TABLE 1. Number of migrant Peregrine Falcons sighted in northwestern Peru.

Observation period	Numbers of Peregrine Falcons observed				
	Total	Adults	Im-matures	Males	Females
Oct. 1980	0	0	0	0	0
Nov. 1980	2	—	—	—	1
Dec. 1980	3	—	1	—	—
Jan. 1981	4	—	3	—	2
Feb. 1981	3	—	1	—	1
Mar. 1981	3	—	1	—	—
Apr. 1981	0	0	0	0	0
Oct. 1981	4	—	—	1	—
Nov. 1981	22	11	9	10	11
Dec. 1981	5	1	—	3	2
Jan. 1982	6	—	—	1	3
Feb. 1982	16	9	2	6	7
Mar. 1982	16	12	0	5	5
Apr. 1982	6	—	—	2	2
	90	33	17	28	34

In summary, our observations, when considered with those of other investigators, suggest that the Peregrine Falcon's breeding range extends from Ecuador to Chile and Argentina, throughout the western foothills of the Andes, and possibly into the central and eastern Andes as well. Our observations also document the migration of North American Peregrines at one point along the coast of western South America.

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A REEXAMINATION OF THE METABOLIC RESPONSE OF HOUSE FINCHES TO TEMPERATURE

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Resting metabolic rates (*RMR*) have afforded important baseline information for our studies of seasonal acclimatization in cardueline finches (see, for example, Dawson and Carey 1976, Carey et al. 1978, Marsh and Dawson 1982, Yacoe and Dawson 1983, Dawson et al. 1983b). In studying the House Finch (*Carpodacus mexicanus*; Dawson et al. 1983a, Marsh et al. 1984), we have needed such *RMR* data. Accordingly, we determined the effects of temperature on resting metabolism of birds from one population of this species. The results, summarized here, update one facet of Salt's (1952) metabolic study of members of the genus *Carpodacus*. His study represented an early and innovative application of the comparative method for investigating the physiological ecology of birds. Criteria at that time for determination of *RMR* in birds, however, were far less well defined than at present.

Here, we also present seasonal comparisons of standard metabolic rate (*SMR*), i.e., *RMR* in the zone of thermal neutrality, for House Finches from two localities that differ in severity of winter weather. We undertook these comparisons in part to determine whether *SMR* of House Finches shifts between winter and spring at either locality. Such shifts figure prominently in laboratory studies in which birds are acclimated to various temperatures (summarized by Gelineo 1964). We also wanted to see if *SMR* changed with latitude in House Finches. A direct correlation between these two variables has been described for passerines at the interspecific level (Weathers 1979).

MATERIALS AND METHODS

We made most of our measurements on birds from Riverside, Riverside County, California (hereafter identified as CA). Members of this population were studied from 18 January to 8 March, and from 10 to 24 May 1979, within a week of capture. During the former period, we examined the relation of metabolism to ambient temperature (T_a). Our efforts in May, however, were confined to determination of *SMR*s. While in captivity, the CA birds were kept in 0.6-m^3 outdoor cages on the roof of a building at the University of California, Riverside, where water and a seed mixture consisting principally of millet were freely available.

From 1 to 5 March and from 1 to 22 May 1979, *SMR*

TABLE 1. Thermal conditions for periods in which metabolic measurements on House Finches were made during 1979.[a]

Locality (elevation and coordinates)	Period	Daily maximum temperature (°C) range (mean)	Daily minimum temperature (°C) range (mean)	Average temperature[b] for period (°C)
Boulder, CO (1,652 m; 40°01'N, 105°16'W)	1–5 March	4.4 to 13.3 (9.4)	−11.7 to −2.8 (−6.6)	1.4
	1–22 May	5.0 to 28.9 (18.3)	−1.7 to 11.7 (4.4)	11.3
Riverside, CA (300 m; 33°58'N, 117°21'W)	18–31 January	10.0 to 19.4 (14.2)	−0.6 to 7.2 (3.0)	8.6
	1–28 February	9.4 to 26.1 (17.9)	0 to 9.4 (5.4)	11.7
	1–8 March	10.6 to 30.0 (22.8)	2.8 to 11.7 (6.3)	14.6
	10–24 May	20.0 to 37.8 (28.9)	6.7 to 15.0 (11.7)	20.3

[a] Based on data in U.S. Environmental Data Service (1979a, b).
[b] Calculated as the mean of the daily maximal and minimal temperatures for the particular period.

was also measured on House Finches collected near Boulder, Boulder County, Colorado (hereafter identified as CO). Four of the six birds in the March sample were tested in Boulder within a few hours of capture. The other two were used there after 1 and 3 days in captivity, respectively. Caging arrangements for these finches were similar to those for the CA individuals, except that the birds were housed indoors, where they were exposed to natural photoperiods but more moderate temperatures (ca. 15°C) than those prevailing outdoors (Table 1). All of the May birds were studied in Boulder within a few hours after capture.

