

Body Weights of Adult and Juvenile Northern Pocket Gophers, *Thomomys talpoides*, in Central Alberta Alfalfa Fields

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In an effort to recognize adults from juveniles in late summer and early fall, carcasses of Northern Pocket Gophers (*Thomomys talpoides*) captured from April to October 1994 in a pure alfalfa (*Medicago* spp.) field in Camrose and a mixed alfalfa-orchard grass (*Dactylis glomerata*)-dandelion (*Taraxacum* spp.) field in Lacombe, in central Alberta were analyzed. Mean weights of adult males and females were significantly ($P < 0.05$) larger than those of juveniles with near-adult body sizes in late summer and early fall. On the basis of the limits of 95% confidence intervals for individual values in Camrose and Lacombe, live-captured males weighing < 130 g could be classified as juveniles; those that are > 180 g would be adults. Males weighing between 130 and 180 g could be either juveniles or adults. Live-captured females weighing < 110 g would likely be juveniles. With larger animals, the pubic symphysis should be used to distinguish young females from adults. Given the variability of body weight in Northern Pocket Gophers, it is suggested that criteria for aging based on weight be derived for local populations in specific habitat types. On average, Northern Pocket Gopher males and females from Camrose were significantly ($P < 0.05$) heavier than those of Lacombe. Animals from both fields were, on average, heavier than those previously studied in natural-vegetation communities. Differences in the food nutritional quality may explain the observed variation in body weights among populations.

Key Words: Northern Pocket Gopher, *Thomomys talpoides*, Alfalfa, *Medicago* sp., body weight, Alberta.

In ecological studies, being able to recognize adults from juveniles in late summer and early fall without killing animals is useful to estimate summer mortality rates and population changes in response to environmental fluctuations (Caughley 1977), and conduct behavioral and physiological investigations (Miller 1952). Northern Pocket Gopher (*Thomomys talpoides*) adults and juveniles are difficult to tell apart in late summer and early fall on the basis of weight. In British Columbia orchard-old field habitats, from July to September, Sullivan et al. (2001) used three age classes of Northern Pocket Gophers based on body weight: juveniles (young of the year, which do not breed until the next year) < 49 g; subadults (individuals of which 50% are mature in the upper weight class) 49-60 g; and adults ($\geq 50\%$ of individuals sexually mature in the lowest weight class) ≥ 61 g. However, previous studies on the body size of *Thomomys talpoides* (Smith 1940; Hansen 1960; Hansen and Bear 1964; Tryon and Cunningham 1968; Hansen and Reid 1973) and *Thomomys bottae*, Valley Pocket Gopher, (Howard and Childs 1959; Daly and Patton 1986; Patton and Brylski 1987) showed that animal weights varied among pocket gopher populations due to habitat types, altitude, latitude, and seasons (Hansen and Reid 1973). Patton and Brylski (1987) found that growth rates and body sizes of pocket gophers inhabiting alfalfa monocultures were greater than those of pocket gophers inhabiting natural-vegetation communities. Then, one may wonder about the usefulness of aging criteria based on weight developed in different regions and habitats to study Northern Pocket Gopher populations in alfalfa (*Medicago* spp.) fields of central Alberta.

According to Reid (1973), young-of-the-year Northern Pocket Gophers would attain near-adult body weight approximately 180 days after birth. That is to say that, in Alberta alfalfa fields where young are born in April-May (Proulx 2002), they would be similar in body size to adults during August-October. However, the growth rate of juvenile pocket gophers may be highly variable from one population to another (Daly and Patton 1986), and Reid's (1973) estimate may not be applicable to central Alberta populations.

Few complete data have been published on body weights of Northern Pocket Gopher populations. Although the Northern Pocket Gopher is common in western Canada (Proulx 2004), little is known about body weights of age and sex classes from different habitats. Within the context of a multi-year ecological study of Northern Pocket Gophers in Alberta alfalfa fields, I collected carcasses to compare body weights of adults and juveniles during summer and early fall in order to determine weight classes that could be used to age animals in live-capture programs. I also wanted to compare the mean weights of adults from central Alberta alfalfa fields to those reported in the scientific literature for other regions and habitat types. I hypothesized that in late summer-early fall: (1) on average, adults would be heavier than juveniles; (2) individual body weights of adults and juveniles would overlap; (3) body weight categories may be established to differentiate some juveniles from adults; and (4) mean body weights of adults inhabiting alfalfa fields would be larger than those of adults from natural-vegetation communities.

