

A STUDY OF ATTITUDES PERTAINING TO THE RICHARDSON'S GROUND
SQUIRREL

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Abstract

Ecologically, Richardson's ground squirrels comprise and uphold a major part of the prairie ecosystem. However, from a societal perspective, many residents of the prairies view them as nothing more than 'pests' in need of eradication. The focus of this research is on attitudes, knowledge, and public support for specific management strategies in relation to Richardson's ground squirrels. Measuring human attitudes about wildlife is a growing field of study that can provide important information to resource management personnel.

Surveys were administered to rural residents, urban residents, and grade 12 high school students residing in Lethbridge, Alberta or within a 60-km radius of the city. Urban people had a significantly more positive overall attitude score than rural people. Rural people had a significantly higher knowledge score than urban residents. Rural people supported lethal management practices in all areas listed whereas urban people more often supported alternative management practices such as capture and relocation or the introduction of predators. Both urban and rural people believed that overpopulation of Richardson's ground squirrels and the depletion of crops caused by Richardson's ground squirrels were serious problems. Overall, rural people perceived problems caused by Richardson's ground squirrels to be more serious problems than did urban residents.

Results provide information for decision-makers and highlight areas where education might focus. In addition, a baseline of existing attitudes toward Richardson's ground squirrels is created against which future change in attitudes or knowledge can be measured.

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CHAPTER 1

Introduction

1.0 Introduction

The measurement of attitudes and values dealing with environmental matters and nature and the relationship between these values and "pro-environmental" intentions and behaviours has received attention in environmental management and policy making (e.g., Shindler, List & Steel, 1993; Vaske & Donnelly, 1999). Understanding the relationship between attitudes and factors that influence attitudes can provide a framework for improving public attitudes toward the environment. Some of the reported dependent factors that influence attitudes are motives, values, feelings, and the context of the situation (Corraliza & Berenguer, 2000; Gagnon Thompson & Barton, 1994).

Attitudes and values studies are based conceptually on the assumption that attitudes predispose individuals to behave in certain ways. That is, attitudes, which are shaped by a person's value orientations, in turn shape behavioural intentions and actual behaviour. In an environmental context, research has examined value orientations and attitudes such as those toward wildlife (Bath, 1988; Edgell & Nowell 1989; McNaught 1987; Zinn & Andelt 1999) and correlated these measures to behaviours such as water conservation (de Oliver 1999), environmental activism (Steel 1996), and hunting (Bjerk, Reitan, & Kellert, 1998). Attitudes are often important indicators of specific behaviours (Vaske & Donnelly, 1999).

Certain animals are perceived as a threat to agriculture and to public health, leading them to be labelled as pests (Van Vuren, Kuenzi, Lored, Leider, Morrison, 1997). Various species are given the label of pest regardless of the fact they were present long before European settlement. Among other factors, this thesis examines why a particular animal species of the prairies is considered to be a pest even though it is a key contributor to the ecosystem it occupies. Indigenous agricultural pests in Alberta, as defined by Alberta Agriculture, include: black-billed magpie (*Pica pica*), coyote (*Canis latrans*), and field rodents (Bourne, 1989). One of these rodents is the Richardson's ground squirrel (*Spermophilus richardsonii*) (RGS), referred to colloquially as a "gopher". Since European settlement of the Canadian prairies, Richardson's ground squirrels have been considered a nuisance animal at the very least and a pest by many (Palmateer, 1989). This label was bestowed upon the animal because of a number of factors, including socially constructed subjective beliefs and perceived problems, such as economic competition with humans for agricultural land and crops. RGS may be one of the most misunderstood and controversial species on the prairies.

1.1 Objectives and hypotheses

"[T]he common human conclusion that some things are ultimately unexplainable is less easily accepted by scientists" (Babbie, 1995, p. 37).

The main objective of this research is to increase our understanding of the values, attitudes and behaviours of southern Albertan people toward Richardson's ground squirrels. A secondary objective is to evaluate people's knowledge of Richardson's

ground squirrel ecology and biology using value-attitude-behaviour theory and to apply evaluative methodology used in norm theory research. The value orientation concept is used to explain results. Also, management preferences of people who share their environment with RGSs are studied. This is a unique contribution to the essential and expanding field of human-wildlife interactions (Vaske & Manfredi, 2002) because it is the first exploration of attitudes in relation to RGSs.

The literature indicates a host of correlations between demographic and other factors and attitudes toward wildlife; these findings provide the basis for development of the hypotheses for this study (see literature review). The hypotheses of this research are:

- Rural people will perceive RGSs more negatively, as more of a problem and support lethal management practices more often than urban people.
- Generally, women will be more tolerant of RGSs, holding more positive attitudes toward them and being less supportive of lethal management, than men.
- Students will hold a more pro-environmental orientation resulting in more positive attitudes and will support alternative management practices more than the adult population.
- Rural people and those with agricultural experience will have greater knowledge of RGS biology than will urban people and those without agricultural experience.

1.2 Outline of Thesis

The introductory chapter (chapter one) reviews factors that contribute to labelling wildlife as pests and the conceptual framework upon which this thesis is based. To fully appreciate the problem at hand, elaboration on what constitutes a pest, and a review of literature on attitudes and human perceptions toward wildlife is needed. Furthermore, issues related to problem animals and management, current management methods, and RGS biology and its role in the ecosystem are explored. A general synopsis of the biology of the Richardson's ground squirrel is then provided. The purpose is to introduce basic information essential to an understanding of this study and to provide some background to the development of the knowledge section of the questionnaire.

Fascinating and more detailed information regarding the biology of the RGS can be found elsewhere (Michener, 1998; Michener & Koepl, 1985) but is beyond the scope of the study presented here. Chapter two presents the methodology for this study, reviewing the development of the questionnaire and its administration, including the sampling procedures. Chapter three contains the results, which are organized in sections according to demographic variables of location of residents (urban-rural), gender, agricultural experience, and age (adult-student). Chapter four consists of the discussion of results in light of the selected theories, suggestions for future management of RGSs, and suggestions for future research.

1.3 New paradigm in wildlife management

The Richardson's ground squirrel is of special interest because it is a controversial species, believed by some to be ecologically important but by others to be an overpopulated pest. Researchers place beliefs alongside core values if they are enduring and strong (Vaske & Donnelly, 1999). Value orientations such as protectionism, utilitarianism, and eco-centrism are a pattern of basic beliefs. Protectionist-oriented stakeholders may be interested in how many individuals exist in a given population and how the animals are treated (Zinn, Manfredi, Vaske & Wittmann, 1998), whereas utilitarian-oriented stakeholders may be interested in decreasing or even eliminating RGSs. A variety of interest groups with different value orientations are becoming more organized and demand involvement in decision-making regarding wildlife (Wittmann, Vaske, Manfredi & Zinn, 1998).

Wildlife management has shifted from an anthropocentric biological basis to a new paradigm that includes additional social and ecological factors. The underlying belief is that wildlife conservation cannot be studied without incorporating human influence. An interdisciplinary combination of social psychology, wildlife management, and conservation biology has contributed to a younger field of study referred to as human-wildlife interactions. The paradigm shift has resulted from the realization that social science is an important part of wildlife management because biology alone does not provide a holistic view of specific issues facing wildlife management personnel.

The study of values, behaviours and attitudes is considered a field of social psychology because the theories stem from previous research in this social science, such as norm theory and the value orientation continuum. According to Edgell and Nowell (1989) “aspects of wildlife management must rest on a sound understanding of people’s beliefs, values, and attitudes” (p. 286). This statement implies that the public plays a vital role in any management strategy because policy and conservation efforts rely on public support (politically and financially). Social perspectives affect wildlife management so the public should be involved in assessing, planning and implementing management strategies. In the past, wildlife management focused on biological information and on “expert” decision makers instead of on public opinion (Wittman, Vaske & Sikorowski, 1995). Seeking public input is likely to result in more efficient and functioning management initiatives. As discussed in the following segments of this thesis, the way in which people view wildlife will have an impact on tolerance levels and outcomes of increasing human-wildlife interactions and on the success of specific management plans.

1.3.1 Attitudes - The conceptual framework

“Watch your thoughts; they become words. Watch your words; they become your actions. Watch your actions; they become your habits. Watch your habits; they become your character. Watch your character; it becomes your destiny.” (Outlaw, 2000)

The conceptual framework of this research is rooted in value, attitude and behaviour theory, in particular the “inverted pyramid” of values, attitudes and behaviours (Fishbein & Ajzen, 1975; Vaske & Donnelly, 1999).

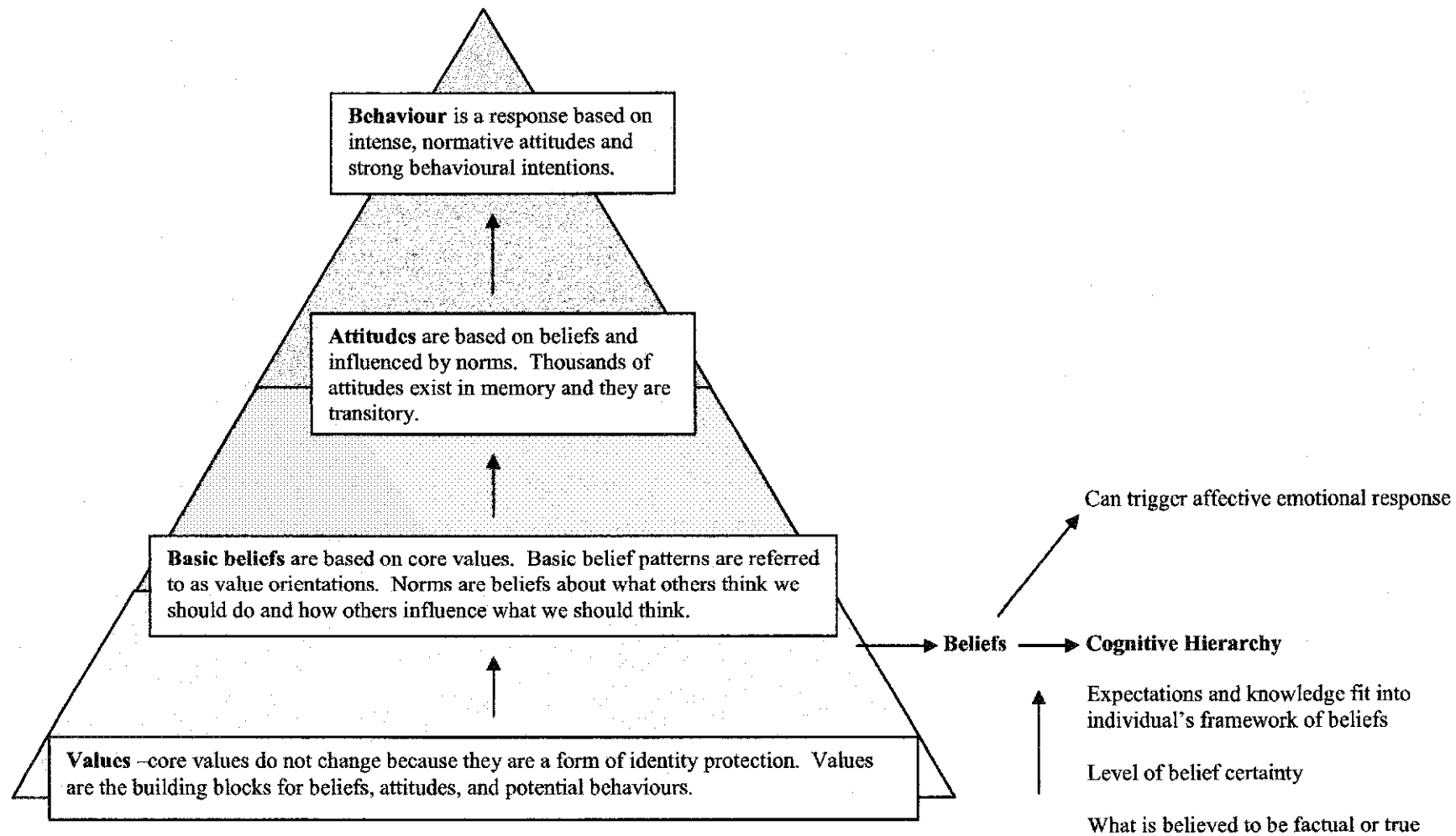


Figure 1: Value-attitude-behaviour inverted pyramid (Fishbein & Ajzen, 1975; Vaske & Donnelly, 1999).

This theory suggests that values, which are at the base of the pyramid, influence attitudes, and attitudes predispose individuals to behave in certain ways (Figure 1). Core values and beliefs influence higher order concepts such as attitudes, and a series of salient beliefs can be seen as a part of attitude formation (Pouta & Rekola, 2001). Values are the basic building blocks that often guide behaviour. Furthermore, beliefs provide explanations for attitudes. Although values are not directly explored in this study, the theory is used to explain existing relationships between attitudes and reported behaviours for certain demographic groups. The social construction of attitudes toward wildlife is a secondary concept. Social constructionism suggests that the way in which we value, perceive and treat (manage) animals is primarily influenced by our social and cultural understandings.

Norms are beliefs about what is appropriate, and norm theory is often used to evaluate behaviours, management, or policies (Vaske, Shelby, Graefe, & Herberlein, 1986). The evaluative dimension of an act is an important way to describe norms (Jackson, 1965). In this study, norm theory underpins “the distribution of feelings of approval and disapproval by a particular set of others for a given Actor, situation and behaviour dimension” (Jackson, 1965, p.309). Similarly, attitude and belief theories are based on two important predispositions: the strength of the belief about something and the evaluative aspect (positive, neutral, negative) of those beliefs (Fishbein, 1965). For example, salient beliefs are the most prominent beliefs a person holds; these are based on information that is important to the person at a given time (Tesser & Shaffer, 1990).

The conditions created by behaviour or evaluation of specific behaviours can be used to define norms (or standards) that range from acceptable to unacceptable. In order to explore norms empirically, individual responses to behaviour, attitudes, or knowledge are collected and then responses are compared across various groups. Use of the norm theory has been widely used in research in areas such as management of wildlife (Whittaker, 1997) and in cultural studies (Jackson, 1965).

Brooks, Warren, Nelms, & Tarrant (1999) state that “*important* attitudes are more likely to predict behaviour” (p. 1095). Important, or salient, attitudes are defined as those that are resistant to change, last over time, and are capable of guiding behaviour. Strong attitudes are more likely than weak ones to lead to active agreement with or objection to an issue. In their review of attitudes and attitude change, Tesser and Shaffer (1990) state the “best predictor of behaviour is intention. Behavioural intentions, in turn, are said to be a function of one’s attitude toward the behaviour of one’s subjective norms” (p. 489). Intention predicts behaviour fairly accurately. Their review indicates that behaviour is guided by automatically activated attitudes and that attitudes may guide behaviour without individuals intending them to or being aware of their influence. Generally, if people hold strong beliefs regarding an issue it is difficult to change their beliefs, even if compelling information contradictory to those beliefs is presented. Beliefs and opinions are strengthened by personal experience. Similarly, those who feel they possess expertise in an area are less likely to accept information that goes against their beliefs.

Attitudes may be influenced by factors such as prior experiences and socialization (Donnelly & Vaske, 1995). For example, previous research suggests that demographically young, educated women from urban centres are most likely to be eco-centric, animal rights oriented, and humanitarian (Layden, Manfredi, & Tucker, 2001; Vaske et al., 2001; Zinn & Pierce, 2002). I fit into this demographic and my personal philosophy also reflects this stereotype.

Previous researchers have used value orientations to place values into context by arranging core values into categories (Zinn, Manfredi, & Barro, 2002) or to describe human relationships with wildlife on a continuum. On one end of the continuum lie extreme utilitarian value orientations which are described as “endorsing human use and manipulation of wildlife” (Zinn et al., 2002, p. 148) and on the other end lie extreme protectionist value orientations that “[oppose] human use and manipulation of wildlife and [endorse] human protection of wildlife” (Zinn et al., 2002, p. 148). Vaske, Donnelly, Williams, & Jonker (2001) used the value-orientation continuum to predict normative beliefs about national forest management. Normative beliefs are an individual’s evaluations about what is appropriate in certain situations (Zinn et al., 1998). My study explores whether management preferences for RGSs are preservation (e.g. relocation), alternative (e.g. predator introduction), or lethal (e.g. poison, shoot) oriented and some of the underlying attitudes and potential explanations for these particular orientations.

1.3.2 Limitations of attitude theory

Value-attitude-behaviour theory is controversial because not all research supports the position that attitudes shape actual behaviour. Steel (1996) conducted a study on environmental behaviour and found that attitude is correlated with *self-reported* environmentally-oriented behaviour. Actual behaviour does not always follow self-reported environmentally conscious attitudes or behaviours. In studying water conservation attitudes, de Oliver (1999) found that conservation has become a socially desirable term. When attitudes were measured using a survey, affirmative responses were found, but once an actual conservation policy was implemented, participation (i.e., behaviour) rates were very low. On the other hand, researchers using the hierarchical value-attitude-behaviour model to predict wildland preservation voting intentions found attitude did predict behavioural *intentions* (Vaske & Donnelly, 1999). To clarify, actual behaviours are behaviours directly observed or measured by the researcher, self-reported behaviours are actions reported by the respondent, and behavioural intentions are behaviours that the respondent intends to engage in.

1.3.3 Role of Knowledge

Arcury (1990) found a direct significant positive relationship between environmental knowledge and environmental attitude, indicating that more knowledge results in a more positive environmental attitude. However, this positive correlation is not found for specific wildlife species that are negatively perceived. For example,

increased knowledge levels of the ecology of black-tailed prairie dogs (*Cynomys ludovicianus*) did not translate into a positive attitude toward the species (Zinn & Andelt, 1999).

Lee and Henderson (1989) found that, in Kansas, 5% of people with black-tailed prairie dogs on their land considered them ecologically important whereas 18% of the general public felt this way. In a related study, every rancher considered prairie dogs to be a pest (Reading & Kellert, 1993). Many ranchers opposed prairie dogs and black-footed ferrets (*Mustela nigripes*), the vast majority, even those supporting black-footed ferret reintroduction, were opposed to sustaining prairie dogs on their land. These results indicate that people may not understand that black-footed ferret reintroduction efforts will not succeed if prairie dog colonies are not protected because black-footed ferrets require prairie dogs for food and their burrows for shelter. It seems that public attitudes reflect a misunderstanding of prairie ecosystem function and relationships. The majority of the Kansas population with prairie dogs on their land reported using fumigants as a management technique which is also detrimental to black-footed ferrets (Lee & Henderson, 1989).

1.3.4 Social constructions of wildlife

As Babbie (1995) pointed out, “[m]uch of what we know, we know by agreement rather than by experience” (p. 36). A key aspect of my conceptual framework is that social construction of wildlife, rather than actual experience of wildlife-human interactions, is what shapes attitudes. That is, attitudes are formed through socially

reinforced understandings. For example, Stout, Stedman, Decker, and Knuth (1993) found that the awareness gained from local sources of information, rather than actual personal experience, of increased human-deer interactions led to an increase in perceived problems.

