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THE EFFECT OF DAILY WINTER TEMPERATURE EXTREMES ON FOOD INTAKE BY CHUKARS[1]

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During the early 1900's, Larguier des Bancels (1902) and Lapicque and Lapicque (1909) noted that food consumption by some small wild birds varied inversely as a function of ambient temperature. A great deal of subsequent research has been directed to understanding the influences of environmental factors on the metabolism of avian species. Kendeigh (1949), Seibert (1949) and West (1960) demonstrated that gross energy intake of some passerine birds increased as temperature decreased. A negative relationship was also shown for temperature and time spent on feeding (Verbeek 1964). Of greater importance to game managers are more recent studies concerning the bioenergetics of Willow Ptarmigan (West 1968), Blue-winged Teal (Owen 1970), Black-bellied Tree Ducks (Cain 1973), and Bobwhite Quail (Case and Robel 1974) which also revealed a negative relationship between food intake and ambient temperature. Most of these studies were conducted under controlled environmental conditions in which ambient temperature was held constant for periods of 24 hr or more. The few studies conducted in outdoor settings have dealt only with mean daily temperatures (West 1968, Owen 1970). The effect of daily environmental temperature extremes on avian bioenergetics has been largely neglected. This study attempts to test the hypothesis of variable food intake by Chukars (*Alectoris chukar*) as a function of daily temperature extremes during outdoor winter conditions.

METHODS

Fifty adult Chukars, in a ratio of approximately three females per male, were placed in an outdoor brooding pen at the Utah Division of Wildlife Resources' game-bird facility at Springville, Utah. The birds had free access to an enclosed protective shelter so that they could avoid wind and/or precipitation if they desired. Over the course of a 30-day study period, a daily, preweighed ration of crushed grain and whole millet seeds was provided in feeding troughs inside the enclosed shelter. The amount remaining after each 24-hr period was weighed and subtracted from the original ration to calculate net daily intake for the entire group. Trays were placed beneath the troughs to collect spilled feed. Feed collected by the trays was sieved to remove fecal material and was included with the left-over feed in the calculation of daily intake. Five birds were randomly selected and their body weights were recorded at the beginning of the study and at weekly intervals thereafter in order to detect any net metabolism of energy reserves. A hygrothermograph located within the protective shelter recorded daily temperature extremes. Mean daily temperature was calculated as the mean of hourly recorded temperatures.

RESULTS AND DISCUSSION

Maximum daily temperature during the course of study varied from −6 to 13°C (21 to 55°F), and the range of minimum daily temperatures was −12 to 9°C (10 to 48°F). All temperatures were well below the range of 25 to 32°C (77 to 90°F) preferred by Chukars (Laudenslager and Hammel 1977).

The relationship between daily temperature measurements and daily food intake was negative and highly significant (Table 1). The inverse relationship between ambient temperature and food intake is well established and logical. As temperature declines, the animals lose more heat to the environment, and more energy is required to maintain a constant body temperature. Behavioral adaptations may temporarily counter small drops in ambient

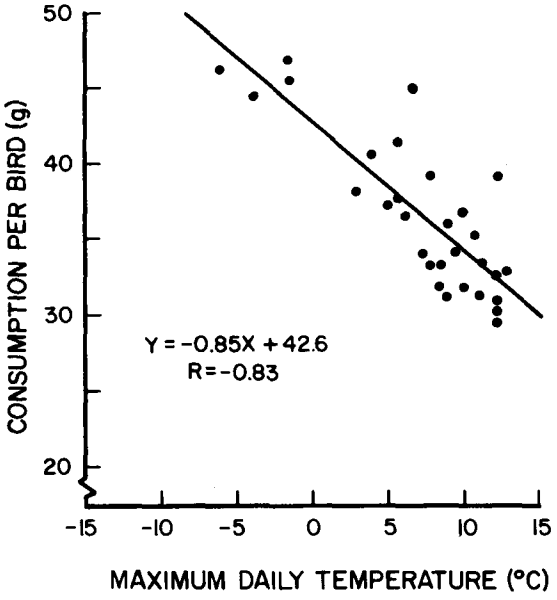

FIGURE 1. Relationship of food consumption by Chukars to maximum daily ambient temperature extremes during the winter at Springville, Utah.

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TABLE 1. Simple correlation coefficients for daily temperature measurements correlated with daily food intake by Chukars at Springville, Utah.

Variable measured	*R*	Significance level
Max. temperature	−0.83	0.001
Min. temperature	−0.68	0.001
Mean temperature	−0.76	0.001

temperature so that additional energy is not required. Ultimately, however, a net increase in existence energy requirements will necessitate increased energy intake and/or metabolism of stored energy reserves. No significant weight change occurred for the birds evaluated in this study, indicating minimal net metabolism of stored energy during the 30-day study period and primary reliance on increased energy intake.