Methods

The study was carried out in two alfalfa fields of central Alberta, in the communities of Camrose and Lacombe. The Camrose field was a 3-year-old pure alfalfa stand with a high forage yield and excellent second cutting (Alberta Agriculture 1992*). The Lacombe field was approximately 5 years old, and corresponded to a mixture of alfalfa with orchard grass (*Dactylis glomerata*) and abundant dandelion (*Taraxacum* spp.). Alfalfa was cut once and thereafter the field was used as pasture. Spring adult populations were estimated at 22.4 animals/ha in Camrose (Proulx 1997), and 23.5/ha in Lacombe (Proulx 1995*). The ratio male:female was 0.7:1 in Camrose, and 0.75:1 in Lacombe. Mean litter size was significantly larger in Camrose ($\bar{x} = 6.4$; standard deviation = 1.4) than in Lacombe (5.1 ± 1.1) (Proulx 2002).

In 1994, kill-trapping was conducted from 18 April to 27 October. Trapping methodology was described by Proulx (1997). Animals were individually marked in the field, and frozen. The weight, sex and age were determined in the laboratory. In central Alberta, females produce only one litter (Proulx 2002). The size of the reproductive organs was used to distinguish young-of-the-year from adults. Young males have smaller testes, and young females have smaller ovaries and narrower uterine horns than adults (Hansen 1960; Hansen and Reid 1973). As precocial breeding is not known to occur in Alberta populations (Proulx 2002; Proulx and Cole 2002), the pubic symphysis was also used to distinguish young females from adults; in adult females the bones are resorbed, leaving a pubic gap (Hisaw 1924; Hansen 1960).

An analysis of variance followed by the Tukey test was used to compare mean weights between Camrose and Lacombe population samples (Zar 1999). Student *t*-tests were used to compare mean body weights of Northern Pocket Gophers of Camrose and Lacombe populations to those of populations reported in the scientific literature. Probability values $P \leq 0.05$ were considered statistically significant.

Results

Males

Mean weights of Camrose adult males differed significantly ($F_{2,63} = 5.9$, $P < 0.005$) among samples collected from 18 April to 31 May. Animals captured in late May were significantly ($P < 0.005$) lighter than those collected earlier in the year (Table 1). In Lacombe, mean weights of adult males were similar ($F_{3,86} = 1.7$, $P > 0.05$) among samples collected from 18 April to 31 May (Table 1).

Mean weights of juvenile males differed significantly among samples in Camrose ($F_{4,74} = 21.7$, $P < 0.005$) and Lacombe ($F_{4,67} = 11.3$, $P < 0.005$) (Table 1). Juveniles captured in September-October were the heaviest; they were similar in size ($P > 0.05$) to those captured in August-September (Table 1).

Mean weights of adults and juveniles differed significantly in Camrose ($F_{4,74} = 21.7$, $P < 0.005$) and Lacombe ($F_{3,156} = 80.2$, $P < 0.005$). In both study areas, the mean adult weight was larger ($P < 0.001$) than that of each juvenile sample collected from June to October (Table 1). In Camrose, the limits of 95% confidence intervals for individual values were 142-230 g for adults, and 108-172 g for September-October juveniles. In late summer-early fall, although males were, on average, heavier than juveniles, there was a marked overlap between age class weights. Then, on the basis of weight alone, live-captured animals weighing between 142 and 172 g could be classified as either adults or juveniles. Those weighing < 142 g could be juveniles while those > 172 g could be adults. In Lacombe, the limits of 95% confidence intervals for individual values were 136-213 g for adults, and 106-174 g for September-October juveniles. Live-captured animals weighing between 136 and 174 g could then be classified as either adults or juveniles. Those weighing < 136 g could be juveniles while those > 174 g could be adults.

Females

In Camrose, mean weights of adult females were similar ($F_{3,113} = 1.0$, $P > 0.05$) among samples collected from 18 April to 27 June (Table 1). In Lacombe, mean weights of adult females differed significantly ($F_{4,107} = 3.0$, $P < 0.05$) among samples collected from 18 April to 27 October. Animals captured in late May and in August-October were the only samples to differ significantly ($P < 0.005$) from each other (Table 1).

Mean weights of juvenile females differed significantly among samples in Camrose ($F_{2,38} = 20.3$, $P < 0.005$) and Lacombe ($F_{3,34} = 11.8$, $P < 0.005$) (Table 1). In Camrose, juveniles captured in August-September and in July were of similar ($P > 0.05$) size, but were larger ($P < 0.05$) than those of June (Table 1). In Lacombe, juveniles captured from August to October were of similar ($P > 0.05$) size, but were larger ($P < 0.05$) than those of July (Table 1).

