

might remain out of sight in the wall interior for some minutes, to emerge perhaps a hundred feet further along. Thus a more accurate measure of the value of this habitat to the Wrens is not the profile area of the wall but the surface area of the rocks from which it is made. From the shape of these rocks, which are flattened but somewhat rounded rectanguloid solids, we calculate that such rocks would have to be two to three deep in the walls in order to increase by a factor of 12 the profile area of the wall. This approximate figure concurs well with our observations; the walls had rocks showing faces to one or the other side of the wall, and occasionally rocks which were not exposed to the outside at all.

An alternative explanation, that the walls supported a greater density of insect food per actual surface area exposed to scrutiny by the Wrens, can be ruled out. We counted insects caught per 24-hr period on linoleum grease-covered plaques and found that we caught 1.60 0.25 inch insects/plaque/day in the walls and 1.55 on the cliffs. Thirty-four plaques were used over 2 days, = 68 plaque/days of trapping effort. Only one other factor affects the amount of food available to the Wrens in the two habitats, and that is the presence of competing species. No other bird species used the walls as foraging sites, and one other species, the Rock Pipit *Anthus petrosus*, used the cliffs. We therefore calculated an index of similarity between

the Wren and the pipit, which takes into account feeding behavior, habitat preferences, and bill morphology. This index came to 0.301, where a value of 0 denotes complete separation and a value of 1 denotes complete overlap in feeding ecology. The observed territory size of Wren M₁ is therefore scaled down from 38,400 ft² to 23,900 ft² in the way described in detail in our longer paper (see p. 473). Likewise, the cliff-face component of Wrens M₂ and M₇ is reduced because of its lessened value in the presence of the Rock Pipit. M₆ is the only Wren whose territory is located exclusively in ruined buildings. These are constructed much more solidly than the walls, with much reduced interstitial space and hence reduced surface area for foraging Wrens. This territory is therefore worth less per unit wall area than this measure indicates, and its recorded value is somewhat inflated.

We conclude from this brief study that each Wren secures and defends a territory which varies in size (a measure of foraging area), habitat quality (a measure of insect productivity), and in the numbers and types of competitors (an adjustment to the measure of available food) but which, rather dramatically, varies little in overall food value.

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ROOSTING AGGREGATIONS OF BUSHTITS IN RESPONSE TO COLD TEMPERATURES

SUSAN M. SMITH

Wellesley College
Department of Biological Sciences
Wellesley, Massachusetts 02181

On 9 January 1969, I discovered the roosting location of a flock of 29 Common Bushtits (*Psaltriparus minimus*) in a hawthorn tree (*Crataegus douglasii*) on the University of Washington campus. Thereafter, roosting was observed regularly until the spring break-up of the flock, which occurred in the third week of February. Under normal conditions the birds arrived in the hawthorn almost simultaneously, and immediately began to roost; there was minimum shifting of position after arrival. The result was an evenly spaced group with no two birds being closer than 2 inches from each other. If two birds landed closer together than this, there followed a concentric ripple of shifting until the "correct" spacing was achieved.

On the evening of 21 January, I saw what appeared to be a thick branch in the roost tree. This "branch" was actually a row of 25 bushtits packed tightly together along their perch. Four other individuals were roosting singly nearby.

Table 1 shows the records of roosting behavior with respect to temperature. There was a period of 10 days in January when the average temperature in Seattle was at least 10°F below normal. During this period, the bushtits roosted nightly in a row, each bird in close contact with its neighbors.

The night of 1 February was the first for over 2 weeks when the temperature did not descend below freezing. At 17:45, the bushtits were observed packed

TABLE 1. Roosting behavior of the Common Bushtit with respect to temperature.

Date	Temperature			Departure from normal	Roosting behavior
	Max.	Min.	Avg.		
Jan. 9	41	35	38	-1	even
10	43	35	39	0	even
11	39	34	37	-2	even
12	39	29	34	-5	even
13	39	32	36	-2	even
14	40	33	37	-1	d.n.o. ^a
15	39	33	36	-2	even
16	37	33	35	-3	even
17	35	30	33	-5	even
18	35	28	32	-6	d.n.o.
19	37	31	34	-4	even
20	36	25	31	-7	d.n.o.
21	31	25	28	-10	clumped
22	29	23	26	-12	clumped
23	29	17	23	-15	clumped
24	30	18	24	-14	clumped
25	30	25	28	-10	clumped
26	27	23	25	-14	clumped
27	27	21	24	-15	d.n.o.
28	22	15	19	-20	d.n.o.
29	27	19	23	-16	d.n.o.
30	30	22	26	-13	d.n.o.
31	40	28	34	-5	clumped
Feb. 1	39	35	37	-2	clumped
2	42	35	39	0	even

^a d.n.o. = did not observe.

tightly together. The next night the whole flock was seen evenly dispersed in the roost tree, with individual distance restored. The temperature did not fall below freezing again that spring, nor was clumping seen again.