Social constructions are complex and important in shaping beliefs. A study of the black-footed ferret provides an illustrative example. Ranchers disliked black-footed ferrets and black-tailed prairie dogs and considered them both to be pests even though the black-footed ferret is on the brink of extinction and kills black-tailed prairie dogs (Reading & Kellert, 1993). Almost 100% of ranchers agreed with controlling or reducing prairie dog numbers even though they provide food and habitat for the highly specialized black-footed ferret. The study consisted of moralistic, humanistic, and naturalistic questions assessing value orientation toward wildlife. Ranchers that participated in the study scored lowest on moralistic, humanistic, and naturalistic/ecology based questions. The ranchers held a pattern of hostility toward ferrets and prairie dogs and viewed them as ecologically and ethically unimportant. Ranchers also expressed the strongest beliefs in individual rights and freedoms, and in subordination and control of wildlife and wildlife habitat. On the other hand, the general public with high scores on moralistic, humanistic and naturalistic/ecology-based scales were most supportive of ferret reintroduction. In another study that questioned people's wildlife viewing preferences, respondents were least interested in seeing prairie dogs out of 10 animals listed (6 mammals, 4 birds) (Wittmann et al., 1995). One might expect, given that a similar social and ecological milieu exists for the RGS as for the black-tailed prairie dog, that a rural

population would display similar attitudes and lack of ecological understanding toward the RGSs. These studies suggest that beliefs about particular species are shaped by social interactions between members of certain communities.

1.3.5 Value orientations between different populations

Zinn et al. (2002) suggested that overall societal value orientations are shifting from utilitarian to protectionist. Typically respondents who grew up in rural areas, lived in one state their entire lives, and had less than a post-secondary education held similar utilitarian-based basic beliefs (Vaske et al., 2001). On the other hand, I would speculate that the current generation of rural students has access to higher levels of education and more mobility than previous generations leading to exposure to different ideologies and to people from diverse backgrounds. These diversified experiences might translate into acquisition of different ideologies, which the young adults might bring back into rural communities. Also, the shift toward protectionist value orientations may be partially explained by migration into some desirable rural areas by urban dwellers (Jones, Fly, & Cordell 1999). Generally, urbanites hold protectionist value orientations in comparison to rural populations.

Demographic characteristics, such as type of occupation or rural versus urban residency, have been found to contribute to shaping perceptions of particular species. For example, livestock and poultry farmers cited coyotes as the animal most responsible for losses of agricultural products (Wywiałowski, 1994), whereas wildlife specialists

perceived ground squirrels (*Spermophilus* spp.) and prairie dogs (*Cynomys* spp.) to cause the most agricultural damage (Conover & Decker, 1991). Sheep and cattle producers held negative attitudes toward wolves (*Lupus canis*) even though this attitude is inconsistent with documented damage and livestock predation. Very little, if any, predation damage can be attributed to wolves but historical and social constructs of the wolf may have ingrained this ideology (Kellert, 1985). Social construction of wolves is not based on direct experience of their predatory habits, but rather on socially constructed beliefs. Also, farmers viewed the most visible and numerous species, sandhill cranes (*Grus canadensis*), as causing the most damage even when the species had little or no impact on the crop. Danger to humans is another variable that affects the way in which an animal is valued. Perceived, not actual, deer-related vehicle accidents were negatively correlated to preferences toward deer population sizes (Stout et al., 1993). The more people believed that deer-related vehicle accidents were prevalent, the lower number of deer they tolerated.

Rural-urban bipolar value orientations (utilitarian-protectionist) are also evident in relation to agricultural employment. Those employed in agriculture were less inclined to support protection of additional wildlife habitat, whereas those employed outside of agriculture were more likely to support the idea (Layden et al., 2001). Although, generally, urban area users held positive attitudes toward wildlife and wanted to learn more about them, prairie dogs and coyotes were still considered a moderate to extreme problem most often out of ten animals listed (Wittmann et al., 1995). Previous studies found that farmers have a lower tolerance level of wildlife presence than hunters (Zinn,

Manfredo, & Vaske, 2000). These results form the basis of another hypothesis in my study: rural people hold more negative attitudes and view RGSs as causing more serious problems than do urban people.

Perceptions toward wildlife differ between those exposed to farming activity and those with no farming experience. In one study, farmers rated levels of damage by wildlife species as more severe than did non-farmers (McIvor & Conover, 1994). Negative attitudes toward deer were most prevalent among fruit farmers when compared to other farmers, even though fruit farmers may mistakenly blame deer for damage caused by other wildlife (Decker & Brown, 1982). Compared to other farmers, fruit farmers attributed more monetary damage to deer and this affected their attitudes. They considered deer a nuisance that caused severe damage, even if they had not experienced the damage themselves, and preferred a decrease in overall population levels. It appears that these attitudes were socially reinforced through information exchange in the fruit-farming community. On the other hand, if feeding on crops by deer was not excessive, farmers (not exclusively fruit farmers) even supported an increase in deer populations (Brown & Decker, 1979). Based on this review, predominant differences between those with farming experience and those without farming experience were predicted to exist in my study.

Gender research on value orientations shows that women are more concerned about animal welfare than men and that women are more likely to oppose lethal management methods (Lauber, Anthony, & Knuth, 2001). In Alaska, more male than

female respondents favored baiting black bears as a hunting technique (Miller, Miller, & McCollum, 1998). Explanations for protectionist orientations in women vary from socialization arguments (Ozanne, Humphrey, & Smith, 1999) to moral arguments because women are the traditional caregivers (Lauber et al., 2001). However, the current model of wildlife management rests on male-based value orientations because most resource management personnel, holding high ranking wildlife management positions, are men (Davidson & Black, 2001). These findings indicate that women respondents in my study should be more protectionist in their management orientation than men.

In their literature review, Zinn et al. (2002) suggested that the patterns of values in family groups are similar. I surveyed students from small-town schools (rural) and city schools (urban) as well as adults from the city and surrounding farms to gain a better understanding of the differences and similarities between the younger and older generations. Although values may be imprinted within a family group, children have access to more education than their parents and an increase in urbanization between generations has occurred (Manfredo & Zinn, 1996). Generally, a shift from utilitarian to protectionist value orientation has occurred, so values and attitudes toward RGSs of younger rural respondents may be more preservationist oriented than those of older rural respondents.

Socialization and demographics play an important role in forming values, attitudes, and eventually behaviours toward animals. Kellert (1985) found that the wolf, coyote, and rattlesnake (*Crotalus* spp.) are among the animals least liked by the general

public. Those who reported positive attitudes toward the wolf were younger, more educated, and more knowledgeable about the animal. "Variations in norms and customs are often influenced by demographic and geographic factors" (Reading & Kellert, 1993, p. 571). For example, in Alaska, people were willing to pay more for a trip to view a brown bear (*Ursus arctos*) than to view other wildlife (Miller et al., 1998).

Conover and Decker (1991) found a growing consensus among U.S. citizens that overall damage to crops by wildlife has increased in the last 30 years. However, overall tolerance levels have shifted from negative to positive since the 1800s, when attitudes were considerably more negative toward predators (Kellert, 1985). The aforementioned examples illustrate that the symbolic value of a certain species and the species' image and perceived abundance influence the attitudes held by people toward it. The symbolic value and image are based on socially reinforced understandings.

More non-farmers than farmers prefer non-lethal methods of management (McIvor & Conover, 1994). As human-animal interactions increase, support for invasive (e.g., killing, trapping, relocating) management practices also increase (Locker, Decker & Schwager, 1999). Kellert (1985) found that the general public objected to the use of poisons and to shooting and trapping coyotes to control predation, whereas sheep and cattle producers felt that as many coyotes as possible should be shot or trapped and agreed with the use of poison. The general public favoured targeting individual offending animals only. The implication for my study is that rural populations or those

with agricultural experience who interact more with RGSs should be more likely to support lethal management practices.

1.3.6 Methods used in attitude research

In human-wildlife research, it is imperative to collect data on public sentiment. In social research, demographic information such as gender or age is sometimes used to make predictions regarding support for certain wildlife management initiatives. Donnelly & Vaske (1995) suggest that demographic indicators are not precise enough in wildlife management research to be used to generalize to the population and to make decisions based on those generalizations. What is needed is to focus on current controversial wildlife management issues and to ask the general public about these issues specifically instead of predicting their beliefs based on previous demographic findings.

Researchers have focused on measuring value orientations toward natural resources and have argued that these values can be aligned on a spectrum ranging from anthropocentric to biocentric (Vaske & Donnelly, 1999). Others argue that such linear, unidimensional measures are a poor attitudinal measure because attitudes of individuals are often ambiguous and even contradictory toward a particular issue and that a variety of factors contribute to attitude formation that cannot be placed on a simple linear spectrum (Macnaghten, 1995). The main criticism of unidimensional models is that simply measuring affective orientations is not sufficient to describe or ascertain attitudes, which are comprised of more than just the affective domain (Chaiken & Stangor, 1987). On the

other hand, multidimensional models which consider affective, cognitive, and behavioural components are deemed inaccurate by some because behaviour does not always follow attitudes and needs to be studied separately. Chaiken and Stangor (1987) provide a review of literature in which the multidimensional model has been found to be predictively valid. It seems that the best choice of model likely depends on the specific type and aims of the research being conducted. Further literature reviewed by Chaiken and Stangor (1987) suggests that unidimensional measures may be useful in research that is methodologically verbal or written, for example, surveys, whereas multidimensional measures are better suited for testing attitudes when the object (for example an animal) being evaluated is actually present. The unidimensional construct in this survey required, therefore, a self-administered pencil and paper survey.

Surveys, which play an important role in attitude-behaviour measurement and in the human-wildlife interaction literature, are cost and time effective (Dixon & Leach, 1978; Dixon & Leach, 1979). The self-administered survey method used in this study was chosen, in part, because of economic and time constraints and to reach a geographically dispersed rural population. The self-administered paper and pencil survey was the chosen format for this study because previous studies suggest that attitudes change depending on the presence of an audience (Chaiken & Stangor, 1987). To guard against this “audience effect”, individuals were asked to fill out the survey without discussing it with others until they were finished. Respondents were asked to evaluate several aspects of the controversial RGSs.

1.3.7 Norm Theory

The following mathematical measurements and terms from the norm theory developed by Jackson (1965) are utilized in the analyses made throughout this study. The norm for the attitude or behaviour in question is calculated using the mode, the most frequently chosen option for the population. The **intensity** of a norm is measured by finding the highest score below and above the neutral point of indifference. In this study, the average between responses of two populations was used to describe the intensity of the norm. I considered the beliefs and attitudes as more intense if one population compared to another displayed a high average. Intensity was also considered high if a population chose a particular option most frequently without choosing contradictory responses. Intensity was considered low if a population was split in agreement on a statement.

1.4 How many are too many?

Recent research in wildlife management suggests that a shift from considering individual species to a broader ecology-based outlook is taking place, however this varies geographically and demographically (Ninth International Symposium on Society and Resource Management, 2002). Historically, wildlife management concentrated on predators such as wolves that compete with humans for game or that prey on livestock. Alaskan voters continue to concentrate on predator management by agreeing with reduction of wolf populations and increasing moose and caribou numbers (Miller et al.,

1998). In addition, bears are reduced in some areas to increase moose populations but there is no documented evidence to suggest that this will increase moose numbers in these areas. From an ecological perspective, there is no need to increase ruminant numbers. Rather, social reasons guide this management objective because hunters value moose and want to increase their numbers in certain areas.

1.4.1 Socially based wildlife (over)population theories

Those espousing cultural and social carrying capacity concepts try to contextualize human-wildlife interaction, and the potential application of these concepts for this study is considered. McAninch (1993) suggests that the wildlife management literature has tended to focus on how many animals are “too many”, while neglecting to pursue how many are “too few”. Lower and upper socially acceptable population levels need to be determined for specific animal species so that management personnel can use this information to set specific educational or compatible conservation management objectives. In the case of RGSs, perceptions of how many are too few also need to be measured so that education can be tailored to inform the public of populations needed to increase or maintain the current ecological composition. It is important to recognize that public perceptions of population levels may not be based on biological or ecological information. For example, if RGSs are observed to be more populous one year than another, it may be an ecological response to predatory species numbers or to environmental processes but the public may perceive overpopulation as due to poor RGS management or increased crop availability for forage. Population levels preferred by the

public may not sustain the species in question or the species that are dependent on it. If public opinion regarding population levels of wildlife is to be considered, certain levels of knowledge regarding the biology of the species should be a prerequisite.

With difficulty, some researchers have attempted to apply the biological concept of carrying capacity to wildlife management. For example, one suggested way to identify overabundance of herbivorous species is to find the point at which vegetation and soil exhibit detrimental effects (Jewell, Holt, & Hart, 1981). Although the carrying-capacity concept originated in the biological field, social scientists have adapted it to suit an aspect of human dimensions of wildlife research by altering the carrying capacity concept to reflect social tolerance levels of certain numbers of animal species. The concept of a cultural carrying capacity (Ellingwood & Spignesi, 1986) suggests that humans tolerate a maximum number of animals due to socially constructed cognitive and affective (perceptions, values, beliefs, attitudes, preferences) and conative responses, rather than on objective biological and ecological information regarding the animal in question. Similarly, the wildlife acceptance capacity (WAC) concept developed by Decker and Purdy (1988) suggests that there is a maximum number of wildlife tolerated by humans. The tolerance threshold depends on specific situations and on the severity of the interaction. Tolerance levels of RGSs may have been surpassed due to a number of complex and interacting factors such as negative culturally influenced attitudes and perceived or experienced economic damage and health concerns. The social carrying capacity model slightly differs from the cultural carrying capacity by focusing on descriptive and evaluative components of the wildlife-human interaction instead of on

socially constructed perceptions, values, beliefs, and attitudes toward specific animal species. Evaluative components in this study include attitudes toward RGSs and the perceived levels of problems caused by RGSs. Understanding public perspectives is important even if people are misinformed or oppose environmental initiatives because the information gained can be used to build effective and functioning conservation programs.

1.5 What constitutes a pest?

The label of pest has been bestowed upon a wide range of animals from leopards (*Panthera pardus*) (Cobb, 1981) to the northern fur seal (*Collarhinus ursinus*) (Chapman, 1981). Wagner and Seal (1992) group the outcomes of animal actions that are perceived as negative world wide into several categories: agricultural damage, property damage, negative effects on positively viewed wildlife, alteration of ecosystems, direct attack on humans, and reservoirs and vectors for diseases. Two main themes suggested are explored in this research: economic competition and overabundance, and health threats to humans. RGSs are perceived locally (Lethbridge area) as overpopulated and as agricultural pests in need of management. Some concern over RGS colonies acting as disease reservoirs has also been expressed.

1.5.1 Economic competition and overabundance

Many marine mammals are perceived as pests due to their local abundance and because they compete with commercial fisheries for a common prey species (Harwood &

Lavigne, 1981). Humpback whales (*Megaptera novaeanglia*) which collide with fishing gear and are seen more often off the coast of Newfoundland than previously, are perceived to be abundant by the local people (Harwood & Lavigne, 1981). An increase in fishing activity has forced the whales away from scarce prey due to over-fishing and closer to shore where prey are more plentiful. The change in distribution of prey species brought on by human interference may explain this change in location where whales congregate, rather than the human perception that the species are overpopulated. Surprisingly, some animals perceived to be pests are also protected and include: polar bears (*Ursus maritimus*), sea otter (*Enhydra lutra*), and the Northwest Atlantic humpback whale (Harwood & Lavigne, 1981).

On a more local level, complaints regarding coyotes in Alberta became more common as cattle production became more prominent, resulting in an increase in animal-human and predator-livestock interactions thereby reinforcing their pest status (Bourne, 1989). There is limited literature about the interactions between humans and RGSs. Therefore, an analogous case of the black-tailed prairie dog, which is ecologically similar to the RGS, is used as a basis of comparison throughout this study. Although biological differences such as size, tendency to hibernate and some aspects of social grouping exist between the two species, they fulfill similar environmental roles and are therefore perceived and managed similarly by farmers and ranchers.

As with ground squirrels, an effort to exterminate prairie dogs in the arid grasslands of North America was a mechanism to reduce grazing competition with

livestock (Miller, Wemmer, Biggins & Reading, 1990). When comparing sites that did and did not contain black-tailed prairie dogs, Hansen and Gold (1977) found that cattle body weight did not significantly drop where prairie dogs were present. In fact, more species of annual and perennial plants occur within prairie dog colonies and some plants such as blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) are even more abundant, providing additional forage for cattle. Prairie dogs have also been found to improve herbage quality (O'Meilia, Knopf, & Lewis, 1982). Other researchers (e.g., Uresk, 1985) noted that the control of black-tailed prairie dogs may not result in a significant increase (or decrease) in forage production. Contrary to popular belief, scientific research shows that vegetation does not decrease with the presence of prairie dogs. Other research suggests that clippings from herbivorous activity are hard to attribute to one species (Bonham & Lerwick, 1976). Herbivorous activity of prairie dogs and cottontail rabbits looks very similar. Perhaps, species such as ground squirrels and prairie dogs may be incorrectly targeted as the main culprits of vegetative consumption.

The abundance of RGSs and the species palate for crops led to the belief that they present an economic threat to farmers because they over-multiply as a result of devouring crops (Banfield, 1974). Since European settlement, RGSs have adapted their diet to suit the dominant vegetation available to them, but current levels of crop consumption are unknown. For burrowing rodents such as prairie dogs, farmers overestimate herbivorous consumption rates (Miller, Ceballos, & Reading, 1994). These assumptions may be based on nothing more than the observable presence of RGSs in the field. Other animal species that are observed to be present in crop fields, such as the sandhill crane, have

been perceived as pests that deplete crops simply because of their observed presence (McIvor & Conover, 1994). Farmers perceived sandhill cranes to cause extensive damage and rated them as being the second worst pest, even though they only cause approximately 3% damage, mostly by trampling and crushing vegetation. Estimates of prairie dog vegetative consumption in an area is only 4 -7% of what cattle consume (Miller et al., 1994). It is unlikely that RGSs consume more than prairie dogs since they are smaller, uphold a similar environmental niche and hibernate for many months each year. RGS competition with humans for other vegetative resources and aesthetically pleasing areas, such as lawns, flowerbeds, and vegetable gardens, also contributes to their pest status. Urban views on RGSs may be more affected by questions on areas such as vegetable gardens and lawns because urban residents relate to these areas better than they would to areas such as cropland.

1.5.2 Health Hazard

Throughout history, human societies have coded certain animals as dirty and unhygienic leading them to be excluded from human realms (Philo & Wolch, 1998). On the other hand, animals regarded as clean or charismatic have been included in human societies. Dirty animals may be analogous to diseased animals in people's minds and, as a result, their presence is not tolerated because they are seen to pose a risk to human health.

Health risk and economic damage are often presented as analogous concerns. For example, people who had a low tolerance toward deer reported that Lyme disease or damage to tree plantings was a concern (Decker & Gavin, 1987). Kellert (1985) found

that, generally, animals that cause or present some kind of risk to humans are disliked. Another study found that people who visited outdoor suburban areas most accepted lethal management when the animal carried a disease harmful to humans or was believed to be potentially harmful to humans or pets (Wittmann et al., 1995). The main reason for managing prairie dogs is that they compete with livestock for forage, but sometimes management is also based on a concern regarding a plague outbreak among prairie dog populations (Collins, Workman, & Uresk, 1984).

