FIGURE 1. Weight and wing measurements of a nestling Marbled Murrelet, East Amatuli Island, 1979.

by Simons. This probably reflects a real difference in size of the two chicks. The wing length plateaus seen in Figure 1 were possibly a result of different measuring techniques of the three observers in 1979. In 1979, wing length was measured to the end of the down, and

to the end of the longest primary. The initial plateau and sudden gain in length parallels the same trend in weight gain, and may be due to underfeeding.

Observations of the chick and adults were made on the night of nest departure. On 16 August both parents came to the nest at twilight and called with the chick. It became very active, left the nest, and walked about on the ledge. All three murrelets remained at least as long as light permitted observation (22:00). The next day the nest site was deserted, suggesting that the chick had departed in the night or early morning.

On 19 August we saw an adult with a juvenile in the cove within 0.5 km of the nest site. On 22 August six adults and four juveniles were on the ocean within 1 km of the same area, indicating the recent fledging of a small local population of ground-nesting murrelets.

# NEIGHBOR/STRANGER SONG DISCRIMINATION IN WHITE-CROWNED SPARROWS

MYRON CHARLES BAKER

DANIEL B. THOMPSON

AND

GREGORY L. SHERMAN

Studies have demonstrated that male songbirds respond more strongly to the playback of the song of a conspecific stranger than to that of a neighboring territorial individual (Weeden and Falls 1959, Brooks and Falls 1975, Harris and Lemon 1976, Wunderle 1978). Milligan and Verner (1971) showed that male Nuttall's White-crowned Sparrows (*Zonotrichia leucophrys nuttalli*) responded weakly to playback of a foreign dialect compared to the stronger response given to the dialect representing the population of the tested individuals. Thus the results of neighbor/stranger experiments on other species in comparison to the own/foreign dialect results from these sparrows seem paradoxical. The foreign dialect is that of a conspecific stranger yet the response is weaker; if neighbor/stranger discrimination follows the same pattern as dialect discrimination, one might expect results from Nuttall's White-crowned Sparrows opposite those of neighbor/stranger experiments with other species.

We carried out a playback study to determine if Nuttall's White-crowned Sparrow exhibits neighbor/stranger discrimination in a direction different from that predicted by studies on other species.

## METHODS

The study was conducted in the Point Reyes National Seashore, Marin County, California. Nuttall's White-crowned Sparrow breeds primarily as monogamous pairs in this coastal scrub habitat. Territories average from 0.5 to 1.0 ha (Ralph and Pearson 1971, Chamberlain 1972) during a 125-day breeding season commencing in late March (Mewaldt and King 1977).

We color-banded four pairs of neighboring males in two adjacent song dialect populations. Here we report data on four males that received playback of their neighbor's song followed by playback of a distant (>1 km) stranger's song of the same dialect on one day, and then, two weeks or more later, each received these stimuli in reverse order. The experiments took place during late May to early June at a time of intense reproductive activity. In a session, 5 min of stimulus at a rate of one song every 15 s was followed by 10 min of silence, then 5 min of the other stimulus, followed by 10 min of silence.

Playback was accomplished by one observer placing the speaker (Perma Power S-610) near the border between the neighboring territories, retreating to the tape recorder (Uher 4200 Report Stereo IC), starting the tape (9.5 cm/s) and recording data while another observer narrated the behavior of the target bird. The songs had been recorded previously using the same recorder with a Uher microphone mounted in a 61-cm parabolic reflector (Torngren Co., North Billerica, MA).
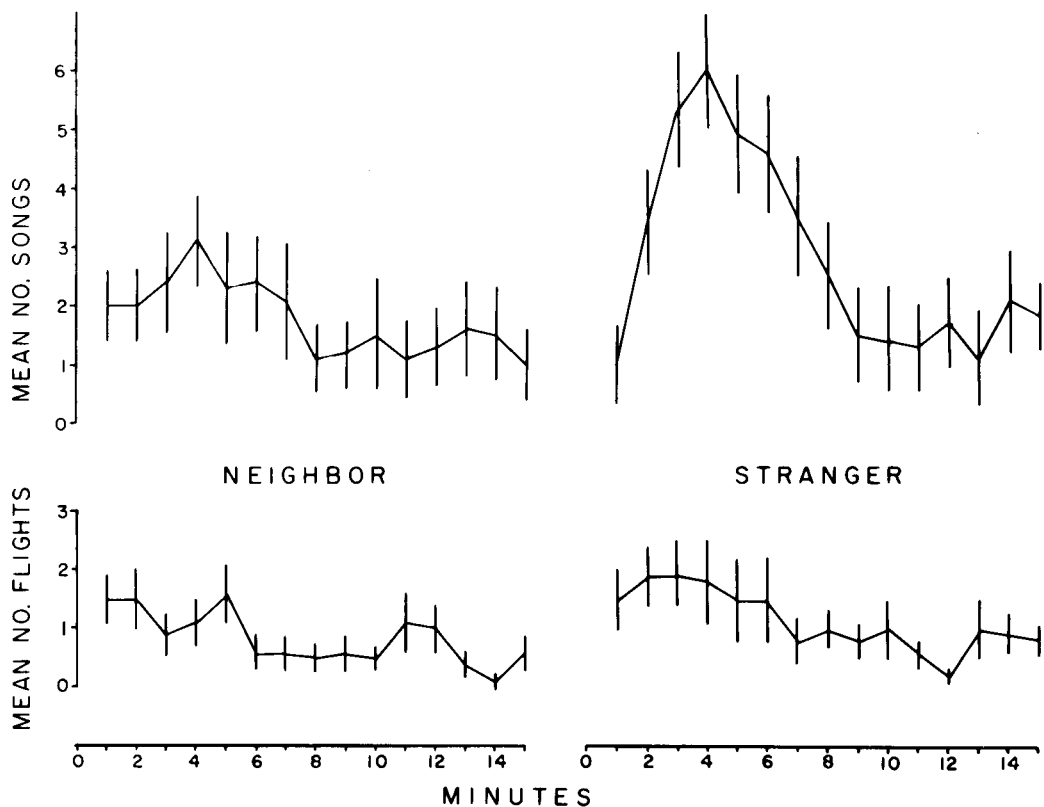
FIGURE 1.    Mean number (±SE) of songs and flights performed per minute during eight observation periods on four White-crowned Sparrows. Stimulation during the first five min of each session was by a neighbor's vs. a stranger's song; there was no stimulation during the remaining 10 min of observation.

