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Recoveries of Ferruginous Hawks Banded in South-central North Dakota.—The objectives of this note are to describe dispersal patterns, migration routes, wintering areas, and mortality of Ferruginous Hawks (*Buteo regalis*) banded in North Dakota. We also discuss papers summarizing recoveries of this species banded in other areas, including those of Lincoln (1936), Salt (1939), Thurow et al. (1980), and Harmata (1981).

From 1977 through 1979 we banded 1010 Ferruginous Hawks within a 16,519-km² study area encompassing Stutsman, Kidder, Burleigh, and Logan counties in south-central North Dakota. Banding was done in conjunction with nesting studies of the Ferruginous Hawk (Gilmer and Wiehe 1977, Gilmer and Stewart 1983). We also included 21 additional Ferruginous Hawks banded in the same area in 1976 by J. W. Grier. All birds were banded as nestlings, 3 weeks or older, with U.S. Fish and Wildlife Service leg bands. Guidelines described by Fyfe and Olendorff (1976) were followed to prevent injury to young birds. Although male and female Ferruginous Hawks differ in size, the wide overlap did not permit reliable sexing. We grouped recoveries into seasons for analysis: fall (1 August to 31 October), winter (1 November to 31 January), spring (1 February to 30 April), and summer (1 May to 31 July). We calculated band recovery rates by dividing the total reported recoveries of banded birds by the total number of birds banded.

Forty Ferruginous Hawk recoveries were reported through 1982. Four were recovered within 10 km of their nests between 30 and 80 days following fledging. However, most young and adults probably left the nest site vicinity within 40 days following the peak period of fledging—about the first week of July (Konrad and Gilmer, unpubl. data), a finding also noted by Thurow et al. (1980).

Evidence of a premigration drift or dispersal (Stewart 1980) was suggested by recoveries 350 km northwest and 600 km southwest of banding sites within 55 days of fledging. In Idaho, prevailing winds and reduced prey populations in natal areas may have encouraged young birds to drift northeasterly (Thurow et al. 1980). However, these factors did not satisfactorily explain the dispersal movements we observed, which may have been random (Brown and Amadon 1968). Factors such as terrain features may also have influenced these movements.

Recovery patterns observed for Ferruginous Hawks we banded define a migration route through the midwestern states into Mexico (Fig. 1). Only one bird was recovered west of the Rocky Mountains. None was recovered east of the Mississippi River, but few sightings occur in the east (Adams 1978). Ferruginous Hawks banded in Alberta (Salt 1939) and Colorado (Harmata 1981) had recovery patterns similar to those we banded, while hawks banded as nestlings in southern Idaho (Thurow et al. 1980) were recovered in a wide region on both sides of the Rocky Mountains.

Texas and Mexico appeared to be important wintering areas for Ferruginous Hawks banded in south-central North Dakota. About 46% of all winter and spring recoveries of hawks we banded were reported from those regions. Harmata (1981) also reported Texas as a primary wintering area for Ferruginous Hawks produced in northeastern Colorado.

Spring migration for some <1-year-old hawks may be a leisurely drift northward, as suggested by recoveries of our banded birds in Oklahoma (8 April), Kansas (20 April, 15 May), and South Dakota (20 May, 18 June), all of which occurred when Ferruginous Hawk pairs in North Dakota usually had eggs or young. Since there is no evidence that this species breeds during the first year, it seems likely that prior to breeding age Ferruginous Hawks may wander widely, seeking areas with adequate prey. Weather patterns may also influence seasonal movements of these hawks.

Three Ferruginous Hawk recoveries were reported from locations 250 to 500 km northwest of the banding site in southern Saskatchewan. Two were year-old birds re-

