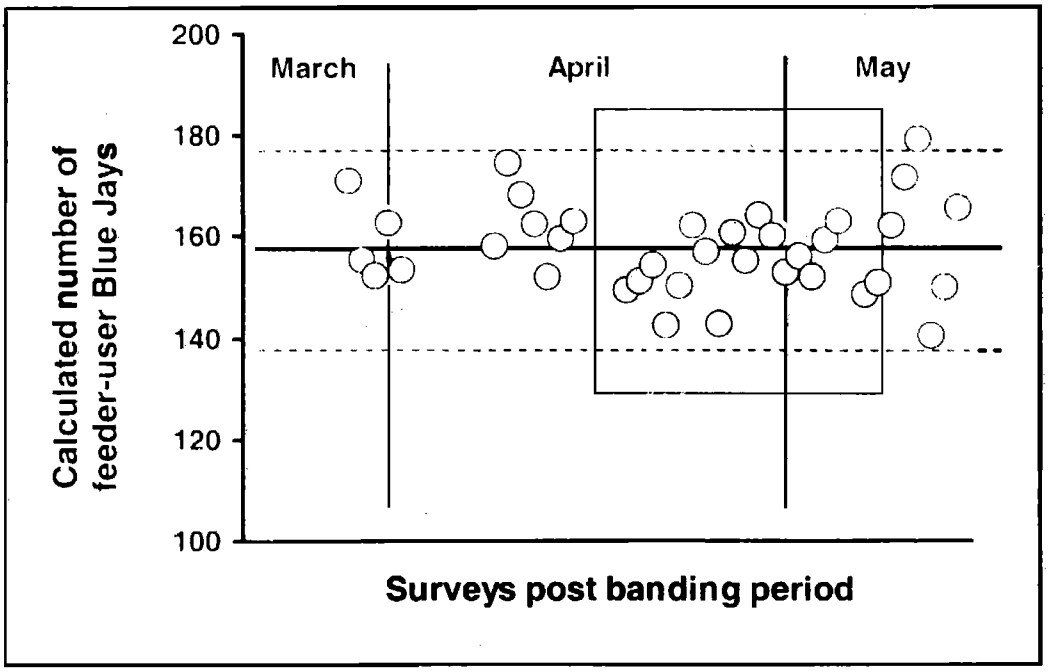


**Fig. 4.** Feeder-user Population Estimates: Calculated population estimates for the number of Blue Jays using the peanut feeder based on the total number of Blue Jays banded (117) and the relative distribution data obtained 28 Mar through 13 May (presented in Fig. 3). The horizontal solid and intermittent lines indicate the mean and ± 2 S.D., respectively, for the calculated feeder-user population estimates. The rectangular box indicates when Blue Jays were observed migrating through the study area, and the vertical lines designate the month.

***Effects of Multiple Feeder Visits*** — It was expected (and confirmed by observing the jay banded on the right leg) that some individuals would make multiple visits to the feeder during a survey; but since all of the jays had equal access to the feeder, the relative ratio of banded to unbanded jays visiting the feeder during each survey was accepted as being unaffected.

***Inter-species Competition*** — Four competitors usurped the Blue Jays at the feeder: (1) Gray squirrels *(Sciurus carolinensis),* a primary competitor, made from 4 to 32 visits/survey, (2) Red-bellied Woodpeckers *(Melanerpes carolinus),* a minor competitor, routinely visited the feeder (1 to 16 visits/survey), (3) American Crows *(Corvus brachyrhynchos),* a sporadic competitor, visited the feeder during 35 of the 85 surveys conducted (1 to 9 visits/survey), and (4) Common Grackles *(Quiscalus quiscula),* a seasonal competitor, made between 6 and 59 visits to the feeder during surveys conducted 20 May to 15 Jul.

## DISCUSSION

Previous studies of Blue Jay behavior at feeders were based on food being supplied continuously for *ad libitum* consumption (Racine and Thompson 1983, Hickey and Brittingham 1991). This resulted in migrating Blue Jays discovering and using the resource. In our study, a limitless supply of peanuts was not provided. Limiting the number of peanuts supplied each morning, coupled with a temporal component (filling the feeder at dawn), created a task that had to be learned by the Blue Jays in order for them to benefit regularly from this preferred food source. Banding feeder users in the winter, when Blue Jay migrations were not in progress, and surveying the feeder users after banding (before, during, and after the spring Blue Jay migration and breeding periods in New Jersey) allowed us to determine if the banded jays were "winter" migratory residents that emigrated in the spring and/or if attitudinal Blue Jay migrants used the feeder.