Similar health concerns related to RGSs are explored in this study. Severity of public concern about RGS burrows causing horses, livestock, and humans to break their legs, and RGSs carrying and transmitting disease to humans is measured. No studies are available to document actual economic or health damage due to limbs maimed or broken on burrows created by burrowing prairie rodents. In addition to pastures that include burrows, cattle roam pastures that have steep, rocky, and uneven terrain (Wellicome, 1997). It may not be possible (or ecologically desirable) to make the ground even and to stop all burrowing creatures from burrowing in order to prevent humans or domesticated animals from breaking their legs.

In 1939, a population of RGSs in Stanmore, Alberta was confirmed to be infected with sylvatic plague (Brown & Roy, 1943). Approximately 3200 square kilometers of prairie east of Drumheller was considered plague infected. However, only one human death in Alberta in 1937 resulted from bubonic plague, the human version of sylvatic plague, that may have been contracted from RGS hosts (Banfield, 1974). RGSs are hosts

to fleas that can transmit the bubonic plague to humans. Besides this one publication, I was unable to find literature related to RGSs spreading disease to humans.

RGSs are also reservoirs for tularaemia and Rocky Mountain spotted fever. Ticks (*Dermacentor andersonii*) transmit these diseases directly to humans. Tularaemia is caused by an infection of the bacillus *Pasteurella tularensis* and Rocky Mountain spotted fever is caused by the virus *Rickettsia*. One to four cases of these diseases have been found in humans in the south eastern part of Alberta in Lethbridge and Medicine Hat regions over an approximate 30-year period (Brown & Roy, 1943). The transfer of the diseases to humans has not been directly linked to RGSs because various other rodents and deer also act as hosts to the two diseases. As it stands, the small number of cases reported in humans is not likely a serious threat to the general population.

1.6 Problem Animals and Management

"[A]ll animals are equal but some are more equal than others" (Orwell, 1966, p. 148).

A variety of solutions to "problem" wildlife have been explored (Wittman et al., 1998). Capture and relocation, frightening animals with rubber bullets and fireworks, and destroying animals are methods with both advantages and disadvantages. For example, live trapping and relocating animals is expensive and some animals, such as ground squirrels, exhibit low survival rates when relocated.

Tension between preservationist and utilitarian-minded advocates of wildlife management has led to some experimentation with relocation (Van Vuren et al., 1997). Relocating California ground squirrels (*Spermophilus beecheyi*) has been found to be unreliable as a management method because the ground squirrels had a low survival rate and did not settle at the site at which they were released. As a result, relocation of California ground squirrels may be counterproductive because they settle or resettle in areas where they are not tolerated by humans, or the squirrels without established burrows become easy prey for predators. Michener (1996) successfully established a RGS colony on a site previously inhabited by RGSs, but starter burrows and disused old burrows were available.

Coyotes, also considered to be problem animals, have a long history of being “managed”. For example, pairs of coyote ears were traded in for a monetary bounty until 1948 in Alberta (Bourne, 1989). Other methods of management for coyotes are lethal neck snares (which do not require federal registration), poisons such as strychnine and cyanide, leg hold traps, guard dogs, guard llamas, electric fences, and den hunting. Inadvertently, the swift fox (*Vulpes velox*) was extirpated from the Canadian prairies in the 1930s because of management methods which often targeted other predatory species using methods such as shooting, trapping, and poisoning (World Wildlife Fund [WWF], 1997).

Lethal management of RGSs and other field rodents includes an effective and widely used poison called zinc phosphide. For example, zinc phosphide has been

reported to be 98.7% effective at eliminating black-tailed prairie dogs from targeted areas (Cincotta, Uresk, & Hansen, 1987). Farmers that report unsuccessful prairie dog control are most likely experiencing re-occupation by immigrating (dispersing) yearling prairie dogs, particularly males, to areas devoid of original prairie dog occupants. The researchers found that previously poisoned sites contained more yearling males than females. Males are typically the sex biologically inclined to disperse. Bishop and Culbertson (1976) found that large "prairie dog towns have generally been reduced in size and number by agricultural practices and poisoning" (p. 217).

The use of poisons, such as zinc phosphide, to control black-tailed prairie dogs has been found to be not "...economically feasible and required annual maintenance, [and] costs exceeded the annual value of grazing increases" (Collins, et al., 1984, p. 361). Other reported prairie dog eradication resources are: gasoline, propane, anhydrous ammonia, poisoned peanuts, and chloropicrin (Lee & Henderson, 1989).

The cost of strychnine to manage RGSs in Alberta did not affect volume used because it was sold to farmers at a low cost (Schmutz, Houston, & Barry, 2001). In 1911, poison was allocated to farmers in Alberta at no cost (Banfield, 1974). Subsequently, and perhaps due to other environmental and human factors as well, lower RGS numbers were observed. As a result of these poisoning campaigns, predators that had depended on, or supplemented their diet with, RGSs had to find alternative food sources.

Swainson's hawks (*Buteo swainsonii*) switch prey items in response to RGS scarcity, changing their diet to ducklings and songbirds (Schmutz et al., 2001). Based on increased quantities of strychnine sold, the same researchers reported observing more red foxes and coyotes than RGSs, a reversal from previously observed patterns. Some explanations for the changes in wildlife composition are the industrialization of agriculture (monoculture), increased use of fertilizers, pesticides, and biocides, reduced shelterbelts and suitable habitat for animals. If these changes lead to decreases in RGSs less prolific species such as songbirds will be adversely affected.

1.6.1 Current Management Methods

Management preferences have been associated with value orientations and placed on a continuum ranging from preservationist orientations to utilitarian orientations or on a continuum entailing humanitarian to anthropocentric value orientations (Wittman et al., 1998). Most management for RGSs has traditionally entailed lethal methods that could be associated with utilitarian value orientations. The application of alternative or preservation orientated management methods are not at the forefront.

Many current lethal methods of control are painful and cause much suffering for the targeted animal. Shooting individual animals has been advocated by some as a humane and quick solution to manage small areas of land (Raine, 2002). This may be true for an accurate shot, but if a lactating female is shot, the infants are left to starve (Michener, personal communication, March, 2001). Historically and presently, Western

culture encouraged trapping and shooting RGSs as a recreational activity. In the past, youngsters were rewarded three cents per "gopher" tail in Manitoba (Banfield, 1974). This cultural predisposition has persisted into the twenty-first century. In fact, a museum in Torrington, Alberta, celebrates a collection of RGSs preserved through taxidermy, dressed up as settlers and pioneers in the prairies and displayed in cultural prairie scenes (Malpas, 1998). Forms of leisure engaged in by this sub-culture include viewing preserved ground squirrels and hunting ground squirrels for recreational purposes. These recreational pursuits, especially hunting, may also serve the secondary purpose of RGS population management.

Registered lethal RGS controls include strychnine alkaloid, zinc phosphide, anticoagulants (chlorophacinone and diphacinone), and cholecalciferol (vitamin D₃). Anticoagulants such as chlorophacinone and diphacinone interfere with blood clotting mechanisms of mammals, including humans and ground squirrels. After three or more days following consumption, the animal that ingested the anticoagulant will bleed to death internally. Strychnine is a fast-acting poison that enters the blood stream and interferes with the central nervous system resulting in convulsions followed by respiratory failure (Alberta Agriculture, Food and Rural Development, 1997). Zinc phosphide produces phosphine gas (PH₃) in the stomach resulting in asphyxia (less oxygen delivered to body, not enough blood flow, build up of carbon dioxide). Cholecalciferol mobilizes calcium from the bones into the blood stream. Death is caused by hypercalcemia (excess calcium in the blood) 2 to 4 days after consuming the bait. Death occurs in humans and other animals that ingest strychnine and zinc phosphide even

in small quantities. If animals ingest a ground squirrel poisoned with strychnine, zinc phosphide, or anticoagulants, secondary poisoning can occur. However, chances of secondary poisoning with the use of zinc phosphide are fairly low because phosphine gas in the intestinal tract of RGS dissipates quickly. Alberta Agriculture suggests burning all poisoned ground squirrels whose carcasses remain above ground.

Schmutz, Rose, and Johnson (1989) suggest that certain management practices, such as placing poisoned bait into a tire, may poison numerous non-target wildlife. Alberta Agriculture warns that dogs are especially drawn to commercial bait containing the poison strychnine. Secondary poisoning of predators by prey that had been directly poisoned (e.g. RGSs poisoned by carbofuran) is a potential threat since “on a relative scale, carbofuran accounts for a large proportion of documented wildlife kills in North America” (Fox, Mineau, Collins, & James, 1989, p.6). Several studies, reviewed by Fox et al. (1989), found mortality in several bird species linked to the toxicity of carbofuran.

Commercial gas cartridges (suffocating gases) are recommended by Alberta Agriculture, as well as trapping using leg hold traps, jaw traps, and live capture traps. Other methods of control suggested include the growth of tall vegetation which may promote RGS to move to more open grass fields and the introduction of raptor nests and perches close to RGS colonies. Methods that are mentioned by Alberta Agriculture with little data on success rates include vacuum devices to remove RGSs from their burrows and explosive gases such as anhydrous ammonia, oxy-acetylene, or propane/oxygen mixtures which can be injected and then ignited in burrows.

According to the Lethbridge Herald, Lethbridge and surrounding towns have experimented with a variety of management techniques (Schurtz, 2002). The City of Lethbridge has used poisons such as anticoagulant chlorophacinone and strychnine. In addition, drowning and beating to death of RGSs using a variety of objects have been used as a method of control in the city of Lethbridge. Popular currently used methods include gases such as carbon monoxide and sulphur dioxide (“gopher” bombs) that are placed into ground squirrel burrows to asphyxiate RGSs.

Environmentalists have spoken out against methods that introduce chemicals into the environment, arguing that they may contaminate water supplies and potentially damage or eliminate flora and fauna. The burrowing owl (*Speotyto cunicularia*), ferruginous hawk (*Buteo regalis*), and swift fox are just a few endangered animals that have been negatively affected by such widely used and accepted poisoning campaigns (Schmutz & Hungle, 1989; Sovada, Roy, & Telesco, 2001). Some local communities have expressed concern over child and adult health resulting from liberal distribution of toxic pesticides (Tracey, 1999).

1.6.2 Current RGS numbers and reduction campaigns

Undoubtedly, ground squirrel numbers declined in Saskatchewan in summer 2002 as a result of a ground squirrel derby where a prize was awarded to the individual that produced the largest number of ground squirrel tails (Raine, 2002). A total of 63 610 tails were submitted. At least 10 000 applicants expressed an interest but only 211 people

actually submitted tails. From afar, endangered burrowing owls have been mistaken for RGSs and shot as a result. RGSs are considered yellow A status by Alberta Environment which means that they are a common species but a long-term decline in numbers has occurred (Alberta Environmental Protection: Natural Resources Service, 1996). Effective poisoning campaigns and habitat alteration have led to this decline. The report also states that RGSs are an important prey species for Red, Blue, and Yellow A listed raptors.

In some counties of Kansas, the landowner is legally obligated to meet certain prairie dog control requirements (Lee & Henderson, 1989). If the landowner opposes prairie dog eradication, the county will destroy prairie dogs against the landowner's wishes at his or her expense. In Kansas, more than 97% of the land is privately owned, resulting in successful eradication campaigns in part due to such regulations. In 1979, over 5 670 hectares in Kansas had prairie dogs, but by 1988 less than 121.5 hectares were inhabited by prairie dogs. The majority of respondents (53%) reported a success rate of 90% or higher for prairie dog control.

1.7 Biology of RGSs

RGSs are well adapted to the prairie environment. They have the ability to warn other ground squirrels in the colony of the presence of terrestrial or avian predators with a variety of calls pitched to communicate the type of predator and degree of threat (Koepl, Hoffman, & Nadler, 1978). The social organization consists of matriarchal groups of related females. Single-family female clusters exist where the mother-daughter bond is

the basis of the social structure and where the bond established between females lasts throughout life (Michener, 1972; Michener, 1981). RGSs possess the ability to recognize related and unrelated members (Michener, 1972). Individual recognition is at least partially olfactory. After nasal contact, cohesive behaviour often follows if Richardson's ground squirrels are related, or agonistic behaviour follows if the animals are unrelated.

RGSs live in southern Alberta, southern Saskatchewan and parts of southern Manitoba and their geographic range extends south into Montana, Wyoming, and Idaho. In this study, respondents were asked about RGSs that live in the natural region of Alberta identified as the grassland area of the province (Alberta Environmental Protection: Natural Resources Service, 1996). RGSs can survive on irrigated and cultivated land, however they prefer grazed pasture (Michener, personal communication, March, 2001). If RGSs develop a burrow system on land that is irrigated, they risk some chance of drowning. Likewise, their burrows will be disturbed by cultivation practices. RGS are mainly herbivorous but will occasionally consume invertebrates and scavenge road kill. Unlike the Franklin's ground squirrel, RGSs do not prey on eggs (Sargeant, Sovada, & Greenwood, 1987).

Male RGSs have lower survival rates than females due to dispersal, more aggressive behaviour and greater conspicuousness to predators (Michener, 1981; Michener & McLean, 1996). The sex ratio among adults, but not juveniles, is biased toward females because more female than male juveniles survive to adulthood (Michener, 1989). Only 50% of females and 20% of males survive to adulthood (Michener, 1998).

The maximum life span for females is 6 years whereas the maximum lifespan for males is only 4 years but it is rare for either sex to live to the maximum life span. Females reproduce only once annually and have more reproductive years than males. Females can have only one litter per year, whereas males have the potential to sire many litters. The costs of reproduction are higher for male RGSs. In the spring males are the sex to disperse in higher numbers than females (Michener & Sheppard, 1972). Compared to other *Spermophilus*, RGS females have larger litters but a shorter lifespan (Michener, 1989). RGSs are a popular prey item and therefore most mortality is probably the result of predation. *Neobellieria citellivora* is a lethal parasite of RGSs that attacks approximately 9% of juveniles (Michener, 1993a).

In the Chinook zone of southern Alberta, males emerge from hibernation in late February to early March followed about 2 weeks later by adult females in mid-to late March (Michener, 1998). Mating occurs in late March and the litters emerge in late April to mid-May. Adult males immerge underground to begin their hibernation in late June and adult females immerge in early July. Juvenile females disappear underground in late August and the last to hibernate are juvenile males in mid-October. The following year, yearlings emerge at dates similar to older adults of the same sex. In southern Alberta, the typical litter size at birth for RGS is 6 to 9, with an average of 7.7 young (Michener, 1998).

The hibernaculum is a chamber specially prepared by the individual ground squirrel in which it hibernates alone (Michener, 1993b). Both male and female ground

squirrels fill their hibernacula with bedding material (dry grass) and, before they begin torpor, the entrance is plugged with soil. Many male RGSs store caches of seeds in their hibernacula, whereas females do not store food in their hibernacula. One explanation for seed storing by males is that males need to be big and heavy upon emergence the following year when they compete for females. As a result, males require bigger hibernacula to accommodate their bigger size but also to provide storage room for their food. Females forage and consume vegetation directly or shortly after gathering it. Michener (1998) found caches to contain 60 to 1736 grams of dry mass of seeds.

1.8 RGS Role in Ecosystem

"[I]t is a terrible illusion to think that we can take over the ancient expertise of those living organisms that create and maintain the soil habitat they need" (Suzuki, 1997, p. 103).

Intricate and dependent relationships exist between RGSs, other animals and ecological processes of the prairies. The purpose of this section is to introduce some of the information available on these relationships. Again, the black-tailed prairie dog is used as an analogous example when information on RGSs is unavailable.

The case of the black-footed ferret and its dependence on prairie dogs (*Cynomys spp.*) for survival can be used to set the stage for similarly intricate, but less dependent, relationships between the RGSs and numerous other species (Biggins & Crete, 1989). In addition, the black-footed ferret historically occupied an overlapping geographical range

with the RGS and undoubtedly used RGSs as a secondary source of prey. Black-footed ferrets are specialists that primarily depend on a single prey species, the black-tailed prairie dog, for food and shelter (Seal, Thorne, Bogan, & Anderson, 1989).

Large prairie dog towns have ceased to exist (Bishop & Culbertson, 1976). Only 405 000 hectare to 810 000 hectare of prairie dog habitat remained as of 1988 in the U.S., but large amounts of that habitat are unsuitable for black-footed ferrets (Biggins & Crete, 1989). Human factors, such as habitat destruction and poisoning campaigns, have been the greatest contributors to the near extinction of the black-footed ferret.

It has been a challenge to accommodate reintroduction of the black-footed ferret when the 3 000 to 15 000 hectare prairie dog habitat needed to sustain a population of black-footed ferrets is hard to find (Seal et al., 1989). Fragmented, isolated populations are susceptible to random environmental events (including diseases such as the sylvatic plague) that can lead to extinction. Numerous independent populations are needed if the black-footed ferret is to exist in the wild.

Fragmentation of RGS habitat is highest in cultivated areas. Populations of RGSs are fragmented and restricted to uncultivated lands (Alberta Environmental Protection: Natural Resources Service, 1996). Fragmentation can lead to isolated populations, interrupting normal flow of individuals between sites, and increasing predation by dogs, cats and raccoons, predators that are associated with highly cultivated regions (Wellicome, 1997). Because of land management practices and human development in

the prairies, habitat fragmentation is an increasing problem for RGSs. As Wilcox and Murphy (1985) suggest, most animal populations are already naturally subdivided. In other words, optimal fragmentation has already naturally occurred and further fragmentation is often detrimental to the population. A single area supports more species than two smaller units with the same area; therefore further fragmentation results in a lack of complexity in population structure or habitat.

In addition, extinction of keystone species may cause the entire food web to collapse (Wilcox & Murphy, 1985). RGSs are an essential component in the food web of the prairie ecosystem and further elimination will, at the very least, degrade the food web. The keystone concept is controversial due to its inconsistent use and lack of defining criteria (Mills, Soule, & Doak, 1993). The review of the ecological information that follows sets the foundations for the argument that without RGSs, keystone or not, the current prairie ecosystem would suffer immense losses.

1.8.1 Species connected to RGSs

Just as the prairie dogs create habitat for species such as the black-footed ferrets within their geographical range, the RGSs sustain habitat for the endangered burrowing owl, the black widow spider (*Latrodectus mactans*), numerous other invertebrates, salamanders (*Ambystoma*), cottontails (*Sylvilagus floridanus*), and snakes such as the rattlesnake (*Crotalus viridis viridis*) and the bull snake (*Pituophis catenifer*). RGSs also serve as prey items for long-tailed weasels (*Mustela frenata*), ferruginous hawks,

Swainson's hawks (*Buteo swainsoni*), owls such as the great horned owl (*Bubo virginianus*) (Michener, 2001), and coyotes (Alberta Environmental Protection, 1996; Michener & Koepl, 1985; Michener & Michener, 1977). Eradication of burrowing rodents (such as RGSs) decreases habitat for burrowing owls (Wellicome, 1997). Also, farming trends have led to a decrease in pasture land (potential burrowing owl habitat) and to an increase in cropland (unsuitable burrowing owl habitat), although not all pasture land is suitable as burrowing owl habitat (Wellicome, 1997).

