APPLE FEEDING BY WILD BLUE JAYS (CYANOCITTA CRISTATA) IN CAPTIVITY[1]

By Lloyd A. Mitterling

INTRODUCTION

Bird damage to horticultural crops creates many complex problems and in some instances emotion replaces reason when statements are made about it. Wright (1959) discussed some of its many aspects and emphasized the complexities associated with control measures. Two factors were considered significant relative to depredation. The first concerned an understanding and knowledge of the bird species causing the damage and the second was the difficulties of damage assessment.

The design of the University of Connecticut apple orchard was such that an accurate appraisal of damage was made (Mitterling, 1965). Bird observations indicated that the principal species responsible was the Blue Jay (*Cyanocitta cristata*). Our studies are now directed toward learning more about the jay's habits since such insight is prerequisite to a solution of the problem. The research reported here was conducted within the above framework to determine whether jays, captured from the wild, would survive in an enclosure for a period sufficiently long to enable their study.

MATERIALS AND METHODS

The birds were confined in a "*beta-confinement*" enclosure, 80′ X 60′ X 20′ high, containing 12 apple trees (Mitterling, 1966). Four trees were of the variety McIntosh, four of Richared Delicious, three of Yellow Delicious and one of Cortland. The trees were spaced at 20′ and 8 circumference poles over which a #2 - 1″ bar mesh nylon net was stretched were 10′ from the trees. Besides the apple trees, the cage contained watering pans, hooded feeding troughs containing a pelleted high-protein chicken mash, cracked corn and sunflower seeds and an open feeding platform with the same feed mixture. Five jays, captured in a trap located fifty miles away, were tagged for identification and then released into the cage during the late afternoon of August 27, 1965.

RESULTS AND DISCUSSION

Bird responses summarized: The immediate response of the jays after release was to fly directly at the net and then in a pattern from pole to pole, particularly at the corners of the cage. Occasionally they would alight on the sides of the cage and either rest or attempt escape by this route. At first the birds disregarded the food and water but within an hour they were observed to alight occasionally in a tree. As darkness approached the birds became quiet and

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TABLE 1. TIME AND NUMBER OF OBSERVATIONS CITED BY EACH OBSERVER FOR EACH JAY DURING THE PERIOD OF DETAILED STUDY

Observer	Time in blind	Observations cited			Average citations/minute
		Jay 1	Jay 2	Jay 3	
	(Hrs)	No.	No.	No.	No.
1	5	460	454	416	4.6
2	8	264	323	274	2.5
3	7	242	252	227	2.2
4	3	156	142	34	2.3

roosted in the trees. Two of the jays died within the following 48 hours, presumably as a result of their identity tags becoming tangled in the net. During the afternoon of August 30, observations showed that the three remaining jays were adapting sufficiently to undertake a period of detailed continuous observations.

Four observers were scheduled for periods of two hours each and a portable tape recorder was used to record the activities observed. The blind was sufficiently soundproof so that a low voice was not audible in the cage. The total time of the observations was 23 hours. Tape changing, exchange of observers and other interruptions reduced the period of active observations to 19 hours. Differences were noted in the citations made by each of the observers (Table 1) but despite the differences, detailed information was consistently obtained.

Prior to the study it was believed that as many as six birds might be observed by one observer. Afterwards, each agreed that a maximum of three was more realistic, and that the observation blind should be above ground level. Also, two recorders or longer tapes would improve observation efficiency. Two hour observation periods were deemed sufficiently long.

More than 100 pages (both sides) of longhand notes from 18 rolls of tape (20 minutes on a side) were transcribed. The data were then summarized in various categories (Table 2).

