ALPHA WILDLIFE
RESEARCH & MANAGEMENT LTD.

THE 2010 RICHARDSON'S GROUND SQUIRREL RESEARCH & CONTROL PROGRAM

A report prepared by

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and submitted to

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EXECUTIVE SUMMARY

On the basis of 2007-2009 findings, the Richardson's Ground Squirrel Research Group identified a series of research priorities, and requested that Alpha Wildlife Research & Management Ltd. develops a research program with the following objectives:

1. Test various attractants that may be used with various control methods to enhance their control efficacy.
2. Assess the control efficacy of different strychnine formulas:
   - With and without a thickening agent;
   - With different additives to enhance bait acceptation by ground squirrels.
3. Test currently available bait stations (commercial and home-made) with strychnine-treated oats for:
   - Efficacy
   - Selectivity
4. Test the efficacy of multi-capture pen traps baited with strychnine-treated oats on a small scale.

The study was carried out in grasslands and pure or mixed alfalfa fields in Hazenmore, southern Saskatchewan.

Attractants: Three attractants with the potential of increasing capture efficiency were tested: peanut oil, vanilla extract, and linoleic acid (component of sunflower and canola oils). The presence of fecal pellets near doors and on the top of pen traps indicated that peanut and sunflower-canola oils were more attractive to ground squirrels than vanilla extract.

Toxicants: The following strychnine baits were tested:

- 0.4% strychnine-treated oats with anise oil, with a thickening agent (Maxim).
- 0.4% strychnine-treated oats with anise oil, without a thickening agent (Nu-Gro).
- Nu-Gro 0.4% strychnine-treated oats (2 kg) with peanut butter (2 tablespoons) and peanut oil (325 ml).
- Nu-Gro 0.4% strychnine-treated oats with 500 ml of corn syrup.
- 0.4% strychnine-treated oats with 250 ml of sunflower oil and 100 ml of canola oil.
- Nu-Gro 0.4% strychnine-treated oats with 1 cup of coarse salt (Proulx 2004) and 1150 g of mineral mix.

In spring, control with strychnine baits was highly variable among treatments, ranging from 33.3% to 76.9% in adults, and from 50 to 100% in juveniles. Strychnine-treated oats with salt and mineral mix was the most effective formula, killing 69.2% and 76.9% of the adults, and 75% and 82.6% of the juveniles; on average, this bait controlled 75.7% and 77.8% of populations. It was the only strychnine bait to control ≥ 70% of all animals in both study plots where it was applied. In summer, however, this bait controlled < 70% of ground squirrels.

Bait stations: Three types of bait stations were tested with strychnine-treated oats with coarse salt and mineral mix: 1) Inverted T; 2) Inverted T with 45° angle spill guards; and 3) Bell box. On the basis of preliminary assessments with remote cameras, Inverted T bait stations with spill guards

were not used by ground squirrels. Other bait stations controlled <39% of ground squirrel populations.

Multi-capture pen traps: Collapsible pen traps were easy to install and carry. Richardson's ground squirrels entered traps but were not interested in grain baits; they successfully re-opened doors and escaped. Pen traps failed to capture and kill at least 70% of marked ground squirrels.

The 2010 weather conditions differed completely from previous years, and by May, vegetation was green and a large amount of forage was available to ground squirrels. Richardson's ground squirrels were less receptive to strychnine baits when natural food was abundant. Because strychnine baits were not attractive to ground squirrels, bait stations and pen traps failed to control populations. This study suggests that more work should be carried out on oils as attractants. Also, strychnine baits should be studied and improved to be effective under different environmental conditions. Finally, it is recommended that further work be conducted on the development and testing of multi-capture pen traps.

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1.0 INTRODUCTION

During the last two years, the Richardson's Ground Squirrel (RGS; *Spermophilus richardsonii*) Research Program has led to a greater understanding of ground squirrel populations and control methods. Proulx et al. (2009, 2010) identified 3 toxicants that could be used to control ≥70% of ground squirrels: 1) Phostoxin® gas pellets, effective over small areas; 2) freshly produced and mixed 0.4% Nu-Gro strychnine on oats; and 3) Rozol® (chlorophacinone) on oats. However, both strychnine and Rozol® raised concerns due to their impact on non-target species and predator species. In the search of effective and socially acceptable toxicants, Alpha Wildlife Research & Management Ltd. demonstrated that fresh strychnine baits could be used in multi-capture (pen) traps to control ground squirrels while minimizing risks of non-target and secondary poisoning.

In the light of the 2007-2009 findings, the RGS Research Group identified a series of research priorities, and requested that Alpha Wildlife Research & Management Ltd. develops a research program (email dated 27 November 2009 – in file @ Alpha Wildlife's Headquarters in Sherwood Park, Alberta). This project took into account these priorities.

2.0 OBJECTIVES

The objectives of the 2010 research program were to:

1. Test various attractants that may be used with various control methods to enhance their control efficacy.
2. Assess the control efficacy of different strychnine formulas:
    - With and without a thickening agent;
    - With different additives to enhance bait acceptation by ground squirrels.
3. Test currently available bait stations (commercial and home-made) with strychnine-treated oats for:
    - Efficacy
    - Selectivity
4. Test the efficacy of multi-capture pen traps baited with strychnine-treated oats on a small scale.

3.0 STUDY AREA

The study was carried out in grasslands and pure or mixed alfalfa fields in Hazenmore, southern Saskatchewan (Figure 1).

