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## PREDATOR RECOGNITION THROUGH AUDITION IN THE BLACK-CAPPED CHICKADEE (*PARUS ATRICAPILLUS*)

The behavior of bird species toward a potential predator has been investigated in various studies in which a live or model predator has been presented to the subject(s). However, with the exception of a few reports of the responses of birds to imitated calls of different birds of prey (e.g., Miller, 1952), little work has been done on how a bird's behavior is influenced by the vocalizations of predators. The purpose of this study was to record the behavior of free-living Black-capped Chickadees (*Parus atricapillus*) when tape-recorded calls of predatory birds were played back to them.

### MATERIALS AND METHODS

The study was undertaken at The University of Wisconsin—Milwaukee Field Station in Saukville, Wisconsin, between 21 February and 16 April 1974. The experimental sites were six feeding stations (A8, B8, E9, F11, F9, D7), the majority situated in bog forest habitat. Sunflower seeds and suet were stocked in the feeders, which were surrounded by sufficient vegetation to provide perches and cover for the birds.

Vocalizations of the following avian species occurring in the area comprised the stimulus tapes: Barred Owl (*Strix varia*), Saw-whet Owl (*Aegolius acadicus*), American Kestrel (*Falco sparverius*), Sharp-shinned Hawk (*Accipiter striatus*), Blue Jay (*Cyanocitta cristata*), and, as a control, White-breasted Nuthatch (*Sitta carolinensis*). Each of the six stimulus tapes, recorded from the Peterson's Field Guide record albums, "A Field Guide to Bird Songs (Eastern and Central North America)" and "A Field Guide to Western Bird Songs," consisted of 20 vocal sequences with a 20-second interval between each sequence. The amplitude (in decibels) of the call sequences at 1 m were: Barred Owl (82-86), Saw-whet Owl (80-87), American Kestrel (84), Sharp-shinned Hawk (83-87), Blue Jay (84), and White-breasted Nuthatch (84).

A 6x6 Latin square of 6 playback calls and 6 feeding stations comprised the experimental design. At a feeder one stimulus tape was played, followed by the playing of a different tape at another feeder as determined by the order set down in the Latin square. Each stimulus tape was played only once per feeder, and experiments were conducted throughout the day. Chickadee vocalizations and my oral field notes, including data on the number of feeder visits, were recorded simultaneously on Scotch 207 tape with an Electrovoice 644 cardioid microphone and a Uher 4400 tape recorder at 9.5 cm per sec. In this fashion data were recorded during the experiment and also during a ten-minute baseline (in which no tapes were played) prior to each experiment. After the baseline, the 10-minute experiment was begun in which the 20 calls on a stimulus tape were played through a Uher 4200 tape recorder and a Nagra DH Amplifier/Speaker. Post-experiment observations of recovery time were then made before the equipment was dismantled and moved to the next feeder.

## RESULTS

Analysis of the data entailed examining the following three aspects: feeder visitation, vocalizations given, and general behavior. The data were statistically analyzed using the Latin square analysis of variance in which significance for all tests was judged at the 0.05 level.

### *Feeder Visitation*

A Latin square ANOVA of the total numbers of feeder visits during baselines resulted in a nonsignificant F-ratio of 0.71. Thus, there were no significant differences in feeder visits at various times during the baselines.

I determined whether the playing of stimulus tapes had any effect on the number of feeder visits during each experiment by calculating an ANOVA. The statistical test resulted in an F-ratio of 3.39, indicating that significant differences were produced by the 6 types of stimulus calls.

Feeder visitation was also examined by comparing the number of visits made during the experiments with those made during the baselines (Table 1). In general, more feeder visits were made during the baselines than during the experiments, although exceptions occurred in individual experiments. The total number of visits during experiments was greatest during the Barred Owl playback and lowest during the Sharp-shinned Hawk playback. On a percentage basis feeder visitation was highest for the Barred Owl stimulus tape, lowest for the American Kestrel.

