



Re-evaluation Decision

RVD2020-06

Strychnine and Its Associated End-use Products (Richardson's Ground Squirrels)

Final Decision

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Re-evaluation Decision

Under the authority of the *Pest Control Products Act*, all registered pesticides must be regularly re-evaluated by Health Canada's Pest Management Regulatory Agency (PMRA) to ensure that they continue to meet current health and environmental standards and continue to have value. The re-evaluation considers data and information from pesticide manufacturers, published scientific reports and other regulatory agencies. Health Canada applies internationally accepted risk assessment methods as well as current risk management approaches and policies.

Strychnine is an active ingredient used in restricted-class products which may be applied as baits to control predators, Northern pocket gophers and ground squirrels (Richardson's, Columbian, Franklin's, and thirteen-lined). Since the uses on predators and Northern pocket gophers were re-evaluated separately in 2007,¹ this re-evaluation decision focusses only on ground squirrels, specifically Richardson's ground squirrels. Uses on other ground squirrel species were recently discontinued by the manufacturer. Currently registered products containing strychnine used to control Richardson's ground squirrels can be found in the Pesticide Label Search and in Appendix I.

The regulatory approach for the re-evaluation of strychnine (ground squirrel use) was first presented in the Proposed Re-evaluation Decision PRVD2018-13,² which underwent a 90-day consultation period ending on 27 September 2018. PRVD2018-13 proposed the cancellation of strychnine used to control ground squirrels due to environmental risks of concern for non-target organisms, including species at risk.

Health Canada received comments relating to the environmental and value assessments. These comments are summarized in Appendix II along with responses by Health Canada. Respondents are listed in Appendix III. These comments and new data/information did not result in revisions to the risk assessments (see Science Evaluation Update), and did not result in changes to the proposed regulatory decision as described in PRVD2018-13. A reference list of information used as the basis for the proposed re-evaluation decision is included in PRVD2018-13, and further information used in the re-evaluation decision is listed in Appendix IV of this document.

This document presents the final regulatory decision³ for the re-evaluation of strychnine (Richardson's ground squirrels), including the required risk mitigation measures to protect the environment. All products containing strychnine that are registered to control Richardson's ground squirrels in Canada are subject to this re-evaluation decision.

¹ Re-evaluation Note REV2007-03, *Update on the Re-evaluation of Strychnine*.

² "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

³ "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Outcome of Science Evaluation

An evaluation of available scientific information confirmed that there are risks of concern for non-target organisms, including species at risk, for products registered to control Richardson's ground squirrels.

Regulatory Decision for Strychnine (Richardson's Ground Squirrels)

Health Canada has completed the re-evaluation of strychnine (Richardson's ground squirrels). Under the authority of the *Pest Control Products Act*, Health Canada is cancelling the registration of strychnine, and all associated end-use products, used to control Richardson's ground squirrels for sale and use in Canada. An evaluation of available scientific information has not shown that risks to the environment are acceptable when strychnine is used according to the current conditions of registration, or when additional mitigation is considered. No additional data are requested.

Risk Mitigation Measures

The mitigation measures required, as a result of the re-evaluation of strychnine (Richardson's ground squirrels), are summarized below.

Environment

- Cancellation of strychnine used to control Richardson's ground squirrels.

Next Steps

To comply with this decision, products that are cancelled will be phased out following the implementation timeline outlined below. Refer to Appendix I for details on specific products impacted by this decision.

- One (1) year of sale by registrant from the publication date of this decision document, followed by;
- One (1) year of sale by retailer from the last date of sale by registrant, followed by;
- One (1) year of permitted use from the last date of sale by retailer.

Other Information

Any person may file a notice of objection⁴ regarding this decision on strychnine (Richardson's ground squirrels) within 60 days from the date of publication of this Re-evaluation Decision. For more information regarding the basis for objecting (which must be based on scientific grounds), please refer to the [Pesticides](#) section of the Canada.ca website (Request a Reconsideration of Decision) or contact the PMRA's Pest Management Information Service by phone (1-800-267-6315) or by e-mail (hc.pmra.info-arla.sc@canada.ca).

⁴ As per subsection 35(1) of the *Pest Control Products Act*.

The relevant test data on which the decision is based (as referenced in PRVD2018-13 and this document) are available for public inspection, upon application, in the PMRA's Reading Room (located in Ottawa). For more information, please contact the PMRA's Pest Management Information Service.

