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James A. Gessaman
Utah State University

Andrew G. Goliszek
North Carolina Agricultural and Technical State University, Greensboro, North Carolina

MARMOT SCATS SUPPLEMENT HAY PILE VEGETATION AS FOOD ENERGY FOR PIKAS

James A. Gessaman[1] and Andrew G. Goliszek[2]

Abstract.—During summer pikas do not store fat for the winter months; hay piles are the main energy source in winter. All the hay piles collected in an area where pikas (*Ochotona princeps*) coexisted with marmots (*Marmota flaviventris*) contained marmot scats. Marmot scats had a higher energy density than the most abundant type of vegetation in hay piles.

In feeding trials pikas on a diet of hay pile vegetation plus marmot scats consumed significantly less food per day than they did on a diet of hay pile vegetation alone. These findings suggest that pikas coexisting with marmots use marmot scats to supplement the energy contained in the vegetational component of hay piles.

North American pikas (*Ochotona princeps*) gather meadow vegetation and store it in their talus territories during late summer and early fall (July–September). After this activity ceases, pikas continue to feed in meadows until snow covers the meadows, and then they feed under the snowpack on lichens and materials from their hay piles. Individuals usually construct several hay piles but do not cooperate with others in this construction. The hay piles gathered by an individual rarely contain sufficient energy or protein to provide adequate sole resources for surviving winter (Johnson and Maxwell 1966, Millar and Zwickel 1972, West 1980). Huntley et al. (1986) described factors that might cause this early termination of haying in the fall. In early spring hay piles may be critically important to individual survival because alpine conditions periodically prevent surface foraging and/or delay the emergence of new vegetative growth (Conner 1983).

Pikas, like other lagomorphs, are coprophagous. Besides ingesting their own caecal pellets, pikas have been observed collecting and eating the feces of animals with which they often coexist (Taylor and Shaw 1927, Broadbooks 1965, Elliott 1980). This observation suggests that feces as well as caecal pellets may be used by pikas as an added energy source in summer and winter.

In this study we measured food consumption rates of pikas fed hay piles with and without marmot scats, and the mass and energy content of vegetation and scats in hay piles at field sites with and without marmots. The fat content of pikas trapped in the spring and fall was measured to determine whether fat is stored before winter.

Methods

We studied pikas in two rocky slope areas above 2,700 m in Cache County, Utah, about 56 km northeast of Logan. Area 1 contained populations of approximately 16 pikas and 12 marmots (*Marmota flaviventris*). Area 2 had a pika population of about 10 individuals, but no marmots. During 1979 and 1980 we located hay piles in areas 1 and 2, and marmot scats and vegetation in the hay piles were weighed at the end of the haying season. The most common materials in the hay piles were identified and their energy density measured with a Parr microbomb calorimeter (Model 1411).

The fat content of 10 pikas snap-trapped in 1980 was measured by fat extraction (Bligh and Dyer 1959). Two pikas were live-trapped in June 1980 and were caged separately indoors at 24 C on a light:dark schedule of 14:10. Food consumption of each pika was measured in nine feeding trials, each lasting 10 days. The diet alternated from trial to trial between: (1) 300 g dried vegetation (120 g grasses; 180 g *Rubus*, *Populus*, *Senecio*, and *Solidago*) and (2) 225 g dried vegetation (85 g grasses; 140 g *Rubus*, *Populus*, *Senecio* and *Solidago*) plus 75 g marmot scats. Hay piles in the feeding trials were constructed to simulate hay piles in the natural habitat. Weight of hay pile

[1]Department of Biology and Ecology Center, Utah State University, Logan, Utah 84322.
[2]Biology Department, North Carolina Agricultural and Technical State University, Greensboro, North Carolina 27411.

TABLE 1. Weights and energy content of pika hay pile components during fall 1979 and 1980 in study areas 1 and 2.