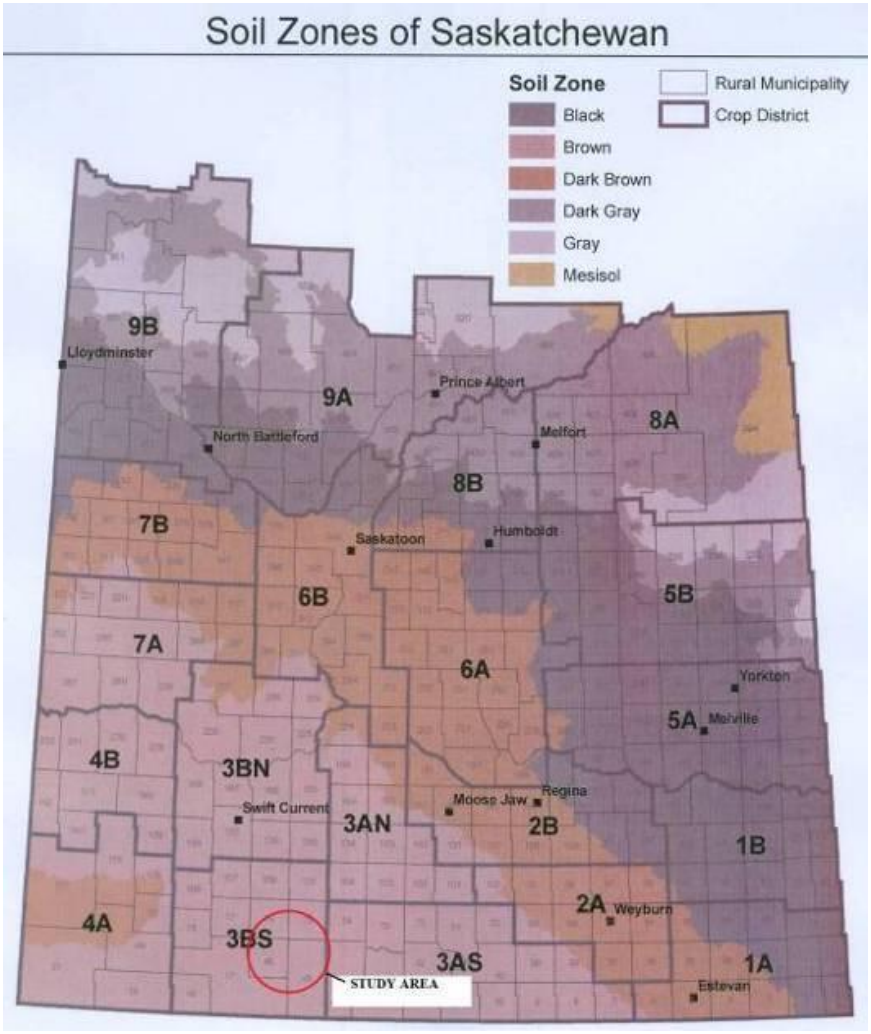

Figure 1. Location of the study area.

3.0 METHODS

3.1 Attractants

Live-trapping (15 x 15 x 48 cm Tomahawk Live Trap, Tomahawk, Wisconsin) was initiated on May 15. Live-trapping followed the highest standards of humaneness (Powell and Proulx 2003). Storms, flooding and cold temperatures occurred from 21 to 31 May, and trapping was stopped. From 31 May to 4 June, previously tagged ground squirrels were recaptured, and new ones were tagged. Since all the animals involved in the testing of attractants were captured within a few days before testing, it was not necessary to estimate natural mortality in control populations. Natural mortality was therefore estimated to be nil.

Three attractants with the potential of increasing capture efficiency were tested[1]:

- Peanut oil[2] (Andelt and Woolley 1996, Beer 1964, Proulx et al. 2009).

[1] The original proposal planned to study female conspecifics odors and anise oil. However, due to bad weather and pressing deadlines, it was not possible to secure the urine of females. Also, it was not possible to purchase anise oil, which was replaced by vanilla extract.

- Vanilla extract (in Alberta, the Strathcona County adds vanilla extract to poisoned oats to attract ground squirrels; Proulx, personal notes).
- Linoleic acid (e.g., component of sunflower and canola oils) (Hansson 1973)

The testing of attractants was conducted from 5 to 8 June in pasture and alfalfa study plots (Figures 2). Each attractant was tested with 3 collapsible pen traps (approx. 25 x 90 x 90 cm, PowerSource Performance, Edmonton, Alberta) properly placed to take advantage of the dominant wind direction, and were monitored daily. Two attractant-saturated sponges were placed in aluminum containers that were secured at the centre of pen traps (Figure 3). Pen traps were visited early in the morning and the evening. Data were collected on the presence of ground squirrels, and more attractant was poured on the sponges. Originally, the number of captures was to be used to assess the ability of attractants to incite animals to enter traps. However, later work with pen traps showed that ground squirrels were reluctant to enter traps, and when they did, they escaped soon after their entry. On the other hand, observations with a remote camera showed that ground squirrels approached and investigated traps by climbing on the roof of traps or spending more time investigating door surroundings (Figure 4). Therefore, the evaluation of the attractants was based on the single presence of fecal pellets accumulated near doors and on top of traps.

3.2 Toxicants

Because of impending bad weather, the assessment of strychnine baits was conducted immediately after the attractant tests, i.e., June 9, in the same study plots (Figure 5). The following strychnine baits were tested:

- 0.4% strychnine-treated oats with anise oil, with a thickening agent (Maxim[3]) – study plots # 1 and 2.
- 0.4% strychnine-treated oats with anise oil, without a thickening agent (Nu-Gro[3]) – study plots # 3 and 4.
- Nu-Gro 0.4% strychnine-treated oats (2 kg) with peanut butter (2 table spoons) and peanut oil (325 ml) – study plots # 5 and 6.
- Nu-Gro 0.4% strychnine-treated oats with 500 ml of corn syrup (Chamberlain et al. 1981) – study plots # 7 and 8.
- 0.4% strychnine-treated oats with 250 ml of sunflower oil and 100 ml of canola oil – study plots # 9 and 10.
- Nu-Gro 0.4% strychnine-treated oats with 1 cup of coarse salt (Proulx 2004) and 1150 g of mineral mix (EMF breeder beef premix, Saskatoon, Saskatchewan) – study plots # 11 and 12.

[2] Alpha Wildlife realizes that, because ground squirrels were previously live-trapped with peanut butter baits, attractant tests may be biased in favor of peanut butter odor. This was taken into consideration in the evaluation of the peanut butter attractant.

[3] A report from an independent laboratory confirming 2% strychnine concentration, before mixing, of the Nu-Gro product. No laboratory report was made available for Maxim strychnine. Brent Punga from Maxim indicated that tests conducted in early spring were rating at 1.8% (G. Proulx, personal notes).