Science Evaluation Update

1.0 Environmental Risk Assessment Updates

1.1 New 2019 study submitted by the Saskatchewan Ministry of Agriculture

The Saskatchewan Ministry of Agriculture submitted a study (Tansey, J. A. 2019, PMRA# 3027442) to address concerns about the potential for primary and secondary poisoning of non-target organisms resulting from Richardson's ground squirrel (RGS) control programs using strychnine poisoned baits. Strychnine bait (0.4% in grain) was applied at sites in three separate treatment groups: 1) bait applied to a depth of 30 cm in RGS burrows with the burrow entrance covered (covered treatment); 2) bait applied to a depth of 30 cm in RGS burrows with the burrow entrance left uncovered (uncovered treatment); and 3) bait applied to a depth of at least 1 m in RGS burrows with the burrow entrance left uncovered (1-m deep treatment). A control plot was maintained where no baits were applied to any burrows. Twenty-five burrows were treated at each site (0.16 hectares). RGS populations were evaluated pre- and post-treatment and numbers of dead animals were recorded. The presence of any non-target organisms (dead or alive) and ejection of baits was also documented. All plots were observed daily for four days after treatment.

For a summary of the results of the study, see Table 1. The results of the study indicated that application of strychnine baits significantly reduced RGS counts in all treated plots compared to the control plots. Some RGS carcasses were found on the surface of the soil for all strychnine treatments. Analysis of the carcasses showed that 73% of those found tested positive for the presence of strychnine; others appeared to have died from non-treatment related causes. In this study, one RGS carcass was found on the surface of a treated site for every 15 burrows baited with strychnine. When considering only confirmed strychnine-poisoned RGS carcasses, this study found one poisoned carcass on the surface of a treated site for approximately every 20 burrows treated. The presence of non-target animals at the treated plots was confirmed by direct observation and/or game camera footage. These sightings included hawks, grouse, crows, grackles, swallows, meadowlark, songbirds, coyotes, foxes, antelope, and badgers. The only non-target carcasses found were four deer mice (1-m deep treatment sites only), three of which were necropsied and whose deaths were confirmed to be the result of strychnine poisoning.

The results of this study confirm previous observations discussed in PACR2005-08⁵ and PRVD2018-13 that the application of strychnine baits, in accordance with label instructions to control RGS populations, results in the availability of poisoned RGS carcasses on the surface of treated sites. Observations recorded during the study period confirmed that non-target animals were actively scavenging these carcasses within the treatment plots. Although the results from this study did not conclusively determine that predators or scavengers had consumed a lethal dose of strychnine through scavenging of poisoned carcasses (as no dead predators or scavengers were reported), there is evidence from previous studies and incident reports that secondary poisoning does occur (PACR2005-08, PRVD2018-13). Observations for this study were

⁵ Proposed Acceptability for Continuing Registration PACR2005-08, *Re-evaluation of Strychnine*.

conducted over a limited four-day period and any animals that may have consumed strychnine bait or scavenged on poisoned carcasses may have left the area under observation. In addition, if treatment is repeated multiple times during an infestation, the risk to predators and scavengers would be greater. A low percentage of treated burrows (8–15%) were reported to have bait ejected from them. As strychnine is a highly toxic substance, bait ejection, even at these levels, is considered to be an important route of primary exposure for non-target organisms. This is supported by the presence of deer mouse carcasses in the treatment area whose deaths from strychnine were confirmed. These non-target primary poisonings could subsequently lead to a higher potential for secondary poisonings as well.

Table 1 Results and Observations: Application of strychnine bait (0.4% in grain) in three treatments (30-cm covered, 30-cm uncovered, and 1-m uncovered) to burrows in field sites in Saskatchewan for the control of Richardson’s ground squirrels

Observations ^{1,2}	Treatment			
	Control	30 cm - Covered	30 cm - Uncovered	1 m - Uncovered
Number of burrows treated	75	75	75	75
Total dead (all replicates)	1	4	4	7
Cause of death	Autolysis (1)	Autolysis (1); Strychnine (2); No diagnosis (1)	Strychnine (3); No diagnosis (1)	Pulmonary emmonsia (1); Strychnine (6)
Total bait ejection events	0	6	6	11

1 Three replicates per treatment; 25 burrows per replicate plot

2 Four-day observation period post-treatment

In general, the results of this study support the observations reported in field studies that were previously reviewed for the re-evaluation of strychnine for the control of RGS (PACR2005-08, PRVD2018-13). Although the number of target and non-target poisonings recorded in this study are relatively low, it is important to relate these results to the size of the area that was treated. The total baited area covered by the study was 1.44 hectares, which is small compared to the amount of land that would likely be baited during an infestation of RGS. This is also a much smaller area than was treated in some of the studies that were conducted previously, where non-target deaths were also reported (PACR2005-08, PRVD2018-13). For this 2019 study, 75 burrows received untreated bait and 225 burrows received strychnine-treated baits. In contrast, several thousand burrows had been baited in some of the previous studies that were conducted. In addition, this study involved a single application of bait to the treated area, whereas for other studies multiple applications were made. Considering the limited size and duration of this study and the number of burrows that would be treated during a full scale RGS program, the number of poisoned RGS carcasses that would be available on the surface to be scavenged is likely to be much larger than what was observed in the four-day study that was submitted to Health Canada.

