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Effects of female scents on the trappability of northern pocket gophers (*Thomomys talpoides*)

Gilbert Proulx*

Alpha Wildlife Research & Management Limited, 229 Lilac Terrace, Sherwood Park, Alberta, Canada T8H 1W3

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Abstract

I assessed the effect of female adult scents on the trappability of northern pocket gopher (*Thomomys talpoides*) in Alberta (1995, 1996, 2001), Saskatchewan and Manitoba (2003). Tests with scented and unscented traps were carried out during three periods: reproduction, end of reproduction, and emergence of young on the surface. Female-scented traps captured a significantly ($P<0.05$) greater number of pocket gophers than unscented traps during the end of the reproductive season in 1995, 2001 and 2003. The success with female scents warrants chemical analyses of scents to identify compounds that could be used as attractants, and also studies on spatio-temporal variations in the breeding activities and movements of pocket gophers.

Keywords: Female scents; Northern pocket gopher; *Thomomys talpoides*; Trapping

1. Introduction

The northern pocket gopher (*Thomomys talpoides*) is a fossorial rodent found throughout agricultural regions of western North America (Chase et al., 1982). Pocket gopher burrowing and feeding activities result in a reduction in forage yield and stand life, an increase in soil degradation and erosion, an increase in operational costs because of significant machinery breakdown and repairs, and a reduction in the speed and efficiency of forage harvesting due to the roughness of the fields (Proulx, 2002a). Although poison baits are often recommended for the control of the northern pocket gopher (Tietjen, 1973; Bonar, 1995), investigations in western Canada demonstrated that they were ineffective in reducing and controlling populations inhabiting alfalfa fields (Proulx, 1998). Proulx (2002b) suggested that trapping could effectively be used to control northern pocket gopher populations in alfalfa fields, if it is integrated with the border control strategy (Proulx, 1997a) at the beginning of the growing season to remove breeders before the emergence of juveniles.

The pocket gopher maintains a closed burrow system. When a trap is set in a surface tunnel, it creates a breach in the system. The pocket gopher gets captured while investigating and repairing (by "back filling" the opening with loose soil) the excavation site (Witmer et al., 1999). Pocket gophers usually plug an opening in their burrow system within 24–48 h (Hungerford, 1976). While some do not plug holes within 48 h (Engeman et al., 1999), others plug the tunnel leading to an opening, rather than plugging the opening itself (Proulx, pers. observ.). In the spring, females may not be as vulnerable as males to trapping because of pregnancy, parturition, and postnatal care of young (Hansen, 1960).

In order to improve trapping efficiency, capture success should occur within 24 h, and should remove as many females as possible since they provide postnatal care. Attractants, e.g., conspecific scents (also known as pheromones) left or added to traps could improve trapping success (see review by Pawlina and Proulx, 1999). Rodents can differentiate between the odors of individuals of their own species (e.g., Bowers and Alexander, 1967). Responses to conspecific scents may be influenced by the sex, age, or condition of the marking individual and the receiver as well, and by the spatial relations of the individuals whether they are dispersing or occupying a territory (Motykowicz, 1974;

*Tel.: +1-780-464-5228; fax: +1-780-417-0255.
E-mail address: gproulx@alphawildlife.ca (G. Proulx).

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Brown and Macdonald, 1985; Nolte et al., 1994). Because pocket gophers are solitary and territorial, conspecific scents potentially could attract them to trap sites.

In this study, I first compared the effects of female and male adult scents on trapping success and, thereafter, tested female scents in alfalfa fields in Alberta, Saskatchewan and Manitoba. I hypothesized that conspecific female scents would enhance pocket gopher capture success during the reproduction season.

2. Methodology

2.1. Study areas

Scent tests were carried out in alfalfa fields in Vegreville (1995), Mundare (1996) and Sherwood Park (2001) in Alberta, in Canora (2003) in Saskatchewan, and in St. Claude (2003) in Manitoba (Fig. 1). Two different subspecies inhabit these areas: *Thomomys talpoides talpoides* in the Alberta and Saskatchewan study sites, and *T. t. rufescens* in southern Manitoba (Banfield, 1994). There is no apparent difference in the behavior of these two subspecies (see Deniset, 1993), and it was assumed that both of them would respond in a similar manner to conspecific scents.