The burrowing owl is listed as endangered throughout its Canadian geographical range (Alberta Environmental Protection, 1996; Wellicome, 1997). The burrowing owl is also considered endangered under the Alberta Wildlife Act. If burrowing owl numbers continue to decline the species will eventually cease to exist. Burrowing owl staple foods are insects such as grasshoppers (Orthoptera) and beetles (Coleoptera); burrowing owls also consume rodents (Rodentia) (Fox et al., 1989). Burrowing owls are generalist and opportunistic predators and may consume infant ground squirrels. Burrowing owls use a variety of burrows excavated by animals such as ground squirrels, black-tailed prairie dogs, and badgers (*Taxidea taxus*) for dens and for nesting, roosting and caching food (Wellicome, 1997). Wellicome (1997) also reports that burrowing owls are more likely to occupy areas with greater densities of RGS burrows rather than lesser or non-existing densities of RGS burrows. Therefore, RGSs are important habitat providers for burrowing owls.

1.8.2 Predators of RGSs

Badgers prey on infant RGSs in spring and on hibernating animals in autumn (Michener, 2000). The badger is the major underground predator of the RGS. Aerial predators include a wide variety of raptors, some of which are rare or in decline. For example, the ferruginous hawk is listed as threatened and is on the blue list (Alberta Environmental Protection, 1996). The main prey for the ferruginous hawk and for the Swainson's hawk is the RGS (Schmutz & Hungle, 1989). Swainson's hawks use a greater variety of prey than do ferruginous hawks, which primarily prey on RGSs. A positive correlation was found by Schmutz & Hungle (1989) between an increase in sales of poison to control RGSs, an indication of high populations, and an increase in numbers of nesting densities of ferruginous hawks. Put another way, ferruginous hawk numbers correlated positively with the number of ground squirrels.

When parent raptors fed strychnine-poisoned ground squirrels to nestlings, it did not affect their growth rate (Schmutz et al., 1989). One potential explanation for this finding is that birds of prey do not consume the gastrointestinal tract of ground squirrels where most of the poison resides. Schmutz et al. (1989) suggested that during prey scarcity, when the birds are already stressed and in need of food, they may engorge all parts of the poisoned ground squirrels resulting in increased death rates at an already vulnerable and sensitive time. Mammalian predators may be at greater risk of secondary poisoning than other predators because of less selective eating patterns.

The diet of the prairie rattlesnake mainly consists of small mammals. Even when RGS populations were low, RGS remains were found in rattlesnake scat suggesting that RGSs may be an important prey item for the rattlesnake. However, RGS's relative importance in rattlesnake diet was not determined (Hill, Lawrence, & Russell, 2001).

1.8.3 Importance of RGSs in maintaining soil quality

In addition to providing food and shelter to various forms of life, RGSs, like prairie dogs, serve a multitude of other environmentally beneficial functions through their digging and grazing activity. Soil disturbance is a process required for a functioning prairie ecosystem. "Trampling and digging by animals is an important process in prairie ecosystems. The primary agents of soil disturbance were bison, ground squirrels, and badgers" (Saunders, 1996, p. 315). As Maclintok (1970) notes "Air and water containing solvents entered the soil where prairie dogs were active. Microbial life and small living things flourished on the oxygen and contributed to soil enrichment. Better growth of short grasses followed in the wake of prairie dog towns" (p.30). The ingestion of seeds passed on through feces of rodents and other animals has been found to contribute to the germination of vegetation (Sovada et al., 2001).

1.8.4 RGSs and herbivorous foraging relationships

Several studies have explored the relationships between several grazing species on prairie dog colonies. These ecological studies provide insight into the relationships

between the land and grazing animals, which can be applied to manage land more wisely in cattle management and in finding a balance between cattle and wildlife. Once again, literature regarding the RGS is unavailable. However, there is reason to believe that similarities would exist for an animal that is ecologically similar. Prairie dogs and RGSs are both ground-dwelling sciurids and the genus *Cynomys* is closely related to the genus *Spermophilus*. The subgenus *Spermophilus* which houses RGSs is especially closely related to *Cynomys* (G. Michener, personal communication, February, 2003). Although important differences exist between the two species, the potential for similarities should be explored.

Prairie dogs induce succession in plant communities and provide valuable forage for native ruminants such as pronghorns (*Antilocapra americana*) (Cincotta et al., 1987). While they still roamed the prairie, bison (*Bison bison*) were drawn to regrowth grasses around prairie dog colonies due to the high nitrogenous and low fiber content of these grasses. Forbs are rich in nitrogen and provide variety in bison diets; pronghorns are also attracted to easily digestible components and dicot plants which feeding habits of prairie dogs promote (Costello, 1970). Buffalo dust wallows also attracted ground squirrels and prairie dogs. Knowles (1986) stated that prairie dogs appear after soil disturbances, indicating the occurrence of soil and vegetation disturbance caused by bison wallowing first, followed by prairie dog (or RGS) burrowing and grazing activity in the disturbed areas. Today, parallels could be drawn between mismanagement of cattle (overgrazing) and land degradation rather than burrowing mammals being the primary reason for land degradation.

Sympatric grazers usually are not direct competitors because they have slightly different grazing patterns and styles where they selectively choose different vegetation or graze it in such a way that promotes further vegetative growth and nutrition (Krueger, 1986). Bison always chose to forage on the edges of prairie dog towns that were not poisoned (Krueger, 1986). Pronghorns foraged more efficiently on prairie dog towns than in uncolonized areas. Bison and prairie dogs were not competitors; they developed a relationship with mutual gains. Presence or absence of pronghorn grazing did not alter grazing behaviour of prairie dogs, whereas bison foraging on prairie dog town edges improved prairie dog foraging activity.

A slight decrease (10%) of plant biomass was found around prairie dog towns but overall plant diversity increased (Hansen & Gold, 1977). O'Meilia et al. (1982) found that pastures with prairie dogs have more small mammals and fewer insects, especially grasshoppers (Orthopterans). Prairie dogs provide habitat for a variety of animals that also help to keep insect numbers under control. Also, prairie dog colonies were found to support harvester ants and more herbage was found surrounding ant mounds.

Cows were found to eat less tall to mid-size grass species on prairie dog sites (O'Meilia et al., 1982). Even under heavy use, herbage met the needs of both prairie dogs and cows. Hence, prairie dogs and cattle can coexist on pastureland without significantly decreasing weight in steer.

Moderate grazing stimulates new shoot growth and nutrients from urine and feces feed roots of vegetation so that plants can take up nutrients and produce high quality shoots and leaves (Jewell et al., 1981). Light grazing or no grazing results in plants that store or relocate nutrients from shoots to underground organs or produce stems of low nutritional value. The prairie ecosystem supported large numbers of animals and therefore had rapid nutritional element cycling. Grazing and relationships among the grazers are important to the prairie ecosystem but the exact contribution of RGSs as prairie grazers needs to be studied.

CHAPTER 2

Methodology

2.0 Methodology

Surveys are a very old and frequently used mode of observation in attitudinal research (Babbie, 1995). In this study bias was minimized through the use of established methods such as pilot testing, by using previously tested questions, and through the use of qualitative questioning during a post-analysis survey. Established guards for objectivity such as the way in which questions are asked were incorporated, but as Babbie (1995) states "...social research can never be totally objective, since researchers are humanly subjective...However intersubjectivity is possible when scientists with differing subjective views arrive at the same results when using research techniques" (p. 461). Because this research is in the social sciences, it is important to reiterate the assumptions that underpin this research. Based on ecological and biological information, I believe that Richardson's ground squirrels are, as animals native to the prairies, essential (or critical) to the prairie ecosystem. Stating my position alerts readers to potential bias.

2.1 Questionnaire

The survey developed for this study was divided into four sections: a) preferences for management methods and extent of problems caused by RGSs, b) attitudes toward RGSs, c) knowledge of RGS biology and ecology, and d) demographic information (Appendix A). Each section addressed a particular domain of interest. All questions

targeted the affective domain with the exception of the knowledge questions that targeted the cognitive domain (Table 1).

Several questions, such as those regarding management, indirectly addressed behavioural intentions of the respondents even though previous studies, discussed earlier, have found that people tend to enhance behaviour they deem to be socially acceptable and downplay unacceptable behaviour in self-reports, when it is compared to their actual behaviour. That is, people report to behave in a way that is socially accepted and viewed as positive (Tarrant & Cordell, 1997).

Questions were developed based on salient beliefs gathered through informal conversations with rural and urban people of southern Alberta, Saskatchewan, and Manitoba. Students in various classes that I had taken at the University of Lethbridge, roommates, friends, and colleagues during my undergraduate and graduate career expressed various, often negative attitudes toward RGSs. These views were further supported by a post-hoc study discussed in section 3.9. Numerous informal conversations regarding RGSs over a five year period provided the initial list of problems that people (especially from rural backgrounds) felt were caused by or attributed to the presence of RGSs. Comments indicated RGSs are thought of as: agricultural pests, disease carriers, and that their burrows are a hazard to both domestic animals and humans. Perceptions of out-of-control “gopher” population explosions were compared to grasshopper infestations. RGSs were often described as disease-infested, cannibalistic, overpopulated vermin.

Table 1: Rationale for attitude and knowledge questions

A) Rationale for the questions included in the attitude section

Question: Rationale

RGSs give a traditional Western feel to the area: question developed and used by Zinn and Andelt (1999) on prairie dog. Question evaluates value orientation toward RGSs of respondent and targets the affective domain of respondent.

RGSs are native animals to the prairies: targets cognitive domain. This question is knowledge-based but it depends on respondent's definition of native.

Trapping and/or shooting RGSs are enjoyable recreational activities: value-attitude-behaviour based question. (utilitarian, killing RGSs provides entertainment for humans, humans over nature orientation).

RGSs are less common now than in the late 1800s due to human interference: exploring the belief that humans have increased RGS numbers due to providing crops for food etc. or the belief that space and land previously used as habitat has decreased RGS numbers. Human RGS interaction.

If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting RGSs: ecology based –idea from black-footed ferret dependence on prairie dogs where studies found that attitudes were incompatible with reintroduction (Miller et al., 1990).

Ferruginous hawks directly depend on RGSs for survival: ecology-knowledge based.

Burrowing owls directly depend on RGSs for survival: ecology-knowledge based.

RGSs should be protected: value-attitudes and ecology based.

Black widow spiders use RGS burrow for shelter: ecology-knowledge based.

Farmers/ranchers should be reimbursed for the damage caused by RGSs: omitted from scale to increase internal consistency but political/action based.

B) Assumptions upon which the knowledge questions were based

Knowledge question: Assumption

Habitat: assumption that respondents view RGSs as overpopulated and their numbers are increasing everywhere

Diet: assumption that respondents view RGSs as cannibals and scavengers

Hibernation: biology-based – assumption that respondents view RGSs are present year round.

Number of litters produced by a mature female annually: biology-based - assumption overpopulation

Reproductive age: biology-based - assumption overpopulation

Natural cause of mortality: assumption that RGSs are important prey items

Consumption of RGSs by a family of ferruginous hawks in one season: RGSs are an important prey item for certain species which may be more socially valued

Sex of RGS that stores seeds for the winter: perception that RGSs consume and store more crops/seeds than they really do – economic competitors with humans for food

It appeared that these beliefs led to a number of observable behaviours and were expressed through casual conversation. Purposefully running over RGSs with vehicles, trapping, torturing, ripping off tails while still alive and shooting RGSs were examples of this behaviour. In addition, clubbing RGSs with hockey sticks, snaring them, and flooding them out of their burrows were activities activity engaged in by some University students. Questions addressing RGSs were unique to this study but themes similar to those developed by Zinn and Andelt (1999) in a study on attitudes toward black-tailed prairie dogs and by Wittmann et al. (1995) in a study on attitudes toward urban wildlife were included in the questionnaire.

Questions also sought to explore behavioural intentions regarding management. Management methods including poisoning, shooting, and relocating were drawn from reviewed literature and through informal conversations. Management preferences for seven geographical areas and a “one other” option included six choices ranging from lethal management (poison, fumigants, shooting), alternative management practices (capture and relocation and introduction of natural predators), and preservation management (leave them, reintroduce them). The problem scale was comprised of seven potential problems that were attributed to RGSs .

The attitude scale was comprised of 10 statements. The questions on attitudes included some questions addressing behaviour and ecological roles of RGSs as well as questions trying to explore why negative or positive attitudes exist. A standard Likert scale (Dixon & Leach, 1979) was used to evaluate each attitudinal statement ranging

from -2 (strongly disagree) -1 (somewhat disagree), 0 (neither agree or disagree was used but labelled by some researchers as neutral, don't know, neither, don't care), +1 (somewhat agree), +2 (strongly agree).

The knowledge section of the survey focused on RGS biology and ecology. It was developed with the assistance of biologist G. Michener, a specialist in the study of RGSs (Michener, 1998). The knowledge section consisted of nine questions. Seven addressed biology, such as habitat and reproduction, and two questions addressed ecological interdependencies, including the number of ground squirrels a family of ferruginous hawks consumes in a season. Attention to ground squirrels as prey was deemed particularly important in order to establish how people perceived the ecological role of RGSs as prey and habitat providers for other species of the prairies. Three biology-based questions directly asked about numbers of ground squirrels (how many in a litter, how many litters in a year, and when females become reproductively mature). One question addressed the interesting biological fact that only male ground squirrels store seeds. These questions were included to determine the relationship between respondents' perceptions of crop damage and sex-specific seed storing activity, and to correlate them to perceptions of ground squirrel population levels. Also, several other common misconceptions regarding RGS biology were revealed in informal conversations and queried in this study. Many people believed that ground squirrels prefer to live on irrigated and cultivated land; however, due to frequent soil disturbance such as tilling and flooding these areas are not ideal habitat for ground squirrels though they can sustain some animals. Some people felt that ground squirrels were carnivores, but they are

mainly herbivores with the exception of scavenging minimal amounts of road kill and consuming small numbers of grasshoppers. General beliefs about RGS biology were assessed in the knowledge segment of the questionnaire.

Responses to knowledge tests of environmental issues become more complex as knowledge levels of participants regarding environmental issues increase (Mangas, Martinez, & Pedauye, 1997). Because no other knowledge tests on the RGS have been performed, the knowledge section from my study can act as a baseline to determine current knowledge levels between different demographic groups. Other researchers have used biological information to address specific questions regarding wildlife management issues such as the use of bear-viewing platforms (Whittaker, 1997). Objectives for this study include gathering information on management preferences for a variety of areas, which can then be compared, to knowledge levels and possibly applied to potential management plans.

Following standard questionnaire format, the last section of the survey obtained general demographic information from the respondent. Demographic variables such as rural-urban residency and gender were used to categorize respondents for use in later analysis.

2.2 Sampling and data collection procedures

2.2.1 Pilot Testing

Pilot tests were performed on the survey tool. The length of the survey, clarity of wording, question interpretation, and bias were discussed with a convenience sample of six colleagues and friends. Dixon and Leach (1978) suggest that a small pilot sample should consist of people as similar to the final respondent group as possible. In this study, a convenience sample of eight people at three bus stops and two mall entrances in Lethbridge were asked to complete the survey. This process was interactive and respondents were encouraged to ask for clarification or to make comments about the survey. Changes to the survey were made following the collection of the pilot surveys. Two respondents did not complete the survey due to its length and suggested a shorter version. The final version of the survey was therefore shortened to encourage a higher response rate. In addition, questions that were misunderstood or caused confusion were reworded. For example, the question asking about trapping and/or shooting RGSs as an enjoyable recreational activity was reworded to emphasize that it was asking about the individual's own behaviour.

2.2.2 Data Collection

Data collection was carried out during two separate periods, one in summer and one in winter. Approximately half of the entire sample was obtained during each data collection period. This seasonal separation explored if results would differ when RGSs are not visible in the winter. To ensure appropriate and ethical research procedures the

survey methodology was submitted to the Office of Research Services at the University of Lethbridge and was approved with minor adjustments to the introductory letter.

2.2.3 Rural Sample

A 60-km radius surrounding Lethbridge was drawn on a map to establish rural towns with postal boxes to reach the farming community (Figure 2). Towns with post offices were selected so that mailed questionnaires could be used. Admail, a service offered by Canada Post, distributes unaddressed mail. One limitation is that those who do not wish to receive mail that is not addressed to them personally (colloquially referred to as junk mail) can block Admail. Only slots labelled as farms by the post office were sampled in the chosen rural communities. Slots are allocated to farmers based on availability and are allocated to residents in no particular order. Put another way, there is no method to assigning boxes or box arrangement at the post office. This sample was haphazardly random because of how mailboxes are allocated to farmers.

The following criteria were used to divide the number of surveys dropped off at each post office. If the post office had 40-100 farm slots, surveys were placed in every slot. If the post office had 100-160 slots, surveys were randomly placed in 50% of farm slots present. If the post office had >160 farm slots, the number of slots was divided by eight (to accommodate large numbers of mail slots) and corresponding numbers of surveys were randomly allocated into the slots present. The post office personnel were asked to randomly distribute the questionnaire if all slots were not considered.

