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FOOD PREFERENCES OF THE CLIFF CHIPMUNK, *EUTAMIAS DORSALIS*, IN NORTHERN UTAH

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Abstract.—Food consumption by the cliff chipmunk, *Eutamias dorsalis*, was observed in northern Utah in the natural habitat during May, June, July of 1965, 1966. Plant food sources nearest the cliff den sites were used in early spring, and as the season progressed, chipmunks increased ranges proportionately with the positioning of specific maturing food plants. Total daily frequencies of plant use suggested the following plants as prime energy sources in order of observed usage: *Tragopogon*, *Balsamorhiza*, *Poa*, *Lomatium*, *Bromus*, *Crepis*, *Amelanchier*, *Agoseris*.

The cliff chipmunk, *Eutamias dorsalis*, occurs in mountainous, rocky areas of parts of Utah, Nevada, Arizona, Colorado, Wyoming, New Mexico, and Mexico (Hall and Kelson, 1959). Its extreme wariness, coupled with habitation of partially inaccessible areas, probably accounts for the incomplete knowledge of its life history. This study was initially undertaken to relate chipmunk movement to environmental factors, especially food plants (Hart, 1967).

Materials and Methods

This investigation was conducted at a cliff located on the east side of Beirdneau Hollow, Logan Canyon, 7 miles east of Logan, Cache County, Utah. The face of the lower of two parallel perpendicular cliffs 35 m in height and the adjoining hollow to the south of this cliff were designated as the study center. The entire study area encompassed approximately 20 acres surrounding the lower cliff. Cliff chipmunk habitat consisted of precipitous cliffs which contained dens, and talus slopes interspersed with clumps of bigtooth maple (*Acer grandidentatum*), sagebrush (*Artemisia*), and juniper (*Juniperus utahensis*).

Snow cover normally persists from November to March or April; the frost-free season extends from May until late September or early October.

The study site was visited over 140 times, usually from 0600 to 1300 hr and from March through July 1965 and 1966; occasional trips were made in August, September, and October. Animals were captured in early May with modified Sherman live traps, toe clipped and dyed in individually identifiable patterns with black Nyanzol A dye (which persisted up to three or four months) and released. Seven-power binoculars were used to study animal movements and life history. During each visit areas were traversed below and above the cliff in order to observe foraging chipmunks.

Frequency of use of observed plant feedings was recorded for both marked and unmarked animals. Each sighting was scored

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singly as were observations of exploited plant remains deposited in typical chipmunk style. Plants of doubtful identity in the field were preserved for later comparison with reference materials. From the summary of daily-use frequencies, total observed utilization of each plant species was calculated. Temporal ranges were determined by grouping chipmunk movement patterns that corresponded to the time periods formed by the highest observed frequency of use of specific plants (Hart, 1967).

Results and Discussion

Exploitation of plants by cliff chipmunks appeared to be most intense in early spring in the area closest to the central cliff, where

Table. 1. Incidence of plant use by cliff chipmunks in Utah in 1966.

	May		June		July	
Plants	Observations	Percentage of Observed Feedings	Observations	Percentage of Observed Feedings	Observations	Percentage of Observed Feedings
Acer	15	26.8	3	1.14	1	.42
Achillea					1	.42
Agoseris			24	9.13	2	.85
Allium			1	.40		
Amelanchier	20	36.7	4	1.52	3	1.27
Artemesia	2	3.7	2	.80	2	.85
Balsamorhiza	6	10.7	66	25.10		
Bromus			26	10.00	10	4.24
Cirsium					17	7.20
Clarkia					1	.42
Collimia			1	.40		
Crepis	1	1.8	19	7.22	8	3.39
Hachelia			12	4.94		
Hesperochlea			2	.80		
Juniperus	2	3.7	3	1.14	3	1.27
Lichens	1	1.8	1	.40		
Linum			1	.40	2	.85
Lithospermum			1	.40		
Lomatium	1	1.8	32	12.20	13	5.41
Mertenisa	1	1.8	5	1.90	2	.85
Montia			1	.40		
Petrophytum	2	3.8				
Poa	2	3.8	32	12.20	18	7.62
Prunus					3	1.27
Purshia	1	1.8	1	.40	56	23.73
Symphoricarpos	1	1.8	4	1.52	5	2.12
Tragopogon			22	8.37	89	33.47
Viola	1	1.8				
Total	56		263		236	

the den sites were located. These foraging activities appeared to dominate overall activity of chipmunks, especially from just prior to sunrise to about 12-1300 hr.