2.2. Scent collections

From April to June of each year, and until mid-September in 1995, pocket gophers were captured in custom-built wooden live traps ($10 \times 10 \times 22.5$ cm) set in the animals' tunnels. Pocket gophers were kept individually in $66 \times 34 \times 37$ cm cages, inside sheds; they were subjected to normal day–night cycles, and fed a daily ration of alfalfa, vegetables, and water *ad libitum*. Absorbing pads were placed at the bottom of cages. Excretions and feeding material were in contact with the pads for at least 48 h before using them in field tests. In 1995, freshly collected pads were used throughout the study period. During the other years, freshly scented pads were used in May and early June; thereafter, pads collected in June were frozen, and thawed before their use. In 1995, scents from both sexes were collected. In other years, only female scents were collected. Assuming that male scent could incite females to produce sexual pheromones (see Pawlina and Proulx, 1999), a few males were kept in proximity to females. In 1995 and 1996, scents were collected from $\geqslant 6$ females. In 2001, females were difficult to live-trap in early April, and scents were collected from two pregnant and one non-pregnant female. In 2003, five females were originally live-trapped in southern Manitoba; however, most of them perished during a sudden, unusual cold front in April. Scents of one non-pregnant female captured in May were then used for field tests conducted in Manitoba and Saskatchewan.

Fig. 1. Location of study areas.

2.3. Test periods

In Alberta, on the basis of an extensive study of pocket gopher reproduction in 1994, Proulx (2002c) concluded that pocket gopher breeding began at the earliest near the end of March; the majority of females gave birth before mid-May, and breeding activity in alfalfa fields was virtually completed before June. Therefore, in 1995, scent tests were carried out during three periods: reproduction (April to mid-May), end of the reproduction (mid-May to 1 June), and emergence of young (June). The 1995 tests were preliminary in nature. They aimed to compare the effect of male and female scents on trapping, in order to select one of them for future testing, and to assess the pertinence of test periods. These test periods were repeated in Alberta in 1996 (all test periods, until the end of July) and 2001 (reproduction and end of reproduction tests, until 24 May), and in Saskatchewan (reproduction, until 29 May) and Manitoba (all test periods, until the end of June) in 2003. In 1996, in Alberta, and in 2003 in Saskatchewan and Manitoba, the beginning of the growing season was markedly colder than in 1995 and 2001, and crop germination and growth were delayed (Proulx, unpubl. observ.; AAFRD 1995, 1996, 2001). Carcass analyses revealed the presence of recently bred females during the last 2 weeks of May, and suggested that the reproduction period lasted until the end of May (Proulx, unpubl. data). In all study areas, the end of the

reproduction period was approximately 2 weeks preceding the emergence of young on surface.

2.4. Field tests and data analyses

ConVerT (L. B. Bachelder, Calgary, Alberta) killing box traps were selected for their relatively high efficiency to capture pocket gophers (Proulx, 1997b); they were set in burrow systems with fresh mounding, $\geqslant 30$ m apart, as per Witmer et al. (1999). Traps were scented by placing a 3×6 cm piece of absorbing pad behind the trigger, on the floor of the pocket gopher's tunnel. In control traps, a piece of clean, unscented pad was used. Depending on weather, field tests involved 1–2 trapping sessions/week. Each trapping session involved $\geqslant 11$ traps with scent, and an equal number of unscented control traps. Traps were set one morning, and visited and removed 24 h later. Therefore, they were set for 1 trap-night at a time. All traps were thoroughly washed with a mild dish detergent, and rinsed with a high-pressure hose between trapping sessions. The sex and age (i.e., adult or juvenile) of captured animals were recorded.

Trapping sessions within a same test period were pooled together for analysis. Chi-square statistics with Yates correction (Zar, 1999) were used to analyze trapping results and determine whether there were any differential responses to the various trap treatments. Probability values "P" $\leqslant 0.05$ were considered statistically significant.

3. Results

3.1. 1995—Vegreville, Alberta

3.1.1. Reproduction

Only one test with 12 traps was carried out during this period. Female- and male-scented traps capture success was similar ($P > 0.05$) to that of unscented traps (Table 1).

