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DURATION OF FEEDING BOUTS AND RESPONSES TO SALT SOLUTIONS BY HUMMINGBIRDS AT ARTIFICIAL FEEDERS

D. M. BROOM

The feeding methods of hummingbirds depend upon the characteristics of the flowers from which they feed, nectar quantity and quality, crop volume, and rate of absorption from the gut (Skutch 1952, Grant and Grant 1968, Hainsworth and Wolf 1972, Snow and Snow 1972, Wolf et al. 1972, Hainsworth 1973). In this paper, I report on interspecific differences in feeding bout duration in seven species of hummingbirds. Most observations were made at artificial feeders, but a few birds were observed feeding from

flowers. Certain other aspects of feeding behavior are described (see also Broom 1975).

Two of my experiments were prompted by Bacon's (1973) observation of a hummingbird hovering over the sea and apparently drinking. The hummingbird may have been responding to its reflection or drinking to obtain water or salt. I therefore tested the preferences of hummingbirds for salt solutions of different concentrations in artificial feeders.

Hummingbirds of 10 species were observed feeding from 15 artificial feeders at a home in Aripo Valley, Trinidad, between October and December 1972. A few birds of three species feeding from hibiscus flowers were observed with binoculars from a distance of 20 m. The duration of each feeding bout, i.e. the time that the bill tip was inside the flower, was recorded. In Experiment 1 bouts were timed with a stopwatch from distances of 4 to 10 m. In Experiments 2 and 3, hummingbird consumption of liquid

TABLE 1. Duration of feeding bouts of three species of hummingbirds at hibiscus flowers.

Species	Mean duration N of drinks (sec)	Comparison ^a of species 1 with:	
		species 2	species 3
1. <i>Amazilia tobaci</i>	21 2.4 ± 1.8	P < 0.001	P < 0.001
2. <i>Chlorestes notatus</i>	13 1.0 ± 0.5	-	P < 0.001
3. <i>Phaethornis longuemareus</i>	45 < 0.5	P < 0.001	-

^a 2-tailed Mann-Whitney U tests (Mann and Whitney 1947).

from four feeders on two posts was measured. The frequency and duration of visits by hummingbirds seemed unaffected by the presence of an observer 4 m away.

Prior to all observations and during Experiment 1, the feeders contained 0.55 molar sugar solution and red food coloring. Feeding bouts consisted of series of drinks with pauses when a bird hovered in front of the feeder before returning to drink again. When a bird was absent from the feeder for more than 2 sec, the total time spent drinking, excluding pauses, was recorded as a feeding bout. If one bird was displaced by another, or if it returned to a feeder within one min, the record was ignored. Approximately 20 hummingbirds were observed.

In Experiment 2 the four feeders contained either distilled water or colorless salt solution (0.1 or 0.5 M NaCl). In Experiment 3 the feeders contained either red-colored sugar solution (0.27 M) or this same sugar solution with salt added to strengths of 0.03, 0.05, 0.07, 0.125, 0.25 or 0.31 molar NaCl. Hummingbirds feeding on the normal sugar solution showed no preference for upper or lower feeders but did prefer feeders on one post to those on the other. Therefore, in Experiments 2 and 3 one type of solution was put in the upper left (A) and lower right (D) feeders and the other in the lower left (B) and upper right (C) feeders. The amount of each solution drunk by hummingbirds was recorded by measuring the levels in the feeders initially and after 20 or 30 min. After each choice test, the four feeders were filled with the normal sugar solution for at least 30 min before the next test was started.

FEEDING FROM FLOWERS

Hummingbirds of three species were observed feeding from hibiscus flowers. The duration of bouts (table 1) was greatest for Copper-rumped Hummingbirds (*Amazilia tobaci*) and least for Little Hermits (*Phaethornis longuemareus*), who drank too briefly to be timed accurately.

EXPERIMENT 1

Seven species of hummingbird fed on sugar solution in the feeders sufficiently frequently to allow comparison among species (table 2). Feeding bouts of the Little Hermit were significantly briefer than those of the six other species; feeding bouts of the White-chested Emerald (*Amazilia chionopectus*) were significantly briefer than those of the remaining

TABLE 2. Duration of feeding bouts of seven species of hummingbird at artificial feeders.

Species	Mean duration N of bout (sec)	Comparison ^a with	
		<i>P. longuemareus</i>	<i>A. chionopectus</i>
<i>Glaucis hirsuta</i>	18 8.8 ± 4.4	P < 0.01	P < 0.05
<i>Phaethornis longuemareus</i>	5 3.2 ± 1.4	-	P < 0.01
<i>Florisuga mellivora</i>	28 8.9 ± 5.2	P < 0.01	P < 0.05
<i>Anthracothorax nigricollis</i>	16 8.3 ± 2.3	P < 0.01	P < 0.01
<i>Chlorestes notatus</i>	7 8.9 ± 3.4	P < 0.01	P < 0.05
<i>Amazilia chionopectus</i>	32 6.7 ± 2.5	P < 0.01	-
<i>Amazilia tobaci</i>	11 8.8 ± 3.1	P < 0.01	P < 0.05

^a 2-tailed Mann-Whitney U tests (Mann and Whitney 1947).

five species. Differences among other species were not statistically significant.