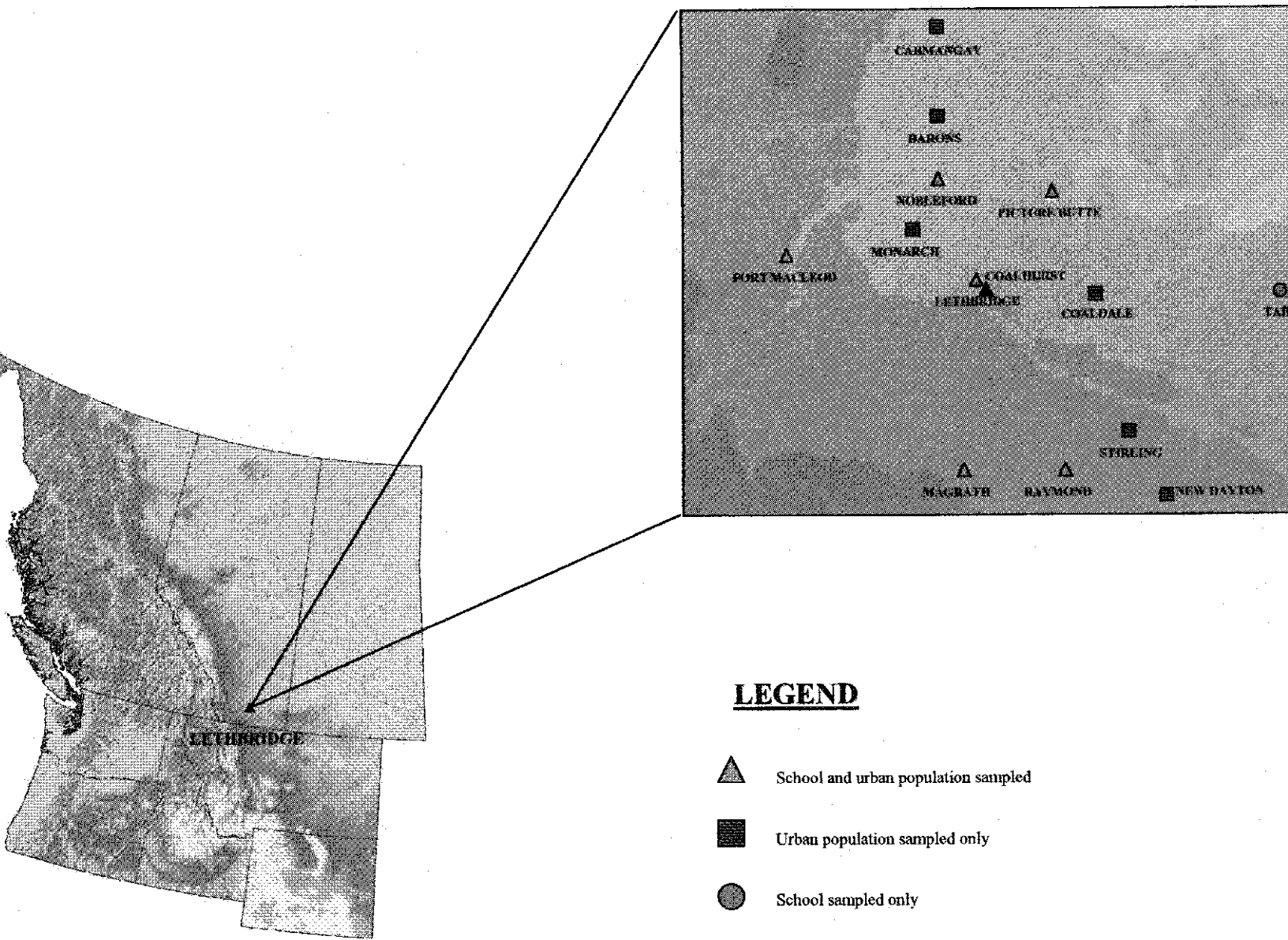


Figure 2: Map of rural areas sampled

The response rate for the rural population was 34% of 691 potential respondents (Appendix B).

Dillman (1978) identified several stages of follow-up to increase response rates to surveys. Some of the suggested follow-up stages suggested by Dillman (1978) were not feasible due to the way in which Admail is set up. There were advantages and disadvantages to using Admail. One disadvantage was that respondents could not be individually identified for follow-up or reminders to submit unreturned surveys. Nevertheless, an improvisation was used, and where permitted, colourful posters were displayed at the post office to serve as a reminder for those who had failed to return the surveys. The rural package placed in farm slots consisted of an introductory letter, the survey, and a stamped and addressed return envelope to ensure higher response rates (Dillman, 1978).

2.2.4 Urban Sample

The City of Lethbridge had a population in 2001 of approximately 70 000 and is divided into three geographically distinct areas: north, south, and west. The west side is currently expanding and is the newest part of the city with 25% of the city's population. The remaining 75% of the population is divided approximately equally between the north side (35%) and the south side (40%). The population of the west side has grown from zero to approximately 22 500 in the last 35 years (L. Kurio, personal communication, January 18, 2003). West and north Lethbridge have the newest developments.

Lethbridge has higher percentages of young adults (18-24) and seniors (65+) than other similarly sized municipalities (City of Lethbridge, 1998). South Lethbridge has the oldest population and west Lethbridge has the youngest population within the city.

In order to strategically identify a representative sample of the population of Lethbridge, a map of sampling areas was developed in north, south, and west Lethbridge (Figure 3). This was an attempt to capture the attitudes of a representative sample of the population of Lethbridge.

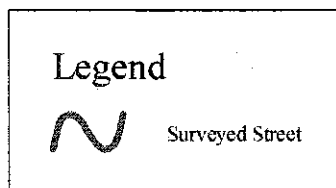
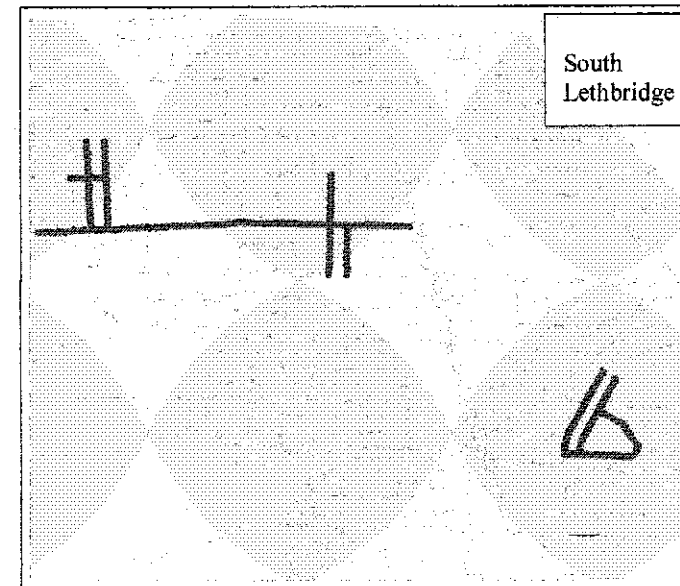
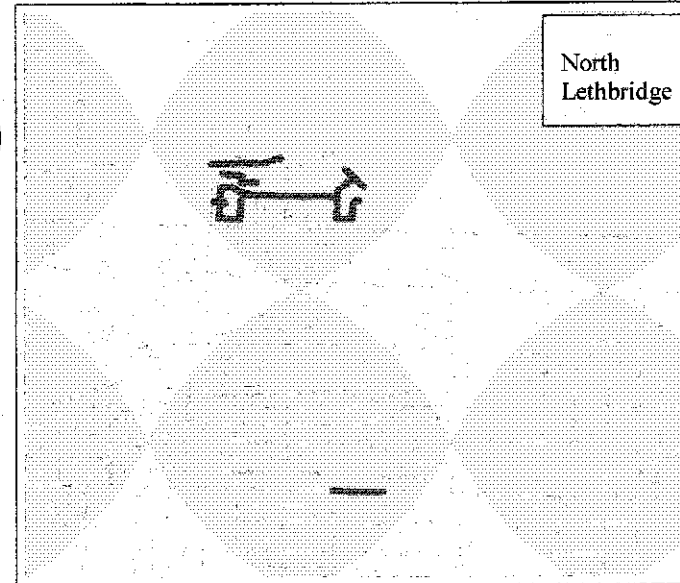
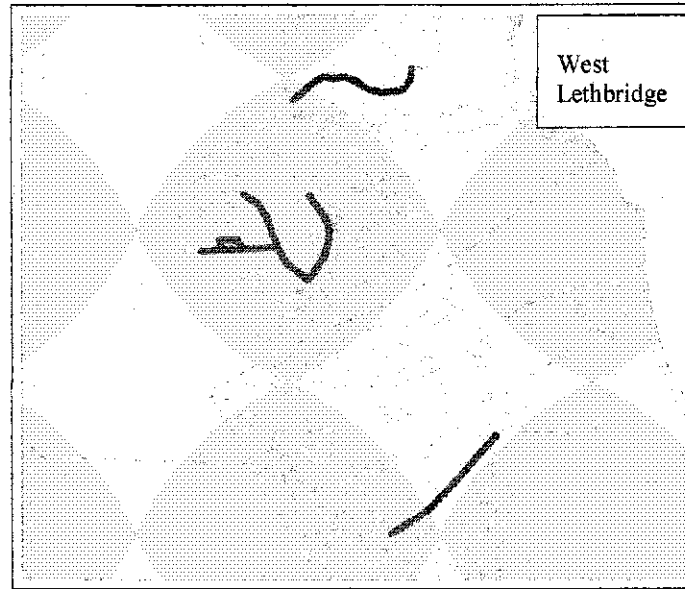
Combinations of methods were used to select the sample. Geographical stratification was used to divide the city into north, south, and west and the number of households chosen was proportional to the number of people on each side of the city. Cross-stratification sampling was used to select areas of the city based on the price range of the dwellings on the street (Table 2). Market value of the sampled residential buildings was determined using the City of Lethbridge property assessment records to ensure a diverse population was sampled (City of Lethbridge, 2002). Defining characteristics were government-sponsored housing, rental units (town homes), and single-family dwellings of various sizes. Single-family homes are most prominent in Lethbridge. Cross-stratification increases the precision and, hence, reliability of estimates and other generalizations (Freund, 1988). Cross-stratification sampling is often used in attitude research (Babbie, 1995). Finally, systematic sampling was used to select the sample.

Table 2 North, South and West Lethbridge sampling of dwellings according to the City of Lethbridge assessed property values (\$).

Price range of defined property value neighbourhoods			
Property Value Range (\$)	North Lethbridge	South Lethbridge	West Lethbridge
48 000-75 000	0	3	4
75 001-120 000	4	8	13
120 001-170 000	6	2	20
170 001-225 000	15	15	0
225 001 and up	0	2	0
Lower income and subsidized housing	30	0	2
Price range of broad property value neighbourhoods			
Mixed Property Value Neighbourhoods (\$)			
48 000-120 000	0	42	0
75 000-170 000	40	0	30
120 000-225 000	20	0	0
170 001 and up	0	31	20
Total	115	103	89
Response Rates	67% (77/115)	64% (66/103)	79% (70/89)

Note: All numbers include surveys that may have been discarded during final analyses and/or data entry.

Sampled Urban Residential Areas (2001-2002)



All maps drawn to approximately 1:45,000 scale.
10TM Projection.

Cartography: J.M.Montain

Figure 3: Map of general urban areas sampled in Lethbridge

Two houses were selected and then three passed, until desired numbers were reached. If a dwelling was unoccupied, the previous home was selected. This pattern was followed until an occupied home was found. The occupant who answered the door was informed about the survey, asked to complete it and leave it in their mail box or in an agreed upon area where it could be picked up the following evening. If the survey was not completed or not left as agreed, one attempt to contact the respondent was made to arrange another time for collection.

The response rate was 213 of 307 (69%) sampled respondents for the urban sample (Table 2). Only 10% of those who answered the door simply refused to participate. Four surveys were unusable. Response rates were: 77 of 115 (67%) potential respondents for the north side, 66 of 103 (64%) potential respondents for the south side, 70 of 89 (79%) potential respondents for the west side. The response rates led to the following distribution of overall responses; 36% of the sample was from the north side, 31% from the south side and 32% from the west side.

2.2.5 Student Sample

Similarities and differences between present adults and future generations of adults were explored; grade 12 high school students were surveyed (Table 3). Permission to contact the high schools was obtained, where required, by contacting the specific board of education.

Table 3: Demographics of adults and students surveyed

Area of residency and agricultural experience

	Adults			Students		
	Male	Female	Total	Male	Female	Total
Overall Total	248	135	383	161	126	287
Farm or Ranch	(53%) 131	(24%) 33	(43%) 164	(24%) 38	(24%) 30	(24%) 68
City	(36%) 89	(62%) 84	(45%) 173	(32%) 51	(31%) 39	(31%) 90
Village or Town	(5%) 13	(7%) 9	(6%) 22	(37%) 59	(37%) 47	(37%) 106
Rural Acreage	(6%) 15	(7%) 9	(6%) 24	(7%) 12	(10%) 12	(8%) 22
Overall Total	248	135	383	161	126	287
Agricultural Experience	(85%) 211	(67%) 90	(79%) 301	(58%) 94	(51%) 64	(45%) 129
No Ag. Experience	(15%) 37	(33%) 45	(21%) 82	(42%) 67	(49%) 62	(55%) 158

Note: Agricultural experience and no agricultural experience is from the same sample as those from farm, city, village or acreage

Type of Agricultural Experience

	Adults			Students		
	Male	Female	Total	Male	Female	Total
Overall Total	210	90	300	94	64	158
Horticulture	(1%) 3	(0%) 0	(1%) 3	(4%) 4	(0%) 0	(3%) 4
Ranching	(4%) 9	(8%) 7	(5%) 16	(7%) 7	(13%) 8	(9%) 15
Farming	(42%) 89	(87%) 78	(89%) 267	(81%) 76	(80%) 51	(80%) 127
Other	(4%) 9	(6%) 5	(5%) 14	(7%) 7	(8%) 5	(8%) 12

Students in classes for core subject areas were sampled or students from a number of classes were assembled in a large room to capture an inclusive group of students. Rural schools were selected based on the 60 km radius established for the adult rural sampling procedure. The largest urban high schools and some alternative schools in Lethbridge were also selected to obtain student samples. A teacher strike interrupted data collection and some schools later refused to participate once the strike ended, resulting in lower urban student response numbers than had been planned. The response rate was 100%, with five of 287 surveys unusable because the students did not complete the survey. The survey was introduced to the students by presenting information similar to the written cover letter used in the mail out (Appendix A). Students were asked to fill out the survey independently and silently. Discussion was postponed until all surveys were collected. I led post-survey discussions with classes that were interested in the research.

2.2.6 Limitations of this methodology

People tend to inflate self-reported behaviour, that is people report that they behave in socially acceptable ways even when that is not how they actually behave (Tarrant & Cordell, 1997). This inflation is a major limitation of self-administered questionnaires. A limitation of this sampling procedure was a non-response bias attributed to those rural residents who did not return a completed survey. A larger sample was drawn from the rural sample to allow for the possibility of a low response rate. Elderly people, immigrants and less educated people are less likely to respond and are often underrepresented (Robinson, 1998). Increased sample size does not correct the

misrepresentation of these groups of people. The highest non-response rate from the urban sample consisted of those with little or no English proficiency and those from the government-sponsored lower income housing developments. Little is known about non-respondents from the rural population, except for the general geographic location of those with high and low response rates (Appendix C).

2.3 Data management

This section provides an overview of the way in which data were entered, coded and categorized. One statement regarding trapping and shooting RGSs as an enjoyable recreational activity was reversed during coding because it represents a “negative” attitude. The total scores of all the statements for each respondent were added, to produce an overall attitude score. Questions related to management were agglomerated from six choices into three categories. Categories for the questions related to management (section A of survey) were developed as follows: poison/fumigate, shoot = lethal management; capture and relocate, introduce natural predators = alternative management; leave them in area, reintroduce = preservationist management.

Those respondents who changed the headings were categorized according to one of the three agglomerated categories. For example, some respondents included capture and kill so their response was categorized in the “lethal” category. Categories were further collapsed to discriminate between the aggressiveness of management acceptable to individuals belonging to different populations (1 = management techniques that will decrease RGS numbers, 2 = management techniques that will increase or maintain

current RGS numbers). When respondents left questions blank in the knowledge portion of the survey, their answers were entered within the “don’t know” category. When more than one box was marked, the response was also treated as “don’t know”.

Responses in the section about perceptions of RGSs as problem animals were treated in a similar fashion to the knowledge section. If the response space was left blank, the “don’t know” option was entered. The “don’t know” category also represents a neutral, apathetic position because 19 respondents chose to include comments such as “don’t care” beside this particular option throughout the survey. The rating options presented to respondents for the problem statements were: 1 = don’t know, 2 = not a problem, 3 = minor problem, 4 = moderate problem, 5 = major problem. A total problem score was obtained by suppressing the “don’t know” category and totaling the score for each problem evaluated by the respondent.

Three response options were presented for each knowledge question, with one correct answer and two false answers. A fourth option of “don’t know” was available to the respondent, but they were directed in the written instructions to write the words “don’t know” beside the knowledge question to which they were referring. According to Converse and Presser (1986), as many as 20% of respondents choose a middle alternative, such as “don’t know”, when it is offered. This could result in a loss of information about the direction in which some people lean. In order to discourage respondents from choosing “don’t know”, the ease and accessibility of that option was decreased and their preconception encouraged by making it easier to check the box with

the answer presented rather than making the effort to write the words “don’t know” beside the statement.

2.4 Statistical Analyses

First, the urban adult population was compared to the rural adult population. Urban versus rural farm people were compared to determine how place of residence affects perceptions. Then, all adult respondents were redivided to compare those with and without agricultural experience (Table 3 and 4). As discussed in section 1.3.5, the differences between rural and urban people should correspond with the differences found between those with and without agricultural experience. One may argue that the rural culture is influenced by agricultural experiences whereas urban culture is not. If the results between rural and urban residents are similar to the results between those with and without agricultural experience, then it increases confidence in these results. Exploring whether the place of residency (rural versus urban) or agricultural experience is a stronger indicator of attitudes is another objective of this study.

Second, student samples were compared in a different way because many respondents indicated on the survey that they were from a village or a town, whereas few adults sampled came from villages or towns. Because of this demographic difference, students were compared using only agricultural or no agricultural experience.

Table 4: Age and level of education and place of residency of adult respondents.

Age	Number of Respondents			Residency	Adults	Students
	Male	Female	Total			
Overall Total	248	135	383	Alberta	(87%) 336	(97%) 279
25-34	(48%) 35	(52%) 38	73	B.C.	(3%) 11	(.03%) 1
35-44	(60%) 56	(40%) 38	94	Other Provinces	(7%) 28	(2%) 5
45-54	(69%) 67	(31%) 30	97	U.S.A.	(1%) 3	(.03%) 1
55-64	(74%) 48	(26%) 17	65	Other Country	(3%) 10	(.03%) 1
65+	(78%) 42	(22%) 12	54	Total	388	287
Education	Number of Respondents					
	Male	Female	Total			
Overall Total	247*	131*	378*			
Elementary	(100%) 4	(0%) 0	4			
Secondary	(73%) 66	(27%) 25	91			
Technical or Vocational	(69%) 46	(31%) 21	67			
Some Post-Secondary	(58%) 75	(42%) 54	129			
University Completed	(65%) 42	(35%) 23	65			
Post-Graduate Degree	(64%) 14	(36%) 8	22			

*Note: Education total differs because 1 male and 4 female respondents refused to answer this particular question.

Following these analyses, students and adults with agricultural experience were compared and students and adults without agricultural experience were compared. These comparisons between adults and students about attitudes, problem perceptions and knowledge levels lend insight into direction for management practices. Presumably, some children of farmers will continue to farm in the future so their values, perceptions, attitudes and management preferences are useful to consider in terms of future management direction. Lastly, gender differences between urban and rural people from the adult population were determined, followed by comparisons between males and females with and without agricultural experience. Students were divided by agricultural experience, and males and females from the student sample were compared.

Social psychology research on attitudes has used Likert scales to evaluate and organize data into interval categories (Zinn & Andelt, 1999; Zinn et al., 2000). This practice enables the use of parametric tests such as the t-test, which has elicited criticism from some statisticians and others for two main reasons. First, it violates the prerequisite of a normal distribution. Second, the evaluation scale consists of numbers that are superimposed and arbitrarily assigned. Psychologists and sociologists defend the use of the Likert scale based on several key arguments (Nunnally & Bernstein, 1994). It is safe to assume that “strongly” means more than “somewhat” and “somewhat” means less than “neutral” (Zinn, personal communication, July 1, 2002). Researchers who use Likert scales recognize that the intervals between these options may be different. Several responses are available to deal with this criticism based on extensive research by social scientists. If the sample sizes are small (less than 30), only frequencies and percentages

are reported, followed by non-parametric categorical statistical tests. When sample sizes are large, as in this study, ordinal level data are treated as interval level data. Tests have demonstrated that with large samples, ordinal data can be treated as interval data because potentially differing interval sizes can be overcome by large samples (Nunnally & Bernstein, 1994). Individual differences in interval sizes tend to average out and non-normal distributions closely approximate the behaviour of normal distributions. In large samples, the central limit theorem takes place and “the sampling distribution of the mean can be approximated closely with a normal distribution...[the central limit theorem theory] justifies the use of normal-curve methods in a wide range of problems...” (Freund, 1988, p. 262).