We counted the number of full songs sung by the target bird as well as the number of flights made each minute of the entire half-hour covered by the experiment, as suggested by the methods and results of Milligan and Verner (1971).

## RESULTS

The target birds typically responded to the onset of playback by counter-singing and by approaching the speaker (see Milligan and Verner 1971 for descriptions). The frequency of singing and flying gradually dwindled during the 10-min post-stimulus period and rose again at the onset of the second stimulus session. The composite result of the two separate playback trials (Fig. 1) was tested for statistical significance by t-tests. The number of songs sung in response to playback of the neighbor's song during all the 15-min trials ($\bar{x} = 1.8$, SE = 0.16) was significantly lower than the number sung ($\bar{x} = 2.8$, SE = 0.44) to the playback of a stranger's song ($P = 0.03$, 2-tailed). A similar trend was observed in the number of flights (neighbor $\bar{x} = 0.8$, SE = 0.12, stranger $\bar{x} = 1.1$, SE = 0.13) but the distributions were not quite significantly different ($P = 0.09$, 2-tailed).

## DISCUSSION

Our results indicate that Nuttall's White-crowned Sparrows discriminate between neighbor and stranger songs in a manner similar to that demonstrated by work on other species. The response is in the same direction as that found by other workers; a male sings more to a stranger's song than to a neighbor's song.

The usefulness of singing behavior as a discriminator between stimuli is also confirmed by the work of Milligan and Verner (1971). Flight activity as a behavioral discrimination may sometimes follow the same patterns as singing (Brooks and Falls 1975, but see Goldman 1973), but in our study this was not strongly evident. One problem we found with flights as a variable is that the possibilities of flight are influenced by the vegetation in the neighborhood of the playback speaker.

We cannot, by our experiment, account for the low response of males to playback of distant dialects as found by Milligan and Verner (1971) although another experiment that we have recently completed (Baker et al., 1981) confirmed the Milligan and Verner result of a weak reaction to playback of a distant dialect.

A weak response to a distant dialect may be interpreted as implying that a particular bird may not fully recognize the distant dialect as a conspecific song. The song from a distant dialect is responded to, however, and this level of response is clearly greater than the response to the song of another species (e.g., the Song Sparrow; *Melospiza melodia*; Milligan and Verner 1971). An individual bird may be responding to the threat of an invader when it sings most frequently to a non-neighbor's song so long as this new song is "familiar." The recognition of familiarity could result from brief experiences during the breeding season when an occasional long distance excursion takes place, from hearing non-neighbor songs while on territory because of especially favorable weather conditions that allow sound to carry greater than usual distances, or, as mentioned by Milligan and Verner (1971),

from the stimulus generalization capacity of the bird, which sets up a gradient of response to songs differing in degrees from the one the bird learned early in life.

This research was supported by a grant (DEB-78-22657) from the National Science Foundation to the senior author.

## LITERATURE CITED

BAKER, M. C., D. B. THOMPSON, G. L. SHERMAN, AND M. A. CUNNINGHAM. 1981. The role of male vs. male interactions in maintaining population dialect structure. Behav. Ecol. Sociobiol. 8:65–69.

BROOKS, R. J., AND J. B. FALLS. 1975. Individual recognition by song in White-throated Sparrows. I. Discrimination of songs of neighbors and strangers. Can. J. Zool. 53:879–888.