3.1.2. End of reproduction

Female-scented traps captured a significantly greater number of pocket gophers than unscented traps ($\chi^2 = 5.35$, df: 1, $P < 0.05$) (Table 1). They captured 2.5 times as many females than unscented traps. There was no significant difference ($P > 0.05$) between the capture success of male-scented traps and unscented traps ($\chi^2 = 2.52$, df: 1, $P > 0.05$) and female-scented traps ($\chi^2 = 0.38$, df: 1, $P > 0.05$). All traps captured more female than male adults. However, the sex ratio of captured animals differed from 1:1 only in female-scented traps ($\chi^2 = 5.60$, df: 1, $P < 0.05$) (Table 1).

3.1.3. Emergence of young

There was no difference ($P > 0.05$) in the capture success of scented and unscented traps (Table 1). The scented and unscented traps captured more adult females than males, but the sex ratio of captured animals differed from 1:1 only in female-scented traps ($\chi^2 = 7.76$, df: 1, $P < 0.01$) (Table 1).

On the basis of these results, only female scents were used in subsequent years.

3.2. 1996–2003—Alberta, Saskatchewan, and Manitoba

3.2.1. Reproduction

There was no difference ($P > 0.05$) in the capture success of scented and unscented traps throughout the years (Table 1). Both scented and unscented traps captured significantly more males ($P < 0.05$) than females in Mundare in 1996, and in Canora and St. Claude in 2003. The sex ratio was even for both treatments ($P > 0.05$) in Sherwood Park in 2001 (Table 1).

3.2.2. End of reproduction

There was no difference ($P > 0.05$) in the capture success of scented and unscented traps in Mundare in 1996 (Table 1). Female-scented traps captured 2.5 times as many females ($n = 15$) as males ($n = 6$); unscented traps captured 10 females and 8 males.

Female-scented traps captured a significantly greater number of pocket gophers than unscented traps in Sherwood Park in 2001($\chi^2 = 5.16$, df: 1, $P < 0.05$) and in St. Claude in 2003 ($\chi^2 = 4.65$, df: 1, $P < 0.05$). In both study areas, scented traps captured twice as many females, and $\geqslant 1.6$ times as many males, than unscented traps (Table 1). In all study areas, the sex ratio was even for both treatments ($P > 0.05$).

3.2.3. Emergence of young

There was no difference ($P > 0.05$) in the capture success of scented and unscented traps in 1996 and 2003. The sex ratio was even for both treatments ($P > 0.05$).

4. Discussion

In this study, the hypothesis that adult female scents would enhance pocket gopher capture success was validated during the end of the reproduction season, in 1995, 2001, and 2003. In 1996, although female scents did not significantly improve capture success when compared to unscented traps, they still captured a markedly larger number of females than males. The 1995 study also suggested that female scents were more effective than male ones. Different responses to scents depending on the sex of the donor animal have been

Table 1
Capture frequencies of northern pocket gophers in scented and unscented traps from the beginning to the end of the reproduction season, and during the emergence of young on surface, in Alberta (1995, 1996, 2001), Manitoba (2003), and Saskatchewan (2003)

Test period	Trap nights	Unscented traps					Female-scented traps					Male-scented traps				
		Adults				Juveniles	Adults				Juveniles	Adults				Juveniles
		Males	Females	Unknown	All		Males	Females	Unknown	All		Males	Females	Unknown	All	
1995—Vegreville, Alberta																
Reproduction 25–28 April	12	2	7	0	9	0	4	3	1[a]	8	0	0	8	0	8	0
End of reproduction 10–31 May	48	8	10	0	18	0	10	25[b]	1	36[c]	0	10	19	1	30	0
Emergence of young 12–26 June	24	3	10	0	13	2	3	12[b]	0	15	4	5	10	0	15	3
1996—Mundare, Alberta																
Reproduction 22 April–22 May	72	29	13[b]	0	42	0	20	10	1	31	0	—	—	—	—	—
End of reproduction 28 May–11 June	36	8	10	0	18	0	6	15	0	21	0	—	—	—	—	—
Emergence of young 17 June–4 July	36	6	10	0	16	10	3	10	0	13	13	—	—	—	—	—
2001—Sherwood Park, Alberta																
Reproduction 27 April–10 May	48	15	8	0	23	0	9	9	0	18	0	—	—	—	—	—
End of reproduction 15–24 May	82	17	8	0	25	0	27	18	0	45[c]	0	—	—	—	—	—
2003—St. Claude, Manitoba																
Reproduction 21 April–28 May	219	52	10[b]	0	62	0	56	7[b]	1	64	0	—	—	—	—	—
End of reproduction 31 May–11 June	110	11	8	0	19	0	20	16	0	36[c]	0	—	—	—	—	—
Emergence of young	56	11	5	0	16	1	8	5	0	13	5	—	—	—	—	—
2003—Canora, Saskatchewan																
15–29 May	121	43	7[c]	1	51	0	35	14[b]	0	49	0	—	—	—	—	—

