A TIME AND ENERGY BUDGET STUDY OF THE BREWER BLACKBIRD

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The concept of the time and energy budget (Orians, 1961) and its role in the annual and diurnal activity cycles has been recently developed by the contributions of several authors. The concept implies that birds have to spend a certain amount of time in satisfying elementary needs of self-maintenance, above all in gaining sufficient energy for their metabolism. All other activities, such as migration, reproduction, and molt, require extra energy and are therefore incompatible and are budgeted throughout the annual cycle so that they do not coincide (Pitelka, 1958). Experimental work has shown the inverse relationship of food intake and environmental temperature (Kendeigh, 1949; Seibert, 1949; Davis, 1955; Steen, 1957; Rautenberg, 1957; and Hart, 1962) which is evidently adaptive, for it aims at maintaining the body temperature at a steady, specific optimum level. Seibert (1951) suggested that herons depart earlier from their roosts to the feeding grounds when temperatures are lower because of increased energy demands. An inverse relationship of time spent on feeding and environmental temperature, however, has not yet been demonstrated.

In this study the field approach has been used to gather data about this concept in the Brewer Blackbird (*Euphagus cyanocephalus*) during the winter.

STUDY AREA

The study was carried out on the campus of the University of British Columbia, Vancouver, British Columbia. Brewer Blackbirds mostly frequented that part of the campus where the agricultural barns and fields are located. This area consists of several livestock units and meadows as well as some cultivated fields. The buildings are arranged in such a way that the flock could be observed from some convenient point at most times. There are a few tall trees and many telephone wires among the buildings which serve as the main perching sites during the day.

METHODS

On December 29, 1961, January 13, 17, 24 and February 3, 1962, the flock, numbering at that time about 250 birds, was observed continuously for a period starting 224 minutes before sunset. This 224-minute period was arbitrarily chosen for it was the length of time used on the first observation day and was maintained to make subsequent work comparable. The sunset values were obtained from the Dominion Astrophysical Observatory, Royal Oak, British Columbia. Observations were made on a one-minute basis and recordings were only made when it looked as if more than 50 per cent of the birds in the flock were participating in either one of four types of activities. I recorded time spent in: (1) feeding, (2) sitting and flying, including the preroost flight, (3) bathing and preening, not including regular dry preening, and (4) chasing hawks and being chased by them. These categories are important entities in the diurnal cycle of activities, even though duration of each may be small on some of the days analyzed here.

DAILY ACTIVITY IN REGARD TO FEEDING

The daily activity was marked by nervousness and a constant condition of alertness among the Brewer Blackbirds. Sudden loud noises or the sudden appearance of a moving object, such as a swooping woodpecker, caused the whole flock to fly up from whatever it was doing. This alertness breaks the activity pattern into small parts, with the birds feeding at one moment and flying or sitting idly the next.

Food was available at all times. Earlier in October the birds fed, among other places,

on a large parking lot, which they carefully searched for scraps of food left by the students the day before. With progression of the season this source of food was lost because the parking lot filled with cars before the Brewer Blackbirds arrived. As the days grew shorter the birds ventured closer to the barns and pens and thus began to utilize feeding areas that had formerly not been visited or had been used only slightly.

Usually the birds fed shortly after their arrival from the nearby roost in the morning and kept feeding irregularly throughout the day. Toward evening the birds congregated on a pre-roost gathering site, from which site they departed for the roost.