Between the hours of 1200 to 1600, there appeared to be generally decreased activity, though occasional single animals would be encountered far from the cliff center in the middle afternoon hours. From 1600 to dusk, overall activity increased somewhat. The period of lessened afternoon activity may have been attributable to less central cliff activity due to previous radiation of animals into more favorable and productive peripheral feeding areas. Although the study site was visited in the afternoons and early evenings, sightings were never as consistent and numerous as during the early morning hours. Chipmunks underwent somewhat regular periods of sedentary activity in the afternoons; consequently, they were very difficult to locate, except by carefully traversing the area on foot. Positive identification was made difficult under these circumstances; rapid flight of startled animals frequently occurred, giving no prior indication of their presence.

As soon as the snow cover melted in late March and early April, chipmunks began to investigate many food sources and this activity continued throughout the summer. They dug in dead leaves, possibly for seeds, young roots, and/or insects; also, lichens and mosses were utilized substantially as the first herbaceous growth appeared.

As the season progressed, animals could be observed departing the central cliff, feeding as they moved out toward more abundant sources of preferred food plants 150 m (and further) up the mountain. Chipmunks seemed to establish general pathways over which they traveled daily and foraged systematically. One could almost invariably predict the location of familiar animals at given periods during the morning hours.

Activities of the cliff chipmunk related to the most preferred foods were as follows (Table 2):

Bigtooth maple (*Acer grandidentatum*) budded early in May and chipmunks fed on tender leaf buds. Trees located nearest the cliff edge were foraged upon first, and it was common to see several individuals feeding simultaneously in different parts of the same tree.

Exploitation of the serviceberry (*Amelanchier utahensis*) began around the middle of May. The chipmunks initially chose the budding, tender leaflets; later in the summer fruit was preferred. Serviceberry grew almost exclusively on or near the cliff rim. Thus, few chipmunks were observed more than 50 m from the cliff during maximum availability of *Amelanchier;* no caching of this plant was noted.

Arrowleafed balsamroot (*Balsamorhiza sagittata*) was a major source of food for the chipmunks. This plant species was widespread over the entire study area and was available much of the summer. Leaves, stems, and seed heads were consumed. Chipmunks typically cut the stem and deposited the seed hulls in a small pile. On occasions up to four individuals fed simultaneously on plants within 5 m of one another.

TABLE 2. Observed frequency of utilization of food plants by the cliff chipmunk in Utah during the summer of 1966.

Food Plants	No. of Feeding Observations	Percentage of Total Feeding Observations
Tragopogon dubius	111	20.0
Balsamorhiza sagittata	72	13.0
Purshia tridentata	58	10.4
Poa spp.	52	9.4
Lomatium dissectum	46	8.3
Bromus spp.	36	6.5
Crepis acuminata	28	5.5
Amelanchier utahensis	27	4.9
Agoseria glauca	26	4.7
Acer grandidentatum	19	3.4
Cirsium spp.	17	3.1
Hackelia spp.	12	2.2
Symphoricarpos oreophilus	10	1.8
Mertensia spp.	8	1.4
Juniperus utahensis	8	1.4
Artemesia spp.	6	1.1
Linum lewsii	3	0.5
Prunus virginiana	3	0.5
Petrophytum caespitosum	2	0.4
Hesperochlea kingii	2	0.4
Lichens	2	0.4
Viola vallicola	1	0.2
Allium campanulatum	1	0.2
Lithospermum spp.	1	0.2
Collomia parviflora	1	0.2
Montia perfoliata	1	0.2
Clarkia rhomboidea	1	0.2
Achillea spp.	1	0.2
Total	556	100.0

Bluegrass (*Poa fenderliana* and *P. secunda*) and wild carrot (*Lomatium disectum*) grew mostly within 150 m of the cliff, and maturation of the three plants corresponded closely. These were found to be utilized in almost equal quantities. Chipmunks preferred stems and seeds of *Lomatium* and the seeds of *Poa*.

Salsify (*Tragopogon dubius*) matured in late June and July. This plant was selected for both the seed head and leaves. Dissected seed heads were found frequently throughout the plot as chipmunks commenced feeding.

Bitterbrush (*Purshia tridentata*) matured in June and was eaten continually thereafter. *Purshia* shrubs were located in three main areas of the study area as follows: immediately below the central cliff, about 150 m above the rim, and near a high rocky outcrop 250 m higher than and southeast of the cliff rim. As *Purshia* seeds matured, chipmunks were seen to feed on the shrubs closest to the study center at least four days before they were seen to exploit the more peripheral sources (250 m). Seeds were often stored by chipmunks. These were transported rapidly from the distant rocky outcrop to caching areas closer to the cliffs; travel routes inevitably followed talus slopes. One chipmunk (F2-9) made three trips, covering a total of about 1500 m in approximately four hours.