[a] Damaged due to scavenging.
[b] Sex ratio significantly ($P<0.05$) different from a 1:1 ratio.
[c] Significantly ($P<0.05$) different from unscented traps.

reported in the past (Wuensch, 1982; Drickamer, 1984; Salmon and Marsh, 1989).

Female scents elicited a response among pocket gophers, but during a very specific time period, i.e., at the end of the reproduction season, just before the emergence of young on surface. The temporal difference observed between study areas is likely related to a variation in the duration of breeding seasons. The effect of female scents on trapping success appears largely related to the behavior of female breeders. Hansen (1960) found that the adult sex ratio showed a higher percentage of males than females in spring, but that the proportion of females was greater in summer. He attributed the low number of females in spring to the fact that they were not vulnerable to traps at this time because of pregnancy, parturition, and postnatal care of young. In this study, males dominated captures during the 1996 and 2003 reproduction periods; females became more abundant at the end of reproduction seasons throughout the years. Our data are in agreement with Hansen's (1960) conclusion that females become more susceptible to trapping later in the summer. It is possible that female pocket gophers resume their feeding activities and day-to-day tunnel investigations only towards the end of their maternal care. This would explain why trapping becomes more successful at this time of year. Female-scented traps may attract the attention of females that now move more extensively, and more readily defend their burrow system, and their young from intruders. The effect of female scents on trapping success becomes less apparent after the emergence of young, which will soon leave the maternal den to establish their own burrow system (Proulx, 1997a).

The end of the reproduction season varies in time and in space. It happened in late May in 1995 and 2001, but apparently occurred at a later date in 1996 and 2003. This would explain why female scents failed to increase trapping success in Canora in late May 2003, when the sex ratio of the captured population was more akin with that of other populations captured during the reproduction period, i.e., it significantly favored males.

5. Management implications

In the past, the absolute capture of a breeding population has been accomplished through perseverance, with repeated trap-nights at the same burrow system, without conspecific scents (Proulx, 1997a). However, being able to entice animals into the trap during the first trap-night, and to significantly increase the number of captured females is advantageous when trapping pocket gopher populations over large areas. The removal of a greater number of females in scented traps than in unscented ones is significant from a control point of view as it may result in the elimination of young that are not weaned and are still dependent. Conversely, when a female is allowed to successfully raise a litter (mean number of viable embryos: 5–8; Proulx, 2002c) more pocket gophers would establish their own burrow systems in the summer, thus resulting in an increase in mounding activities (Proulx et al., 1995). Using female-scented traps from mid-May to mid-June, in conjunction with Proulx's (1997a) border control strategy, has good potential to improve pocket gopher control in alfalfa fields.

In the last decade, I tested various novel odors (e.g., peppermint oil, peanut butter, commercial lures) without improving capture success during or after the reproduction season (Proulx, unpubl. data). This study showed that female scents may increase the trappability of northern pocket gophers at the end of reproduction, and warrants chemical analyses of scents to identify compounds that could be used as attractants. Without such analyses, scenting traps may not be considered a practical option. In order to use female scents, farmers would have to live-capture females early in the spring, and keep them in captivity to collect scents. Other approaches should be investigated to collect and use scents. For example, the collection of urine or pieces of fur from kill-trapped females could be used to enhance trapping success.

Differences between periods of effectiveness of female scents among years and study areas suggest that pocket gopher populations should be the subject of more investigations at the regional level in order to determine their breeding periods and variations due to weather, soil characteristics, crops, etc. Even if no scents were to be used, knowing when females resume their activities on the surface could lead to more successful trapping programs.

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