Other differences in feeding habit among species of hummingbirds were noticed. Little Hermits, Rufous-breasted Hermits (*Glaucis hirsuta*) and Green Hermits (*Phaethornis guy*) flew close to the ground and fed from the lower feeders. The drinks which made up each feeding bout were briefer, especially for the Little Hermit, than for other hummingbirds. Between bouts, several White-chested Emeralds perched within 2 m of a feeder and attempted to drive off other hummingbirds which approached. Black-throated Mangoes (*Anthracothorax nigricollis*) seemed the most successful at driving off other species, and Hermits were most easily displaced, but this was not studied systematically. Throughout most of the observation periods a Brown Violet-ear (*Colibri delphinae*) was present, but it rarely visited the feeders. It often flew out and caught insects on the wing.

EXPERIMENT 2

When the normal sugar solution was replaced by colorless distilled water or salt solution, most hummingbirds drank for less than 0.5 sec. The number of visits to the feeders declined rapidly (fig. 1), and very little of either solution was taken. Visits to water or salt solution were similar in number, but those to the salt solution were slightly longer (table 3). Twenty-four percent of the visits to the 0.5 M solution lasted for more than 0.5 sec, but only 9% of those to water lasted this long ($P < 0.1$, 2-tailed binomial t-test).

EXPERIMENT 3

In three control experiments lasting a total of 60 min, in which all four feeders contained sugar solution, the amount taken from feeders A and D was almost equal to that taken from feeders B and C (fig. 2). When two of the feeders contained salt at a concentration 0.07 M or less, the salt plus sugar solution was taken in proportions equal to the plain sugar solution. When the concentration was 0.125 M or

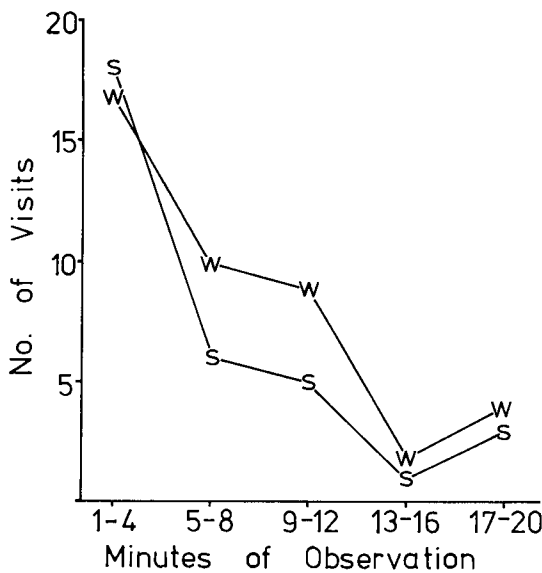


FIGURE 1. Decline in number of visits by hummingbirds of seven species to water (W) and 0.5 molar salt solution (S) in feeders during a 20 min. observation period.

greater, only 20% of the total amount drunk was salt and sugar mixture. In the control experiments 1.8-3 ml/feeder/min were taken, whereas in feeders with a salt concentration of 0.125 molar or higher, it was always less than 1.0 ml/feeder/min. Some of these salt-sugar mixtures were taken when first presented. Later in the experiment, the hummingbirds moved to other feeders after a brief taste, so a longer experiment might show more obvious avoidance of salt.

DISCUSSION AND CONCLUSIONS

Hummingbird species differ consistently in the duration of feeding bouts at artificial feeders. The Little Hermit had the briefest feeding bouts at artificial feeders and hibiscus flowers. Snow and Snow (1972) also observed a short drink. The White-chested Emeralds, which sat near the feeders, had shorter feeding bouts than the other species which sat further away. Two of these other species were fairly small, and three were fairly large, but they varied little in feeding bout duration. Larger species have larger crops (Hainsworth and Wolf 1972), but, due to differences in the rate of liquid uptake (Hainsworth 1973), two species which differ in size may fill their crops in feeding bouts of similar duration.

That hummingbirds drank much less sugar solution

TABLE 3. Duration of visits by hummingbirds of seven species^a to water and salt solutions.

Water		Salt solution	
No. visits <0.5 sec	Total no. visits	No. visits <0.5 sec	Total no. visits
5	34	0.1M:7	33
6	67	0.5M:13	54

^a Species listed in Table 2.

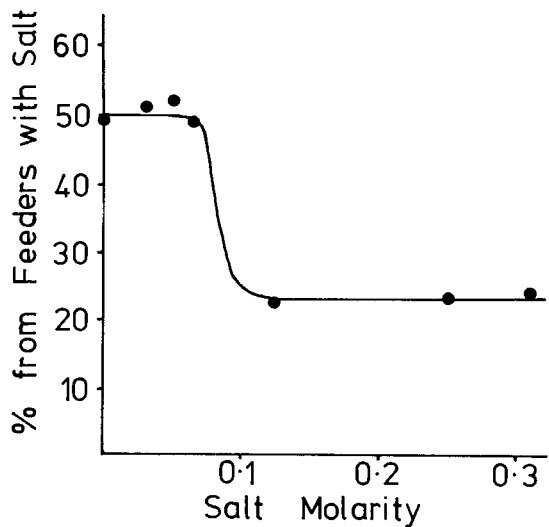


FIGURE 2. The percentage of the total amount drunk by hummingbirds of seven species (listed in table 2) from four feeders, containing sugar solution only or sugar solution plus salt at one of six concentrations.

if it included high concentrations of salt is not surprising, but it is of interest that the concentration at which some avoidance was first evident was 0.07-0.125 molar. The concentration which first reduces hummingbird intake is considerably weaker than that of sea water (0.5 M). Little of the water or salt solution with no sugar was taken, but more visits longer than 0.5 sec were made to the salt solution. Thus it seems possible that the hummingbird observed by Bacon (1973) may have drunk small amounts of sea water for the salt.

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Department of Zoology, University of Reading, Reading, England. Accepted for publication 27 May 1975.