Concurrent harvest and other necessary orchard operations were continued even though they were a source of agitation to the birds. Jay 1 was an adult. Jays 2 and 3 were fledgings. They did respond differently to external cage activity. The discomposure of one bird was frequently a contagion of excitement to the other two. The observations cited by observers 2 and 3 (Table 1) were gross relative to jay 3 (Table 2) during periods of apparent discomposure. All observers commented that jay 3 appeared to be the least adjusted, and that both jays 1 and 3 appeared to associate more with 2 than each other. Jay 3 was observed to be more sensitive to human activities around the cage than either 1 or 2. Jay 1 was more alert and the first to demonstrate miscellaneous flight when hawks, species unidentified, and crows (*Corvus brachyrhynchos*) were in the vicinity of the cage. For example, one observer's attention was

TABLE 2. CAGED WILD BLUE JAY ACTIVITIES NOTED DURING A 23 HOUR PERIOD OF DETAILED OBSERVATION

Activity Observed*	Citations made		
	Jay 1	Jay 2	Jay 3
	No.	No.	No.
Roosting	341	372	285
Feeding			
Feeders	(124)	(135)	(87)
Ground Forages	(122)	(149)	(53)
Apples	(2)	(16)	(19)
Total feeding	248	300	159
Watering	21	7	0
Exercising	300	321	233
Miscellaneous	212	171	274
Total	1122	1171	951

*Roosting included landing on any object other than the net or a pole, but did not include feeding and watering activity. Exercising was flight from object to object within the cage. Miscellaneous included flight from an object within the cage to the net or a pole of the cage. Frequently the latter was presumed an escape effort because of agitation.

focused on the presence of two hawks after jay 1 became agitated. Traffic on a state highway, approximately 1/4 mile distant, appeared to be disturbing. Commercial airplanes caused some concern among the jays but local air traffic in the immediate vicinity of the orchard caused more. The peak periods of unrest associated with any disturbance appeared to occur one to two hours after day break, after the morning feeding peirod and then just prior to darkness. During the onset of a cold front and bad weather on September 1 (just before discontinuing the detailed observations) the birds were not disturbed from roosting in the trees by human activity adjacent to the cage.

Previous studies of free jays in the same orchard indicated that they perched on the tall fence posts surrounding the orchard and from such a position searched for insect prey in the grass below and in front of them. Under the beta-confinement conditions of this study, the captive jays were noted to perch in the lower scaffold branches of the apple trees to conduct the same type of search.

The interesting feature of the data in Table 2 is the inverse relationship shown between jay 1 and 3 regarding feeding on apples and drinking water. Arnold (1938) stated that he had not observed wild jays to drink water and could find no reference to it in the literature at that time. However, captive jays, both young and old, were noted to do so. That the jays had been captured at a peach orchard and jay 1 was an adult bird was stated before. What influences or experiences jay 1 may have had on apple feeding is

TABLE 3. PRESSURE RESISTANCE (PR), SOLUBLE SOLIDS (SS) AND RED COLOR (RC) RATINGS FOR BIRD DAMAGED COMPARED WITH RANDOM SAMPLES OF UNDAMAGED APPLES

Variety[a]	Large wounds			Small wounds[b]			Undamaged		
	PR	SS	RC	PR	SS	RC	PR	SS	RC
	lbs.	%	%	lbs.	%	%	lbs.	%	%
Cortland	17.1	10.4	62	18.2	11.6	65	18.5	9.6	55
McIntosh	16.1	10.4	60	17.7	10.6	55	18.8	10.0	50
Richared Delicious	19.0	8.8	75	20.0	8.4	90	20.5	7.8	90

[a]Average of 3 apples for each variety in each category.
[b]Small wounds measuring less than 10 mm in length or width and 5 mm deep.

unknown, but jay 3 apparently obtained all of its water supply, during the period of detailed study, from apples (and perhaps insects foraged from the ground) since none of the observers saw it visit the watering pans. Arnold (1938) also found that the fledgling jays, in three territories he studied, were not taken to a source of water by the adults during a week of observation. He believed that the insect and fruit diets supplied sufficient moisture. Apples are currently being used to supply the water needs of caged rodents at this station (Luginbuhl, 1966), so it would appear that they could serve this purpose for birds. Since the data were not transcribed and summarized until more than a month after the birds were released, further investigation of this phase was not possible. However, some fruit growers have been noted to comment that fruit depredation increases in dry seasons and Arnold (1938) stated that his captive jay went for a number of days without drinking even when the diet was nuts and other dry food. The evidence obtained for the water/depredation relationship in this study is worthy of further investigation even though only a few birds were involved.