Some social scientists argue that t-tests are robust and are not as sensitive when the data do not meet the normal distribution condition. Attitudes are abstract and difficult to measure because they are complex and shift over time. The statistical tests are only tools used to describe and present results. In this study, to overcome some of the statistical difficulties, parametric tests were used to analyse the Likert-scale results for attitudes and perception of RGS as problem animals, but percentages were also used as a basis for non-parametric tests and as a way to describe the data visually. Mann-Whitney U is the non-parametric equivalent to the t-test and was used for total knowledge score analyses because of nominal categories. Parametric tests are more powerful; they require a smaller sample size than non-parametric tests to provide the same level of reliability to test the null hypothesis (Robinson, 1998). However, several advantages can be attributed to non-parametric tests when compared to parametric tests: 1) probability statements

obtained are exact regardless of the shape of the probability distribution, 2) they can be applied to very small samples, 3) they can utilize data on a variety of measurement scales, 4) suitable tests can be used to analyse samples taken from several different populations, 5) no assumptions about background population from which samples are drawn are made (Siegal, 1956).

A statistical package for social science data, SPSS (11.0.1, 1991-2000) was used to create a database and to analyse all data. Parametric analyses were used to evaluate the two Likert-scale data sets – for problem perception and attitudes, which for the purposes of analyses were considered to be interval data. All other analyses consisted of non-parametric testing. The comparisons made for all demographic categories consisted of the following standard analyses. Attitudes were tested using the Student's t-test when comparing averages and final scores between two populations. To gain further understanding of attitudes percentages were evaluated using Chi squared. When looking at problem perceptions of RGSs, percentages were useful and Chi squared was used to test for significance. Displaying averages and conducting non-parametric tests in conjunction with Student's t-tests provides additional information. The knowledge portion of the questionnaire was explored using Chi squared. Answers were categorized as either correct or incorrect and tested for significance. The questions were also analysed using all the options presented to the respondent. Total knowledge scores were analysed using the Mann-Whitney U test. Management preferences for listed areas were most comprehensible when displayed as percentages on contingency tables, and significance was tested using Chi squared.

2.4.1 Results of scale testing

Scale reliability was tested using Cronbach's coefficient Alpha, which examines internal consistency based on correlations of items on a single scale, where 0.70 is considered acceptable (Nunnally, 1978). Two scales were created from the measuring tool. Alpha for each scale is reported in Table 5. The highest correlations between variables in the two scales are also reported. The two questions in the attitude scale that are most strongly correlated address the issues of protection and the allocation of funds (Table 5). The next most strongly correlated questions deal with dependence of burrowing owl and ferruginous hawk on RGSs in order to survive. In order to improve the Alpha of the attitude scale, the question regarding monetary reimbursement for damage caused by RGSs to farmers and ranchers was omitted from the scale (Table 5). As a result, only 9 of the 10 statements were used for total scale analyses.

The scale pertaining to RGSs as problems shows strong interchanging correlations between all questions dealing with broken limbs to livestock, horses and people on ground squirrel burrows (Table 5). A strong correlation also exists between the two human health-related risks listed (broken legs and RGSs as carriers of the plague). The question regarding economic damage and the question on RGS overpopulation were also correlated. The total Alpha of the problem scale is very strong (Table 5). Management preferences and knowledge questions consisted of independent categories which could not be ranked. Therefore non-parametric tests were used.

Table 5: Correlations related to the scale questioning RGSs as problem animals.

A) Correlations greater than 0.4 found between problem related questions

<i>RGS Problem Scale</i>	
Correlations => 0.4	Correlation
Horses break legs & Livestock break legs	.8757
Livestock break legs & Adults break legs	.5171
Horses break legs & People break legs	.4839
Economic damage & Overpopulate	.4825
Economic damage & Destroy lawns	.4367
Livestock break legs & Economic damage	.4275
Destroy lawns & Overpopulate	.4079
Horses break legs & Destroy lawns	.4065
Plague & People break legs	.4035
Total Alpha of Problem Scale = .7936	

1 indicates that you are asking the same question, n=672

B) Correlations greater than 0.4 found between attitude questions.

<i>Attitude Scale –correlation matrix</i>	
Correlations => 0.4	Correlation
Protection/money/burrowing owl	.7005
Hawks depend on RGSs & burrowing owls depend on RGSs	.5993
Western feel & RGS protection	.4480
Total Alpha = .5956. If farmer reimbursement statement is deleted from scale Alpha = .7241, n = 667	

2.5 Sample Demographics

2.5.1 Adult population

Overall, the majority of the sample from the general population consisted of men (65%) (Table 3). Farm or ranch respondents were more likely to be men, while city respondents were equally likely to be men as women. Women who responded to the survey were considerably younger than the men.

Only 12% of respondents reported that they were from an acreage or a village or town. Farm/ranch and city people were almost equally represented at 43% and 45% respectively. The vast majority of all those surveyed reported having 12 months or more of agricultural experience (79%). The type of agricultural experience reported was farming, ranching, other related fields, and horticulture in that order, for both men and women (Table 4).

2.5.2 Grade 12 students

High school students were from a less defined rural/urban split. Students were more likely to be from acreages and villages than adult respondents. A teacher strike occurred in the area during the second data collection phase, and some schools refused to participate in the study because of time constraints once the strike ended. These unexpected circumstances led to a smaller urban sample size than had been anticipated. The different proportions of areas of residency among the students when compared to the

adult population led to the dismissal of farm/ranch-city comparisons. Instead, the populations were compared using agricultural versus no agricultural experience, because unlike the adult sample, the students were almost evenly divided between agriculture experience and no agricultural experience. In fact, fewer had been exposed to agricultural activity than in the adult sample. Male and female distribution was slightly biased in favour of males (56%) for students.

CHAPTER 3

Results

3.0 Results

3.1 Adult population differences in attitudes toward RGSs

Overall, rural and urban residents differed in their attitude score. Rural residents displayed more negative attitudes in comparison to attitudes of urban residents. This was especially true on questions dealing with the allocation of funds to RGSs and prairie ecosystem protection issues. When the middle option of “don’t know” was suppressed, the opinions became stronger for most statements. The urban sample selected the neutral option more often than the rural sample, and was less likely to strongly agree or strongly disagree with any one statement.

Urban and rural residents held significantly different views on all statements except the statement asking about RGSs being native animals to the prairies. Both urban and rural people agreed most strongly that RGSs are native animals to the prairies. RGSs were perceived more negatively by rural residents (Table 6). As a single statement, trapping and/or shooting RGSs as an enjoyable recreational activity was most often strongly disagreed with by urban residents (57%). On the other hand, rural residents somewhat agreed with the statement most often (28%) out of all the options on the Likert scale (Table 7).

Table 6 Average scores for attitudes of urban (city) (n=172-175) and rural (farm/ranch) (n=165-167) residents of southern Alberta.

Statement	Urban	Rural	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
RGSs give a traditional Western feel to the area	0.54	-0.19	0.12	5.937	309	<0.001
RGSs are native animals to the prairies	1.20	1.12	0.10	0.825	338	0.410
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-1.01	0.15	0.15	7.612	327	<0.001
RGSs are less common now than in the late 1800s due to human interference	-0.08	-0.51	0.11	3.915	332	<0.001
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-0.72	-1.65	0.11	8.636	304	<0.001
Ferruginous hawks directly depend on RGSs for survival	0.59	0.35	0.10	2.459	339	0.014
Burrowing owls directly depend on RGSs for survival	0.51	0.00	0.09	5.422	337	<0.001
RGSs should be protected	-0.33	-1.55	0.11	10.998	322	<0.001
Black widow spiders use RGS burrows for shelter	0.12	-0.07	0.09	2.146	335	0.033
Total average score	2.81	-2.64	0.54	10.175	330	<0.001

Note: The total average score is the sum of the averages of 9 attitude questions ranging from a possible positive score of 18 to a negative score of -18.

Table 7 Percentage of responses comparing attitudes for urban (n=172-175) versus rural (165-167) people and in parentheses, the same sample re-divided for attitude comparison of no agriculture (no ag.) (n=82-83) versus agriculture experience (ag. ex.) (n=301-304).

Attitude Statements	Strongly disagree %	Somewhat disagree %	Neither %	Somewhat agree %	Strongly agree %	Chi ²	df	p
Western feel								
Urban (no ag.)	5 (6)	7 (5)	33 (37)	41 (39)	15 (13)	36.1	4	<0.001
Rural (ag. ex.)	24 (17)	13 (12)	26 (25)	30 (35)	6 (10)	(13.3)	(4)	(0.009)
Native to prairies								
Urban (no ag.)	1 (0)	1 (0)	15 (14)	43 (52)	40 (33)	6.6	4	0.158
Rural (ag. ex.)	1 (2)	7 (5)	13 (14)	36 (35)	42 (43)	(12.6)	(4)	(0.014)
Recreational trap/shoot								
Urban (no ag.)	57 (66)	10 (8)	17 (14)	9 (7)	7 (5)	52.6	4	<0.001
Rural (ag. ex.)	25 (35)	7 (7)	18 (18)	28 (22)	22 (16)	(28.9)	(4)	(<0.001)
Less common								
Urban (no ag.)	10 (9)	15 (11)	51 (57)	19 (21)	4 (1)	18.0	4	0.001
Rural (ag. ex.)	25 (22)	16 (17)	48 (46)	8 (11)	3 (4)	(15.3)	(4)	(0.004)
Owl and RGS protection								
Urban (no ag.)	32 (31)	30 (25)	22 (21)	10 (17)	6 (6)	76.8	4	<0.001
Rural (ag. ex.)	78 (64)	13 (20)	5 (10)	2 (3)	1 (2)	(43.6)	(4)	(<0.001)
Hawks and RGSs								
Urban (no ag.)	0.6 (1)	5 (5)	45 (45)	35 (36)	15 (13)	11.0	4	0.026
Rural (ag. ex.)	5 (4)	9 (8)	41 (42)	35 (34)	10 (13)	(2.1)	(4)	(0.712)
Burrowing owls and RGSs								
Urban (no ag.)	0 (0)	3.5 (4)	51 (48)	36 (41)	9 (7)	37.2	4	<0.001
Rural (ag. ex.)	9 (6)	17 (12)	45 (49)	24 (26)	5 (8)	(14.0)	(4)	(0.007)
RGS protection								
Urban (no ag.)	18 (13)	27 (28)	30 (32)	19 (21)	6 (6)	109.2	4	<0.001
Rural (ag. ex.)	73 (57)	16 (17)	7 (14)	3 (9)	2 (3)	(50.5)	(4)	(<0.001)
Spider and RGSs								
Urban (no ag.)	6 (7)	4 (6)	69 (63)	16 (15)	6 (9)	5.2	4	0.268
Rural (ag. ex.)	10 (9)	(4)	73 (71)	10 (12)	3 (4)	(4.6)	(4)	(0.329)
Damage pay								
Urban (no ag.)	24 (28)	24 (30)	25 (20)	18 (18)	9 (4)	86.1	4	<0.001
Rural (ag. ex.)	6 (13)	13 (15)	9 (15)	23 (22)	49 (35)	(41.6)	(4)	(<0.001)

Of the nine attitude statements, urban people most disagreed with trapping and shooting RGSs as an enjoyable recreational activity, whereas rural people most strongly opposed spending equal amounts of money to protect RGSs as to protect burrowing owls (Table 6). The most intense attitude in the rural population was the statement regarding equal expenditure on RGSs as on burrowing owl protection with 78% of the population strongly disagreeing with the statement. This was closely followed by strong disagreement regarding the statement: RGSs should be protected (73%).

Rural and urban people disagreed most on RGS protection ($t = 10.9$, $df = 322$, $p < 0.001$). When asked about equal allocation of funds to protect both burrowing owls and RGSs, rural and urban respondents, on average, favoured the negative (disagree) end of the scale, but this was also where the highest disparity between the two groups was found. Rural people disagreed with any type of protection allocated to RGSs whereas urban people disagreed but were not as strong in their disagreement.

Rural residents strongly disagreed that RGS populations had decreased or become less common since the 1800s (25%), but almost half (48%) reported not knowing or neither agreeing or disagreeing with the statement (Table 7). The urban people most often somewhat agreed with this statement (19%), but more than half (51%) were neutral on the issue.

In order to tease out opposing views, neutral options were excluded. Opposing viewpoints between the rural and urban population were evident for the following two

statements: trapping and/or shooting RGSs are enjoyable recreational activities (Figure 4), and RGSs are less common now than in the late 1800s due to human interference (Figure 5). Although not included in the computation of the overall attitudinal score to increase alpha, rural residents most often strongly agreed that farmers/ranchers should receive reimbursement for the damage caused by RGSs, whereas urban residents most often somewhat disagreed with the statement (Figure 6).

Table 6 presents urban-rural attitudes whereas Table 8 presents attitudes of the populations grouped according to those with agricultural experience versus those without agricultural experience. Presumably, people with agricultural experience should report attitudes similar to rural residents and those without agricultural experience should hold views similar to urban residents. I only report trends for agriculture-no agriculture experience that differ from the urban-rural analysis. Unlike the rural sample, those with agricultural experience, on average, somewhat agreed that RGSs give a western feel to the prairies.

Some attitude questions which were knowledge-based, such as trends in population numbers of RGSs (less common) and their role in the ecosystem (hawks and RGSs, burrowing owls and RGSs, black widow spiders and RGSs), solicited the highest neutral responses of all the attitude questions, ranging from 41% to 72% for that particular question (Table 7).

Table 8 Attitude comparison in the adult sample for those with agricultural experience (n=301-304) and those without agricultural experience (n=82-84).

Statement	Ag. Ex.	No Ag. Ex.	Standard error difference	t	df	p
RGSs give a traditional Western feel to the area	0.07	0.49	0.13	3.231	164	0.001
RGSs are native animals to the prairies	1.13	1.19	0.09	0.667	192	0.505
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-0.25	-1.23	0.16	6.142	162	<0.001
RGSs are less common now than in the late 1800s due to human interference	-0.41	0.06	0.11	3.058	161	0.003
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-1.41	-0.58	0.15	5.623	111	<0.001
Ferruginous hawks directly depend on RGSs for survival	0.45	0.55	0.11	0.915	385	0.361
Burrowing owls directly depend on RGSs for survival	0.18	0.55	0.11	3.044	383	0.002
RGSs should be protected	-1.16	-0.22	0.14	6.696	384	<0.001
Black widow spiders use RGS burrows for shelter	-0.01	0.11	0.11	1.043	118	0.299
Total average score	-0.89	3.15	0.67	6.059	376	<0.001

Note: The total average score is the sum of the averages of 9 attitude questions ranging from a possible positive score of 18 to a negative score of -18.

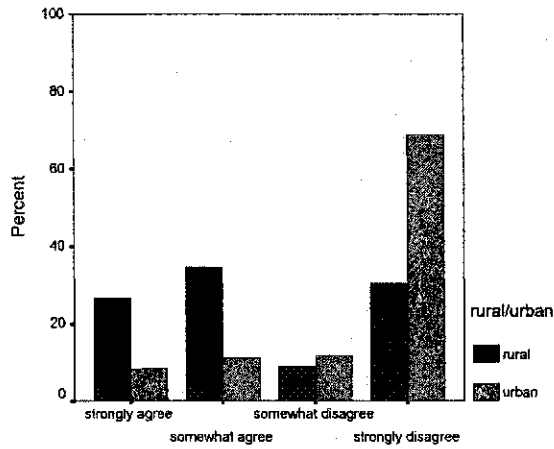


Figure 4: Differing views between urban (n=145) and rural (n=136) people to enjoyment of recreational trapping and shooting of RGSs. $\chi^2=52.570$, $df=3$, $p<0.001$.

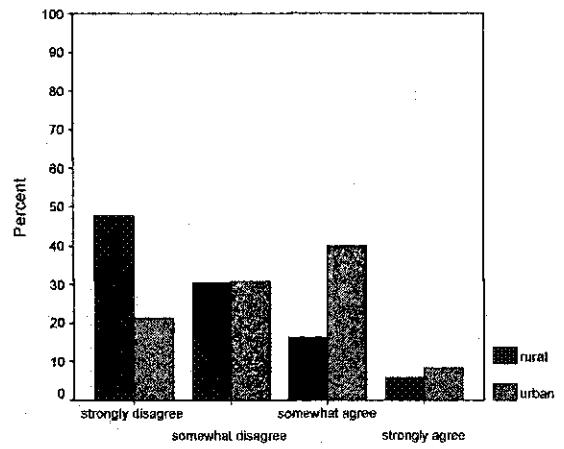


Figure 5: Differing views between urban (n=85) and rural (n=86) people to RGS numbers decreasing since 1800s. $\chi^2=17.628$, $df=3$, $p=0.001$.

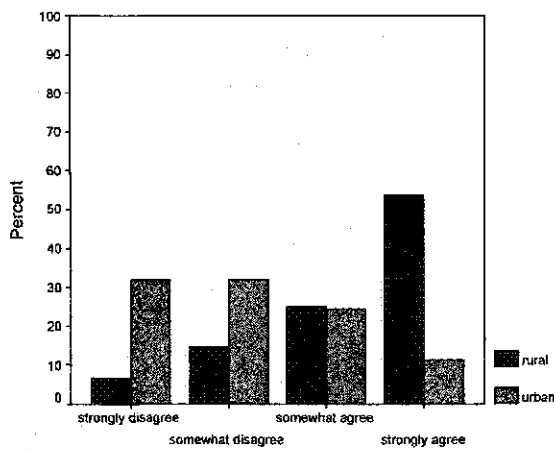


Figure 6: Differing views between urban (n=131) and rural (n=152) people to allocating funds to those sustaining damage caused by RGSs. $\chi^2=71.571$, $df=3$, $p<0.001$.

Differences in attitudes between those with agricultural experience and those without were similar to the rural and urban comparisons with the exception of two ecologically-related statements: one regarding ferruginous hawks and the other black widow spiders (Table 8). On average, those with agricultural experience and those without disagree with trapping and/or shooting RGSs as a recreational pastime. However, people with agricultural experience do not disagree as strongly as those without agricultural experience. Those with no agricultural experience tend to be close to neutral but agree that RGSs are less common today than in the 1800s due to human interference. Both groups weakly agree that ferruginous hawks depend on RGSs for survival; the two populations vary the least in their evaluation of this particular statement. A rural-urban difference was found regarding ferruginous hawks' dependency on RGSs but there was no difference found between those with or without agricultural experience (Table 7).