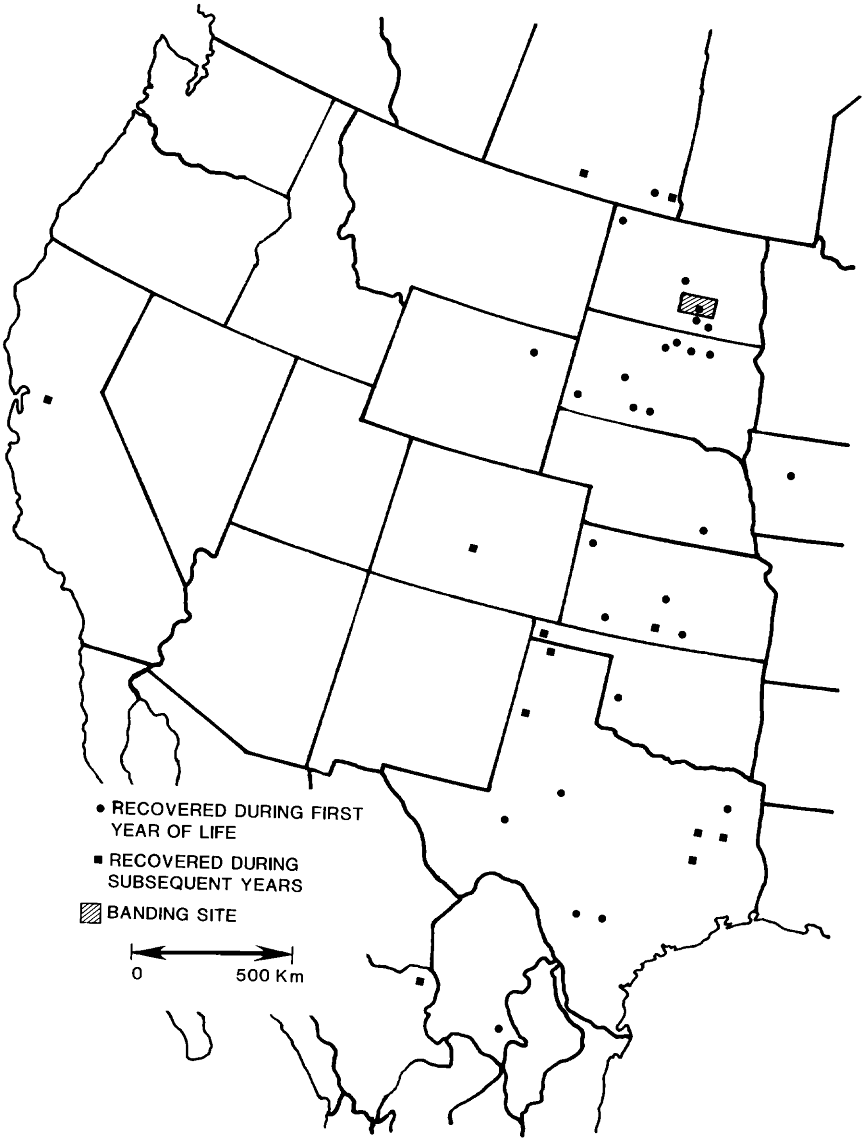

FIGURE 1. Recoveries of Ferruginous Hawks banded in North Dakota, 1976–1979.

covered on 6 May and 26 July, and one 2-year-old bird of unknown breeding status was recovered on 10 September. Band recoveries reported by Salt (1939) and Harmata (1981) indicate that some mature Ferruginous Hawks may return to natal areas to nest. However, the age of initial breeding for this species has not been established (Brown and Amadon 1968).

The one bird recovered west of the Rockies was reported in California 16 months after banding. Other recoveries in California for this species included two birds banded in Idaho (Thurow et al. 1980), one in Colorado (Harmata 1981), and one in Alberta (Salt 1939). Harmata (1981) believed that during winter, Ferruginous Hawks from Colorado mixed in Mexico with populations from West Coast states and then returned through California.

Five (12.5%) of the Ferruginous Hawks recovered were shot and 4 (10.0%) were struck by vehicles. Twenty-eight others (70.0%) were listed as found dead or injured and no information was given on 3 (7.5%). We estimate that most recoveries were made along highways where availability of perches and presence of prey may attract raptors and make them vulnerable to mortality or injury.

Mortality in ≤1-year-old Ferruginous Hawks (n = 28) was highest during fall (35.7%) and winter (32.1%), whereas 75% of the recoveries for birds >1-year-old (n = 12) occurred during winter. Recovery rate for >1-year-old birds in winter was higher than expected ($\chi^2 = 6.46$, df = 3, $P = .09$). The recovery rate for >1-year-old birds was .012, whereas the recovery rate for younger birds was .027. The overall recovery rate of the Ferruginous Hawks banded in this study (.039) was comparable to recovery rates observed in other recent banding studies (.037—Thurow et al. 1980, .078—Harmata 1981) but lower than recovery rates reported in earlier studies (.172—Lincoln 1936, .209—Salt 1939). Shooting in southern areas (Texas, Mexico, California) during winter and spring accounted for recoveries of two (16.7%) of the >1-year-olds and three (10.7%) of the younger birds. Other recoveries probably resulted from shooting which may be more severe in the south because birds inhabit that region during months when most game bird hunting is legal. Shooting of all raptors became illegal in 1972 as a result of an amendment to the Migratory Bird Treaty Act. This restriction may have reduced the number of raptor bands being reported and may have even decreased the number of raptors being shot. This may explain why earlier banding studies of Ferruginous Hawks (Lincoln 1936, Salt 1939) had higher recovery rates.

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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

$G = 384.2$, $P < .001$.