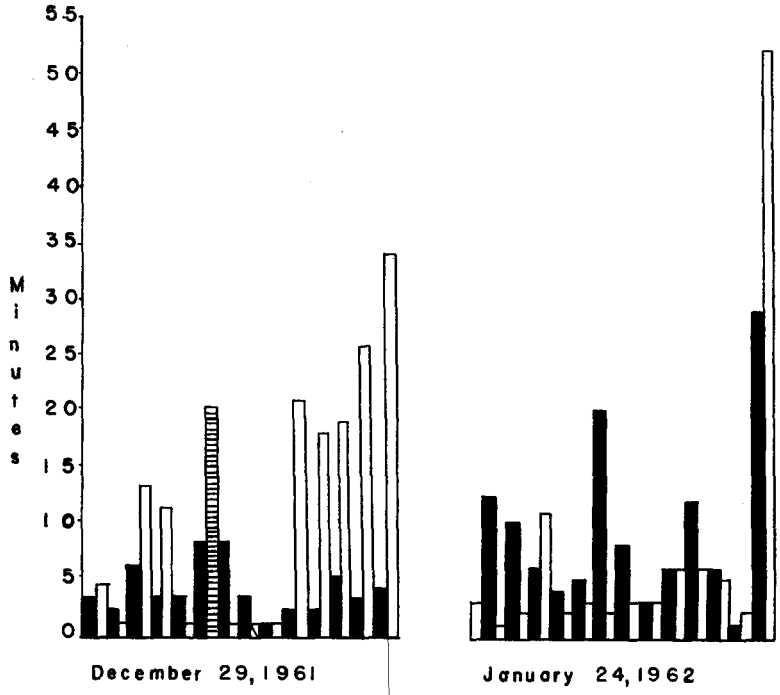

Fig. 1. Two representative activity patterns of a flock of Brewer Blackbirds (*Euphagus cyanocephalus*). Each graph represents 224 minutes of observations and is read from left to right. Activities are indicated as follows: black, feeding; white, sitting and flying; horizontal lines, bathing and preening; diagonal lines, chasing hawks and being chased.

RESULTS

In figure 1, two graphs are given which give a detailed account of two of the five observation periods. These two graphs clearly show the nervous nature of the birds as can be seen in the broken activity patterns. In the left graph nonfeeding activities predominate, while the reverse is true in the right graph. Figure 2 shows the total time spent on each activity for each of the five periods of observation. Figure 3 is the result of adding together the time spent in nonfeeding activities for each day and placing these beside the time spent in feeding for each respective day. This figure also includes a graph of minimum temperatures for the respective days. Only 25 and 16 per cent of the total 224 minutes was spent in feeding on December 29, and February 3, when the temperature was 7.78° C. for both days. On the other three days 53, 56, and 54 per cent of the time was spent in feeding at temperatures of −0.56°, −2.22°, and −1.11° C., respectively. This figure shows the inverse relationship of temperature and time spent on feeding.

DISCUSSION

The Brewer Blackbird is a convenient species to use in the field approach to the time and energy budget concept. The birds feed in open terrain and are conspicuous and remain in a flock which allows the observer to keep in touch with them. Flock behavior, as borne out by my study of this species, is generally a unit behavior. As has

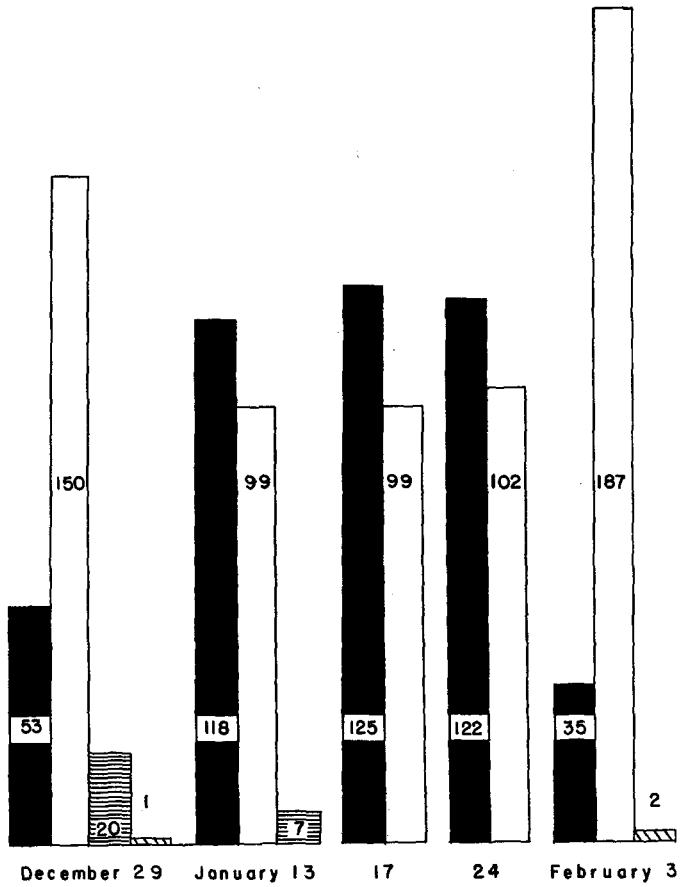

Fig. 2. Total time in minutes spent on each of four types of activities. The numbers in each bar indicate the total time spent on that particular activity. Symbols as in figure 1.

been pointed out, the observations that resulted in figure 3 are based on four types of activities carried out by the majority of the birds in the flock. Since the amount of food did not limit feeding at any time, temperature remained as the chief or only variable.