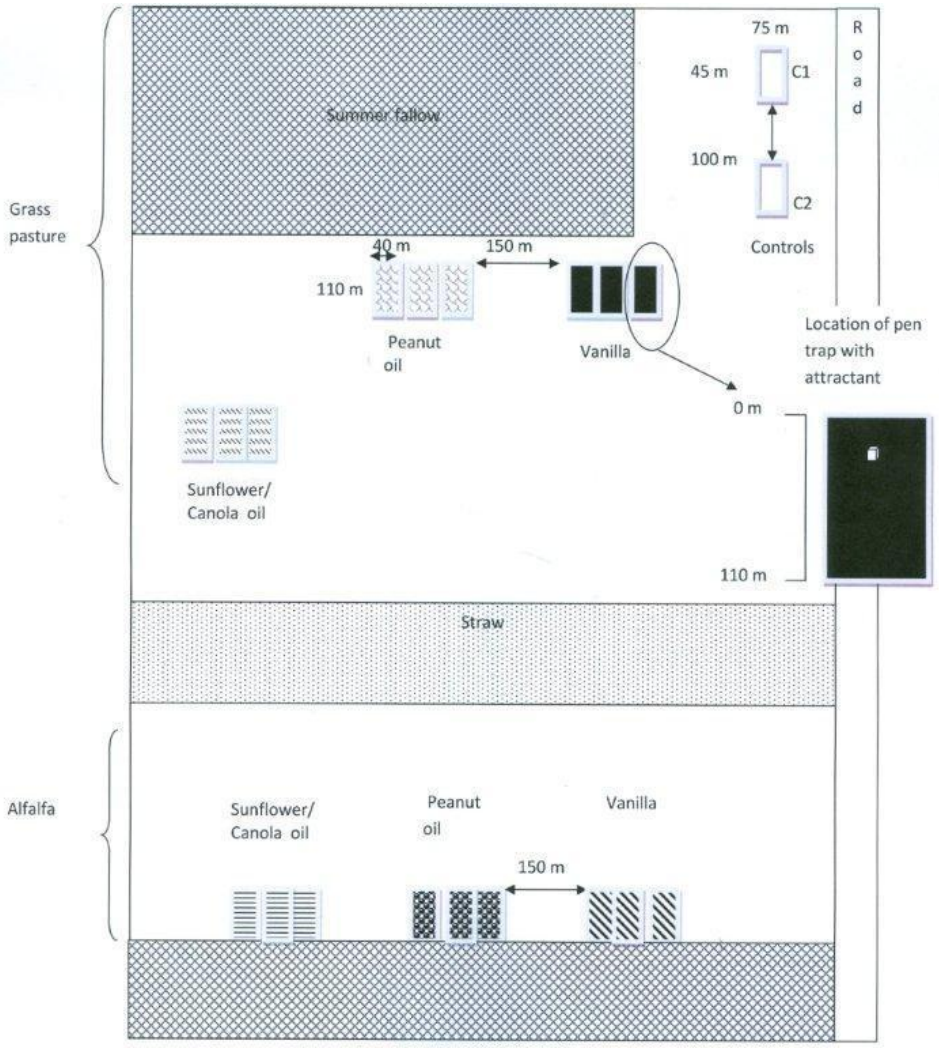

Figure 2. Distribution of study plots and pen traps during the evaluation of attractants, summer 2010.

Figure 3. Sponges saturated with a specific attractant were placed in each pen trap.

Figure 4. Remote video camera frame showing 2 ground squirrels investigating a pen trap with an attractant.

Because juveniles were already active on surface, captured populations included ground squirrels of all ages. Early in the morning, one tablespoon of strychnine bait (approximately 13-15 g) was placed with a long-handled spoon as far as possible into burrow openings where captures and recaptures occurred, and in all the holes with signs of activity located within the study plots,. As per label instructions, the treated holes were covered with dirt. In each study plot, live trapping was initiated the day following treatment, and lasted up to 7 days to capture all animals present. An attempt was made to recover carcasses of ground squirrels and non-target species that died on surface. Dead animals were collected and identified to species. All collected ground squirrel carcasses were buried in a 60 cm-deep dirt hole. When moribund animals were found, they were quickly and humanely dispatched with a blow to the head.

Cold temperatures and strong wind during the attractant study curtailed predator activity in study plots (G. Proulx, pers. observations), and natural mortality was considered to be nil. A toxicant was found acceptable if, in both study plots, it controlled at least 70% of ground squirrel populations (Matschke and Fagerstone 1984, Proulx 2002). Because there is a marked variation in bait rejection from one study plot to the other (Proulx and Walsh 2007, Proulx et al. 2009), and in order to take into account the possible variation in the behavior of animals from different populations, results from similar treatments were not pooled together for statistical analysis. The Fisher Exact Probability test and Chi-square statistics (Siegel 1956) were used to compare the efficacy of baits among them (Witmer et al. 1995, Proulx 1998, Ramey et al. 2002, Arjo and Nolte 2004). A 0.05 level of significance was used for all tests.

3.2 Bait Stations

Three types of bait stations were selected:

- Inverted T (Figure 6);
- Inverted T with 45^{o} angle spill guards (Figure 7); and
- Bell box (Figure 8).