Mean weights of adults and juveniles differed significantly in Camrose ($F_{3,154} = 120.5$, $P < 0.005$) and in Lacombe ($F_{4,145} = 27.5$, $P < 0.005$). In both study areas, the mean weight of adults was larger ($P < 0.001$) than that of each juvenile sample collected from June to September (Table 1). In Camrose, the limits of 95% confidence intervals for individual values were 126-195 g for adults, and 89-163 g for August-September juveniles. Although female adults were, on average, heavier than juveniles, there was a marked overlap between age class weights. Therefore, on the basis of weight alone, live-captured animals weighing between 126 and 163 g could be either adults or juveniles. Females weighing < 126 g could be juveniles while those > 163 g could be adults. In Lacombe, the limits of 95% confidence intervals for individual values were 113-175 g for adults and 101-180 g for September-

TABLE 1. Weights of adult and juvenile Northern Pocket Gophers in Camrose and Lacombe alfalfa fields, summer and fall 1994.

Population	Period	Male weights (g)*						Female weights (g)*										
		Adult			Juvenile			Adult			Juvenile							
		n	\bar{x}	SD	CI	n	\bar{x}	SD	CI	n	\bar{x}	SD	CI	n	\bar{x}	SD	CI	
Camrose	18-30 April	21	193 ^a	16.4	-	-	-	-	18-30 April	31	159.8 ^a	20.8	-	-	-	-	-	
	1-14 May	25	191 ^a	18.0	-	-	-	-	1-14 May	43	164.4 ^a	14.7	-	-	-	-	-	
	15-31 May	20	172.8	27.4	-	-	-	-	15-31 May	38	158.0 ^a	17.1	-	-	-	-	-	
	10-30 June	-	-	-	-	-	-	-	3-27 June	5	157.8 ^a	23	-	-	-	-	-	
	5-14 July	-	-	-	-	-	-	-	14-27 June	-	-	-	-	-	12	86.6	14.0	87-114
	15-31 July	-	-	-	-	-	-	-	1-22 July	-	-	-	-	-	21	108 ^a	11.6	85-131
	1-31 August	-	-	-	-	-	-	-	5 August-	-	-	-	-	-	-	-	-	
	2 September-	-	-	-	-	-	-	-	30 September	-	-	-	-	-	8	126.1 ^a	18.7	89-163
Lacombe	14 October	-	-	-	-	-	-	-	All	117	160.8	17.6	-	-	-	-	-	
	All	66	186.1	22.4	142-230	-	-	-	18-30 April	25	144.4 ^{a,b}	14.9	-	-	-	-	-	
	18-30 April	42	177.0 ^a	17.8	-	-	-	-	1-14 May	37	146.6 ^{a,b}	14.7	-	-	-	-	-	
	1-14 May	24	169.5 ^a	23.8	-	-	-	-	15-31 May	36	138.4 ^a	15.0	-	-	-	-	-	
	15-31 May	19	178.9 ^a	15.8	-	-	-	-	1 June - 31 July	7	143.7 ^{a,b}	21.1	-	-	-	-	-	
	10-30 June	-	-	-	-	-	-	-	17-31 July	-	-	-	-	-	16	99.3	13.1	74-125
	17-31 July	-	-	-	-	-	-	-	1-15 August	-	-	-	-	-	6	126.5 ^a	23.0	81-172
	1-15 August	-	-	-	-	-	-	-	17 August-	-	-	-	-	-	-	-	-	
	17 August-	-	-	-	-	-	-	-	20 September	-	-	-	-	-	6	129.2 ^a	23.1	84-175
	13 September	-	-	-	-	-	-	-	28 September-	-	-	-	-	-	-	-	-	
	18 September-	-	-	-	-	-	-	-	27 October	-	-	-	-	-	10	140.8 ^a	20.1	101-180
	27 October	-	-	-	-	-	-	-	8 August-	-	-	-	-	-	-	-	-	
12 August-	-	-	-	-	-	-	-	27 October	7	158.1 ^b	10.5	-	-	-	-	-		
27 October	5	162.6 ^a	19.0	-	-	-	-	All	112	144.0	15.6	113-175	-	-	-	-		
All	90	174.6	19.5	136-213	-	-	-	-	-	-	-	-	-	-	-	-		

SD: standard deviation; CI: 95% confidence intervals of individual values.

*Within a population, values with same superscripts are not significantly different ($P > 0.05$) from each other.

October juveniles. Live-captured animals weighing < 113 g could be classified as juveniles; those weighing ≥ 113 g could be either adults or juveniles.

Comparison between adult populations

Mean weights of Camrose and Lacombe adults differed significantly ($F_{3,381} = 86.7$, $P < 0.005$). On average, Camrose males and females were heavier ($P < 0.005$) than those of Lacombe.