Those with and without agricultural experience evaluated statements and produced similar significant differences in attitudes as the rural and urban population with the exception of two statements. Unlike the rural-urban populations, those with and without agricultural experience did not significantly differ in their evaluation of the ferruginous hawk dependency on RGSs. Similarly, no significant difference was found in attitudes between those with and without agricultural experience to the statement regarding black widow spiders using RGS burrows as shelter (Table 8).

3.1.1 Adult population differences in perceived severity of problems caused by RGSs

In order to pinpoint reasons for the negative attitudes held toward RGSs, problems were identified and respondents were questioned on perceived seriousness of each problem caused by or attributed to RGSs (Table 9). Overall, rural people (farm $n = 167$, mean rank 186.75, city $n = 171$, mean rank 152.65, Mann Whitney $U = 11397.5$, $Z = -3.213$, $p = 0.001$) or those with agricultural experience (no ag. exp. $n = 81$, mean rank = 158.54, ag. exp. $n = 303$, mean rank = 201.58, Mann Whitney $U = 9520$, $Z = -3.106$, $p = 0.002$) viewed RGSs as more of a problem than those from the city or those without agricultural experience. Both rural and urban people identified crop depletion and overpopulation as the two most serious problems associated with RGSs (Tables 9, 10, 11). Rural people perceived crop depletion, garden destruction and overpopulation to be significantly more serious problems than did urban people (Table 10). The transfer and sustenance of the plague by RGSs to humans was not considered a problem by either population. When the “don’t know” category was suppressed, the modes of the rural and urban samples were the same.

As expected, rural people and those with agricultural experience perceived RGSs to be a bigger problem than urban people and those without agricultural experience (Table 10 and Table 11). A total average score for perceptions of RGSs as problems was calculated by summing the severity of each rating on each of the problem statements, where 5 = major problem, 4 = moderate problem, 3 = minor problem, 2 = not a problem, and 1 = don’t know (which was not included in this particular calculation).

Table 9 Percentage of responses for each perceived problem by urban (n=133-165) versus rural (n=129-167) people and in parentheses, the same sample re-divided using agricultural experience (n=239-298) versus no agricultural experience (n=59-76) populations.

RGS contributions to problems	% Not a problem	% Minor problem	% Moderate Problem	% Major problem	Chi²	df	p
Plague							
Rural (ag. ex.)	63 (60)	20 (23)	8 (10)	9 (7)	5.1	3	0.166
Urban (no ag.)	53 (44)	25 (25)	15 (19)	8 (12)	(7.4)	(3)	(0.060)
Horses break legs							
Rural (ag. ex.)	6 (6)	40 (40)	25 (28)	28 (26)	0.8	3	0.860
Urban (no ag.)	5 (8)	41 (31)	29 (37)	26 (24)	(3.9)	(3)	(0.237)
Livestock break legs							
Rural (ag. ex.)	12 (9)	35 (35)	26 (31)	27 (25)	3.7	3	0.301
Urban (no ag.)	6 (9)	36 (28)	32 (41)	25 (22)	(2.8)	(3)	(0.418)
Deplete crops							
Rural (ag. ex.)	0 (3)	8 (10)	18 (25)	74 (62)	53.1	3	<0.001
Urban (no ag.)	7 (4)	23 (32)	34 (31)	36 (32)	(29.2)	(3)	(<0.001)
Destroy gardens							
Rural (ag. ex.)	16 (18)	36 (40)	31 (25)	17 (17)	14.9	3	0.002
Urban (no ag.)	26 (29)	46 (45)	15 (17)	13 (9)	(7.8)	(3)	(0.050)
Humans break legs							
Rural (ag. ex.)	31 (29)	41 (43)	16 (17)	13 (11)	0.6	3	0.898
Urban (no ag.)	30 (33)	44 (37)	16 (17)	10 (13)	(1.3)	(3)	(0.735)
Over populate							
Rural (ag. ex.)	3 (4)	4 (8)	18 (22)	75 (66)	41.3	3	<0.001
Urban (no ag.)	7 (8)	15 (14)	38 (47)	40 (31)	(30.3)	(3)	(<0.001)

Note: The numbers in parentheses are the same sample re-divided and re-tested using agricultural experience and no agricultural experience instead of the rural and urban variables.

Table 10 Evaluation by urban and rural people of the seriousness of each potential problem caused by RGSs. Average problem score (out of 5)

RGS contributions to problems	Urban (City) ^a Average	Rural (Farm/Ranch) ^b Average	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
Plague	2.77	2.64	0.12	1.16	260	0.248
Horses break legs	3.75	3.76	0.10	0.14	317	0.892
Livestock break legs	3.77	3.70	0.11	0.67	320	0.507
Deplete crops	3.99	4.66	0.09	7.56	259	<0.001
Destroy gardens	3.15	3.49	0.11	3.16	313	0.002
Humans break legs	3.06	3.10	0.11	0.38	321	0.704
Over populate	4.11	4.64	0.09	5.93	322	<0.001
Total Average Score (out of 35) ^c	22.40	24.71	0.49	3.82	307	<0.001

^a City n=171 score out of 5

^b Farm/Ranch n=167 score out of 5

^c Total average score for scale on severity of problem (5 major problem, 4 moderate problem, 3 minor problem, 2 not a problem, 1 don't know not included in count).

Table 11 Average scores of people with agricultural experience (n=239-298) and those without agricultural experience (n=59-76).

Problem	Agriculture Experience ^a	No agriculture experience ^b	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
Plague	2.62	2.98	0.14	2.624	296	0.009
Horses break legs	3.74	3.76	0.12	0.196	359	0.845
Livestock break legs	3.72	3.77	0.12	0.460	363	0.646
Deplete crops	4.47	3.91	0.11	5.108	364	<0.001
Destroy gardens	3.41	3.07	0.12	2.864	124	0.005
Humans break legs	3.10	3.11	0.12	0.480	366	0.961
Over populate	4.50	4.00	0.11	4.652	368	<0.001
Total Average Score (out of 35) ^c	24.24	21.46	0.84	3.337	102	0.001

^a score out of 5

^b score out of 5

^c Total average score for scale on severity of problem (5 major problem, 4 moderate problem, 3 minor problem, 2 not a problem, 1 don't know not included in count).

The rural sample considered crop depletion and overpopulation as major problems and held the highest modal response 74% and 75% respectively out of all populations. Similar results for seriousness of problems were found between those with (same as rural) and without (same as urban) agricultural experience. One exception was a significant difference between those without agricultural experience perceiving RGSs as carriers of the plague as a more serious problem than those with agricultural experience.

3.1.2 Adult population differences in knowledge about RGS biology

Overall, the total knowledge score was significantly higher for those from rural rather than urban locations (rural $n = 167$, mean rank = 206.21, urban $n = 174$, mean rank = 137.21, Mann Whitney $U = 8649.5$, $Z = -6.546$, $p < 0.001$). Rural people scored higher on 6 of 9 knowledge-based questions (Table 12). For each knowledge question, a higher percentage of urban than rural respondents selected the “don’t know” option, although only 6 out of 9 of these differences were significant. The rural people selected the correct answer most often for the question pertaining to hibernation, whereas the urban people selected the correct answer most often for the question regarding the cause of mortality. Both populations selected an incorrect answer most often for the question on the sex of the seed storers. The rural sample chose “don’t know” most often for two questions (RGS numbers consumed by a family of hawks and sex of the seed storer). Urban respondents chose “don’t know” as an option most often for the same two questions, but in addition chose “don’t know” most often for two other questions, number of litters in a year and reproductive age.

Table 12 Percentage of knowledge questions answered correctly by rural (n=167) versus urban (n=174-175) people and by those with agricultural experience (ag. ex.) (n=304) versus those without agricultural experience (no ag.) (n=83-84) using observed and expected numbers by Chi².

Knowledge questions	% answered correctly Rural (agricultural experience) Urban (no agricultural experience)	Chi ²	df	p
Habitat				
Rural (ag. ex.)	75 (73)	9.836	1	0.002
Urban (no ag.)	59 (48)	(19.962)	(1)	(<0.001)
Diet				
Rural (ag. ex.)	76 (73)	8.167	1	0.008
Urban (no ag.)	62 (58)	(7.086)	(1)	(<0.001)
Hibernation				
Rural (ag. ex.)	82 (77)	16.509	1	<0.001
Urban (no ag.)	62 (54)	(17.843)	(1)	(<0.001)
Number of litters in a year				
Rural (ag. ex.)	47 (34)	52.020	1	<0.001
Urban (no ag.)	11 (6)	(25.103)	(1)	(<0.001)
Number of offspring in litter				
Rural (ag. ex.)	73 (64)	28.925	1	<0.001
Urban (no ag.)	44 (35)	(21.724)	(1)	(<0.001)
Reproductive age				
Rural (ag. ex.)	46 (38)	16.222	1	<0.001
Urban (no ag.)	25 (19)	(10.021)	(1)	(0.002)
Cause of mortality				
Rural (ag. ex.)	75 (74)	0.218	1	0.641
Urban (no ag.)	77 (76)	(0.084)	(1)	(0.772)
Hawk consumption				
Rural (ag. ex.)	21 (22)	0.539	1	0.463
Urban (no ag.)	18 (13)	(2.926)	(1)	(0.087)
Seed storage				
Rural (ag. ex.)	6 (4)	0.344	1	0.558
Urban (no ag.)	5 (6)	(0.418)	(1)	(0.518)+

+ 1 cell of expected count missing

Note: The numbers in parentheses are the same sample re-divided and re-tested using agricultural experience and no agricultural experience instead of the rural and urban variables.

Significant differences between respondents with and without agricultural experience mimic the rural-urban samples (Table 12). In fact, all questions that were answered correctly more often by those with agricultural experience than by those without agricultural experience were answered correctly even more frequently by those from rural locations (Table 12).

3.1.3 RGS management preferences in the adult population

Management options were grouped into three categories: lethal (poison, fumigate, shoot), alternative (capture and relocate, introduce predators), and preservation (leave them in area, reintroduce or introduce more into area). Rural and urban respondents differed significantly in the three management categories chosen for each area. The same pattern emerged for respondents with agricultural experience, and those without agricultural experience (Table 13). When the categories were further compressed to display preferences for simply increasing or decreasing RGS numbers, one notable shift occurred: rural and urban differences regarding RGSs on residential lawns ceased to exist (Table 14). Urban people want RGS numbers decreased on their lawns as much as rural people do, but hold a lower degree of aggressiveness toward RGS management preferring alternative management practices in other areas. Management preferences of people with and without agricultural experience were similar to the rural and urban respondents.

Table 13 Management preferences for rural (n=149-164) and urban (n=174-165) residents

Area to Manage	Farm/Ranch			City			Chi ²	df	p
	1	2	3	1	2	3			
City	71%	20%	9%	28%	45%	27%	60.304	2	<0.001
Lawns	73%	16%	11%	35%	50%	15%	49.020	2	<0.001
Outskirts of city	79%	10%	11%	27%	28%	45%	84.330	2	<0.001
Pastures	93%	5%	2%	42%	37%	21%	95.864	2	<0.001
Cropland	94%	4%	2%	47%	38%	15%	86.938	2	<0.001
Rural areas	85%	9%	6%	28%	32%	40%	107.100	2	<0.001
National Parks	41%	22%	37%	9%	26%	65%	47.684	2	<0.001

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 14 Management preferences to increase or decrease RGSs in selected areas by rural (n=149-164) and urban (n=174-165) people.

Area to Manage	Farm/Ranch		City		Chi ²	df	p
	1	2	1	2			
City	91%	9%	73%	27%	16.861	1	<0.001
Lawns	89%	11%	85%	15%	1.021	1	0.312
Outskirts of city	89%	11%	55%	45%	42.822	1	<0.001
Pastures	98%	2%	79%	21%	26.952	1	<0.001
Cropland	98%	2%	85%	15%	18.654	1	<0.001
Rural areas	94%	6%	60%	40%	50.829	1	<0.001
National Parks	63%	37%	35%	65%	26.473	1	<0.001

1=management practice that will decrease or remove RGS numbers

2=management practice that will increase or maintain current numbers of RGS

Note: The only difference when sample was compared by agricultural experience and no agricultural experience was in city outskirts - No agricultural experience 1=48% and 2=53% (reverse result than found here for urban and rural residents).

One difference between the “no agricultural experience” group and the urban resident group existed with respect to managing RGSs on the city’s edge; unlike the urban residents, people with no agricultural experience were more likely to want to maintain or increase RGS numbers (53%).

3.1.4 Perceptions of overpopulation

Three knowledge-based questions regarding reproduction were agglomerated to reveal biologically unrealistic perceptions of overpopulation. These three questions formed a new category called population explosion. Population explosion consisted of the following three questions:

reproductive age – one point allocated to those who incorrectly answered “before one year of age”

number of young in a litter – one point allocated to those who incorrectly answered more than the average number

number of litters per year produced by a single female – one point allocated to those who incorrectly answered “more than one litter per year”.

A score ranging from 1 to 3 was assigned to represent how much overestimation occurred where 1 represented one question that was answered overestimating reproductive numbers and 3 represented the maximum score of overestimating RGS numbers on each question. On average, adult people scored conservatively on reproductive numbers of

RGSs (below 1), but students revealed misconceptions regarding RGS reproductive biology and population numbers. Students with agricultural experience reported unrealistically high numbers of RGSs when compared to adults with agricultural experience (students $n = 158$, mean rank = 293.07, adults $n = 304$, mean rank = 199.05, Mann Whitney $U = 14288.5$, $Z = -7.592$, $p < 0.001$). Similar results were found for students without agricultural experience when compared to adults without agricultural experience (students $n = 129$, mean rank = 115.69, adult $n = 83$, mean rank = 92.21, Mann Whitney $U = 4167.5$, $Z = -2.88$, $p = 0.004$). Students with no agricultural experience thought RGSs had lower reproductive rates than students with agricultural experience (no ag. exp. $n = 129$, mean rank = 133.18, ag. exp. $n = 158$, mean rank = 152.84, Mann Whitney $U = 8795$, $Z = -2.16$, $p = 0.031$). The only difference between gender was for those without agricultural experience, where males perceived a RGS population explosion whereas females viewed their numbers more conservatively (male $n = 67$, mean rank = 72.5, female $n = 62$, mean rank = 56.9, Mann Whitney $U = 1574.5$, $Z = -2.518$, $p = 0.012$).

When considering the entire sample of adults and students, those who correctly answered the question about how many RGSs can be consumed by a family of hawks, also felt more strongly that ferruginous hawks depend on RGSs for survival (correct $n = 149$, mean rank = 405.86, incorrect $n = 527$, mean rank = 319.46, Mann Whitney $U = 29225$, $Z = -5.090$, $p < 0.001$). Also, those who answered the hawk consumption question correctly also agreed more that burrowing owls depend on RGSs for survival (correct $n = 148$, mean rank = 326.28, incorrectly $n = 526$, mean rank = 377.38, Mann

Whitney U = 33022.5, $Z = -3.041$, $p = 0.002$). People who knew that predation is a common cause of death for RGSs tended to feel more strongly that burrowing owls depend on RGSs for survival although only a weak significance was found (correct n = 503, mean rank = 313.27, incorrect n = 171, mean rank = 345.74, Mann Whitney U = 38863, $Z = -2.031$, $p = 0.042$).

3.2 Student-student and student-adult differences in attitudes toward RGSs

Analyses revealed that students display attitudes similar to adults, especially when considering agricultural experience. Student attitude averages were significantly more intense, in both agreement and disagreement, among those with agricultural experience when asked about recreational trapping or shooting, allocating equal amounts of money to RGS protection as to burrowing owl protection, and black widow spiders using RGS burrows for shelter (Table 15). Students agreed less than adults with the statement that RGSs are native to the prairies. Students disagreed less than adults that RGSs are less common now than in the late 1800s (Table 16).

Students and adults without agricultural experience attained similar positive overall attitude scores compared to the more negative scores of students and adults with agricultural experience. Adults without agriculture experience felt more strongly that RGSs were native to the prairies and disagreed more with trapping and shooting RGSs as enjoyable recreational activities than students without agricultural experience (Table 17).

Table 15 Attitudes for students with (Ag. Ex.) (n=158) and without (No Ag.) (n=129) agricultural experience.

Statement	Ag. Ex.	No Ag.	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
RGSs give a traditional Western feel to the area	0.03	0.45	0.129	3.231	285	0.001
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	0.63	-0.53	0.178	6.573	285	<0.001
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-1.16	-0.50	0.138	4.828	264	<0.001
RGSs should be protected	-0.89	-0.14	0.135	5.511	285	<0.001
Total Score	-0.87	2.36	0.614	5.253	285	<0.001

Note: The total average score is the sum of the averages of 9 attitude questions ranging from a possible positive score of 18 to a negative score of -18.

Table 16 Attitudes for adults (n=302-304) and students (n=158) with agricultural experience.

Statement	Students	Adults	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
RGSs are native animals to the prairies	0.86	1.13	0.1	2.749	458	0.006
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	0.63	-0.25	0.15	6.015	458	<0.001
RGSs are less common now than in the late 1800s due to human interference	-0.08	-0.41	0.11	3.005	459	0.003
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-1.16	-1.41	0.1	2.367	277	0.019
RGSs should be protected	-0.89	-1.16	0.11	2.467	314	0.014
Total Score	-0.87	-0.89	0.54	0.34	452	0.973

Note: The total average score is the sum of the averages of 9 attitude questions ranging from a possible positive score of 18 to a negative score of -18.

Table 17 Attitude differences for adults (n=82-84) and students (n=129) without agricultural experience.

Statement	Students	Adults	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
RGSs are native animals to the prairies	0.91	1.19	0.11	2.520	211	0.012
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-0.53	-1.23	0.12	3.655	203	<0.001
Total Score	2.36	3.15	0.68	1.161	209	0.247

Note: The total average score is the sum of the averages of 9 attitude questions ranging from a possible positive score of 18 to a negative score of -18.

3.2.1 Perceived severity of problems caused by RGSs for student-student and student-adult populations

Students with agricultural experience indicated that RGSs were more of a problem than students without agricultural experience (no ag. exp n = 128, mean rank = 131.79, ag. exp. n = 158, mean rank = 152.98, Mann Whitney U = 8613.5, Z = -2.159, P = 0.031). Students with agricultural experience felt that horses breaking their legs, livestock breaking their legs, crop depletion, and overpopulation were more serious problems than did students without agricultural experience (Table 18).

Overall, students with agricultural experience viewed RGSs as more of a problem than did adults with agricultural experience (students n = 158, mean rank = 272.09, adults n = 303, mean rank = 209.58, Mann Whitney U = 17445.5, Z = -4.792, $p < 0.001$). Occurrence of plague, livestock breaking their legs, people breaking their legs, and horses breaking their legs due to RGS presence were rated as more serious problems by students than by adults (Table 19).

Overall, students without agricultural experience viewed RGSs as more of a problem than did adults without agricultural experience (students n = 128, mean rank = 116.88, adults n = 81, mean rank = 86.23, Mann Whitney U = 3663.5, Z = -3.575, $p < 0.001$). Adults and students without agricultural experience differed in their perception of the seriousness of the occurrence of the plague and people breaking their legs in RGS burrows. Adults felt that these were not problems at all or that they were minor, whereas the students viewed them as moderate or major (Table 20).