Feeding selectivity responses: The birds were seen to feed on apples August 28, 1965, the first full day of their confinement. Before and after the period of continuous observations discussed, fruit was periodically removed from the cage and examined for possible clues which might indicate the reason for their choice. More than 100 damaged apples were examined from different periods of observation, and pertinent data are summarized for some of these in Table 3. A Magness-Taylor pressure tester, with a 7/16″ plunger, was used to measure fruit firmness (Haller, 1941). Soluble solids were determined by a portable refractometer from the juices expressed as a result of the pressure testing. The percent red color was a visual estimate. Vertical, horizontal and depth measurements were made on all feeding wounds and their angle of orientation relative to the axial diameter of the apple was indicated where possible.

Consistent differences in the choice of fruit by the birds were observed relative to (1) color in association with the location of the wound, and (2) a reduced pressure resistance of the flesh of a fruit containing a large wound as compared with one having a small wound. Only one instance was noted where the wound was located on the green portion of the apple; all others were located on the blush side of the fruit and usually where the red color was most intense. The firmness of the fruit in which small wounds only were observed was greater in every instance than with that which contained a large wound. The latter would indicate texture to be influential in the choice and acceptability of the fruit as food by the birds. Wright (1959) was of the opinion that dessert varieties of apples (and the most highly colored specimens) were the most susceptible to attack. His statement that "the wound they inflict is usually small, often only a few pecks, but each bird may spoil many fruits" would seem to indicate a possible relationship to firmness as found in these studies with the confined jays. Likewise his statement relative to the largest fruit being more susceptible to feeding wounds was generally but not always borne out.

Adjacent apples (those produced on the same spur) were observed to have been damaged (Table 4). Routinely fruit which had been fed on was picked, then taken to the laboratory for examination. This resulted in a lapse of four hours between wounding and examination in some instances. The fruit for the data shown in table 4 were taken to the laboratory for examination immediately after damage. Ordinarily the firmness was measured on four sides of the fruit unless the wound was so large that it was not possible. Six measurements were made on the 2 3/8" McIntosh shown in the table. The range of the firmness measurements were from 22 to 25 pounds.

Although the jays roosted most frequently in a Yellow Delicious tree, they did not feed on fruit of that variety until after the first week in September when its firmness measurements ranged from 18 to 22 pounds. During the period when the samples were taken for data of the varieties shown in Tables 3 and 4, the firmness of the Yellow Delicious fruit ranged from 19 to 27 pounds with an average of more than 23 pounds.

These data demonstrate a relationship between apple maturity and acceptability of the fruit to the birds as food which has not previously been reported. Under circumstances as they normally occur in an orchard such data would be extremely difficult to gather. For example, bird damage was noted to be present in the orchard during the first week of August. The minimum pressure resistance of fruit at this date has consistently been higher than the maximum registered by the instrument used, which is 30 pounds. However, the type of damage was not particularly noted, except in relation to color as discussed in this study. Also, hungry birds may not be so reluctant to eat firm and immature fruit, particularly if it is the water content of the fruit in which they are interested. Again, observations relative to fruit position indicated a possible association with the convenience of the bird to perch while feeding,

TABLE 4. FRUIT SIZE, WOUND SIZE AND ORIENTATION COMPARED WITH PRESSURE RESISTANCE (PR), SOLUBLE SOLIDS (SS) AND RED COLOR (RC) FOR APPLES PRODUCED ON THE SAME SPUR.

Fruit size	Wound size			Wound	PR	SS	RC
(Diameter)	Length	Width	Depth	orientation[a]			
inches	mm	mm	mm		lbs.	%	%
Cluster of 3 McIntosh							
2 3/8	7	4	3	horizontal	23.5	12.2	40
2 3/4	61	30	16	horizontal	17.0	12.0	80
2 7/8	33	15	13	horizontal	16.0	11.4	50
Adjacent Richared Delicious							
2 5/8	3	3	2	round	19.0	8.2	70
3	22	11	15	horizontal	17.5	8.8	80

[a]87 per cent of the wounds examined indicated a horizontal orientation, about 8 per cent were of a round puncture type and could not be oriented. Less than 5 per cent had a vertically oriented direction.

rather than ". . . because they (the fruits) are borne on the outermost branches where they (the fruits) are most vulnerable," as hypothesized by Wright (1959). This may, however, be another instance in which confined birds respond differently from birds with the ability to move about as they want.