The results of this study further support the environmental risk conclusions presented in PRVD2018-13. When label directions for the use of strychnine to control RGS are followed, this will result in the availability of treated bait ejected from some of the burrows and a number of strychnine-poisoned RGS carcasses on the surface of the field. The treated bait and poisoned carcasses can then be consumed by non-target organisms and may result in secondary poisoning.

As a result of repeated bait applications over a relatively large area during a full-scale RGS control program with strychnine, the level of exposure is expected to be high. Potential mitigation measures, such as placing the bait deeper into the burrow or covering the burrow, have been shown to be ineffective at reducing the number of poisoned ground squirrels available on the surface or the frequency of bait ejections from treated burrows. No further label improvements or additional mitigation measures have been identified that could reduce the potential exposure to non-target organisms to a level that would be considered acceptable. Therefore, based on a scientific evaluation of the available data, the environmental risks associated with the use of strychnine to control RGS are not considered to be acceptable.

1.2 Incident Reports

Three incidents relating to the use of strychnine to control RGS were reported to Health Canada since the publication of PRVD2018-13 either through the Incident Reporting Program or through comments received during the consultation period. All three reported incidents involved the death of dogs. One incident resulted in the death of a dog that was autopsied and confirmed to have died from strychnine poisoning; this incident was assigned a causality of “highly probable.” The dogs in the other two incidents did not have residue analyses performed; one of these incidents was assigned a causality of “possible” while the other had “insufficient information.” The information provided in these incident reports did not alter the conclusions of the environmental risk assessment.

2.0 Conclusion

After considering the 2019 field study and comments received relating to PRVD2018-13, the overall environmental risk conclusions and mitigation measures presented in this re-evaluation decision document are found to be consistent with those previously presented in PRVD2018-13.

Based on the evaluation of currently available scientific information, Health Canada has concluded that the environmental risks associated with the use of strychnine and its associated end-use product to control Richardson’s ground squirrels were not shown to be acceptable when this product is used according to the label directions and required mitigation measures. Therefore, under the authority of the *Pest Control Products Act*, Health Canada is cancelling strychnine used to control Richardson’s ground squirrels.

Appendix I Registered Strychnine Products (Richardson's Ground Squirrels in Canada)¹

Table 1 Products Containing Strychnine Cancelled as a Result of Re-evaluation

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee
30433	Restricted	Maxim Chemical International Ltd.	2% Liquid Strychnine Concentrate	Suspension	2% STR

¹as of 10 December 2019, excluding discontinued products or products with a submission for discontinuation

Table 2 Products Containing Strychnine that Do Not Require Label Amendments

Registration Number	Marketing Class	Registrant	Product Name	Formulation Type	Guarantee
31756	Technical	Maxim Chemical International Ltd.	Maxim Technical Strychnine	Solid	99% STR

¹as of 10 December 2019, excluding discontinued products or products with a submission for discontinuation

Appendix II Comments and Responses

In response to the consultation for the strychnine (ground squirrel use) proposed re-evaluation decision, PRVD2018-13, a total of 9280 written comments were received (respondents' affiliations listed in Appendix III). These comments were considered during the final decision phase of this re-evaluation. Summarized comments and Health Canada's responses to them, are provided below.

1.0 General Comments on the Re-evaluation

1.1 Comments relating to ground squirrels and gophers as target pests

Comments were received from a Member of Parliament for Battle River and Crowfoot relating to clarification between ground squirrels and gophers as the target pest in PRVD2018-03, *Strychnine and Its Associated End Use Products (Ground Squirrel Use)*.

Health Canada Response

PRVD2018-13 focused only on the use of strychnine to control the following ground squirrel species: Richardson's (*Uroditellus richardsonii*; formerly *Spermophilus richardsonii*); Columbian (*Uroditellus columbianus*); Franklin's (*Poliocitellus franklinii*); and thirteen-lined (*Ictidomys tridecemlineatus*). However, ground squirrels species, with the exception of Richardson's, have since been voluntarily discontinued by the manufacturer and are no longer registered. The use of strychnine to control Northern pocket gophers was previously re-evaluated in Re-evaluation Note REV2007-03, *Update on the Re-evaluation of Strychnine*. However, use on Northern pocket gophers was recently discontinued and is no longer registered.

1.2 Comments relating to ground squirrels as pests

Comments were received from the Animal Alliance of Canada indicating that RGS should not be considered pests due to their importance as part of the wildlife ecosystem. Other comments received from Saskatchewan Ministry of Agriculture, crop and livestock associations, municipalities and farmers related to the serious and negative impact of RGS on agricultural producers.

Health Canada Response

Health Canada recognizes that ground squirrels serve an important role in the ecosystem by providing a food source for predators and shelter for other wildlife through their burrows. However, under Section 2 of the *Pest Control Products Act*, a "pest" is defined as:

“an animal, a plant or other organism that is injurious, noxious or troublesome, whether directly or indirectly, and an injurious, noxious or troublesome condition or organic function of an animal, a plant or other organism.”