Maximum daily temperature (Fig. 1) had a markedly better correlation with food consumption than did minimum or mean daily temperatures. This discovery is significant in view of previous studies that have dealt only with constant or mean daily temperatures. As a possible explanation, we suggest that during the night, when daily minimum temperatures normally occurred, the Chukars were mostly inactive and may have lessened physiological temperature stress, as do many other avian species, by seeking shelter, fluffing feathers, slightly lowering body temperatures, and/or huddling in groups (Welty 1962). Also, they may have filled their crops during the day to provide an energy source for utilization during the night as has been reported for Willow Ptarmigan (Irving et al. 1967). During the daylight hours, however, when maximum daily temperatures generally occurred, the Chukars spent a considerable amount of time engaged in foraging and other activities, and were less able to utilize most low-temperature behavioral adaptations. Although the heat increment generated by locomotory activity may have partially substituted for the daytime thermoregulatory requirement (Paladino and King 1984), temperature-related energy expenditures were probably greater during the daytime than at night; hence, the greater correlation of maximum daily temperature with food intake. Under exceptional circumstances where minimum temperature extremes occur during daylight hours (e.g., daytime storm front) the correlation may not hold. In addition, the relationship may lose significance as temperatures approach levels which are non-stressful to the animals.

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LITERATURE CITED

CAIN, B. W. 1973. Effect of temperature on energy requirements and northward distribution of the black-bellied tree duck. Wilson Bull. 85:308–317.

CASE, R. M., AND R. J. ROBEL. 1974. Bioenergetics of the bobwhite. J. Wildl. Manage. 38:638–652.

IRVING, L., G. C. WEST, AND L. J. PEYTON. 1967. Winter feeding program of Alaska Willow Ptarmigan shown by crop contents. Condor 69:69–77.

KENDEIGH, S. C. 1949. Effect of temperature and season on energy resources of the English Sparrow. Auk 66: 113–127.

LAPICQUE, L., AND M. LAPICQUE. 1909. Consommations alimentaires d'oiseaux de grandeurs diverses en fonction de la température extérieure. Compte Rendu Soc. Biol. 66:289–292.

LARGUIER DES BANCELS, J. 1902. De l'influence de la température extérieure sur la ration d'entretien chez l'oiseau. Compte Rendu Soc. Biol. 54:162–164.

LAUDENSLAGER, M. L., AND H. T. HAMEL. 1977. Environmental temperature selection by the chukar partridge (*Alectoris chukar*). Physiol. & Behav. 19:543–548.

OWEN, R. B. 1970. The bioenergetics of captive Blue-winged Teal under controlled and outdoor conditions. Condor 72:153–163.

PALADINO, F. V., AND J. R. KING. 1984. Thermoregulation and oxygen consumption during terrestrial locomotion by white-crowned sparrows *Zonotrichia leucophrys gambelii*. Physiol. Zool. 57:226–236.

SEIBERT, H. C. 1949. Differences between migrant and non-migrant birds in food and water intake at various temperatures and photoperiods. Auk 66:128–153.

VERBEEK, N.A.M. 1964. A time and energy study of the Brewer's Blackbird. Condor 66:70–74.

WELTY, J. C. 1962. The life of birds. W. B. Saunders Co., Philadelphia.

WEST, G. C. 1960. Seasonal variation in the energy balance of the Tree Sparrow in relation to migration. Auk 77:306–329.

WEST, G. C. 1968. Bioenergetics of captive willow ptarmigan under natural conditions. Ecology 49:1035–1045.

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INFANTICIDE IN THE PALESTINE SUNBIRD[1]

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Key words: Infanticide; Palestine sunbird; Nectarinia osea.

Infanticide has been reported for many mammal (Hrdy 1979) and some bird (Mock 1984) species. Several hypotheses have been suggested to explain its possible adaptive value. Killing of young by unrelated adult males was interpreted by Wilson (1975) as enabling the performer to secure mating opportunities sooner than would be possible if the female's offspring (unrelated to the infanticidal male) continued to be reared ("sexually selected infanticide," Hrdy 1974). In his review on the incidence of infanticide in birds, Mock (1984) predicted that sexually selected infanticide in birds is much less likely than in mammals, because most birds are monogamous. Here we report similar infanticidal behavior in the Palestine Sunbird (*Nectarinia osea*), a 7-g, monogamous passerine common in Israel.

In spring and summer, females lay 1 to 3 eggs in a well-

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