We determined the metabolic rates by measuring the birds' rates of oxygen consumption ($\dot{V}_{O_2}$), using procedures described by Dawson and Carey (1976). Briefly, birds were removed from water and food at approximately 16:00 and placed in darkened metabolism chambers. Metabolic determinations were made at least 6 h later, between 22:00 and 01:00, while the finches rested in the dark in a postabsorptive state. This ensured that they were in the inactive phase of their daily cycle. The metabolism chambers were fashioned from new, 3.8-liter paint cans, the inside surfaces of which were painted flat black. The chambers were used in open-circuit metabolism systems in which the respective rates of air flow were measured with rotameters. Chamber temperatures were registered with 30-ga, copper-constantan thermocouples used in conjunction with either a Kaye 8000 data logger (Riverside) or a Honeywell 15 recording potentiometer (Boulder). The oxygen concentrations of dry, CO_2-free air from the upstream and downstream segments of the metabolism systems were determined using an Applied Electrochemistry S-3A Oxygen Analyzer (Riverside) or Beckman E-2 Oxygen Analyzer (Boulder). Drierite and Ascarite were used as desiccant and CO_2 absorbent, respectively. The rates of air flow employed in our tests (450–650 cm³/min, not corrected to standard conditions) were sufficient to maintain the fractional concentrations of oxygen above 20% (>ca. 145 and 122 torr at Riverside and Boulder, respectively). Our data appear most directly comparable to Salt's (1952) results for House Finches at 12% relative humidity (actual humidities in his experiments were probably higher than this). During tests, the metabolism chambers were housed in constant temperature cabinets that maintained the T_a around the birds within 0.5°C of the desired value. The birds' cloacal temperatures (T_b) were measured at the conclusion of these tests, either with a Schultheis thermometer or a 30-ga, copper-constantan thermocouple ensheathed in fine polyethylene tubing.

The values of body mass and standard $\dot{V}_{O_2}$ that follow are means ± SEM. We examined the birds' SMR as a

TABLE 2. Comparison of observed and predicted values for certain physiological functions of *Carpodacus* finches.[a]

Function (units)[b]	Species[c]	Body mass (g)	Observed (A)	Predicted (B)	A/B
h_{min} (cal[g·h·°C]$^{-1}$)	CA House Finch (W)	20.9	0.82[d]	0.88	0.93
		20.9	0.79[d]	0.88	0.90
	Cassin's Finch	28.1	0.43	0.75	0.58
$T_b - T_{lc}$ (°C)	CA House Finch (W)	20.9	17.3	15.9	1.09
	Cassin's Finch	28.1	17.7	17.2	1.03
SMR (cm³ O_2[g·h·°C]$^{-1}$)	CA House Finch (W)	20.5	2.91	2.84	1.02
	CA House Finch (Sp)	20.7	2.87	2.83	1.01
	CO House Finch (W)	20.6	3.17	2.84	1.12
	CO House Finch (Sp)	19.8	3.13	2.87	1.09
	Cassin's Finch	28.1	2.35	2.61	0.90

[a] Data for the House Finch and Cassin's Finch are from this study and Weathers et al. (1980), respectively.
[b] Observed and predicted values for the particular functions are presented in columns (A) and (B), respectively, in the units indicated. h_{min} = minimal heat transfer coefficient; $(T_b - T_{lc})$ = the critical thermal gradient, i.e., the difference between body temperature and lower critical temperature; SMR = standard metabolic rate. The allometric equations used to obtain predicted values for these functions in passerines are: $h_{min} = 4.55\ g^{-0.54}$ (Calder and King 1974); $(T_b - T_{lc}) = 6.98\ g^{0.27}$ (Calder and King 1974); and $SMR = 6.42\ g^{-0.27}$ (Aschoff and Pohl 1970).
[c] CA and CO identify birds captured at Riverside, California, and Boulder, Colorado, respectively; W and Sp indicate individuals studied during winter and spring, respectively.
[d] The value 0.82 cal(g·h·°C)$^{-1}$ was calculated from the slope of Eq. (1). That of 0.79 cal(g·h·°C)$^{-1}$ represents the mean of the heat transfer coefficients calculated from metabolic data obtained at or below 15°C (see text and Fig. 1).
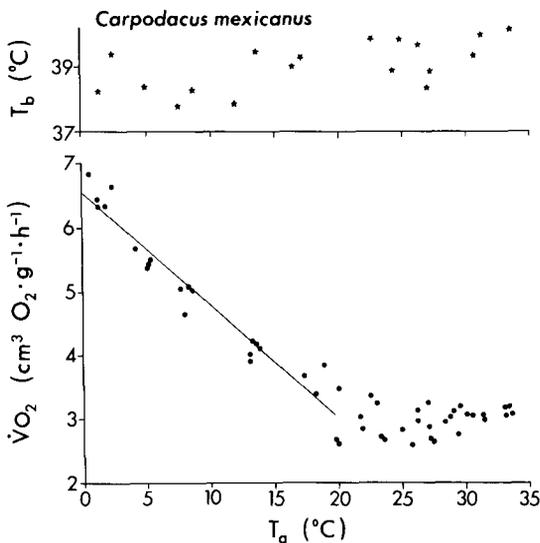
FIGURE 1. Relation of RMR (expressed as $\dot{V}_{O_2}$ corrected to STPD) and T_b to T_a in House Finches from Riverside, California, in winter (see Eq. [1] and [2] in text). Three post-absorptive birds resting in the dark in individual metabolism chambers were tested each night. These chambers were housed together in a constant temperature cabinet. The oxygen consumption of the birds was measured sequentially. Birds were removed from their chambers only after completion of the third measurement. The values presented for T_b pertain to the first bird in each group to be removed, to minimize the effects of disturbance on results.