Based on this definition, ground squirrels, including RGS, are considered agricultural pests due to the substantial damage they cause to crops, livestock and equipment which can result in economic losses for farmers.

1.3 Comments relating to the quality and quantity of information considered

Comments were received from crop and livestock associations, municipalities, and farmers on the limited number of studies reviewed during the re-evaluation of strychnine for RGS control, as well as concerns regarding the quality of these studies.

Health Canada Response

In order to ensure that registered pesticides continue to meet current health and environmental standards, re-evaluations consider available scientific data and information from pesticide manufacturers, published scientific reports and other regulatory agencies. Health Canada applies internationally accepted risk assessment methods as well as current risk management approaches and policies to its re-evaluations.

PRVD2018-13 was a continuation of the re-evaluation of strychnine specific to ground squirrel control. A Re-evaluation Note REV2007-03 identified that the use of strychnine to control ground squirrels was a concern from an environmental perspective. However, this use of strychnine was maintained, with the implementation of interim mitigation measures, in order to allow for the development of new data/approaches by the Richardson's Ground Squirrel Integrated Pest Management (RGS IPM) Steering Committee. This committee was formed to identify, develop and promote the use of products other than strychnine, and to develop IPM strategies to control RGS. Once completed, the data would be submitted to Health Canada for review and to make a final decision on strychnine.

The primary focus of PRVD2018-13 was to consider any new information on the use of strychnine to control RGS since REV2007-03, such as the field studies conducted between 2007 to 2010 as part of the RSG IPM Steering Committee project, grower surveys and published literature.

1.4 Comments relating to humaneness

Comments were received from the Animal Alliance of Canada, Wolf Awareness Inc., Humane Society International/Canada and University of Calgary relating to how the use of strychnine is an inhumane method to kill vertebrate pests.

Health Canada Response

Health Canada acknowledges the growing concern among Canadians about the use of pest control products to control vertebrate pests. Health Canada published *Consultation: Humane Vertebrate Pest Control* in December 2018 in order to consult Canadians on how the humaneness of pesticides to control predators could be considered during their approval and use. Comments from this consultation are currently under review.

2.0 Comments Related to the Environmental Risk Assessment

2.1 Comments related to use of public literature for the environmental risk

Comments were received from the Canadian Cattlemen's Association, Saskatchewan Ministry of Agriculture, Saskatchewan Cattleman's Association, Canadian Canola Growers Association and the Grain Growers of Canada regarding the use of studies available in the public literature. The commenters suggested that Health Canada relied heavily on a study conducted by Alpha Wildlife Research and Management Ltd (Field Evidence of Non-Target and Secondary Poisoning by Strychnine and Chlorophacinone Used to Control Richardson's Ground Squirrels in Southwest Saskatchewan, referenced in PRVD2018-13) and did not adequately consider other studies from the public literature.

Health Canada Response

In 2002, the Richardson's Ground Squirrel IPM and Steering Committee was created to provide advice on sustainable control of RGS in the Prairies. It consisted of experts representing agricultural producers, industry, researchers, provincial governments and Health Canada. With direction from this committee and funding from Saskatchewan's Ministry of Agriculture Development Fund, Advancing Canadian Agriculture and Agri-Food Fund (ACAAF) and Alberta Agriculture and Rural Development, Alpha Wildlife Research and Management Ltd. conducted various studies towards the goal of developing and promoting a pest management strategy for the control of RGS in the Prairies. The study referred to in this comment was part of this work. This study was considered by Health Canada to be particularly relevant as it was commissioned by the multi-disciplinary RGS IPM Steering Committee to specifically assess the impact of strychnine used to control RGS in the Prairies. This study was submitted to Health Canada by the Alberta government in 2011 and was considered to be acceptable and a pertinent study in the re-evaluation of strychnine used for the control of RGS.

It is also important to note that PRVD2018-13 focussed on new information that was made available after the publication of PACR2005-08. All information referenced in both proposed decision documents contributed towards the re-evaluation decision. This includes other important field studies that were carried out by either the Government of Alberta or the Government of Saskatchewan and were also referenced in PACR2005-08. These studies are listed below.

- Bourne et al., 2001 (data also contained in the published report Bourne et al., 2002, PMRA# 3052704) showed that the treatment of 60 hectares with strychnine baits resulted in 221 dead ground squirrel carcasses being observed on the surface and, thus, available to scavengers. These numbers were not corrected for potential losses due to scavenging or low search efficiency (to find dead carcasses) by researchers conducting the study and, therefore, are probably an underestimation of total carcasses resulting from strychnine poisoning.
- McKinnon et al., 2001 (PMRA# 3051149) examined the potential for non-target primary poisonings by comparing the number of strychnine-treated kernels reaching the surface of the soil after bait was placed within ground squirrel burrows. Two scenarios were compared: leaving the burrow open after treatment and collapsing the opening. Results indicated that collapsing the burrow entrance did not result in a significant reduction to the amount of

poisoned kernels reaching the soil surface (a finding that was corroborated by the study submitted in 2019 by the Saskatchewan Ministry of Agriculture, Tansey, J. A. 2019, PMRA# 3027442). Both scenarios would result in a significant number of small concentrated areas of strychnine-treated grain on the soil surface. The study estimated that, at a minimum, 108 000 small concentrated areas of strychnine-treated grain were created as a result of the 2001 Emergency Registration of 2% Liquid Strychnine Concentrate in Saskatchewan. Thus, based on this information, the potential for non-target poisonings from eating ejected grain baits is considered to be significant.

