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ASSIMILATION RATES OF SMALL MAMMAL HERBIVORES

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ABSTRACT

This Technical Report was prepared to make it possible for the programmers in the Grasslands Biome to calculate the probable energy demands made by a population of small mammals on the grassland ecosystem.

When evaluating the impact of grazing animals upon the grassland ecosystem, most researchers have largely ignored the effects of the small mammal populations. Although an individual rabbit or rodent may be inconspicuous, their populations often represent a large portion of the vertebrate biomass and can impose as great an impact on the community as the larger species. The food habits of these small mammals may place them in direct competition with large herbivores. It has also been suggested that they are capable of retarding or even preventing the succession of plant communities (Bond 1945, Clements and Clements 1940, Koford 1958, Turner 1969, and Wood 1969).

In view of their potential impact, it is unfortunate that better studies have not been made on small mammal interactions with the vegetation and on the total amount of energy actually removed by them.

Many dietary composition investigations have been done, but these, by themselves, do not give any indication of the total amount of vegetation removed. Studies involving the weight of food consumed can be used to determine caloric intake of the animals if the energy contained in the diets is known. This is one instance where dietary composition studies can be of value. One of the most comprehensive field studies of this type was undertaken by Wood (1969) on 12 species of rodents occupying the desert grasslands of southern New Mexico. From data on population density, plus the weight of food in a full stomach, he estimated the weights of food eaten during one year by six of the rodent populations. His results, however, are of limited use since they do not include the amount of food harvested, but left uneaten (i.e., wasted or stored), nor can it be converted to caloric intake and it is not clear how he calculated daily intake rates.

Similar, but less extensive studies have been done in the laboratory, but here it must be remembered that a laboratory diet is not equivalent to a natural one, nor are captive animals subjected to the same kind of activity patterns or environmental stresses as wild ones.

Laboratory investigations that directly measure caloric intake or that determine metabolic rates have much the same limitations as the other laboratory-based studies with the metabolic studies having the added disadvantage of not considering assimilation efficiencies.

However, by looking at an accumulation of the results of several of these methods and combining them with studies on population densities, it should be possible to estimate the minimum energy demands made by a population of small mammals on its environment.

The following table is compiled from the work of various investigators on small mammal energetics and food habits. All measurements in each category have been converted to standard units. Metabolic rates originally given as millilters of oxygen have been converted to kilocalories by assuming a respiratory quotient of 0.8 and an equivalent of 4.8 kcal/liter O_2. Included are members of two orders of mammals, Rodentia and Lagomorpha, both primarily comprised of herbivorous species.

Table 1. The rate of food intake and the mean metabolic rate of some species of small mammals that eat plants and/or plant parts.

