Evaluation of Forage Preferences and their Corresponding Nutritional Content for Northern Pocket Gophers (*Thomomys talpoides*)

Gary W. Witmer
USDA APHIS WS National Wildlife Research Center, Fort Collins, Colorado

ABSTRACT: Pocket gophers cause substantial damage in a number of western states. A better knowledge of their forage preferences and the nutritional attributes of those preferences could result in better management of populations and reduction of damage. We live-trapped northern pocket gophers in northern Idaho and brought them into captivity at Washington State University, Pullman, WA. We tested their preferences for several species of forbs, grasses, and woody species. Preferences varied in all plant groups. Forbs were highly preferred in early summer but dropped off in late summer, perhaps due to senescence. However, preference for woody species increased in late summer and winter. There were few consistent correlations between forage preferences and nutritional levels of those forages. However, in one late summer trial, gophers did seem to prefer forage species high in crude protein and apparent digestible protein. This suggests the importance of protein levels in foods of gophers as has been found with other wildlife species and situations.

KEY WORDS: forage preference, nutritional value, pocket gopher, *Thomomys talpoides*

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INTRODUCTION

There are numerous species of pocket gophers in North America, with most species belonging to the genera *Geomys* and *Thomomys* (Nowak 1991). Pocket gophers cause various types of damage to agricultural and rangeland resources and to reforestation (Witmer and Engeman 2007). Pocket gophers (*Thomomys* spp.) are generally considered one of the most damaging wildlife pests in California (Marsh 1992, Clark 1994). A recent study estimated average losses ranging from 5.3-8.8% across a variety of crops in California (Baldwin et al. 2013), with one study showing a loss of 36.5% of annual production in alfalfa fields with high density gopher populations (Smallwood and Geng 1997).

Primary control options for pocket gophers include trapping, burrow fumigation with aluminum phosphide, and baiting with rodenticides (Baldwin 2012, 2014; Baroch and Poché 1985, Evans et al. 1990, Case and Jasch 1994, Witmer and Engeman 2007). Both trapping and burrow fumigation can be highly effective at controlling pocket gophers (Lewis and O'Brien 1990, Proulx 1997; Baker 2004), but are typically more time consuming and costly than baiting (Marsh 1992, Engeman and Witmer 2000). As such, baiting is often preferred by many growers, Pest Control Advisors, and Pest Control Operators. Three baits are used to control pocket gophers: strychnine, zinc phosphide, and first-generation anticoagulants.

Many of our studies in the Pacific Northwest (PNW) were efforts to better understand reforestation damage by wildlife, and in particular, rodents. We also developed and tested methods to reduce that damage. We conducted a study on pocket gopher foraging preferences and the nutritional content of those forages. The details of the study were presented in the M.S. thesis of Russell Davis (1997). In the case of this study, we surmised that a better understanding pocket gopher forage preference and forage quality, as well as how those changed over the course of the summer, would give us an understanding for management purposes.

METHODS

We included plants from 3 forage classes: forbs (8 spp.), grasses (6 spp.), and woody/shrubby plants (7 spp.). The species selected were, in part, derived from the published literature on gopher foraging and food habits (e.g., Cox 1989, Vaughan 1974, Ward and Keith 1962). Freshly-cut plants were used in the trials. The plants were obtained from reforestation units in Idaho. Plants were collected in the early summer and again in the late summer to evaluate seasonal changes in the parameters.

We live-trapped pocket gophers from reforestation units in Idaho and maintained them in individual metal stock tanks containing wood shavings, a den box, and nest material. The maintenance diet consisted of rabbit chow and a chunk of both apple and carrot. They also received water *ad libitum*.

Plants were offered cafeteria style by inserting pieces into holes drilled into wooden boards. Plant segments were weighed at the start of a trial and again at the end of the trial, including all fragments that could be found. These were overnight feeding trials, and in the initial 1994 trials we offered only plant species of the same forage class (e.g., only grasses, only forbs, or only woody/shrub plants). In the 1995 trials, we presented plant species from all 3 plant classes at the same time to gophers (i.e., aggregate trials).

We determined the relative preference of each plant species by using the formula:

$$\frac{\text{Amount (g) of species Y consumed}}{\text{Total amount (g) of all species consumed}}$$

The average relative preference (ARP) was then determined by adding the preference value for each plant species across the 6 gophers used and dividing that total by 6.