- McKinnon et al., 2002 (PMRA# 3051153) examined the potential for secondary non-target poisonings as a result of scavengers feeding on the carcasses of poisoned ground squirrels. On the basis of carcass counts, the study estimated that the 2001 Emergency Registration of 2% Liquid Strychnine Concentrate in Saskatchewan potentially resulted in approximately 4680–4980 strychnine poisoned ground squirrel carcasses being available to scavengers on the soil. A similar exercise was undertaken to determine potential songbird mortalities from consumption of poisoned grain during this baiting season. Researchers estimated that approximately 1800 songbirds (95% C.I. = 300–3600) to 1950 songbirds (95% C.I. = 450–3750) would have been poisoned and that these carcasses would also be available to scavengers. For both estimates, carcass counts were corrected because observations by researchers indicated that a significant amount of scavenging was occurring before researchers could complete their counts in the field. A correction factor was also used to adjust carcass counts based on how well researchers could find dead animals while searching a field. Approximately 85% of carcasses that were deliberately placed in a field were found by researchers. The potential impact on scavengers could not be estimated as the amount and distribution of strychnine within the tissues of the carcasses was not determined. However, this information indicates that the potential for exposure is likely to be significant.
- Mackinnon et al., 2004 (PMRA# 3051152) conducted another study in 2002 and found a total of 82 RGS carcasses on the surface of the fields for an average of 6.8 carcasses/ha. They also found that 94 of 120 Japanese quail carcasses that were deliberately placed in a strychnine-treated field were scavenged after three days.

Researchers affiliated with the Governments of Alberta and Saskatchewan carried out these studies. These studies show that RGS baiting consistently leads to poisoned RGS carcasses available for scavengers on the surface of fields and that rejected strychnine baits are available to non-target organisms on the surface of fields. Additional information provided in these studies indicates that reported target and non-target poisoning counts are likely underestimated because of two factors. First, carcasses may be missed when people are conducting searches of the fields to find dead animals and, second, scavengers are very quick and effective at removing dead animals from the surface of fields.

Other information provided in the above-mentioned studies addressed additional issues that were raised by the commenters. Comments suggested that studies by Schmutz et al., 1989 (PMRA# 3075611), James et al., 1990 (PMRA# 3075616) and Marsh *et al.*, 1987 (PMRA# 3075652) indicated that some raptorial bird species and coyotes eviscerate their prey prior to consumption and, therefore, would avoid much of the strychnine residue in poisoned RGS. McKinnon et al., 2002 (PMRA# 3051153) indicated: “It is important to note, however, that 34% of coyotes, 30%

of Ferruginous Hawks and 45% of Swainson's Hawks did not eviscerate ground squirrels in the studies reported above. In addition, as observed in the male ground squirrels in this study, large amounts of strychnine-treated grain can be stored in their cheek pouches and this source of poison would not be discarded through evisceration (Schmutz et al., 1989, PMRA# 3075611).” Although some individuals of some species of scavengers have been shown to exhibit a tendency to eviscerate RGS before consuming them, this does not eliminate the risk to these non-target organisms or to any of the other non-target organisms that have not been shown to exhibit a tendency for this behaviour. Schmutz et al., 1989 (PMRA# 3075611) and James et al., 1990 (PMRA# 3075616) also provide further evidence that below ground strychnine baiting to control RGS leads to RGS carcasses being available on field surfaces. As summarized in McKinnon et al., 2002 (PMRA# 3051153), “Schmutz et al. (1989) and James et al. (1990) applied strychnine-treated grain bait into burrows, and found 19 dead squirrels (4.4 carcasses/100 burrows) in a study in Alberta and 41 dead ground squirrels (1.37 carcasses/100 burrows) in a study in Saskatchewan, respectively. These studies are not directly comparable to our study either, because they did not correct for scavenging or search efficiency of observers and carcass searches were only conducted on the day of application or the following day.”

2.2 Comments related to non-target poisoning risks from the use of strychnine for pocket gophers

Comments were received from the Canadian Cattlemen's Association and the Saskatchewan Association of Rural Municipalities (SARM) indicating that use of strychnine to control pocket gophers does not lead to significant non-target poisoning risks.

Health Canada Response

Health Canada's current re-evaluation decision is regarding the use of strychnine to control Richardson's ground squirrels only (*Spermophilus richardsonii*). The use of strychnine to control Northern pocket gophers (*Thomomys talpoides*) was previously re-evaluated (REV2007-03); however, it has been recently discontinued by the manufacturer and is no longer registered.