SPECIES	LIVE WT.(g)	FOOD INTAKE (kcal/g/day)	FOOD INTAKE (g/g/day)	AV. DAILY METABOLIC RATE (kcal/g/day)	REFERENCES
Heithrodontomys megalotis	9			0.73-0.95	Pearson (1960)
Pitymys subterraneus	14			0.65	Grodzinski & Gorecki (1967)
Mus musculus	17			0.40	Pearson (1947)
Meriones unguiculates (juv)	17-19	1.19-1.45	0.28-0.34		Arrington (1968)
Apodemus agrarius	20			0.58	Grodzinski & Gorecki (1967)
Apodemus agrarius	21-22	0.59-0.82	0.15-0.16		Drozdz (1968)
Apodemus agrarius	21			0.60	Grodzinski (1963)
Peromyscus maniculatus	19			0.44	McNab (1963)
Peromyscus maniculatus	20			0.35	Pearson (1947)
Clethrionomys glareolus	21			0.42-0.49 (0.25BMR)	Gorecki (1968)
Clethrionomys glareolus	22-23	0.57-1.09	0.08-0.81		Drozdz (1968)
Clethrionomys glareolus				0.58	Grodzinski (1963)
Clethrionomys glareolus	19-21			0.42-0.49	Grodzinski & Gorecki (1967)
Clethrionomys glareolus	25	0.70			Kaczmarski (1966)
Clethrionomys glareolus	25	0.58		0.40	Morrison & Teitz (1953)
Clethrionomys gapperi	21-26			0.41-0.42	Pearson (1947)
Microtus agrestis	22			0.54	Grodzinski (1963)
Microtus agrestis	22			0.54	Grodzinski & Gorecki (1967)
Microtus arvalis	21-23			0.46-0.50	Grodzinski & Gorecki (1967)
Microtus arvalis	22-23	0.69-0.72	0.19-1.15		Drozdz (1968)
Zapus hudsonius	22			0.49	Pearson (1947)
Zapus hudsonius	19-30			0.17-0.20 (BMR)	Morrison & Ryser (1962)
Peromyscus leucopus	22			0.42	Pearson (1947)
Pitymys pinetorum	23			0.50	Pearson (1947)
Clethrionomys rutilus	24			0.49	Grodzinski & Gorecki (1967)
Apodemus flavicollis	24-29	0.51-0.58	0.07-0.15		Drozdz (1968)
Apodemus flavicollis	27			0.37-0.39	Grodzinski & Gorecki (1967)
Apodemus flavicollis				0.51	Grodzinski (1963)
Apodemus flavicollis				0.37-0.40	Gebczynski (1966)
Apodemus flavicollis		0.61-0.62			Turcek (1956)
Napaeozapus insignis	26			0.36	Pearson (1947)
Microtus pennsylvanicus	31			0.40	Pearson (1947)
Microtus pennsylvanicus	32			0.37	Morrison (1948)
Onychomys torridus	34		0.36		Wood (1969)
Oryzomys palustris	34-48	0.29-0.38			Sharp (1967)
Peromyscus truei	33			0.30	McNab (1963)
hamster	40-43	0.82	0.21		Arrington (1968)
Dicrostonyx rubricatus	43	0.67		0.44	Morrison & Teitz (1953)
Peromyscus californicus	50			0.21	McNab (1963)
Cryptomys hottentotus	50		0.24		Genelly (1965)
Dipodomys ordii	51		0.16		Wood (1969)
Glaucus volans	75			0.23	Pearson (1947)
Citellus spilosoma	105		0.20		Wood (1969)
Dipodomys spectabilis	125		0,64		Wood (1969)
Thomomys talpoides	120		0.68		Hansen et al. (1960)
Thomomys talpoides			0.34-0.44		Tietjen et al. (1967)
Citellus richardsoni	133	0.54	0.13		Hansen & Reed (1969)
Neotoma albigula	159		0.13		Wood (1969)
Citellus lateralis	162	0.10-0.14	0.05-0.07		Jameson (1965)
Dahatona princeps	171	0.30			Johnson & Maxell (1966)
Sigmodon hispidus (juv)	180		0.07		Albritton (1954)
Rattus norvegicus (juv)	180		0.04		Albritton (1954)
Rattus norvegicus	70-71		0.19-0.20		Meyer & Nelson (1963)
Neotoma micropus	205		0.11		Wood (1969)
Citellus mohavensis	228-306			0.08-0.12	Bartholomew & Hudson (1960)
Citellus parryi	451	0.15		0.47	Morrison & Teitz (1953)
Citellus oegoodi	683	0.18		0.19	Morrison & Teitz (1953)
Cynomys ludovicianus	750		0.14		Koford (1958)
Cynomys ludovicianus (juv)	625-1400	0.07-0.21			Cavender (1969)
Lepus americanus	1661-1488	0.21-0.22			Hart et al. (1965)
Lepus americanus	1300-1450			0.08	Irving et al. (1957)
Lepus californicus	2000		0.53		Currie & Goodwin (1966)
Lepus californicus	1840		0.06		Arnold & Reynolds (1943)
Lepus alleni	2620		0.05		Arnold & Reynolds (1943)
Lepus townsendii	2800		0.03		Bear & Hansen (1966)
Castor canadensis	9400-15000	0.08-0.10	0.03		Cowan et al. (1957)

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