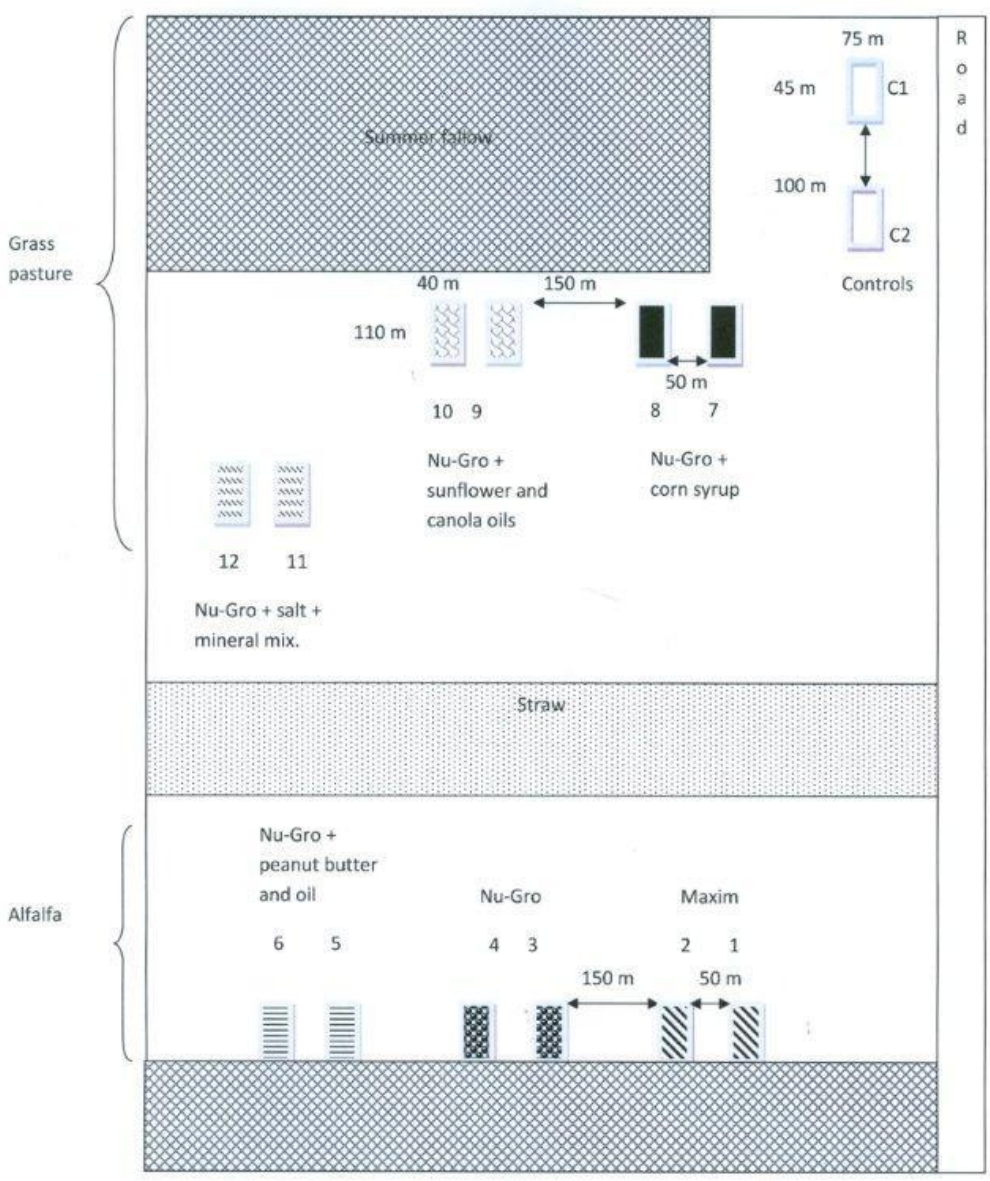

Figure 5. Distribution of study plots during the evaluation of strychnine baits, summer 2010.

Figure 6. Inverted T bait station.

Figure 7. Inverted T bait station with spill guards.

Figure 8. Bell baitbox.

Live-trapping was initiated on June 6, as per Section 3.1, in a mixed alfalfa-grass quarter section (Figure 9). Captured populations consisted of juveniles only, and exceeded 20 animals. On the basis of preliminary assessments with remote cameras, Inverted T bait stations with spill guards were not used by ground squirrels. On June 22, Nu-Gro strychnine-treated oats with 125 g of coarse salt and 125 g of mineral mix were poured (750 ml) in Inverted T (study plots # 4 and 5; Figure 9) and Bell box (study plots # 1 and 8) bait stations, and in burrow openings (15-30 g; study plots # 2 and 3, Figure 9). Two control plots (# 6 and 7) were also established to estimate natural mortality. Bait stations and their surroundings were visited daily. An attempt was made to recover carcasses of ground squirrels and non-target species that died on surface. Dead animals were collected and identified to species. All collected carcasses were buried in a 60 cm-deep dirt hole. When moribund animals were found, they were quickly and humanely dispatched with a blow to the head. Bait stations were left in the study plots for 3 days. Live trapping was initiated the day following treatment, and lasted up to 7 days to capture all animals present.

The control efficacy of toxicants was evaluated using the Abbott's formula modified by Henderson and Tilton (1955) as follows:

$$M = 100 \text{ x } [1 - (t2 \text{ x } c1)/(t1 \text{ x } c2)]$$

where M (%) = Richardson's ground squirrel mortality, t = treated population, c = control population, 1 = population before treatment, and 2 = population after treatment. Data were analyzed as per Section 3.2. A 0.05 level of significance was used for all tests.

3.3 Pen traps

Pen traps were tested in three 4-ha (200 x 200 m) grass-alfalfa study plots. Two of them were located in the same quarter section as the bait stations (Section 3.2, Figure 9). The other one was located in a grass quarter section, approximately 5 km away.

Richardson's ground squirrels were captured from 14 to 25 June. Five pen traps, 50-m apart, were used in each study plot starting 25 June. Pen traps included 0.4% strychnine-treated oats with salt and mineral mix, barley with peanut butter[4], and sponges with sunflower and canola oil. Traps were checked daily for a period of 4 days before being moved another 50 m, as per Figure 10. Dead animals were identified and properly discarded.

Pen traps with strychnine were found acceptable if they recaptured at least 70% of ear-tagged ground squirrels. The assessment of their potential to control Richardson's ground squirrels depended on the ease with which they could be set and moved in the field, the amount of bait used over a study period, and their efficacy to minimize/eliminate non-target and secondary poisoning.

[4] Because of the poor control performance of strychnine-treated oats in previous tests, barley was also used as bait.