The 117 Blue Jays banded were considerably more than anticipated, particularly considering the limited trapping effort. Racine and Thompson (1983) captured and individually marked an average of 125 jays/year during 3.3 years of capture effort (using mist nets and traps) in Worcester County, MA. The majority of their captures occurred during the spring and fall migrations, and only 78 of the 413 jays they banded remained in the vicinity of their feeders for more than one week. Hickey and Brittingham (1991) captured and individually marked an average of 107 Blue Jays/year during 22 years of a continuous trapping effort at their backyard feeders in Madison, WI, but <5% of their jays were captured and banded during the winter (Oct - Mar). Both of these studies found that some of the banded jays appeared to remain in 'cohesive' flocks that exhibited fidelity to the feeders throughout the winter.

***Determining that Feeder-user Blue Jays were Sedentary Residents*** — At the outset of this study, it was not known if the feeder-user Blue Jays were from two seasonally separate migratory groups, as has been noted at other locations (Tarvin and Woolfenden 1999). It was hypothesized that if two migratory groups ("winter" and "summer" populations) were using the feeder, the feeder surveys during the spring migration period should be able to determine (by a substantial reduction in the relative distribution) when the "winter" jays had emigrated and the "summer" jays had arrived. This did not happen when latitudinal Blue Jays were observed migrating through the study site beginning during the third week of April and continuing through the first week of May, which was well within the period when latitudinal Blue Jay migrants historically have passed through New Jersey (Suthers unpublished data, Leck 1975, Walsh et al. 1999).

However, even though the relative distributions did not change significantly until 14 May (Fig. 3), there were decreases in the number of visits made by both banded and unbanded jays when latitudinal Blue Jays were migrating through New Jersey (Fig. 2). This could be interpreted as being an indication that a number of banded and unbanded feeder-user jays had emigrated, but the data presented in Fig. 2 also indicate that the number of visits by banded jays returned to baseline during the last week of June and remained at the baseline level through mid-July. If a portion of the banded jays had emigrated from the feeder site during April and May, then the number of banded jays using the feeder should not have returned to baseline, which is four months before the "winter" migratory population would be expected to return to the feeder site.

It can be concluded, therefore, that the banded Blue Jays using the peanut feeder were sedentary residents based on the finding that the number of visits made by banded jays in late June and July were equivalent to the number of visits made to the feeder during the last week of March and the first two weeks of April (Fig. 2).

***Latitudinal Blue Jay Migrants Assessment***: The consistency of the relative distributions (Fig. 3) during the weeks that latitudinal Blue Jay migrants were observed migrating through New Jersey suggests that latitudinal migrants did not utilize this resource. However, the number of unbanded Blue Jays visiting the peanut feeder did increase during the second half of May (Fig. 2), which is within the reported migration period (Walsh et al. 1999). It is possible that some "summer" residents arrived later than usual and started visiting the feeder and/or perhaps latitudinal migrants lingered during their passage through New Jersey and discovered the peanut feeder. There is also the possibility that other sedentary Blue Jays that were not members of the feeder-user constituencey during the winter had expanded their search for food to feed their mates/young in May and June and had discovered the feeder; this alternative appears to be the most logical.

***Estimating the Feeder-user Population*** — Generally, capture/recapture data are used to determine the proportion of marked individuals in a target population; but in order to use capture-recapture data when using the Petersen method (Spendelow 1984), it must be assumed that recaptures occur randomly and without bias. In this study, we could not assume that the captured/banded jays had not developed an aversion to the trap.

To use the Petersen method for calculating population estimates it was necessary for us to

formulate and accept four assumptions: (1) The constituency of the feeder-users remained essentially unchanged for a few months following the banding period, (2) there was no significant loss of feeder-user jays for a few months after the banding period, (3) the feeder-visiting behavior by the banded jays was unaffected by the trapping/banding experience, and (4) multiple visits by some jays to the feeder during a survey would not skew the relative distribution data. We were able to accept these assumptions for the 37 surveys conducted through 13 May, after which the significant decreases in the relative distribution data (Fig. 3) indicated that there had been changes in the feeder-user constituency.

