Tabasco and Tamaulipas, México. Denham (1959) reported the species from Cozumel Island, Quintana Roo. Alden (1969:55) stated that the first Cattle Egret found in western México was seen south of Culiacán, Sinaloa, 22 March 1964. However, Dickerman (1964) recorded that V. Heig saw two and collected one north of Acapulco, Guerrero, 12 March 1964. Hubbard (1966) found them in the Pacific lowlands of Chiapas in 1965. Hubbs (1968) documented their presence in Baja California in 1964 and 1967, and cited a personal communication from E. N. Harrison to the effect that this species was "becoming rather common near the west coast of México." Dickerman (1964) found them breeding in Veracruz and wrote that the birds were widespread in the lowlands of the southern part of that state and Tabasco. He further wrote that they were "spreading into the more arid interior of the country . . . ," citing records from Chiapas, Campeche, Yucatán, Puebla, Morelos, and México. We have seen the species regularly in southern Tamaulipas in spring, fall, and winter since 1970 (maximum: 60 birds near El Limon, 29 March 1971) and we suspect that they breed there.

I am not aware of previous reports of Cattle Egrets from inland localities in the northern part of the Republic. The temporary presence of these herons west of the Sierra Madre Oriental in Nuevo Leon, and in the deserts of Coahuila, Chihuahua, and Durango, suggests the possibility of transcontinental movement. (We found no Cattle Egrets in these states during several days of field work in late March and early April 1972.) Perhaps the Californian and northwest Mexican records of the species are not entirely the result of northward movement along the Pacific Coast as some of us had heretofore assumed.

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Accepted for publication 20 December 1972.

SOME FACTORS AFFECTING FORAGING BEHAVIOR OF PLAIN TITMICE

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Between 6 January and 25 February 1968, we investigated the effects of certain factors on the foraging behavior of two Plain Titmice (*Parus inornatus*) at the Hastings Reservation, 2.5 miles E of Jamesburg, Monterey County, California. Using a feeding tray and whole sunflower seeds, special attention was paid to position of tray, seed size and pattern, and preference among seeds dyed different colors.

MATERIALS AND METHODS

A wooden tray measuring 61 × 14 cm, with a rim 1.27 cm high, was nailed horizontally to two wooden posts, with the tray surface 1.32 m above the ground and with its nearest edge about 1.22 m from an observer inside a screened porch. The feeding surface was divided into five equal parts by penciled lines. For color preference tests, sunflower seeds were dyed red, yellow, green, or blue with food colors dissolved in boiling water. They were drained on paper towels and oven-dried. Undyed (natural) seeds used as controls were immersed in plain boiling water and dried in the same way. Untreated seeds were used in all experiments save those involving color. To eliminate possible effects of seed size, only seeds measuring 14–15 mm long were used except in the trials of size preference.

THE BIRDS

The two titmice involved could be differentiated readily since one (Bird A) was noticeably larger than the other (Bird B). A was dominant over B; in 16 encounters, A chased B 14 times and was chased by B twice. Of the 1145 trips to the feeding tray made by the two, A made 810 (71%) and B made only 335 (29%). As a result, samples of choices made by B in particular tests were often too small to support meaningful statistical analysis. Since A dominated B, the latter's foraging behavior was undoubtedly influenced more by the presence of the other bird than was A's. Further, since A took many more seeds than did B, the influence of A's foraging on the availability of seeds to B was much greater than the reverse. For these reasons, A provided more reliable information although in most cases both birds showed similar preferences in choice tests.

RESULTS

Effect of tray position. Initially, the tray was placed with its short axis parallel to the porch; section 1 was nearest the observer and section 5 farthest from him. Five untreated seeds were placed in each section and the "order of removal" was noted. If all the seeds in one section were removed first by the two birds, that section would have a score of 15 (1 + 2 + 3 + 4 + 5); if all were removed from one section last, the score would be 115 (21 + 22 + 23 + 24 + 25). Three trials were made and the average scores were: section 1, 113.3; section 2, 90; section 3, 64; section 4, 42.3; and section 5, 15. This is a highly significant deviation from a random distribution ($\chi^2 = 90.65$; $P < 0.001$). The birds were, without exception, first taking the seeds farthest from the observer and then, with few exceptions, working their way toward him. For both birds there was a very high rank correlation

(r_s) between the order of seeds taken and decreasing distance of seeds from the observer. For Bird A, in three trials, r_s was 0.949 ($N = 23$), 0.931 ($N = 19$), and 0.979 ($N = 16$). For Bird B, in two trials, r_s was 0.956 ($N = 6$) and 0.974 ($N = 9$). In every case $P < 0.01$. In the first trial Bird A had removed 23 of the 25 seeds before B appeared; the latter removed the last two seeds, both in section 1.

When the tray was oriented so that the observer was about opposite the middle of the long axis, the average scores of 14 trials were: section 1, 44.7; section 2, 73.4; section 3, 66.4; section 4, 70.4; and section 5, 68.6. This is not a significant deviation from a random distribution ($\chi^2 = 8.11$; $P > 0.05$) and the tray was left in this position for the rest of our work.