There have been several reports, especially for European birds, of sleeping aggregations in response to cold weather. Most of these are for very small species possessing relatively high surface:volume ratios. Such aggregations have been reported for Winter Wrens (*Troglodytes troglodytes*) and for Long-tailed Tits (*Aegithalos caudatus*) (Lack, Ecological adaptations for breeding in birds. Methuen & Co., London, 1968). Löhrl (Vogelwarte 18:71, 1955) has photographed sleeping aggregations of creepers (*Certhia*, sp.) which occur on cold winter nights.

I have found no previous report of sleeping aggregations of Common Bushtits in response to cold

weather. This is not surprising, as freezing temperatures are rarely encountered over most of their range. This makes it all the more interesting that this particular flock showed such an immediate response to abnormally cold conditions. In birds the size of bushtits, aggregations of this kind may greatly increase survival in subfreezing weather.

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INTERSPECIFIC AGGRESSION OF RESIDENT BROAD-TAILED AND MIGRANT RUFOUS HUMMINGBIRDS

CHRISTOPHER DUNFORD

AND

EILEEN DUNFORD

Department of Biological Sciences
University of Arizona
Tucson, Arizona 85721

During the summer dry season, April-early July, flowers of penstemon (*Penstemon barbatus*) are virtually the only hummingbird-pollinated flowers seen under the ponderosa pines (*Pinus ponderosa*) at 2100 m in Rose Canyon, Santa Catalina Mountains, Pima County, Arizona. Penstemon occur singly or in small clusters of a few plants throughout the ponderosa pine forest, but in some places, especially along roadsides, they grow in large clusters of tens or even hundreds of plants. Broad-tailed Hummingbirds (*Selasphorus platycercus*) nest commonly in these mountains and are virtually the only hummingbirds which exploit penstemon in Rose Canyon during most of the summer. Our impression is that female Broad-tails feed at least as often at scattered penstemon as at large clusters, whereas males are almost always seen feeding at larger clusters. In addition, male Broad-tails seem to be aggressive when feeding; a large penstemon cluster seems to be the external reference for a male's intense aggressiveness toward conspecifics of both sexes. Females do not seem to be territorial in this way. Since large penstemon clusters are no doubt more economically defensible (*sensu* Brown, Wilson Bull. 76:160, 1964) than scattered penstemon, it is not surprising that territorial males are seen almost exclusively at larger clusters. Since penstemon are almost the sole local source of nectar for hummingbirds at this time of year, addition of another hum-

mingbird species to the avifauna would seem to create a situation promoting interspecific territoriality (Orians and Willson, Ecology 45:736, 1964).

On 6 July 1971, male Rufous Hummingbirds (*Selasphorus rufus*) were seen for the first time of the year in Rose Canyon. These were probably migrating individuals (female Rufous may have been present also). On 10 July, we observed a male Rufous feeding at a roadside penstemon cluster. Soon a male Broad-tail flew in, and the two birds joined in an aerial fight, rising vertically as they swirled around each other. Then the Broad-tail chased the Rufous for at least 30 m. Immediately the Broad-tail returned to a perch directly above the same penstemon cluster. Soon the Rufous returned, the Broad-tail dived at the Rufous, and they disappeared in a chase. Later in the day we observed another male Rufous feeding at a cluster of penstemon beside a lake, 1-2 km from the location of the first observation. This Rufous chased an unidentified hummingbird as we approached the penstemon. A female (Broad-tail or Rufous) perched for a minute in a pine near the flowers, then she flew down to feed. Immediately a male Rufous flew directly at the female from several meters away. The female flew about 30 m, but the male did not follow. It returned instead to feed at the penstemon. By the end of July all male Rufous seemed to have left Rose Canyon.

Cody (Condor 70:270, 1968) reports a nonterritorial Broad-tailed Hummingbird being attacked by territory-holding Rufous Hummingbirds, but the observations presented here seem to provide the first record of a Broad-tail attacking and chasing a Rufous. These observations provide an additional record of territorial behavior in migrant hummingbirds (Armitage, Condor 57:239, 1955; Cody, *op cit.*; Austin, Condor 72:234, 1970).

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