function of their geographical origin and season using two-way analysis of variance. Regression lines were fitted by the method of least squares.

RESULTS AND DISCUSSION

During winter, CA House Finches have a lower critical temperature (T_{lc}) between 20 and 24°C (Fig. 1). We arbitrarily selected a value of 22°C for comparative purposes. The upper limit of the zone of thermal neutrality is at least 33°C. Salt's (1952) data for "12% relative humidity" suggest a T_{lc} nearer 25°C for the House Finch. The 22°C value that we selected proved identical to that reported by Weathers et al. (1980) for Cassin's Finch (C. cassinii; Table 2), a somewhat larger (ca. 28 g) congener of the House Finch. The relation of $\dot{V}_{O_2}$ to T_a for House Finches below thermal neutrality, based on data in the interval of 0.5–20°C, is best described by the following linear equation:

$$\dot{V}_{O_2} = 6.51 - 0.17T_a \qquad (1)$$

($\dot{V}_{O_2}$ and T_a in cm³ O₂ [g·h]⁻¹ and °C, respectively; $n = 23$; mean body mass: 20.9 ± 0.23 g; $r^2 = 0.93$). At the end of metabolic measurements, when T_as were between 0.5 and 33°C, the birds' T_b was generally 38–40°C, although two birds had temperatures of 37.6 and 37.8°C at T_as of 7.5 and 13.2°C, respectively. We found a weak, but significant ($P < 0.01$) relationship between T_b and T_a, which is described by the following linear equation (based on data for 0.5–33°C):

$$T_b = 38.3 + 0.04T_a \qquad (2)$$

(T_b and T_a in °C; $n = 18$; $r^2 = 0.29$). At T_as of 24.0–30.0°C, the mean SMR of CA House Finches in winter was 2.91 ± 0.055 cm³ O₂(g·h)⁻¹ ($n = 16$; mean body mass of test subjects: 20.5 ± 0.29 g), a value that did not differ significantly from the mean SMR of CA birds in spring,

2.87 ± 0.090 cm³ O₂(g·h)⁻¹ ($n = 11$; mean body mass: 20.7 ± 0.37 g). Our values for CA House Finches in winter and spring, however, are approximately 20% below Salt's (1952) values obtained at 25–30°C and a "12% relative humidity" for birds of this species from a more northerly locality (Alameda County) in California. We believe that this difference is primarily because his tests were carried out during the day, whereas ours were conducted at night. Aschoff and Pohl (1970) noted that the amplitude of circadian oscillations of SMR in passerines approximates 20%.

The mean SMRs of the CO House Finches also were similar in winter and spring. The rates for winter and spring were 3.17 ± 0.042 ($n = 6$; mean body mass: 20.6 ± 0.48 g) and 3.13 ± 0.141 cm³ O₂(g·h)⁻¹ ($n = 9$; mean body mass: 19.8 ± 0.47 g), respectively. The mean SMRs of CA and CO birds did not differ significantly in either season. Moreover, two-way analysis of variance indicated no significant interaction between season and the geographical origin of the birds, despite the variation in temperature by month and locality (Table 1). This stability of SMR contrasts with the lability of this function in laboratory experiments on thermal acclimation summarized by Gelineo (1964). In tests involving several European species of cardueline finches abruptly transferred from one range of environmental temperature to another 15–20°C higher or lower, 25–40% changes in SMR were noted within 3–4 weeks, the ultimate level of SMR varying inversely with the new temperature. The stability of SMR noted for the House Finches adjusted to outdoor conditions is consistent with the more extensive results that Dawson and Carey (1976) obtained for American Goldfinches (Carduelis tristis) from southeastern Michigan. Standard metabolic rate in these latter birds does not differ significantly between winter and late spring in freshly captured individuals.