Surveying is an acceptable method for determining the dispersion and proportioning of a target population containing individuals that have been marked (Suthers 1978, Schneider 1984). Surveying the jays at the feeder allowed us to obtain unbiased proportionality data for the population estimates, and we used the survey results obtain through 13 May to calculate that 157 ± 9 Blue Jays may have been using the feeder during the study. More importantly, the estimated number of feeder-user jays remained relatively constant through the middle of May, which is illustrated in Fig. 4 by the plotted identity lines for ±2 S.D. (indicating the 95% confidence limits) that encompass 36 of the 37 estimates plotted.

It is important to remember that relative distribution data were used to calculate the population estimates and not the number of visits made by banded and unbanded jays to the feeder. Although it may seem that decreasing visits to the feeder would be an indication that the size of the feeder-user population had decreased, it is assumed that during the breeding season some feeder-user jays (particularly those females involved with incubation responsibilities) would not be visiting the feeder (Tarvin and Woolfenden 1999). In addition, increased competition for the peanuts by Common Grackles (particularly during the Blue Jay breeding season) also deterred feeder visitation by the jays. Therefore, even though these factors translate to feeder visit decreases during the surveys, they should not be used to conclude that the membership of the feeder-user population had declined or that the feeder-user jays had emigrated.

In contrast, using our capture/recapture data and the Lincoln-Petersen weighted mean method (see Spendelow 1984) for calculating the number of jays using the feeder during the banding interval resulted in a population estimate of 261, which is 65% higher than the estimate calculated based on the feeder survey data. This indicates that an estimated 144 jays using the feeder remained unbanded, a number that is not supported by the relative distribution data (Fig. 3).

***Competition Effects*** — Squirrels and Common Grackles were the principal competitors affecting the Blue Jay visitation behavior. During the first two weeks of June (when grackles were most prevalent), these two competitors accounted for ~50% of the visits to the feeder by all species; but during the surveys conducted through 13 May, the competitor influences had been considerably lower (~20 % of the visits). Fortunately, the competitors likely affected the visitation behavior of banded and unbanded jays equally, and therefore the relative distributions were not affected.

***Significance of Age Distribution of Feeder-user Blue Jays***—The age distributions of the jays banded appeared to be nearly evenly divided between HY/SY and AHY/ASY birds. This suggests that there may be significant changes in the constituency of the feeder-user population year-to-year, either by HY/SY jays supplanting AHY/ASY feeder-user jays or by AHY/ASY jays dying or leaving the feeder site. A study has been implemented evaluating changes in the feeder-user constituency over time.

In addition, the finding that nearly half of the Blue Jays captured were less than a year old raises questions of how these jays learned to use this food source. Were the HY jays progeny brought to the feeder by parents that were feeder-users, or did HY jays learn the feeder location and filling schedule on their own? Our study was not designed to answer these questions, and it remains to be determined how Blue Jays become members of a feeder-user population.

***Assessment of Feeder Usage and Fidelity*** — Feeder-site fidelity was confirmed by recapturing 28 (24%) of the 117 jays banded at the feeder site (and by the repeated sightings of the right-leg banded jay). It is believed that this recapture percentage would have been higher if a passive capture method (e.g., mist-netting) had been employed.

Estimating that >150 Blue Jays used the feeder presents a slight problem; i.e., it is unlikely that every feeder-user jay obtained at least one peanut from the feeder each morning since the feeder was filled with only ~125 peanuts and competitors always took a portion of the peanuts provided. However, observations of the jay that was inadvertently banded on the right leg indicated that at least one feeder-user jay did not visit the feeder every morning; this jay failed to make an appearance during 12 of the first 40 surveys (30%). This jay was last seen on 15 May.

Our observations are in agreement with previous findings. Racine and Thompson (1983) and Hickey and Brittingham (1991) reported that some individually marked sedentary jays did not come to their feeders every day even though food was provided continuously. Therefore, in our study it was accepted that some jays did not visit the feeder every morning and, more importantly, the peanut feeder was not being utilized as a primary food source instead of seasonally available foods (Suthers et al. 2000).