2.3 Comments related to the importance of reported non-target poisonings from strychnine

A comment received from the Saskatchewan Ministry of Agriculture and the Municipal District of Wainwright No. 61 questioned if the 21 strychnine-related Canadian incidents reported between 2008 and 2017, involving domestic or wild animals, constitutes an important issue.

Health Canada Response

Health Canada has concluded that the evidence provided in reported incidents supports the conclusion that the use of strychnine for the control of RGS poses environmental risks. Results from several of the studies that were considered for this assessment indicated various reasons why poisoning of non-target organisms resulting from strychnine use may be significantly underreported. Scavenging of dead carcasses, such as ground squirrels and ring-necked pheasants, from fields was reported to be high (62–86% of deliberately placed carcasses) and occurred within a few days. Thus, scavengers could quickly remove carcasses of dead animals from a field before being noticed. These studies also showed that attempted recovery by

researchers of deliberately placed carcasses in a field was low, indicating that many animal carcasses, if present in treated fields, may not be found and reported. Based on these findings, McKinnon et al., 2004 (PMRA# 3051152) estimated that thousands to tens of thousands of songbirds may be poisoned by strychnine each year that it is used. Proulx (2010)⁶ had also discussed the potential for underestimation of non-target poisonings.

Therefore, based on the expected low search efficiency of people to retrieve carcasses (either during a planned research project or routine surveillance of treated fields by applicators) and high estimated scavenging rates by animals, it is possible that a large number of carcasses could go undetected, thus underestimating the impact of strychnine on non-target mortalities. These issues were also noted in the more recent study by Proulx (2010)⁶.

2.4 Comments related to the incorporation of integrated pest management strategies in the proposed re-evaluation decision

Comments from the Saskatchewan Ministry of Agriculture suggested that the proposed re-evaluation decision for strychnine use on Richardson's ground squirrels did not sufficiently consider the efforts of the Alberta and Saskatchewan provincial governments to implement RGS Stewardship Programs in 2011, which, among other things, attempted to promote the incorporation of IPM strategies to help control RGS.

Health Canada Response

Health Canada recognizes the efforts of the Alberta and Saskatchewan provincial governments to educate purchasers of strychnine about the merits and implementation of IPM strategies. Health Canada considered the information in the reports that were provided by the provinces and considered the levels of implementation of the various IPM methods. After considering all available information for this risk assessment, Health Canada determined that IPM strategies using strychnine were either not sufficiently effective or practical for strychnine users and, as a result, do not adequately mitigate the risk to non-target organisms from the use of strychnine to control RGS.

2.5 Comment regarding development of Integrated Pest Management (IPM) Strategies

A comment was received from Team Alberta, the Municipal District of Pincher Creek Agricultural Service Board and the Rural Municipalities of Alberta suggesting that Integrated IPM Strategies and adequate mitigation measures need to be researched and developed.

⁶ Proulx, G. 2010. Field Evidence of Non-Target and Secondary Poisoning by Strychnine and Chlorophacinone Used to Control Richardson's Ground Squirrels in Southwest Saskatchewan. Proceedings 9th Prairie Conservation and Endangered Species Conference, February 2010, Winnipeg, Manitoba. (PRVD2018-13, PMRA# 2733770).

Health Canada Response

PACR2005-08 and REV2007-03 considered the ongoing work being conducted by a national expert group to promote and develop a pest management strategy for the control of Richardson's ground squirrels. The Richardson's Ground Squirrel Integrated Pest Management Steering Committee consisted of experts from producers, industry, researchers, provincial governments and Health Canada. The work proposed by this committee was to investigate appropriate IPM strategies and potential mitigation measures for the use of strychnine for RGS. Continued use of strychnine to control RGS was allowed as work on the RGS pest management strategy was continuing. Reports provided as a result of the work conducted by this expert group were ultimately reviewed and considered for the re-evaluation of strychnine to control RGS (PRVD2018-13) and the final re-evaluation decision.

Considering all available information, it was determined that existing mitigation measures cannot adequately address the risks to non-target organisms. As a result, Health Canada has concluded that the environmental risks associated with the use of strychnine for the control of RGS were not shown to be acceptable when used according to label directions and that no further mitigation measures can be implemented that are feasible to users of the product.

2.6 Comments regarding use of chlorophacinone as an alternative to strychnine

2.6.1 The Saskatchewan Cattleman's Association commented that chlorophacinone, suggested as an alternative to strychnine, has also been responsible for non-target species deaths.

Health Canada Response

Health Canada acknowledges that chlorophacinone has also been shown to cause non-target poisoning when used to control RGS. All registered pesticides must be regularly re-evaluated by Health Canada to ensure that they continue to meet current health and environmental safety standards. The re-evaluation of chlorophacinone is scheduled to be initiated in 2021–2022.