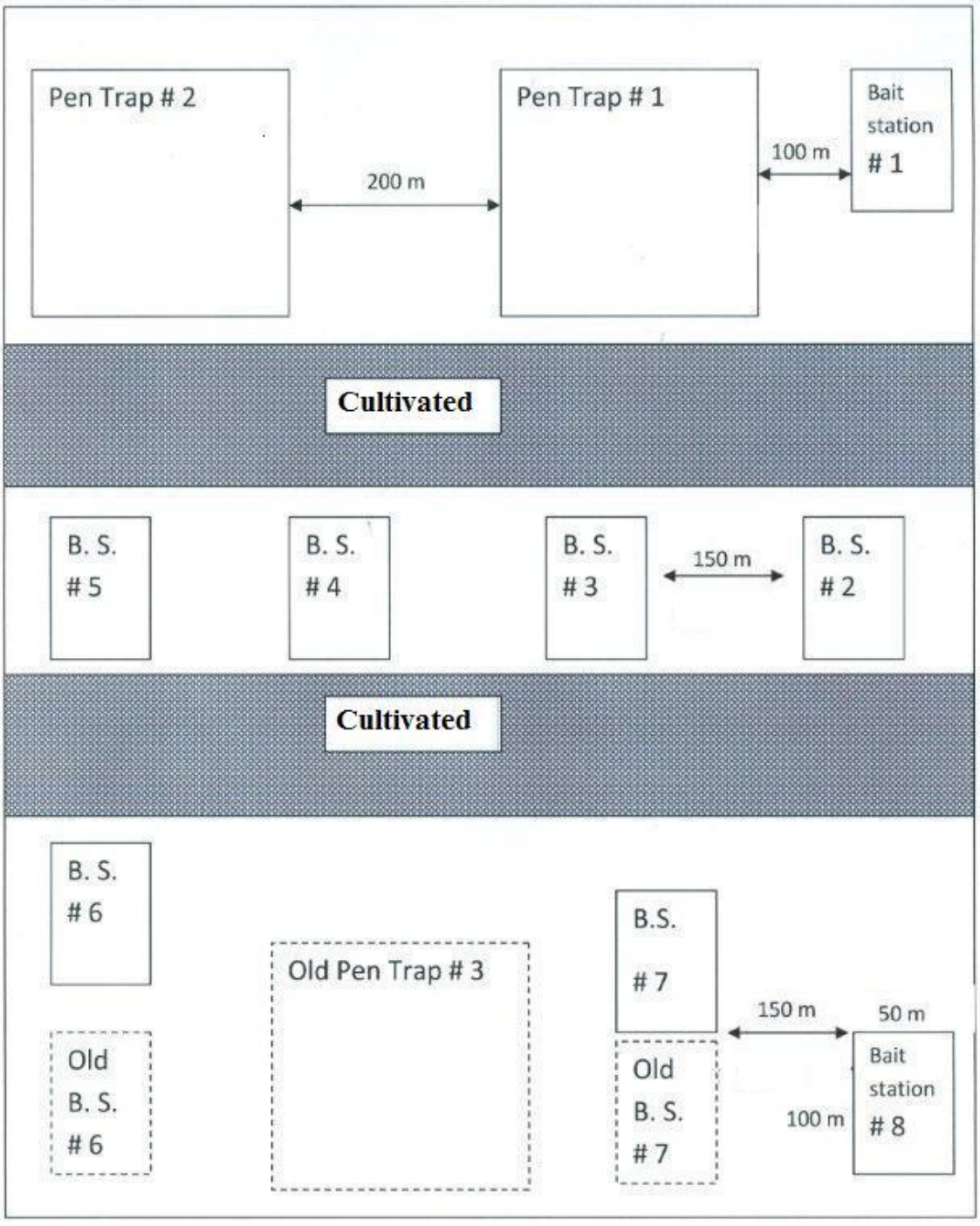

Figure 9. Distribution of study plots during the evaluation of bait stations and pen traps, summer 2010 ("old bait stations" are sites that were abandoned due to high predation by long-tailed weasels (*Mustela frenata*) (Proulx, unpubl. data).

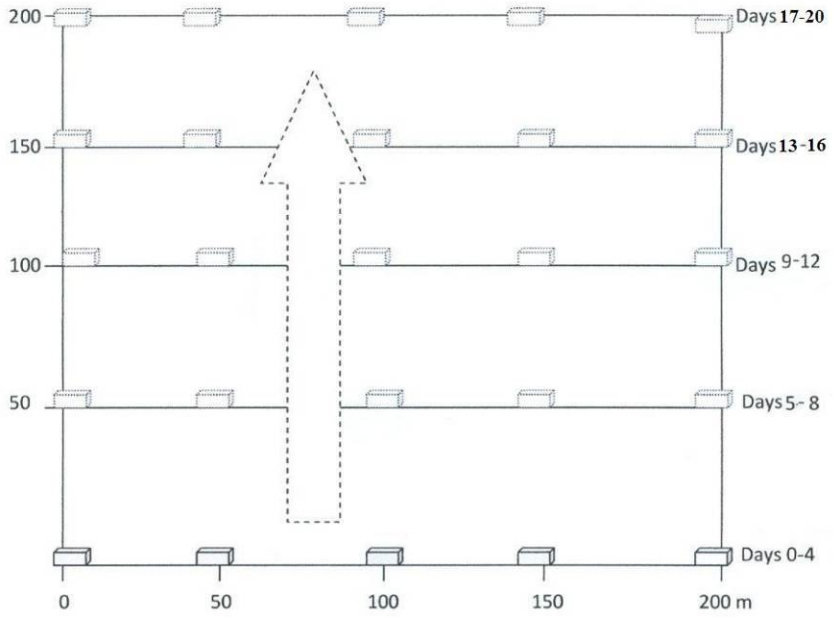

Figure 10. Spatio-temporal distribution of pen traps.

4.0 RESULTS

4.1 Attractants

There were no fecal pellets on the top or beside pen traps with vanilla extract. On the other hand, fecal pellets were numerous at traps with peanut or sunflower-canola oils. The presence of pellets within the traps also indicated that some ground squirrels entered, and escaped, traps with oil attractants.