Our data on the CA and CO House Finches additionally indicate that SMR is independent of latitude, in contrast to the situation described for passerines at the interspecific level (Weathers 1979). The 6°C difference in the latitude of Boulder and Riverside (Table 1), however, is sufficiently narrow that we cannot exclude the possibility that such a trend might exist in House Finches obtained over a greater latitudinal span.

The line fitted to metabolic values of winter CA House Finches at T_as of 20 to 0.5°C (Eq. [1]) extrapolates to zero metabolic rate near 38°C, i.e., to a temperature about 1°C below the birds' T_b at the end of metabolic tests (Fig. 1). Both the similarity between these temperatures and the low dependence of T_b on T_a below T_{lc} (Eq. [2]) suggest that the slope of Eq. (1) is a reasonable estimate of the minimal overall heat transfer coefficient (h_{min}) of these birds. This, in fact, is the case, because the value obtained by converting the slope to energetic terms is within 4% of the mean heat transfer coefficient ($h = 4.8\dot{V}_{O_2}/[T_b - T_a]$) calculated from metabolic tests conducted below 15°C (Table 2).

The SMRs we obtained for birds from CA and CO, as well as the h_{min} and critical thermal gradients (i.e., [$T_b - T_{lc}$] values) of CA House Finches, are within 12% of values predicted using allometric equations for passerines weighing about 20 g (Table 2). The SMR of the somewhat heavier Cassin's Finch also is similar to the value predicted for it (Table 2). The general conformance of SMR of Cassin's Finch and CO House Finches to predicted values is of interest because both encounter relatively severe winter conditions. The observed and predicted heat transfer coefficients of the Cassin's Finch differ markedly, which is thought to indicate that it has relatively good insulation (Weathers et al. 1980).

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SEXUAL COLOR AND SIZE VARIATION IN THE SOUTH POLAR SKUA

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In the South Polar Skua (Catharacta maccormicki), females average larger than males in both weight and size, a fact known for some time (Falla 1937, Spellerberg 1970). During December, 1982, at Cape Crozier, Ross Island (77°31'S, 169°23'E), we attempted to determine whether a visual comparison of the members of skua pairs could be used as a valid means to determine sex. Thanks to our observations, made during previous years, of bonded pairs engaged in copulation or courtship feeding, a sample of 43 pairs of known-sex skuas was available to us. Without knowing the actual sex of the birds as we moved through the breeding colony, we determined which was the larger in each of the 43 pairs. At the outset, we were surprised to find that the larger bird was almost always paler as well. Consequently, we noted the relative color as well as the relative size between paired birds.

Based on size measurements, we were able to correctly sex 38 pairs (88%; Table 1). We did not find a discernible size difference between members of the five remaining pairs, and thus, we withheld a declaration as to their sex. Based on color alone, we would have been able to correctly sex only 31 pairs. Thus, relative size was a better criterion for determining sex than was relative color. By using both size and color, we were not able to increase the number of pairs correctly sexed; however, we could judge the sex of birds with more confidence than by using size alone. Thus, when one member of a pair was obviously larger and paler than its mate (in about 72% of pairs at Cape Crozier), we would have been virtually certain to consider that bird a female and its mate a male. In only one pair was the female darker than the male, and in that pair no obvious size difference was discernible (see below).

At Cape Crozier, males tended to be dark regardless of relative color: 26% of males but only 2% of females in the 43 pairs were unequivocally "dark phase" (Table 1). Conversely, females were more likely to be "light phase" but it was more difficult to define the cutoff between the "light" and "intermediate" phases, owing to the intergradation between the two types (see below for a definition of color phases). Among 230 pairs of banded skuas that we were studying during December, 1982, in only one pair were both partners dark-phase birds.

Even in the region of the Antarctic Peninsula, where dark-phase birds predominate (Watson 1975), the use of color and size to determine sex is a valid technique. In 1984, at our request, W. Z. and S. G. Trivelpiece and N. J. Volkman surveyed the population at King George Island. They found that in 12 pairs of South Polar Skuas of known sex, the male was smaller and darker than the female in 10 instances, but in one pair he was the same color, and in another he was the same size as the female. As with our sample, these workers made their comparisons without immediate knowledge of the real sexes of the birds.

To further confirm that skua mates differ in size, we were able to capture and weigh both birds in eight known-sex pairs. In addition, we had weights from two other "pairs" collected by Ainley in the Ross Sea pack ice during January, 1979; in both these cases, the individual that had begged from and received a fish from the other bird proved to be a female and the other bird proved to be a male; in both pairs, the male was darker than the female. In all 10 pairs, the female was heavier than the male. The difference ranged from 30 to 290 g ($\bar{x}$ = 126 ± 79 g). In eight of the 10 pairs, weight differed by more than 80 g. In the two pairs where the size difference was ≤50 g, we had visually