CHAMBERLAIN, B. 1972. Observations of breeding White-crowned Sparrows. Point Reyes Bird Observatory, Newsletter No. 23.

GOLDMAN, P. 1973. Song recognition by Field Sparrows. Auk 90:106–113.

HARRIS, M., AND R. E. LEMON. 1976. Responses of male Song Sparrows (*Melospiza melodia*) to neighboring and non-neighboring individuals. Ibis 118:421–424.

MEWALDT, L. R., AND J. R. KING. 1977. The annual cycle of White-crowned Sparrows (*Zonotrichia leucophrys nuttalli*) in coastal California. Condor 79:445–455.

MILLIGAN, M. M., AND J. VERNER. 1971. Inter-populational song dialect discrimination in the White-crowned Sparrow. Condor 73:208–213.

RALPH, C. J., AND C. A. PEARSON. 1971. Correlation of age, size of territory, plumage, and breeding success in White-crowned Sparrows. Condor 73:77–80.

WEEDEN, J. S., AND J. B. FALLS. 1959. Differential responses of male Ovenbirds to recorded songs of neighboring and more distant individuals. Auk 76:343–351.

WUNDERLE, J. M., JR. 1978. Differential response of territorial Yellowthroats to the songs of neighbors and non-neighbors. Auk 95:389–395.

*Department of Zoology and Entomology, Colorado State University, Fort Collins, Colorado 80523. Accepted for publication 31 January 1981.*

# DIURESIS ON THE DESERT? EFFECTS OF FRUIT- AND NECTAR-FEEDING ON THE HOUSE FINCH AND OTHER SPECIES

## WILLIAM A. CALDER III

The ability to concentrate urine is usually emphasized in the study of the water balance of desert birds and mammals. In our tendency to focus on the most stressed animals, we may overlook ameliorating circumstances provided by diet or behavior. Poulson and Bartholomew (Condor 64:245–252, 1962) reported urine and serum osmotic concentrations from the desert-dwelling House Finch (*Carpodacus mexicanus*) while exposed to laboratory temperatures of 24.6 to 25.7°C. Urine concentrations ranged from about 130 to 850 mOsm. These concentrations were about 0.4 times serum osmotic concentration (hypo-osmotic urine) when the birds drank distilled water ad libitum, and about 2.3 times serum (hyperosmotic) when they were drinking 0.3 M NaCl. The birds were concentrating their wastes in order to conserve water by the high urine concentration; at the low concentration, osmotic work was performed to void excess water and conserve salts while doing so.

In the suburban bajada-desert scrub environment of this study (near Tucson, Arizona), air temperatures range from lows of 20 to 25°C, to highs of 36 to 40°C in late summer. House Finches under these conditions show classic symptoms of heat stress: gaping, panting, wing elevation to expose axillary regions, and seeking shade. One might expect that evaporative water loss would necessitate maximal urine concentration under these conditions.

In order to collect urine samples in the field for a confirmation of this expectation, I captured House Finches by mist-net between 31 August and 5 September. When cloacal contents were voided by hand-held birds, the fluid was taken into microcapillary tubes. The contents were analyzed immediately thereafter on a Wescor 5100B vapor pressure osmometer. The mean osmotic concentration of the fluid from nine birds was 183 ± 75.2 mOsm/kg (range 81 to 317 mOsm/kg; 2–4 determinations per bird). Air temperatures at time of collection ranged from 26 to 36°C (mean 30° ± 3.5). A blood sample from one finch had an osmotic concentration of 335 mOsm/kg; this value falls midway in the range for the laboratory-maintained birds described by Poulson and Bartholomew (1962). The urine concentration of this individual was 179 mOsm/kg, 0.53 of blood concentration.

At the time, the finches appeared to be feeding mostly on the fruit of the prickly pear cactus (*Opuntia engelmanni*), the fluid of which is bright magenta, sweet, and to me was intermediate in taste between watermelon and beet juice. The osmotic concentration of the prickly pear juice was 457 ± 40.4 mOsm/kg, (n = 6) presumably due largely to sugar.

Urine samples were obtained from three additional species of fruit- and nectar-feeding birds inhabiting hot, arid environments. Urine osmotic concentrations, mostly hypo-osmotic, are listed in Table 1. Plasma samples were not taken, but would be expected to fall within the avian range of 300–350 mOsm/kg.

In order to attempt an explanation of this unexpected finding of hypo-osmotic urine during obvious heat stress, we must consider the processes by which water would reach the cloaca. When the House Finch ingests the juicy pulp of *Opuntia* fruit, sugars and other nutrients available before or after enzymatic breakdown would be absorbed across the gut wall by diffusion and/or active transport. The latter process would tend to reduce the concentration of fluid remaining in the gut below 457 mOsm/kg. Similarly, sugar removed