4.2 Toxicants

Pre-treatment ground squirrel populations ranged from 13 to 30 adults, and 10 to 43 juveniles (Table 1). Control with strychnine baits was highly variable among treatments, ranging from 33.3% to 76.9% in adults, and from 50 to 100% in juveniles.

From a statistical point of view, control levels were similar ($P > 0.05$) among most strychnine baits (Figure 10). From a biological point of view, however, strychnine-treated oats with salt and mineral mix was the most effective formula, killing 69.2% and 76.9% of the adults, and 75% and 82.6% of the juveniles; on average, this bait controlled 75.7% and 77.8% of populations (Table 1). It was the only strychnine bait to control ≥ 70% of all animals in both study plots where it was applied. All the other strychnine baits failed to control at least 70% of populations in both study plots (Table 1).

Strychnine baits with corn syrup had the highest and lowest control values, this pointing out a large variation in the acceptation of baits by ground squirrels. Baits with salt and mineral mix were more effective that all other baits, followed by baits with sunflower and canola oils, and Nu-Gro and Maxim baits with and without peanut butter (Figure 11).

A total of 73 Richardson's ground squirrels marked or unknown were found dead on surface. Four deer mice (*Peromyscus maniculatus*) were also collected.

4.3 Bait stations

4.3.1 Preliminary assessment of bait stations

Richardson's ground squirrels were photographed approaching the Inverted T and the Bell box bait stations (Figure 12). Although they passed by the Inverted T bait station with spill guards, they showed no interest. Ground squirrels feeding on strychnine-treated oats of the Inverted T bait station spread the bait outside the PVC pipe (Figure 13), which attracted non-target species (Figure 14). As it happened in the past with baits placed in burrow systems, some ground squirrels feeding at bait stations died on surface (Figure 15).

4.3.2 Assessment of bait stations

Pre-treatment ground squirrel populations ranged from 21 to 46 juveniles (Table 2). Natural mortality in two control plots averaged 45.6%. The study area was inhabited by weasels, badgers (*Taxidea taxus*) and raptors.

Control levels varied greatly among treatments, ranging from 5.2% to 52.2% (Table 2), and not one treatment was found statistically superior to all others ($P > 0.05$). The highest control level occurred in a study plot where baits had been placed in burrow openings (Table 2). As it happened in preliminary assessments, poisoned oats were found on the ground nearby Inverted T bait stations.

It was difficult to find the carcasses of animals dead on surface because vegetation was high (> 45 cm). A total of 13 ground squirrel carcasses were collected.

4.4 Pen traps

Collapsible pen traps were easy to install and carry. Observations indicated that Richardson's ground squirrels entered traps (Figure 16) but were not interested in grain baits. Most of them successfully re-opened doors by pulling on them with their teeth and claws and twisting them. Animals would then enter and leave traps at will. Adding magnets to trap doors to increase resistance did not solve the problem. As a result, pen traps failed to capture and kill at least 70% of marked ground squirrels (Table 3). One mouse, and surprisingly, a baby badger were found dead in a pen trap.

Table 1. Control performance of strychnine baits to control Richardson's ground squirrels in Hazenmore study plots (0.4 ha), spring 2010.

Study plot and treatment	*Pre-treatment population*							*Post-treatment population*							*Mortality (%)*		
	Adult			*Juvenile*			*TOTAL*	*Adult*			*Juvenile*			*TOTAL*	*Adult*	*Juvenile*	*TOTAL*
	Male	*Female*	*Total*	*Male*	*Female*	*Total*		*Male*	*Female*	*Total*	*Male*	*Female*	*Total*				
1- Maxim	14	11	25	16	20	36	61	5	5	10	9	9	18	28	60	50	**54.1**
2- Maxim	6	12	18	20	23	43	61	2	5	7	6	10	16	23	61.1	62.8	**62.3**
3-Nu-Gro	7	20*	27	15	20	35	62	1	7	8	3	10	13	21	70.4	62.9	**66.1**
4-Nu-Gro	4	15*	19	22	12	34	53	3	8	11	9	4	13	24	42.1	61.8	**54.7**
5-Nu-Gro + peanut oil and butter	9	10	19	15	15	30	49	4	6	10	5	5	10	20	47.4	66.7	**59.2**
6-Nu-Gro + peanut oil and butter	14	16	30	25	11 (+ 1 unknown)	37	67	6	4	10	5	13	18	28	66.7	51.4	**58.2**
7-Nu-Gro + corn syrup	2	4	6	8	5	13	19	3	1	4	3	2	5	9	33.3	61.5	**52.6**
8-Nu-Gro + corn syrup	1	8	9	6	4	10	19	1	2	3	0	0	0	3	66.7	100	**84.2**
9-Nu-Gro + sunflower & canola oils	2	16*	18	25	24	49	67	1	5	6	5	11	16	22	66.7	67.3	**67.2**
10-Nu-Gro + sunflower & canola oils	4	17*	21	9	15	24	45	1	7	8	3	2	5	13	61.9	79.2	**71.1**
11-Nu-Gro + salt & mineral mix	4	9	13	9	15	24	37	1	2	3	1	5	6	9	76.9	75.0	**75.7**
12-Nu-Gro + salt & mineral mix	4	9	13	12	11	23	36	3	1	4	3	1	4	8	69.2	82.6	**77.8**

*Uneven sex ratio ($P < 0.05$)