Also, the metabolism of the bird and its food choice would appear to be related. None of the birds were observed to feed on apples after the first of October. During a storm, damage occurred to the cage so the birds were removed. More than two weeks later the remaining fruit on the trees and ground were harvested (Table 5). The data show that not all of the apples produced on the trees were damaged and that damaged fruit does not always drop immediately after it occurs. Damaged fruit remaining on the tree could be confounding when making damage assessments, if it is also attempted to relate the occurrence of the damage to a particular time, unless bird activity is known.

CONCLUSIONS

Although some aspects of this study can be considered only leads worthy of further investigation, some positive facts are disclosed. The red color or a color contrast of the apple appears to attract the attention of the Blue Jay. Following this, the bird tests the fruit and either accepts or rejects it as food. After rejection it may turn to another fruit or some other activity. Fruit flesh resistance measurements indicated firm fruit (that so firm as to be considered immature by pomologists) is rejected as food by the captive birds. Damaged fruit may remain on the tree long after damage has occurred.

TABLE 5. FRUIT HARVESTED FROM THE TREES IN THE ENCLOSURE CAGE ON OCTOBER 25, 1965 AFTER REMOVAL OF THE BLUE JAYS ON OCTOBER 8.

Variety	Harvest Method[a]	Fruit with feeding wounds	Fruit without feeding wounds
		No.	No.
Cortland	H	3	8
	C	16	3
McIntosh	H	0	4
	C	40	74
Richared Delicious	H	0	17
	C	71	332
Yellow Delicious	H	7	73
	C	42	110

[a]H indicates the fruit was hand picked from the tree.
C indicates the fruit was collected as dropped fruits from beneath the trees.

The study further indicated that captive Blue Jays can be confined without apparent harm to them enabling a study of their habits. For example, within 72 hours of confinement they were noted to have adjusted satisfactorily so that they conducted the same type of pattern to search for insect prey on the ground as free jays did in the same orchard.

SUMMARY

Blue Jays (*Cyanocitta cristata*) were confined in an enclosure containing 12 apple trees with maturing fruit plus alternative foods and water. Despite the alternate foods and water they fed freely on all four apple varieties. However, during a brief but detailed study, one jay drank water frequently and only rarely fed on apples. Another was noted to drink water and occasionally fed on apples. A third drank no water but consistently fed on apples. Red portions of the apple, in contrast to green, appeared to attract their attention; however, there was a definite association between the firmness of the apple fruit flesh and its acceptability to the captive birds as food. Immature fruits were rejected regardless of variety and a later maturing variety was not fed upon by the birds until it had softened to a point of acceptability comparable to the three other varieties included in the enclosure. The responses of the confined jays, relative to the sequence of varietal feeding and to search for insect prey on the ground, appeared to follow the same pattern as that observed for free jays in previous studies in the same orchard.

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BIRD-BANDING IN SOUTH AMERICA

BY C. C. OLROG

Since 1961 the author has had the opportunity to carry out a limited program of bird-banding in Argentina. Although no major results have been obtained, the experiences learned may be of some use for future work in Latin America.

The main problem at first was how people would react to finding a banded bird. I was told by almost everyone (University Professors and the like) that it would be completely impossible to obtain recoveries of banded birds because of the mind of the people; they presumed that a banding program organized in the same way as in the U.S. or Europe would never work because of the special negative mentality of the South Americans. This pessimistic opinion was also shared by the administrations of the "Instituto Nacional de Tecnologia Agropecuaria" and the "Miguel Lillo" Institute which supplied the funds and the staff to carry out the banding. The interest in the possibility of studying the arthroborne virus in birds was, however, so strong that the optimistic views of virologist Dr. Lucio Villa and myself were accepted, though not exactly trusted, and a program was approved for five years.