Study area	No. of hay piles	Year	Vegetation Wt (g)	Vegetation Energy content (kcal)	Scats Wt (g)	Scats Energy content (kcal)
1	12	1979	2,026 ± 975[1]	8,104 ± 3,900	992 ± 639	4,662 ± 3,003
	10	1980	2,256 ± 918	9,024 ± 3,672	412 ± 280	1,936 ± 1,316
			$\bar{x}$ = 2,141	$\bar{x}$ = 8,564	$\bar{x}$ = 702	$\bar{x}$ = 3,299
2	8	1979	5,175 ± 613	20,700 ± 2,452		
	5	1980	4,450 ± 596	17,800 ± 2,384		
			$\bar{x}$ = 4,813	$\bar{x}$ = 19,250		

Differences between hay piles in areas 1 and 2 for both years are significant at the 5% level
[1](± SD).

consumed was measured at the end of a trial. The ratio of vegetation to scat consumed was not measured. Water was given ad libitum.

RESULTS AND DISCUSSION

Pikas began to gather hay piles in both areas in early August 1979 and 1980. Types of vegetation in hay piles from both areas were similar. We have no explanation for the absence of marmots in area 2. In area 1 marmot scats were dispersed throughout the hay piles, and hay piles were significantly smaller than those in area 2 (Table 1). The average weight of vegetation in hay piles in area 1 over two years was less than 45% of the average weight of vegetation in hay piles in area 2. All the hay piles collected in area 1 contained scats; 3 of 22 hay piles had more marmot scats by weight than vegetation. Marmot scats comprised, on average, 49% by weight of hay piles in area 1 in 1979 and 18.2% in 1980. Elliott (1980) found that marmot scats comprised 6% by weight of pika hay piles in Payette National Forest; he suggested that they are utilized as an auxiliary source of protein. Marmot scats had higher energy density (4.7 kcal/g) than grasses, the most abundant type of vegetation in hay piles (3.9 kcal/g). The average energy density of vegetation in hay piles was 4 kcal/g. The average energy content of hay piles (vegetation and scats) in area 1 was about 62% of that in hay piles area 2 (Table 1). Scats made up 27% of the energy content of hay piles in area 1. It is not clear why the average energy content of a hay pile in area 1 was significantly less than in area 2. The quantity and quality of vegetation in the two areas were not measured, but the quantity appeared very similar. The relative importance of scats and vegetation as sources of dietary energy is not apparent from these data because the metabolizable energy (the energy available from the food for maintenance and production) of these two dietary components is unknown.

Two pikas on a diet of hay pile vegetation plus marmot scats consumed significantly less food per day than they did on a diet of hay pile vegetation alone. On a diet of vegetation alone the average consumption rate for both pikas in the feeding trials was 18.9 g/day; 7–12 g/day lower than the food consumption rate reported by Millar and Zwickel (1972) for six captive pikas. On a diet of vegetation and marmot scats the average consumption rate of hay pile material for both pikas dropped 16%. Both pikas ate marmot scats; scat intake was observed more frequently at the end of the 10-day trials when hay piles were nearly depleted. Pikas must have obtained some of their daily maintenance energy requirements from ingested marmot scats because their body weight at the beginning and end of a feeding trial differed by less than 1%.

Body fat contents (% of body DM) of 5 pikas (3 male, 2 female) in the first week of June (6.4% ± 1.0%) and that of 5 pikas (3 male, 2 female) in late September–early October (6.7% ± 2.2%) were not significantly different ($\bar{x}^2$ = 0.1; p > .5).

CONCLUSION

Pikas do not store fat during the summer; therefore, hay piles are a very important energy source in winter for this nonhibernating species. Our field observations and feeding trials suggest that pikas coexisting with marmots use marmot scats to supplement the energy contained in the vegetational component of hay piles. Studies of the metabolizability of vegetation and scats, and the relative feeding preference of pikas for vegetation and scats are needed to determine the relative importance of scats as an energy source.

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