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Attraction of Social Fringillids to Mineral Salts: An Experimental Study.—For many years, Cassin's Finches (*Carpodacus cassinii*), Red Crossbills (*Loxia curvirostra*), Pine Siskins (*Carduelis pinus*), and Evening Grosbeaks (*Coccothraustes vespertinus*) have congregated in groups of up to 30 birds to peck at bare ground within an area approximately 1 × 10 m, adjacent to Elrod Laboratory at the University of Montana Biological Station.

Similar congregations of fringillids have been noted elsewhere (Meade 1942, Van Tyne and Berger 1976, Sainsbury 1978, Flaxman 1983), and the favored explanation is that salts or some other chemical resource might be more readily available at such sites. The idea is consistent with a known extra-dietary "need" for salt by fringillids (Tordoff 1954). Explanations have been speculative to date, however, because of a lack of experimental hypothesis testing (see editors' comments associated with Meade 1942, Bartlett 1976, Sainsbury 1978, Flaxman 1983).

We describe experiments designed to distinguish among 4 hypotheses to explain this congregation at Elrod Laboratory: (1) food hypothesis—food resources are superabundant at the congregation site, (2) soil texture hypothesis—structural attributes of the soil (e.g., grit size) differ from what is available elsewhere, (3) chemical hypothesis—concentrations of potential chemical resources are unusually high at the site, and (4) site hypothesis—there are no unusual aspects associated with the soil, but some physical aspect of the site (e.g., predator protection) makes what resources are available more attractive.

Study site and methods.—The experiments were conducted between 1 July and 20 August 1982 at the University of Montana Biological Station, 25 km S of Bigfork, Lake Co., Montana. Fringillids congregated daily at the Elrod Laboratory site.

We mist-netted during an initial period that lasted from 1 to 7 July. Each bird was banded with either a USFWS aluminum band or plastic color band and released. We continued netting from 8–14 July and recorded the number of newly captured and recaptured birds so that we could estimate the size of the bird population using the site (Lincoln Index, Giles 1969).

We divided the area used into 10 adjacent 1 × 1 m units and removed the top 8 cm of soil. The soil (hereafter referred to as laboratory soil) was sifted through a series of Tyler sieves to determine the relative proportions of soil in each of 5 particle size classes: <.83 mm, .84–1.39 mm, 1.40–2.82 mm, 2.83–7.92 mm, and >7.93 mm. The laboratory soil was then remixed in a drum roller and replaced in a randomly selected 5 of the ten 1 × 1 m units. Soil of a texture similar to that of the soil adjacent to Elrod Laboratory was collected from an area located about 20 m from the laboratory (hereafter referred to as distant soil) and was sifted and mixed to the same size class proportions as the laboratory soil. The remaining five 1 × 1 m units were then filled with this distant soil.

We quantified bird use in each of the 10 units before and after our experimental manipulation by recording the number of birds in each 1 × 1 m unit at 2-min intervals

TABLE 1. Number of birds observed within five 1 × 1 m sections assigned laboratory soil and 5 sections assigned distant soil.

	Laboratory soil	Distant soil
Before soil alteration	722	630
After soil alteration	476	15

$G = 384.2, P < .001$.

TABLE 2. Mean chemical concentrations (ppm ± SD) from extracts of laboratory and distant soils.

Element	Laboratory soil	Distant soil	P*
Ca	171.7 ± 31.2	33.7 ± 17.1	<.05
Na	199.3 ± 41.1	0.1 ± 0.0	<.05
Mg	65.9 ± 7.6	3.6 ± 2.6	<.05
K	33.3 ± 20.8	3.1 ± 2.0	<.05

* Based on Mann-Whitney U test.

for 1 h. There were 5 such 1-h observation periods occurring between 0600–1000 over 2 successive days both before and after experimental treatment.

We took 3 samples each from the laboratory and distant soil to determine concentrations of sodium (Na), calcium (Ca), magnesium (Mg), and potassium (K) in each. We combined 10 g of soil (using the <.83 mm size class) with 100 ml deionized water and mixed the samples in a mechanical shaker for 24 h. Concentrations of each element were recorded to the nearest .001 ppm as determined using atomic absorption spectrophotometric analysis.

As a final experiment, we saturated two 1 × 1 m units containing distant soil with a mixture of 10 l water and either .25 kg NaCl (one unit) or .25 kg $CaCO_3$ (the other unit). We recorded bird use before and after soil treatment.