What effects the playbacks had on feeder visitation were also sought through computing the percentage of "successful" visits (visits which resulted in seeds being taken) out of all visits made. Although the total numbers of successful trips were higher during the baselines, the successful visit percentages were higher in the experiments than the baselines when the Barred Owl, Saw-whet Owl, and White-breasted Nuthatch were played. The highest percentage of success for all experiments occurred during the White-breasted Nuthatch playback, the lowest during the Sharp-shinned Hawk playback.

### *Chickadee Vocalizations*

The calls given by the chickadees during baselines and experiments were examined by tallying numbers for each type of call recorded. However, only Chick-a-dee calls (Ficken, et. al., 1978) were subjected to statistical testing because of their usage in stressful situations and because other calls are relatively rare. A Latin square ANOVA calculated for Chick-a-dee calls recorded during the baselines gave an F-ratio of 0.35, showing no significant differences in rates of vocalization at the different feeders or at different times.

When the numbers of Chick-a-dee calls given during playback of the stimulus tapes were statistically analyzed, a nonsignificant F-ratio of 1.55 resulted. Consequently, two additional Latin square ANOVA's were calculated, one on the number of Chick-a-dee calls in the experiments minus the number in the baselines and the other on the total number of all call types given during the

experiments. The nonsignificance of both resulting F-ratios (0.45 and 0.82, respectively) necessitated the conclusion of no significant differences among the numbers of Chick-a-dee calls or all call types produced during playback of the six stimulus tapes.

Chick-a-dee calls were next examined by determining for each experiment the differences between the number of Chick-a-dee calls during the stimulus playback and the number during the baseline (Table 2). Negative totals resulted in the experiments involving the calls of the two hawks and two owls, indicating that fewer Chick-a-dee calls were given during the experiments when the stimulus calls were played than during the baselines. The opposite was true for the Blue Jay and White-breasted Nuthatch playbacks—more Chick-a-dee calls were given during the experiments than during the baselines.

The same method of comparison of subtracting baselines from experiments was used in analyzing all calls given by the chickadees (Table 3). Although all totals demonstrated more calls recorded during the baselines than during playbacks, the differences were substantially greater in the experiments involving the hawks and owls than for those involving the Blue Jay and nuthatch.

### *General Behavior*

The most common reaction of the chickadees to the different predator playbacks was to leave and avoid the area. The chickadees which did remain in the vicinity showed skittish and hesitant behavior with a general curtailment of activity; e.g., visits to the feeder were often preceded and followed by long flights instead of remaining in the immediate vicinity. During the Saw-whet Owl and American Kestrel playbacks, high-pitched notes similar to High Zees uttered in response to the sight of a predator (Ficken and Witkin, 1977) were given. No actual mobbing erupted during any of the experiments, although Chick-a-dee calls and variants associated with mobbing were given in some experiments (e.g., the greater number of Chick-a-dee calls during the Blue Jay playbacks than during the baselines). Of the four hawk and owl tapes, the chickadees appeared to be affected least by the calls of the Barred Owl. The avoidance of the feeder area during an experiment usually ended 3 or 4 minutes after the cessation of the experiment when more chickadees would appear and remain in the area, visit the feeder, and interact with each other. Thus, the chickadees appeared to wait until the predator calls had stopped before resuming their usual activities.

## DISCUSSION

Miller (1952) reported the reactions of different species of birds in the wild to imitated calls of several owl species. He found a relationship between the responses of birds and their suitability as prey; i.e., birds that were not common prey items of a certain owl species ignored those calls while potential victims were attracted and often mobbed. Hartley (1950) attracted mobbing birds with an imitation of the call of a Tawny Owl (*Strix aluco*). However, Nice and ter Pelkwyk (1941) found that hawk and owl imitations elicited no response from a hand-reared Song Sparrow (*Melospiza melodia*).

Table 1. Total number of feeder visits in the baselines (B) and experiments (E) of the playback experiments, and the percentage the experiment is of the baseline.