Elk thistle (*Cirsium foliosium* and *Cirsium vulgare*) matured in late July. The prickly plant parts did not seem to deter the chipmunks from consuming seed heads. *Cirsium* plants grew singly and were not numerous above or below the cliff.

Cliff chipmunks appeared to be opportunists; they utilized the species of mature plants available. This food was supplemented by other less abundant, but continually available, edible plants such as the mountain dandelion (*Agoseris*), brome grass (*Bromus*), and long-leaved hawksbeard (*Crepis*). These latter plants appeared to remain in edible condition considerably longer than did other "major" food plants. Chipmunks foraged upon the leaves and seeds of *Crepis;* on the leaves, blossoms, and seed heads of *Agoseris;* and on the seeds and stems of *Bromus*.

The cliff chipmunk apparently satisfies its moisture requirements from dew and succulent plant parts. No animals were observed traveling to the closest water supply, about 300 m below the central cliff area.

No evidence of animal predation by *E. dorsalis* was observed though invertebrate life was abundant in the Beirdneau Cliff region. None of the stomachs which were examined from the Green Canyon chipmunks contained recognizable animal remains. This is in contrast to what Aldous (1941) found in his late summer study of foods of *Eutamias minimus* and *Tamias striatus* in California in which he reported that up to 100% of stomach contents was animal, mostly insects.

A small population of potential competitors, the rock squirrel, *Spermophilus variegatus*, occupied the same area of the cliff and foraged on many similar foods. However, chipmunks and squirrels seemed to feed on different parts of similar food plants. Rock squirrels seemed to prefer primarily leaves, while the chipmunks consumed the fruit, seed head, and stems, similar to the feeding habits of the least chipmunk, *Eutamias minimus*, and the mantled ground squirrel, *Spermophilus lateralis*, in Colorado (Carleton 1966).

Cade (1963) stated that survival adaptation was oriented more to food storage than toward altering physiological processes in the genus *Eutamias*. Survival therefore favors those animals which possess superior food hoarding abilities. In *E. dorsalis*, food caching in sub-

sidiary areas apart from the home den apparently was important for winter survival.

Grinnell (1924) was uncertain whether the same or different chipmunks recovered caches; he assumed that in most cases the same individual retrieved them. He stated that olfaction is probably important in cache recovery.

"Shallow hibernating" chipmunks were observed to cache seeds singly or in small numbers in shallow excavations, 2 to 5 cm deep. These caches were observed in several locations around the cliff site and those pilfered or lost (if any) were probably insignificant. Especially in instances of range overlap, individual recognition of food caches is important. Displaced and forgotten caches may become sources of reforestation, of possible value in maintenance of mountain watersheds.

Most caches which I observed were located between source plants and den. Two chipmunks (No. 5-10 and F2-9) had caches located 100 m and 150 m, respectively, above the cliff dens. The use of temporary storage areas allowed chipmunks to devote most of their time to securing abundant natural seeds during optimal harvesting conditions. Caches were presumed to be later transported to winter residences. Chipmunk F2-9 cached 14 *Purshia* seeds on 30 July; the cache was still intact on 7 August, but all seeds were gone on 2 September.

In the Beirdneau habitat, chipmunk survival was probably not dependent on midwinter seed recovery from frozen ground under a snow cover of 0.5 to 2 m in depth, but rather on autumn retrieval. Little or no hoarding of food items was observed during March, April, or May, but mature and relatively nonperishable seeds were stored from June through October.

Of the more than 80 plant species available in the study area, chipmunks definitely utilized 28 during the summers of 1965 and 1966 (Table 2). Chipmunks' food preferences were exhibited according to plant phenology and availability. This was especially evident as various edible plants matured and were almost immediately foraged upon by chipmunks.

Martinsen (1968) and Broadbooks (1970) found, similar to Utah cliff chipmunk behavior, that chipmunk movements were decisively influenced by distribution, abundance, and phenology of food plants in Montana and Washington.

In 1966 the occurrence of warm weather was about 10 days later compared to 1965. Nevertheless, the identical plant locations were visited by many of the same animals from 7 to 10 days later than the previous year; this would seem to correlate plant phenology and chipmunk feeding activity.

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