On average, adult males from Camrose and Lacombe were significantly ($P < 0.05$) heavier than adult males from other alfalfa fields or habitat types (Table 2). On average, adult females from Camrose were also significantly ($P < 0.05$) heavier than females from other habitat types and regions. The mean weight of Lacombe adult females was, however, similar ($P > 0.05$) to those of females inhabiting alfalfa fields in Saskatchewan and Colorado (May sample), and unspecified agricultural lands in central Alberta (Table 2).

The Camrose and Lacombe adult males and females were at least 25% heavier than males and females found in habitats other than alfalfa fields. They were more than twice as heavy as Northern Pocket Gophers captured in British Columbia (Table 2).

Discussion

In this study, the hypothesis that adults would be, on average, heavier than juveniles in late summer-early fall was validated. Adult females grow until 2 years old, and males continue to grow throughout their lifetime (Tryon 1947; Miller 1952; Howard and Childs 1959; Daly and Patton 1986). Even though young-of-the-year appeared as large as adults, they were approximately 6-7 months old in the fall, and their growth was not

completed (Tryon 1947). On the other hand, body sizes of juveniles and adults vary considerably within the same habitat due to differential individual growth rates from a same litter or population (Tryon 1947; Daly and Patton 1986), age of the individuals (i.e., older juvenile vs. younger adult) (Hansen and Bear 1964), and time of year (Miller 1952; this study). All this may explain the marked overlap observed within juvenile populations from August to October, and between juveniles and adults, as reported in previous studies (Tryon 1947; Miller 1952; Hansen and Bear 1964).

This study, and previous work (Tryon 1947; Hansen and Reid 1973; Hansen and Bear 1964), showed that mean body weights of age and sex classes varied considerably within and between study areas. Therefore, it is unlikely that reliable body weight categories may be established to differentiate juveniles from adults. At best, confidence intervals for individual values may be cautiously used to recognize lighter juveniles and heavier adults. Using confidence intervals of individual values for juvenile and adult males in Camrose and Lacombe, I propose that, in late summer-early fall, live-captured animals weighing < 130 g would likely be juveniles. Individuals weighing > 180 g may be adults. Animals weighing between 130 and 180 g might be either juveniles or adults. In the case of females, animals weighing < 110 g would likely be juveniles. Larger animals should be classified on the basis of the presence of an open pelvic girdle, i.e., the pubic bones are widely separated due to the permanent resorption of the symphysis at first pregnancy (Miller 1952).

Given the variability of body weight in pocket gophers, any criteria for aging based on weight will

TABLE 2. Mean weights of adult Northern Pocket Gophers reported in the scientific literature.

Location	Habitat types	Period	Adult weights (g)					
			Males			Females		
			<i>n</i>	\bar{x}	Standard deviation	<i>n</i>	\bar{x}	Standard deviation
Alberta	Unspecified agricultural land near Edmonton – MacDonald (1969)	Summer	43	133	14	37	138	20
British Columbia	Forb-orchard – Sullivan et al. (2001)	Summer 1982	28	69	2	23	68	2
	Old field-orchard – Sullivan et al. (2001) Orchard – Sullivan et al. (2001)	Summer 1983	69	71	2	49	60	1
		Summer 1983	22	61	4	58	63	1
		Summer 1985	22	74	4	59	65	2
Colorado	Alfalfa field – Hansen (1960)	April	86	159	61	49	136	20
		May	58	158	15	36	135	20
		June	18	148	21	25	136	16
		August	9	158	19	22	135	19
		September	9	176	17	12	158	11
	August	14	114	8	34	106	12	
	Alpine tundra – Hansen and Bear (1964)	August	8	134	18	29	108	12
	Meadow – Hansen and Bear (1964)	August	8	116	12	30	105	12
Shrub-bunchgrass – Hansen and Bear (1964)	August	37	127	13	46	114	14	
Weedy rangeland – Hansen and Ward (1965)	August	37	127	13	46	114	14	
Saskatchewan	Alfalfa field – Runnells (1988)	Summers 1983 and 1984	32	158	41	71	141	63
		June-October	5	104	3	14	91	2

have to be derived for local populations in specific habitat types. Body weight confidence intervals determined in this study may be useful to researchers working on Northern Pocket Gophers in central Alberta alfalfa fields. These confidence intervals would not be reliable to age live-captured animals from meadows, old field or orchard populations. Habitat differences in nutritional quality of available food can directly affect the observed variation in body weight among populations of pocket gophers (Smith and Patton 1980; Patton and Brylski 1987). Alfalfa is a superior forage producing more protein per ha than any other crop or grass (Heath et al. 1973). Northern Pocket Gophers inhabiting Camrose and Lacombe alfalfa fields were heavier than animals from other habitat types. A difference in the quality of food available in pure and mixed alfalfa fields may also explain the difference in the mean weights of Northern Pocket Gophers inhabiting Camrose and Lacombe.

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