Playback	Feeder								
	D7			F9			F11		
	B	E	%	B	E	%	B	E	%
Saw-whet Owl	1	1	100	46	33	72	34	3	9
Barred Owl	6	3	50	12	43	358	30	40	133
Sharp-shinned Hawk	6	0	0	18	2	11	26	11	42
American Kestrel	8	1	13	73	25	34	19	11	58
Blue Jay	8	3	38	12	19	158	29	17	59
White-breasted Nuthatch	2	2	100	13	4	31	47	15	32

<sup>1</sup> last 6 min not recorded

<sup>2</sup> last 8 min not recorded

Table 2. Baselines subtracted from experiments showing the net number of Chick-a-dee calls given at each feeder during the playback experiments.

	Feeder						
Playback	D7	F9	F11	E9	B8	A8	Total
Saw-whet Owl	-53	2	-14	-22	26	-15	-76
Barred Owl	5	4	-29	-3	4	-13	-32
Sharp-shinned Hawk	-1	11	-4	-6	-1	-2	-3
American Kestrel	0	11	-67	0	3	2	-51
Blue Jay	7	-55	15	4	7	37	15
White-breasted Nuthatch	-2	10	3	3 <sup>1</sup>	1	-9 <sup>2</sup>	6

<sup>1</sup> last 6 min not recorded

<sup>2</sup> last 8 min not recorded

Table 3. Baselines subtracted from experiments showing the net number of total calls given at each feeder during the playback experiments.

	Feeder						
Playback	D7	F9	F11	E9	B8	A8	Total
Saw-whet Owl	-55	-25	-39	-99	2	-42	-258
Barred Owl	-58	10	-70	-58	6	-11	-181
Sharp-shinned Hawk	-77	3	-10	-67	-18	-18	-187
American Kestrel	14	-3	-99	-25	-21	-26	-160
Blue Jay	-36	-69	-72	19	29	113	-16
White-breasted Nuthatch	-3	-41	9	23 <sup>1</sup>	-46	-90 <sup>2</sup>	-58

<sup>1</sup> last 6 min not recorded

<sup>2</sup> last 8 min not recorded (value omitted in total)

In contrast to the first two reports, no mobbing or aggressive actions were observed in this study. One reason for this discrepancy may be the time of year the studies were conducted. Actions against predators are often stronger during the nesting season than during the nonbreeding period.

The degree of responsiveness to the call of a predator may in part depend upon the birds' familiarity with that call. In this study American Kestrels did not occur in the immediate feeder area, Saw-whet Owls and Sharp-shinned Hawks were not often sighted, but Barred Owls frequently called. The chickadees appeared to respond less to the Barred Owl playback than to the playbacks of the other owl and hawks. Miller (1952) stated that "a species resident in an area outside the native area of the owl seldom reacts to its note." Based on the findings of several studies, Petrinovich (1973) concluded that birds generally habituated to common predators and displayed stronger reactions to rarer ones. Thus, novelty of the stimulus and habituation will undoubtedly affect how the subject responds. The adaptive advantage here is the prevention of time and energy expenditure on environmental stimuli that may be safely ignored.

Another factor affecting responsiveness, proposed also by Miller (1952), may be the amount of danger posed by each predator. Saw-whet Owls and Sharp-shinned Hawks most likely prey on chickadees, while Barred Owls probably do so only rarely. The results of the playback experiments again seem to reflect this. A related factor is that of whether the predator is nocturnal or diurnal. This may partly determine when in the day the predator usually called and hunted, and, consequently, how often birds heard the calls, and whether they would be potential prey.

The type of reaction displayed by birds to predator vocalizations may reflect species and individual variation. Miller (1952) noted that some birds responded to the imitated owl calls with a noisy "scolding" while others approached shyly and warily. Emlen (1969) explained that the attraction of other birds to the cries of a bird in distress occurs in two steps: "the first exploratory in response to the calls, the second aggressive in response to the sight of the hunting predator." Likewise, in this study the wary reaction as opposed to mobbing may have resulted from the lack of visual stimuli that could be associated with the calls.

Since Blue Jays apparently do not prey upon adult chickadees, the chickadees' reaction to the Blue Jay playback, and to live Blue Jays, is puzzling. The response may have been prompted by the possibility that jays chase and harass adult chickadees and/or feed on the young, or simply that the chickadees know that Blue Jays are dominant and perhaps dangerous at very close quarters, such as at a feeder.



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