***Summary Considerations*** — The results of this study indicate that providing a limited daily supply of a preferred food to Blue Jays is sufficient for establishing a fidelity to a feeder if a replenishing routine is established and maintained. In addition, the study appeared to be unaffected by migratory influences, which should make it useful for evaluating the population dynamics of sedentary Blue Jays over time. The results of this study also suggest that fidelity to a feeder by other species can possibly be established by utilizing a preferred food and maintaining a routine feeding schedule, and therefore this paradigm is applicable to other research pursuits.


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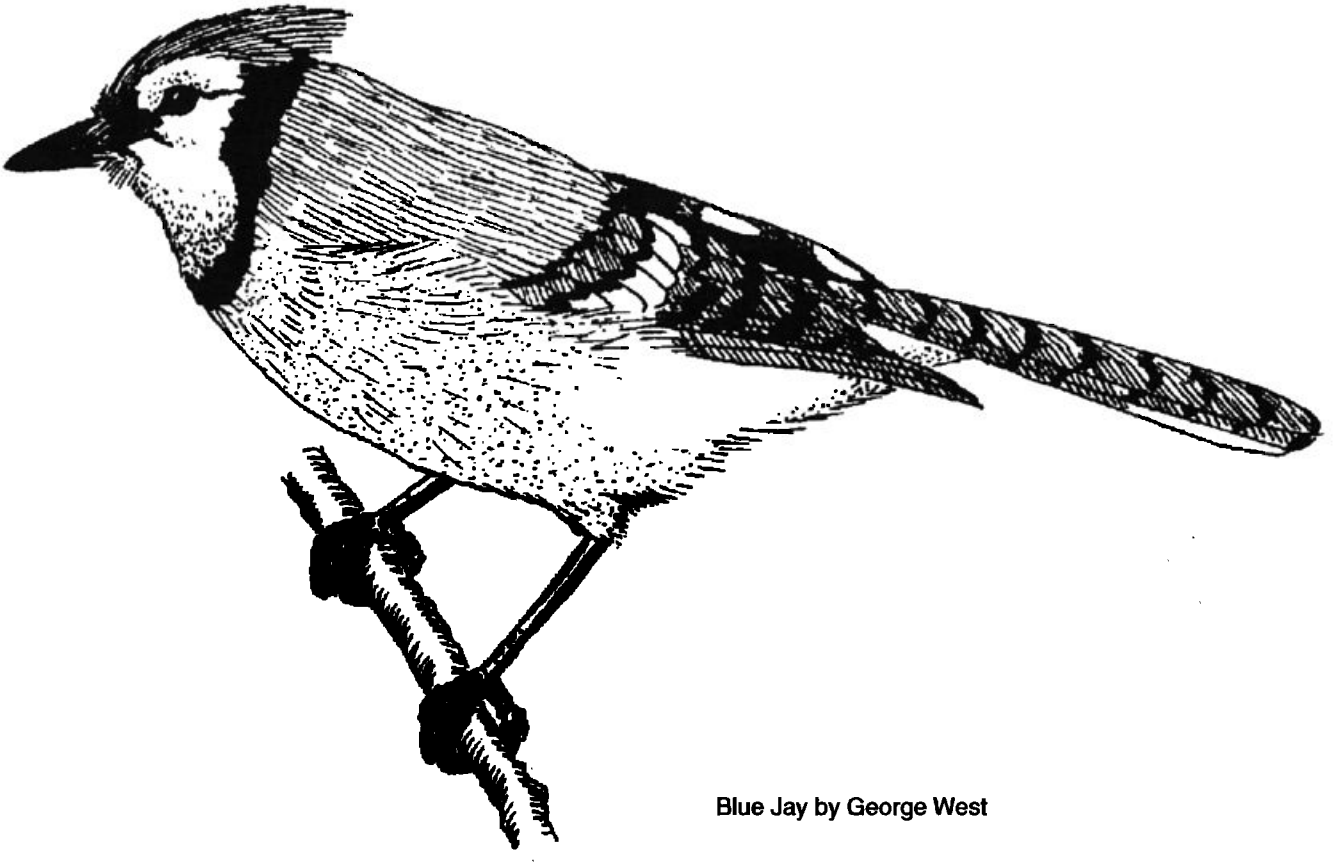

Blue Jay by George West