Effect of tray height. To test the effect of height a second tray, identical to the first, was placed on the ground at the foot of the posts supporting the raised tray. Seeds were scattered on both trays for several days, with the observer absent so that the birds would become accustomed to feeding at these sites. Following this, 100 seeds were scattered on each tray and 100 feeding trips were observed. The two birds made 74 trips to the raised tray and 26 to the one on the ground. Bird A made 55 trips to the raised tray and 16 to the other, a highly significant difference ($\chi^2 = 11.9$; $P < 0.005$). Bird B made 19 trips to the raised tray and 10 to the other; the difference is not significant.

Seed size. To test size preference, seeds were divided into 9–10 mm and 15–16 mm length classes. In each trial one small and one large seed were offered, placed side by side in the center of the tray. In 100 such trials the large seed was chosen 83 times, the small seed, 17. Bird A chose the large seed 65 times and the small seed 9 times ($\chi^2 = 24.42$; $P < 0.001$). Bird B chose the large seed 18 times and the small 8 times; the difference is not significant.

Seed pattern. To test pattern preference, seeds were separated into four classes: all black; black with a narrow white edge; black-and-white striped; and all white. Five of each type were placed in that order in four divisions of the tray and the "order of removal" noted. Scores were: black, 51; black with white edge, 62; striped, 49; and white, 48. The difference among classes is not significant. This was essentially a test of Bird A's preferences since it took 18 of the 20 seeds involved.

Color preference. In the first test of color preference, five seeds each of red, yellow, green, blue, and natural were mixed and placed in the center of the tray. Four trials were made and the "order of removal" was noted. The combined scores for the four tests were: red, 171; natural, 186; yellow, 261; green, 309; and blue, 373. This is a highly significant deviation from a random distribution ($\chi^2 = 110$; $P < 0.001$). Of the 100 seeds involved in the four trials, Bird A took 71 and Bird B, 29. The mean score for each type of seed taken by Bird A was: red, 8.7; natural, 8.9; yellow, 13.2; green, 15.7; and blue, 18.4. Corresponding scores for seeds taken by Bird B were: red, 8.0; natural, 10.6; yellow, 12.7; green, 15.1; and blue, 19.5. Thus, the order of preferences was the same for both birds.

In a second series, pairs of differently colored seeds were placed in the center of the tray so that every possible color pair was used, and selection was recorded in 40 trials made of each pair. Red was preferred to yellow (21 to 19), to green (26 to 14), and to blue (29 to 11). Yellow was preferred to green (24 to 16) and to blue (22 to 18). Green was preferred to blue (21 to 19). Most of these scores are so close that they provide no clear-cut information. The difference between red and blue was significant ($\chi^2 = 8.1$; $P < 0.01$). The difference between red and green was virtually significant at the 5% level ($\chi^2 = 3.6$).

Of the 240 seeds involved in this series, Bird A took 176 and Bird B, 64. The only significant difference for either bird was the choice of red over blue by Bird A (21 red to 6 blue; $\chi^2 = 8.4$; $P < 0.01$). The scores of A and B showed two major differences. A chose yellow over blue 16 to 11, but B showed virtually no preference between the two, choosing blue 7 times and yellow 6. A chose blue over green 17 to 12, but B chose green over blue 9 to 2.

DISCUSSION

The position of the tray relative to the observer affected foraging behavior significantly and the importance of this factor to experimental procedure is obvious. Preference for the raised tray to the one on the ground is compatible with the observations of Dixon (Condor 51:111, 1949) that an elevated foraging niche is a primary habitat requirement of this species and that, even when foraging on the ground, titmice will carry food to an elevated perch to eat it.

The preference for larger over smaller seeds is undoubtedly advantageous in saving time and energy by transporting the same amount of food in fewer trips. Sunflower seeds 15–17 mm long weigh 1.7 times as much as seeds 9–11 mm long; the kernels of the larger seeds weigh 1.8 times as much as the kernels of the smaller (Hespenheide, Wilson Bull. 78:193, 1966). These size classes are nearly the same as those used in our experiment. The additional energy needed to carry the heavier seeds would be almost exactly offset by the increased amount of food contained in the larger kernel. Since the titmice carried one seed at a time, in 10 trips with the larger seeds they would have carried as much edible material as in 17 trips with the smaller. Since nearly all seeds taken were stored, seven empty-billed trips from the storage site would have been saved per 10 round trips, an obvious economy of time and energy.

Hespenheide (op. cit.:195) found that White-throated Sparrows (*Zonotrichia albicollis*) took nearly twice as long to husk the larger seeds than the smaller. Since husking methods are so different in the sparrows and titmice (billing versus hammering), one may assume only that it would probably take more time and energy for a titmouse to open the larger seeds. However, since the stored seeds could be recovered and eaten at leisure, preference for the larger seeds would assure the most efficient utilization of a suddenly available food supply.

As regards color preference, the preference for red and yellow seeds over green and blue seeds in all trials but one suggests that Plain Titmice are sensitive toward the red end of the spectrum and have reduced sensitivity at the blue and violet end. This agrees with the enhanced sensitivity to red and the reduced sensitivity to blue and violet that have been demonstrated in small song birds (S. Duke-Elder, System of ophthalmology, Vol. 1. The eye in evolution, C. V. Mosby Co., St. Louis, 1958; G. L. Walls, The vertebrate eye and its adaptive radiation, Cranbrook Inst. Sci., Bull. No. 19, 785 p., 1942).

As regards seed pattern, the absence of any well-marked preference in this regard suggests that size and shape were more important than pattern in enabling the titmice to recognize the seeds as desirable food items.

Accepted for publication 28 September 1972.