For the nutritional content of the forage plants, we determine water content by comparing the fresh wet weight to the oven-dried weight. The other nutritional parameters were determined using frozen plant material that was later oven dried and ground. We determined the crude protein (CP) content and the total nitrogen (TN)

content by using semi-micro Kjeldahl procedures (Horwitz 1980). We determined apparent digestible protein (ADP) content and apparent digestible energy (ADE) content by using regression equations developed by other researchers. We determined the fiber content using neutral and acid detergent fiber procedures (Mould and Robbins 1981). The gross energy (GE) content was determined by using bomb calorimetry (Golley 1961). Two-way ANOVA tests were used to determine if significant ($P \leq 0.05$) existed in relative preference values.

RESULTS AND DISCUSSION

When offered one plant class at a time, the gophers showed distinct preferences for certain species and these changed from early summer to late summer (Table 1). Only the forb showy aster (*Aster conspicuus*) was disliked in both the early summer and in the late summer. That plant species is known to be a good plant for livestock and elk. Significant ARP differences ($P \leq 0.05$) were found in 1 of 2 forb trials, 1 of 1 grass trial, and in 2 of 2 woody/shrub trials. The most consumed forage plants occurred in an early summer forb trial in which gophers consumed, on average, 31 g of forbs in the overnight trial. However, forb consumption dropped 33% (to 10 g/gopher) in late summer, where no strong preferences among the forb species were shown. We also noted that woody/shrub plant consumption increased in the late summer.

In the aggregate trials, plants from all 3 plant classes were offered at the same time. There were significant ($P \leq 0.05$) ARP differences in 3 of 4 trials. The most preferred species were serviceberry (*Amelanchier alnifolia*) (woody/shrub) and mountain thermopsis (*Thermopsis montana*) (forb). Interesting, grasses were the most consumed plant class in 3 of the 4 aggregate trials with an average consumption of 15.7 g to 37.5 g in the overnight trials.

The nutritional analyses showed distinct differences in the nutritional quality of the 3 plant classes and also showed notable changes in the nutritional quality from early to late summer (Table 2). All plants declined in water content, crude protein, and average digestible protein over time. All plants increased in fiber over time. Grasses tended to have the lowest nutritional quality of the plant classes in both seasons. Forbs had the best nutritional quality, although even this class declined from early to late summer. In a relative sense, woody/shrub species became more nutritious over time because of the least drop in nutritional value. Perhaps that is why gophers feed heavily on woody materials throughout the winter when the forbs and grasses have become senescent (Witmer and Engeman 2007).

The results of this study may provide forest management some insight as to how to manage reforestation units. For example, some plant species can be expected to receive more damage from foraging gophers than other plant species. Also, non-preferred forage species could be plants that might lower the carrying capacity of the site for gophers. Nonetheless, pocket gopher population control will continue to be needed on reforestation units (Engeman and Witmer 2000).

Table 1. Preferred plant species when gopher were offered one class of plants at a time.

Season	Early Summer		Late Summer	
	Liked	**Disliked**	**Liked**	**Disliked**
Forbs	Silky Lupine *Lupinus sericeus*	Showy Aster *Aster conspicuus*	Large-leafed Avens *Geum macrophyllum*	Showy Aster *Aster conspicuus*
Grasses	Smooth Brome *Bromus inermis*	Common Timothy *Phleum pratense*	*N/A – drought*	*N/A – drought*
Woody/Shrub	Serviceberry *Amelanchier alnifolia*	Ponderosa Pine *Pinus ponderosa*	Silky Currant *Ribes cereum*	Douglas Fir *Pseudotsuga menziesii*

Table 2. Nutritional content values by plant class and by season.

	Forbs, Early Summer	Forbs Late Summer	Woody Early Summer	Woody Late Summer	Grasses Early Summer	Grasses Late Summer
% Water	79	67	62	57	48	27
% Crude Protein	13	7	7	6	5	4
% Ave. Digestible Protein	9	4	5	4	4	2
% Non- Detergent Protein	46	57	54	56	68	82
% Ave. Digestible Fiber	26	38	33	36	34	45
% Total Nitrogen	0.56	0.6	1.2	1.1	0.6	0.6
Gross Energy (calories)	4,646	4,830	5,056	5,113	4,549	4,558
Ave. Digestible Energy (calories)	2,540	2,190	2,371	2,370	1,615	1,459

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