Although my sample is small, it is statistically valid and it shows that ambient temperature influenced the length of feeding time of the birds. The correlation is significant, the coefficient being $r = 0.98$ $(P = < .01)$.

The inverse relationship I found compares favorably with results obtained by more exacting and elaborate experimental methods. All birds used for those experiments were kept in captivity and the results refer to food intake in resting condition. Kendeigh (1949) and Seibert (1949) and later Davis (1955) found that in the House Sparrow

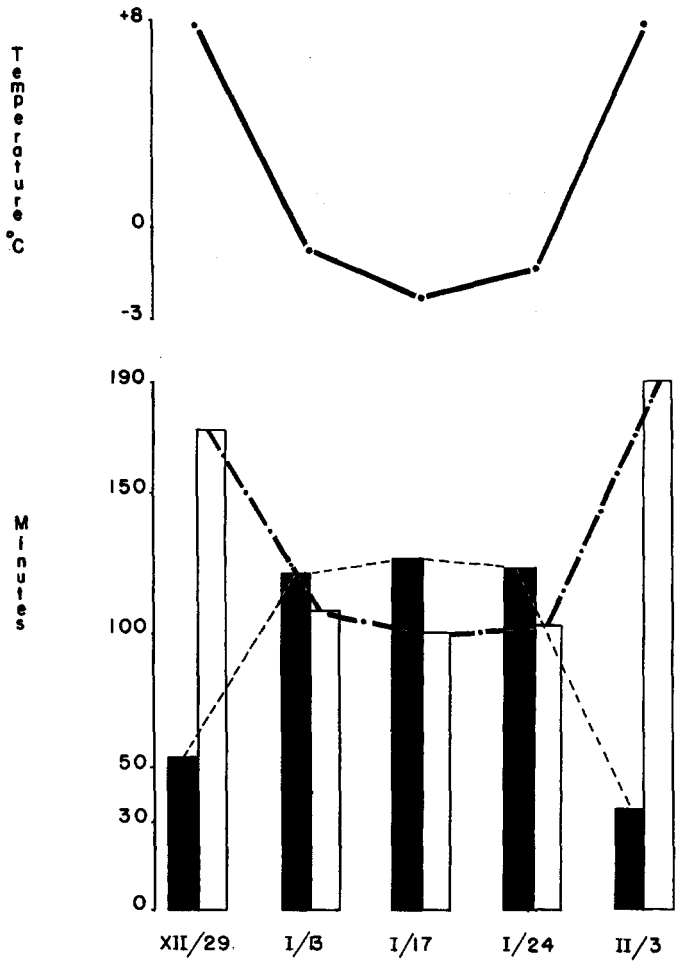

Fig. 3. Relationship between total time spent in feeding (black), total time not spent in feeding (white), and temperature.

(*Passer domesticus*) the gross energy consumed per day increased with decreased temperatures. Rautenberg (1957) and Steen (1957) came to the same conclusion with the Rock Dove (*Columba livia*), House Sparrow, and Brambling (*Fringilla montifringilla*). These workers, however, did not consider the time used in relation to increased need of feeding in cold weather. It is evident from the present observations that among similar conditions and among environmental temperature conditions that necessitate increased heat production, and hence extra food intake to supply the needed energy, feeding time increases with lowered temperatures. The more minutes of a day that are spent in feeding the less time is available for body care, social coordination, habitat selection or other important activities of the individuals and of the flock. This means increased vulnerability during the period of low winter temperature, or as Orians (1961: 302) put it: "The amount of time and energy which a bird devotes to different activities must inevitably influence its survival."

At very low temperatures, there comes a point where the birds are probably no longer able to consume enough food, especially when these temperatures coincide with a short photoperiod. It might well be that the northern extension of range of the Brewer Blackbird to Vancouver, British Columbia, is aided by a mild climate and a dependable food supply such as has existed since agricultural methods and settlements of the white man have been established.

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SUMMARY

Field observations on a flock of wintering Brewer Blackbirds (*Euphagus cyanocephalus*) showed a clear inverse relation between environmental temperature and length of feeding time. As the feeding time increased, time spent on other activities decreased at low air temperatures. The time-energy budget concept has thus been demonstrated for these birds, that is, at low environmental temperature they require longer feeding time, and thus winter temperatures and day lengths combined may influence or limit the existence of the species toward the northern border of its range.

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