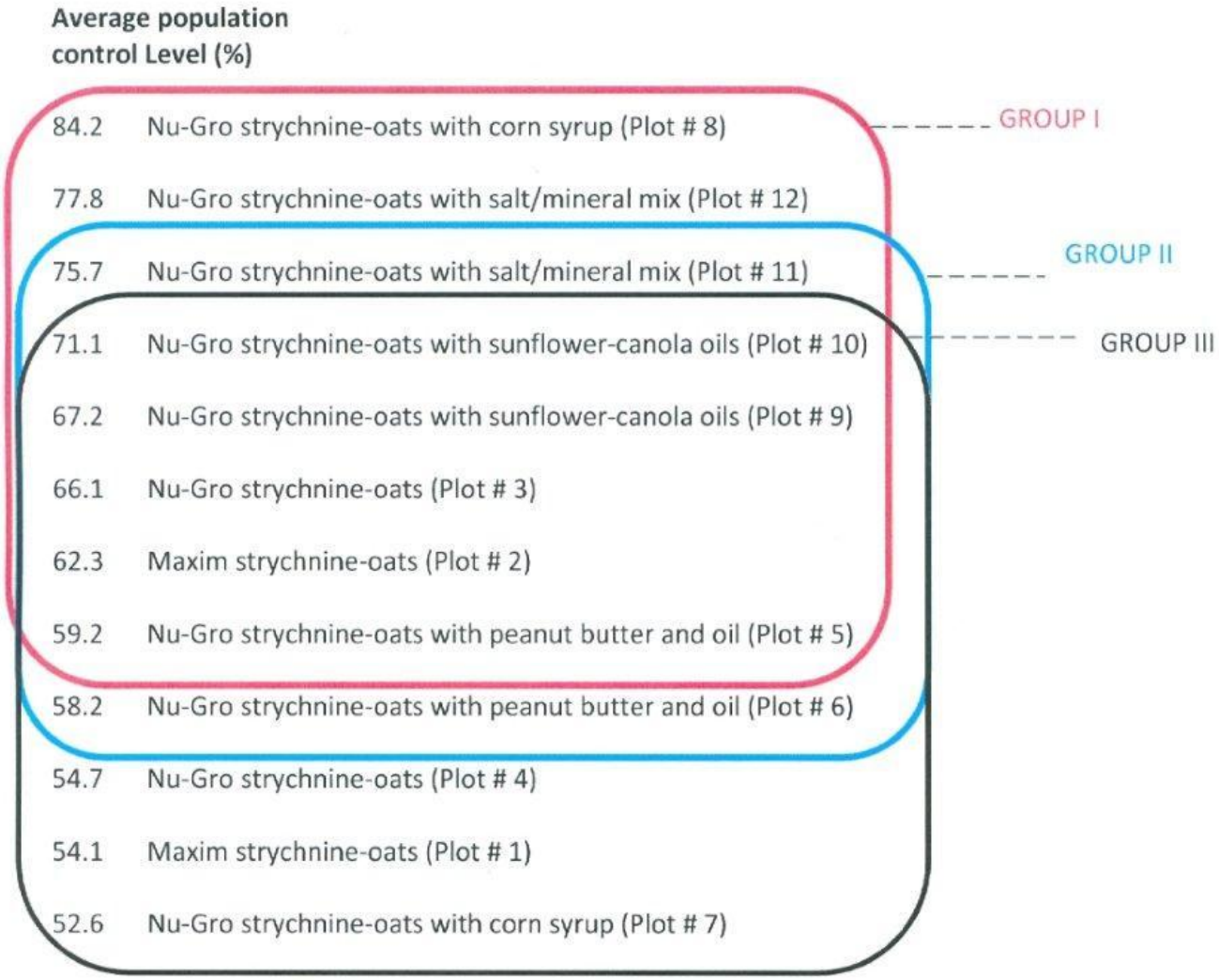

Figure 11. Comparison of the efficacy of various strychnine baits to control Richardson's ground squirrels. Treatments within a same group had similar ($P > 0.05$) mean control levels.

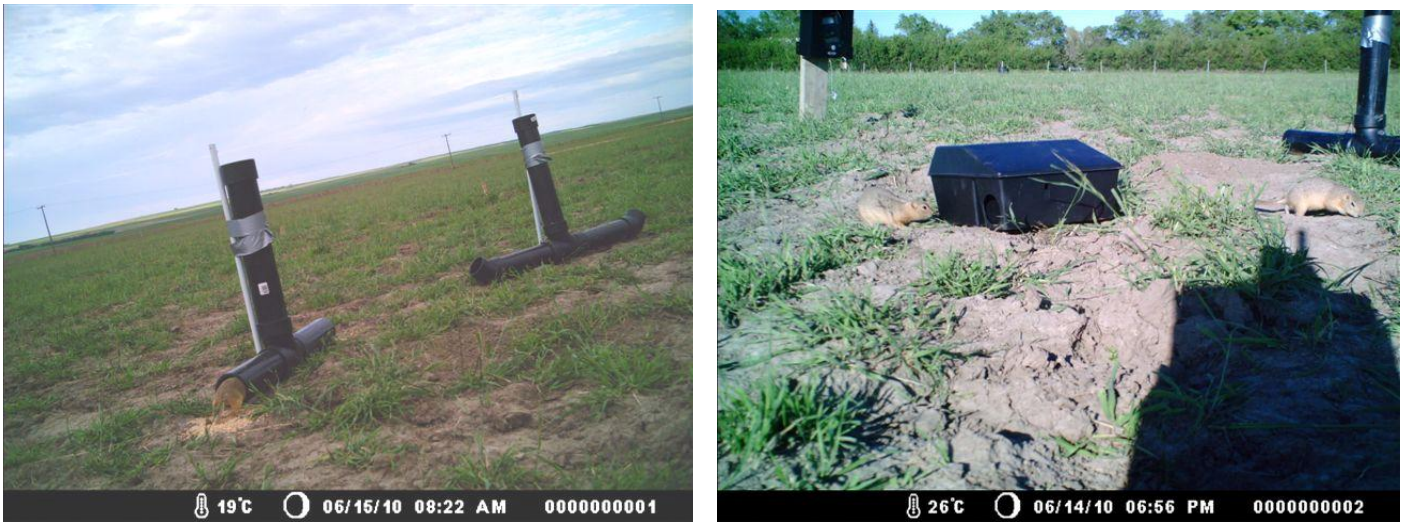

Figure 12. Richardson's ground squirrels feeding at an Inverted T and Bell box bait stations.

Figure 13. Poison bait spilled outside the Inverted T bait station.