2.6.2 The Saskatchewan Ministry of Agriculture cited a paper by Elliott et al., 2016 (PMRA# 3075667) that stated that chlorophacinone and diphacinone tend to persist and accumulate in the body, which has led to widespread contamination of terrestrial predators and scavengers.

Health Canada Response

The paper by Elliott et al., 2016 (PMRA# 3075667), that was cited by the Saskatchewan Ministry of Agriculture, focuses on second-generation anticoagulant rodenticides (SGARs). There are no SGARs registered to control RGS. Chlorophacinone is a first-generation anticoagulant rodenticide (FGAR) that is not as persistent or bioaccumulative as the SGARs. The quotation cited by the Saskatchewan Ministry of Agriculture regarding “their tendency to persist and accumulate in the body” that “has led to the widespread contamination of terrestrial predators and scavengers” has been misattributed to chlorophacinone and was actually referring to other uses of SGARs.

Chlorophacinone is not mentioned in the Elliott et al., 2016 (PMRA# 3075667) paper. Diphacinone is also a FGAR and is not registered for use in Canada to control RGS. It is, therefore, not an alternative to strychnine.

2.7 Comments regarding species at risk

The Saskatchewan Ministry of Agriculture commented that the concern for species at risk is unwarranted as the current use restrictions on the label are adequate and these products are generally not used in areas where species at risk tend to frequent.

Health Canada Response

Species at risk such as the burrowing owl (*Athene cunicularia*) and the swift fox (*Vulpes velox*) are known to inhabit western prairies and grasslands and feed on various smaller animals such as RGS. The 2% Liquid Strychnine Concentrate label states that use of strychnine in any areas where species at risk are known to frequent is not permitted. Although species at risk are monitored by provincial authorities, some overlap may occur between fields where strychnine is being applied and areas where species at risk are expected to inhabit. The potential risk to all non-target species, including those designated as “at risk”, were considered for this review using a weight-of-evidence approach. In other words, the potential risk to species at risk was only one of many factors that were considered for the final re-evaluation decision for strychnine use to control ground squirrels.

2.8 Comment regarding the citation of James et al. (1990) in PRVD2018-13

The Saskatchewan Ministry of Environment commented that Health Canada miscited James et al., 1990 (PMRA# 3075616) in PRVD2018-13 by writing “...strychnine-killed ground squirrels may have an impact on the health of owls.”

Health Canada Response

James et al., 1990 (PMRA# 3075616) evaluated the potential impact of the use of strychnine-coated grain to control RGS on breeding burrowing owls in southern Saskatchewan during 1988. The study found that adult owl survival, breeding success (percent of pairs producing at least one chick), number of chicks produced per successful nest or nest attempt, and chick weights were not significantly different between eight operationally poisoned and seven control pastures. However, the study also found that adult owl weights were significantly higher on the control pastures indicating a possible sublethal effect. Other potential sublethal effects were not investigated.

Health Canada acknowledges that the conclusion based on James et al., 1990 (PMRA #3075616), as cited in PRVD2018-13, should be amended as follows (see **bold**): As burrowing owls nesting in agricultural fields may adopt a specialized diet centred on an abundance of poisoned ground squirrels (Moulten et al. 2005⁷) and considering that information indicates that the burrowing owl may also feed on dead animals (Coulombe, 1971⁷), strychnine-killed ground squirrels may have an impact on the health of owls **in the longer term** (James et al., 1990).

3.0 Comments Related to the Value Assessment

3.1 Comments relating to strychnine efficacy and lack of viable alternatives

Comments were received from Saskatchewan Ministry of Agriculture, crop and livestock associations, municipalities, and farmers relating to how strychnine is the most effective means to control RGS. The alternatives and IPM strategies are ineffective, not available, impractical, or dangerous.

Health Canada Response

Health Canada acknowledges the value of strychnine to agricultural users because it is easy to use, cost effective and kills RGS in a single feeding. There are several registered alternatives to strychnine available to users and it is also recognized that the alternatives have their limitations. However, the primary mandate of Health Canada is to prevent unacceptable risk to individuals and the environment from the use of pest control products. The *Pest Control Products Act* requires that pesticides have acceptable risk in order to stay in the market. After a scientific review of available information, Health Canada has concluded that the environmental risks associated with the use of strychnine to control RGS were not shown to be acceptable.

3.2 Comments relating to additional research into Richardson's ground squirrel control

Comments were received from livestock associations and municipalities that more research is needed in developing a single feed anti-coagulant bait and IPM strategies.

Health Canada Response

Health Canada encourages grower groups to contact the registrants of potential alternative products, Agriculture and Agri-Food Canada (AAFC), and their provincial representatives to discuss the possibility of pursuing further research into RGS control.

3.3 Comments relating to competitiveness with other countries

Comments were received from crop and livestock associations indicating that growers need strychnine to manage RGS problems that threaten to damage crops and livestock in order to remain competitive with other countries.