Results and discussion.—We captured 53 birds (33 Pine Siskins, 4 Red Crossbills, and 16 Cassin's Finches) during our initial netting period. Based on a recapture of 3 previously-marked birds from among 40 birds captured during the second 7 days (24 Pine Siskins, 10 Red Crossbills, and 5 Cassin's Finches) we estimate that as many as 707 different birds visited the Elrod Laboratory site. Although this estimate is crude, we feel the number is certainly much greater than that expected if the only birds to visit were those whose breeding territories included the congregation site. Our banding activities at a site 3 km distant confirmed that some individuals came from at least that far away, since some birds banded there were recaptured at the laboratory site.

The possibility that the birds were attracted to the laboratory site on the basis of food resources (food hypothesis) was eliminated because: (1) visual search of the entire soil surface produced only a few seeds and ants, which might be considered potential food items, and (2) the birds used the laboratory site after the soils had been sifted and the potential food items removed. This conclusion is consistent with the findings of Sainsbury (1978), who also microscopically examined soil taken from a Red Crossbill congregation in Germany and found no traces of potential food, and with that of Flaxman (1983), who found no food on a stone wall in Austria, where large numbers of Pine Siskins were pecking.

After experimental soil manipulation, a significantly smaller proportion of birds was observed in the five 1 × 1 m units that held distant soil than expected on the basis of the

TABLE 3. Number of birds observed within 1 × 1 m units containing either untreated soil (8 units) or units eventually treated with either sodium (1 unit) or calcium (1 unit).

	Untreated soil	Na-treated soil	Ca-treated soil
Before treatment	483	6	2
After treatment	129	55	4

$G = 124.1, P < .001$.

relative use of those units before manipulation (Table 1). We would not expect such a change in the use of the soil types if aspects of the site itself (and not the soil *per se*) attracted the birds, nor would we expect such if soil texture attracted the birds since the textures of the laboratory soil and distant soil were sifted to be identical in size composition. We, therefore, reject both the site and soil texture hypotheses.

For each chemical element tested, the laboratory soil had significantly higher concentrations than the distant soil (Table 2). Therefore, we cannot reject the chemical hypothesis. Further evidence that supports the chemical hypothesis comes from the final manipulation, where we added a dissolved solution of NaCl to one and $CaCO_3$ to another of the 1 × 1 m units. There was a significant ($G = 124.1, P < .001$) increase in the relative use of both units, with a 24-fold increase in the relative use of the NaCl unit and a 5-fold increase in the relative use of the $CaCO_3$ unit (Table 3).

Some fringillid concentrations have been recorded at natural salt deposits (Van Tyne and Berger 1976). For example, Griscom (1937) reported using such deposits to facilitate the banding of crossbills. Social fringillids have also been attracted to artificial sources of salt (Bleitz 1958, Dawson et al. 1965). Meade (1942), in fact, described the demise of hundreds of crossbills and siskins due to traffic along a snow-covered road upon which sand and CaCl had been spread.

We conclude that chemical salts probably attracted large numbers of fringillids to the Elrod Laboratory site. The concentrations of salts probably resulted from chemicals leached from the stone walls of Elrod Laboratory onto the soil. It is common for builders to mix $CaCO_3$ with cement to increase hardening rates in cool climates; such was the case when Elrod Laboratory was built in 1967 (R. Morganstern, pers. comm.). Sainsbury (1978) found $CaCO_3$ flakes in the soil beneath the stone wall that adjoined the location of a similar crossbill congregation in Germany.

Why there is an extra-dietary need for salt ingestion by finches is unanswered (Van Tyne and Berger 1976), but an interesting management implication is that it may be possible to create "concentration centers" in parks, along nature trails, or in back yards, where large numbers of finches might be viewed.

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LITERATURE CITED

BARTLETT, E. 1976. Crossbills feeding at chimney-stacks. Br. Birds 69:312.

BLEITZ, D. 1958. Attraction of birds to salt licks placed for mammals. Wilson Bull. 70:92.

DAWSON, W. R., V. H. SHOEMAKER, H. B. TORDOFF, AND A. BORUT. 1965. Observations on metabolism of sodium chloride in the Red Crossbill. Auk 82:606–623.

FLAXMAN, E. W. 1983. Communal mineral-eating by siskins. Br. Birds 76:352.

GILES, R. H., JR. 1969. Wildlife management techniques. The Wildlife Society, Washington, D.C.

GRISCOM, L. 1937. A monographic study of the Red Crossbill. Proc. Boston Soc. Nat. Hist. 47:77–110.

MEADE, G. M. 1942. Calcium chloride—a death lure for crossbills. Br. Birds 59:439–440.

SAINSBURY, M. 1978. Crossbills 'feeding' on soil. Br. Birds 71:540–541.

TORDOFF, H. B. 1954. A systematic study of the avian family Fringillidae based on the structure of the skull. Misc. Publ. Univ. Mich. Mus. Zool. 81:1–42.

VAN TYNE, J., AND A. J. BERGER. 1976. Fundamentals of ornithology. John Wiley and Sons, New York.

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