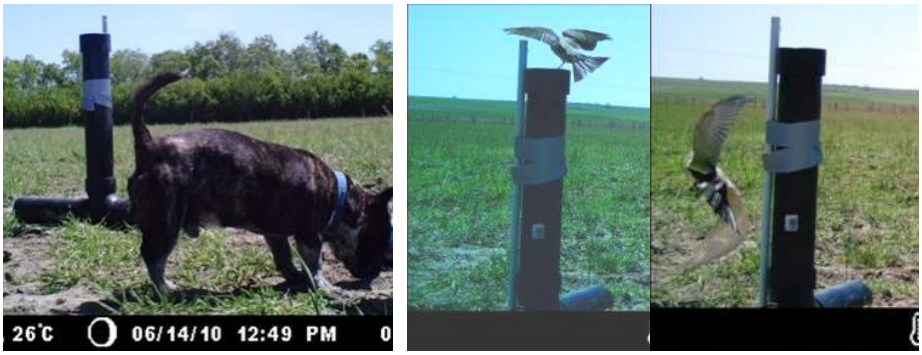

Figure 14. Non-target species at bait stations.

Figure 15. Strychnine-killed ground squirrel found dead on surface, near bait stations.

Table 2. Control performance of strychnine baits in bait stations in Hazenmore study plots (0.5 ha), June 2010.

Study plot and treatment	*Pre-treatment juvenile population*			*Post-treatment juvenile population*			*Mortality(%)*
	Male	*Female*	*Total*	*Male*	*Female*	*Total*	
# 1 – Bell box	18	6	24	7	1	8	38.9
# 8 – Bell box	15	10	25	7	5	12	12.0
# 4 – Inverted T	17	12	29	8	7	15	5.2
# 5 – Inverted T	20	15	35	9	5	14	26.7
# 2 – Hole baiting	15	10	25	7	5	12	12.0
# 3 – Hole baiting	23	23	46	7	5	12	52.2
# 6 – Control – no treatment	10	13	23	4	9	13	43.5
# 7 – Control – no treatment	12	9	21	7	4	11	47.6

Figure 16. Richardson's ground squirrels captured in a pen tap.

Table 3. Control performance of pen traps baited with strychnine-treated grains, summer 2010.

Pen trap #	Adult population	Captured in pen trap	Juvenile population	Capture in pen trap	Total population	Total control
1	54	0 ear-tagged 1 unknown	297	3 ear-tagged 7 unknown	351	3 (0.9%)
2	85	3 ear-tagged 1 unknown	340	2 ear-tagged 6 unknown	425	5 (1%)
3	28	1 ear-tagged	82	1 ear-tagged 3 unknown	110	2 (1.8%)

5.0 DISCUSSION

The 2010 weather conditions differed completely from those observed during the 2007-2009 studies. The spring work was difficult to carry out due to abundant rain and wind storms, snowfalls, low temperatures, and flooding of roads and fields. By May, contrary to previous years, vegetation was green and a large amount of forage was available to ground squirrels. Also, animals showed little interest toward baits placed in burrow openings, bait stations or pen traps.

The control efficacy of freshly mixed 0.4% strychnine baits varied considerable among years and seasons (Table 4). Data suggest that freshly manufactured strychnine is more effective than strychnine that has been produced many years ago or stored over winter. However, differences observed in control efficacy from 2008 (drought year) to 2010 (wet year), and between spring and summer 2010, suggest that Richardson's ground squirrels are less receptive to man-made baits when natural food is abundant. The differences in control levels observed in 2010 also indicate that the acceptability of strychnine baits varies between populations and seasons. Pawlina and Proulx (1999) pointed out that the attractiveness of food baits may vary between species and individuals of a same species according to abundance of natural food and the physiological condition of animals. This variation in the attractiveness of strychnine baits

may explain the difference of opinions about strychnine control efficacy over decades of utilization, i.e., some farmers reported good success while others spoke of indifferent results (Isern 1988). Ideally, before applying strychnine baits over large areas, different strychnine baits (i.e., different grains, with and without attractants, etc.) should be tested with a small number of animals in the field to determine the most effective bait for a particular area, at a specific time of year. Obviously, this is not a practical solution for large-scale landowners. It is therefore recommended that strychnine baits be studied and improved to be effective under different environmental conditions. More work should be invested in attractants. This year's study showed that oils were particularly attractive to ground squirrels. Adding different oils to different grain types, some already rich in natural oils, could lead to the development of more attractive baits.

Because strychnine baits were not attractive to ground squirrels, bait stations failed to control populations. Nevertheless, the 2010 study showed that Bell box bait stations were superior to Inverted T bait stations because they contained poison baits and likely had less of an impact on non-target species such as songbirds. Compared to Inverted T bait stations that require a vertical support and should be filled *in situ* to avoid spilling baits during transport, pre-filled boxes were easy to handle and did not require any special anchor.

Table 4. Performance of strychnine-treated oat baits tested in southern Saskatchewan, 2007-2010.

Year	***Weather conditions***	***Freshly mixed 0.4% strychnine-treated oats***	***Control efficacy***		***Reference***
			Spring	***Summer***	
2007	Drought	5-yr old product	Failed (38.1%)	Not tested	Proulx and Walsh 2007
2008	Drought	Freshly produced by Nu-Gro	Passed (84.3%)	Passed (75.4%)	Proulx et al. 2009
2009	Mixed weather with heavy rains and dry periods	1-yr old (same batch as in 2008 stored by Agrium)	Passed (79.5%)	Failed (59.7%)	Proulx et al. 2010
2010	Wet	Freshly produced by Nu-Gro and laboratory approved	Passed with salt and mineral mix (76.7%)	Failed with or without attractant (< 70%)	Table 1 – this report
		Freshly produced by Maxim	Failed (< 63%)	Not tested	

The lack of attractiveness of strychnine baits partly explains poor control success with pen traps. Contrary to 2008 when ground squirrels entered traps and immediately fed on baits, this year's ground squirrels spent their time trying to escape. Also, contrary to 2008, ground squirrels would grasp doors with their teeth and claws and manage to keep them open. Once a door stayed open, animals came in and out of the trap without feeding on baits. It is likely that in 2008, when natural food was poor in quality and quantity (Proulx et al. 2009), ground squirrels would have ingested enough bait that would have interfered with their escape attempts. The 2010 study showed that pen trap doors should be modified to eliminate escapes. It is recommended that further work be conducted on the development and testing of multi-capture pen traps.

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