⁷ Proulx, G. 2010. Field Evidence of Non-Target and Secondary Poisoning by Strychnine and Chlorophacinone Used to Control Richardson's Ground Squirrels in Southwest Saskatchewan. Proceedings 9th Prairie Conservation and Endangered Species Conference, February 2010, Winnipeg, Manitoba. (PRVD2018-13, PMRA# 2733770).

Health Canada Response

Health Canada acknowledges the importance of producers being competitive with other countries and recognizes the need for pest control products that are effective, but do not pose unacceptable risks to human health or the environment.

Appendix III List of Respondents to PRVD2018-13

List of respondents' affiliations in terms of comments submitted in response to PRVD2018-13.

Category	Respondent
Agricultural	Canadian Cattlemen's Association
Agricultural	Saskatchewan Stock Growers
Agricultural	Agricultural Producers Association of Saskatchewan
Agricultural/Registrant	Saskatchewan Association of Rural Municipalities
Agricultural	The Association of Alberta Agricultural Fieldmen
Agricultural	Team Alberta comprised of Alberta Barley, Alberta Canola, Alberta Pulse Growers and Alberta Wheat Commission
Agricultural	Alberta Beef Producers
Agricultural	Canadian Canola Growers Association
Agricultural	Saskatchewan Cattlemen's Association
Agricultural	Grain Growers of Canada
Agricultural	Agricultural Service Board of Lethbridge
Agricultural	Agricultural Service Board Special Area No. 4
Municipal	Municipal District of Willow Creek Agricultural Service Board
Municipal	Municipal District of Bonnyville No. 87
Municipal	Municipal District of Wainwright No. 61 and its Agricultural Producers
Municipal	County of Warner No. 5
Municipal	Municipal District of Pincher Creek Agricultural Service Board
Municipal	Municipal District of Wainwright No.61
Municipal	County of Vermilion River
Municipal	Vulcan County
Municipal	County of Newell
Municipal	Rural Municipalities of Alberta
Municipal	Lamont County, Agricultural Service Board
Municipal	Wheatland County, Agricultural Service Board Chairman
Government	Member of Parliament Battle River - Crowfoot
Government	Saskatchewan Ministry of Agriculture
Non-government organization	Animal Alliance of Canada
Non-government organization	Wolf Awareness Inc.
Non-government organization	Humane Society International/Canada
Non-government organization	Alberta Wilderness Association
Non-government organization	University of Calgary
General public	Members of the general public

Appendix IV References Considered Following Publication of PRVD2018-13

Note that the following includes only references that were not previously considered in PRVD2018-13.

A. Information Considered in the Updated Environmental Assessment

Additional Information Considered

Published Information

PMRA Document Number	Title
3052704	Bourne, J. B., Roy, L. D., Hiltz, M., Merrill, P. N., & Hoffmann, W. 2002. Strychnine baits to control Richardson's ground squirrels: an old story, a new twist. In <i>Proceedings of the Vertebrate Pest Conference</i> (Vol. 20, No. 20, pp. 11-16).
3075611	Schmutz, J. K., Rose, K. A., & Johnson, R. G. 1989. Hazards to raptors from strychnine poisoned ground squirrels. <i>J. Raptor Res.</i> 23(4): 147-151.
3075616	James, P. C., Fox, G. A., & Ethier, T. J. 1990. Is the operational use of strychnine to control ground squirrels detrimental to burrowing owls?. <i>J. Raptor Res.</i> 24(4): 120-123.
3075652	Marsh, R. E., Schmidt, R. H., & Howard, W. E. 1987. Secondary hazards to coyotes of ground squirrels poisoned with 1080 or strychnine. <i>Wildl. Soc. Bull.</i> 15: 380-385.
3075667	Elliott, J. E., Rattner, B. A., Shore, R. F., & van den Brink, N. W. 2016. Paying the pipers: mitigating the impact of anticoagulant rodenticides on predators and scavengers. <i>BioScience</i> 66: 401-407.

Unpublished Information

PMRA Document Number	Title
3027442	Tansey, J. A. 2019. Evaluation of Strychnine Baiting on Richardson's Ground Squirrel, <i>Uroditellus richardsonii</i> , Control and Effects on Non-Target Organisms. Saskatchewan Ministry of Agriculture. 26 pages.
3051149	McKinnon, D., Wilk, C., & Mineau, P. 2001. Potential for primary poisoning of non-target species from the use of strychnine-treated wheat bait to control Richardson's Ground Squirrels. Unpublished Report.

PMRA Document Number	Title
3051152	McKinnon, D. & P. Mineau. 2004. Effectiveness and non-target impact of zinc phosphide and various concentrations of strychnine in controlling Richardson's Ground Squirrels in Saskatchewan. Unpublished Report.
3051153	McKinnon, D., Wilk, C., & Mineau, P. 2002. Potential for secondary poisoning from the use of 2% strychnine-treated wheat bait to control Richardson's Ground Squirrels. Unpublished Report.