Table 18 Student comparison (significant results only) for students with (n=154-156) and without (n=120-125) agricultural experience (ag. ex. and no ag. ex.) in rating RGSs as problem animals.

RGS contributions to problems	% Not a problem	% Minor problem	% Moderate Problem	% Major problem	Chi²	df	p
Horses break legs							
ag. ex.	4	19	41	36	11.89	3	0.008
no ag. ex.	4	24	55	17			
Livestock break legs							
ag. ex.	5	16	40	39	13.96	3	0.003
no ag. ex.	4	20	57	19			
Deplete crops							
ag. ex.	1	10	31	58	10.46	3	0.015+
no ag. ex.	3	21	33	43			
Over populate							
ag. ex.	6	9	32	53	17.01	3	0.001
no ag. ex.	5	21	43	31			

+2 cells less than 5 count

Note: "Don't know" omitted

Table 19 Differences in problem perception of RGSs for adults (n=239-304) and students (n=131-156) with agricultural experience

RGS contributions to problems	% Not a problem	% Minor problem	% Moderate Problem	% Major problem	Chi ²	df	p
Plague							
Students	27	20	13	40	71.292	3	<0.001
Adults	61	23	9	7			
Horses break legs							
Students	4	19	41	36	23.707	3	<0.001
Adults	5	41	28	26			
Livestock break legs							
Students	5	16	40	39	23.707	3	<0.001
Adults	9	35	31	25			
Humans break legs							
Students	16	38	24	22	18.673	3	<0.001
Adults	29	43	17	11			

Note: Don't know omitted

Table 20 Differences in problem perception of RGSs for adults and students with no agricultural experience

RGS contributions to problems	% Not a problem	% Minor problem	% Moderate Problem	% Major problem	Chi ²	df	p
Plague							
Students' response n=109	23	19	28	30	12.995	3	0.005
Adults' response n=59	44	25	19	12			
People break legs							
Students' response n=124	16	36	25	23	9.774	3	0.021
Adults' response N=76	33	37	17	13			

3.2.2 Student-student and student-adult differences in knowledge of RGS biology

Students with agricultural experience (ag. exp.) answered significantly more questions correctly than students without agricultural experience (no ag. exp. $n = 129$, mean rank = 128.16, ag. exp. $n = 158$, mean rank = 156.93, Mann Whitney $U = 8147.5$, $Z = -2.994$, $p = 0.003$). Students with agricultural experience answered the (two) questions on habitat preferences of RGSs and the average number of young in each litter correctly more often than those without agricultural experience (Figures 7 and 8).

Adults with agricultural experience correctly answered significantly more knowledge-based questions than students with agricultural experience (adults $n = 304$, mean rank = 245.34, students $n = 158$, mean rank = 204.87, Mann Whitney $U = 19808.5$, $Z = -3.147$, $p = 0.002$). When comparing adults and students with agricultural experience, two questions, number of litters per year and age of reproduction, were answered correctly more often by adults (Figure 9 and 10). Knowledge questions regarding RGS seed storage and hawk consumption of RGSs were answered incorrectly by both populations (correct answer was not selected most often among choices provided). Adults felt less confident in both cases selecting “don’t know” more frequently than the students (Figure 11 and 12). Similarly, adults were more likely than students to select “don’t know” as an option, even though both populations picked the correct answer most often (72% students, 73% adults). Regarding habitat of RGSs, adults selected “don’t know” more often than students (Figure 13).

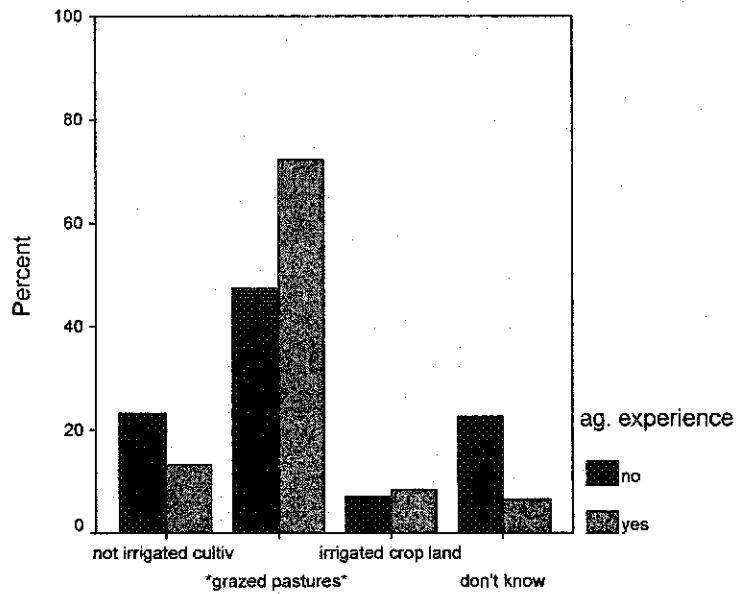


Figure 7: Responses to RGS habitat from students with (n=158) and without (n=129) agricultural (ag.) experience. $\chi^2=24.948$, $df=3$, $p<0.001$. *Grazed pastures* signifies the correct answer.

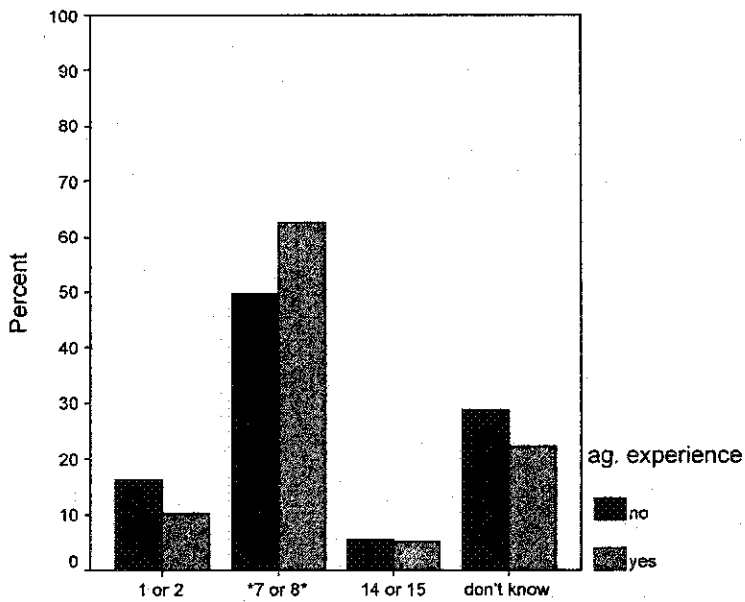


Figure 8: Responses to the average number of young in a RGS litter from students with (n=158) and without (n=129) agricultural (ag.) experience. $\chi^2=5.438$, $df=3$, $p=0.142$. *7 or 8* signifies the correct answer.

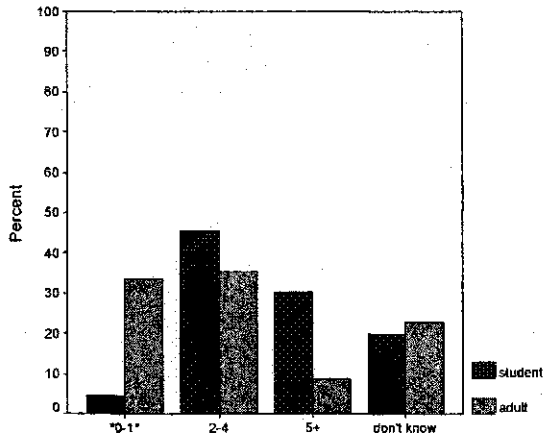


Figure 9: Responses to the number of litters female RGSs have per year from adults (n=304) and students (n=158) with agricultural experience. $\chi^2=71.638$, $df=3$, $p<0.001$. *0-1* signifies the correct answer.

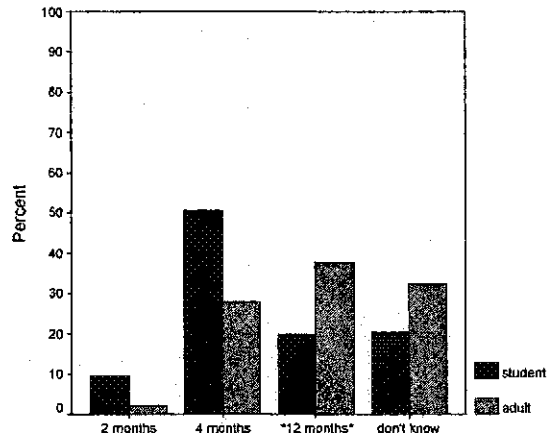


Figure 10: Responses to RGS age of reproduction from adults (n=304) and students (n=158) with agricultural experience. $\chi^2=44.112$, $df=3$, $p<0.001$. *12 months* signifies the correct answer.

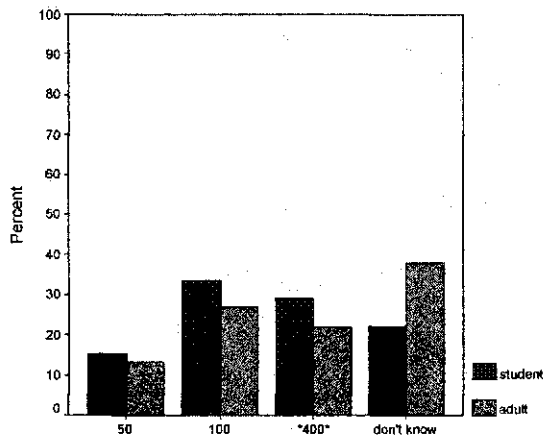


Figure 11: Responses to how many RGSs a family of hawks can consume from adults (n=304) and students (n=158) with agricultural experience. $\chi^2=12.346$, $df=3$, $p=0.006$. *400* signifies the correct answer.

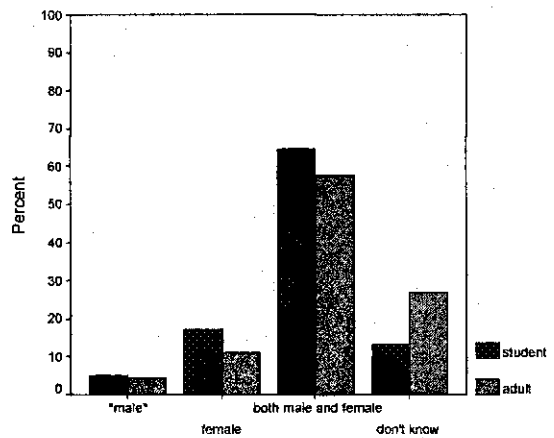


Figure 12: Responses to the sex that stores seeds in RGSs from adults (n=304) and students (n=158) with agricultural experience. $\chi^2=12.464$, $df=3$, $p=0.006$. *Male* signifies the correct answer.

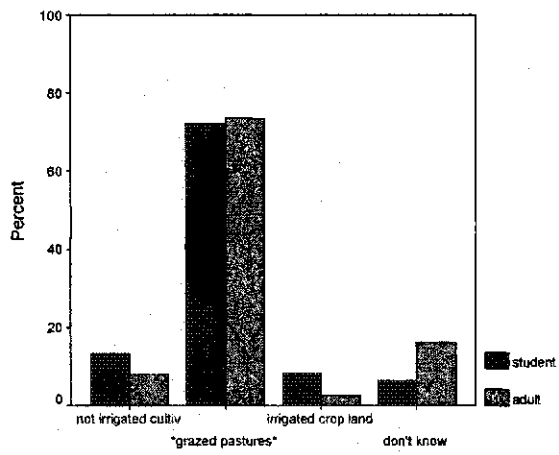


Figure 13: Responses to RGS habitat from adults (n=304) and students (n=158) with agricultural experience. $\chi^2=18.094$, $df=3$, $p<0.001$. *Grazed pastures* signifies the correct answer.

When asked about the yearly consumption of RGSs by a ferruginous hawk family, neither population picked the correct answer most often, but adults were more likely to admit that they did not know (52%). Students appeared more likely to risk the incorrect answer rather than choosing “don’t know.”

Adults and students without agricultural experience did not differ in the number of questions that they answered correctly. Adults and students without agricultural experience did differ in one of the knowledge questions presented. Students knew the answer to the numbers of RGSs that can be consumed by a family of hawks more often than adults (Figure 14), and just over half of the adults picked “don’t know” as their answer.

3.2.3 Student-student and student-adult differences in RGS management preferences

A comparison of students with and without agricultural experience shows that those with agricultural experience preferred lethal management methods for all areas listed, including national parks (Table 21). Students without agricultural experience preferred alternative or preservationist-oriented management practices in all areas listed.

When comparisons were statistically possible between students and adults with agricultural experience, they showed that students preferred preservationist management

surrounding the city whereas adults preferred lethal management (Table 22). Also, students preferred alternative management methods in city parks, whereas adults preferred lethal management.

Comparisons between student and adult populations with no agricultural experience showed only one difference - the majority of both students and adults preferred decreasing RGS numbers on cropland but more adults than students were in agreement with maintaining or increasing current RGS numbers (Table 23).

Table 21 Management preferences from students with and without agricultural experience

Area to Manage	Agricultural Experience			No Agricultural Experience			Chi ²	df	p
	1	2	3	1	2	3			
City	36.5%	45.5%	17.9%	17.3%	52.8%	29.9%	14.316	2	0.001 n=283
Lawns	53.9%	37.7%	8.4%	37.6%	54.4%	8%	8.229	2	0.016 n=279
Outskirts of city	54.7%	14%	31.3%	24.6%	19%	56.3%	26.210	2	<0.001 n=276
Pastures	79.4%	10.3%	10.3%	49.6%	30.1%	20.3%	27.874	2	<0.001 n=278
Cropland	80%	14.2%	5.8%	56.3%	39.8%	3.9%	24.103	2	<0.000 n=283
Rural areas	60%	20.6%	19.4%	28.2%	24.2%	47.6%	32.755	2	<0.001 n=279
National Parks	22.9%	30.7%	46.4%	9.4%	26.6%	64.1%	12.003	2	0.002 n=281

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 22 Differences between management preferences by students and adults with agricultural experience.

Area to Manage	Students			Adults			Chi ²	df	p
	1	2	3	1	2	3			
City parks	37%	46%	17%	59%	28%	13%	20.335	2	<0.001 n=442
Outskirts of city	55%	14%	31%	62%	18%	20%	6.788	2	0.034 n=428

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 23 Preferences to increase or decreasing RGSs between adults and students

Area to Manage	Students		Adults		Chi ²	df	p
	1	2	1	2			
Cropland	No Ag.exp 96%	No Ag.exp 4%	No Ag.exp 83%	No Ag.exp 17%	10.53	1	0.001
Outskirts of city	ag.exp 69%	ag.exp 31%	ag.exp 80%	ag.exp 20%	6.675	1	0.010

1=management practice that will decrease or remove RGS numbers

2=management practice that will increase or maintain current numbers of RGS

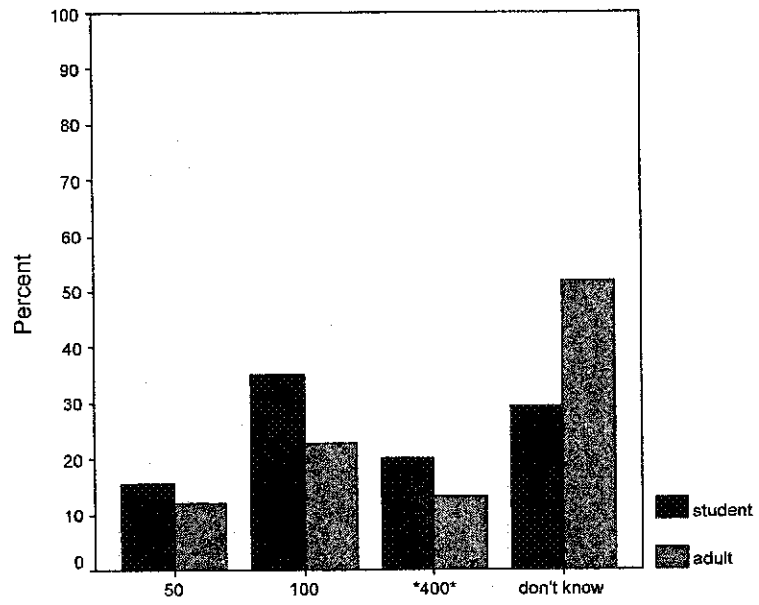


Figure 14: Responses to how many RGSs a family of hawks can consume from adults (n=83) and students (n=129) without agricultural experience. $\chi^2=10.814$, $df=3$, $p=0.013$. *400* signifies the correct answer.

3.3 Gender differences in attitudes toward RGSs for the adult population

3.3.1 Rural people

Attitudes of rural males and females differed overall (male $n = 126$, mean = -3.38, female $n = 32$, mean = 0.06, $t = 3.253$, $df = 40.993$, $p = 0.002$, standard error difference = 1.059) (df has been adjusted to correct for unequal variances), with women displaying a more positive attitude than men. Women disagreed more than men with trapping and shooting RGSs as a recreational pursuit. Women agreed more than men that ferruginous hawks depend on RGSs for survival and that burrowing owls depend on RGSs for survival (Table 24).

3.3.2 Those with agricultural experience

For those with agricultural experience, women expressed significantly more positive attitudes toward RGSs than men (male $n = 204$, mean = -2.11, female $n = 89$, mean = 1.84, $t = -5.983$, $df = 291$, $p < 0.001$, standard error difference = 0.661). These two groups also differed in their levels of agreement or disagreement with 7 out of 9 attitudinal statements (Table 25). Unlike men, women were more likely to agree that RGSs bring a western feel to an area and that black widow spiders use RGS burrows for shelter. Women disagreed with trapping and shooting RGSs as an enjoyable pastime, whereas men agreed.

Table 24 Gender (male n=129-131, female n=33) differences in attitudes for farm/ranch adults.

Statement	Male	Female	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-0.37	-0.67	0.279	3.723	50	0.001
Ferruginous hawks directly depend on RGSs for survival	0.27	0.73	0.188	2.453	162	0.015
Burrowing owls directly depend on RGSs for survival	-0.1	0.42	0.189	2.77	161	0.006
Total Score	-3.38	0.06	0.912	3.777	156	<0.001

Table 25 Gender (male n=208-211, female n=90) differences in attitudes for adults with agricultural experience

Statement	Male	Female	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
RGSs give a traditional Western feel to the area	-0.09	0.44	0.155	3.132	297	0.002
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-0.11	1.1	0.177	6.818	297	<0.001
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-1.55	-1.07	0.13	3.702	134	<0.001
Ferruginous hawks directly depend on RGSs for survival	0.34	0.70	0.117	3.090	294	<0.001
Burrowing owls directly depend on RGSs for survival	0.07	0.46	0.116	3.316	297	0.001
RGSs should be protected	-1.37	-0.71	0.15	4.412	139	<0.001
Black widow spiders use RGS burrows for shelter	-0.09	0.16	0.101	2.436	296	0.015
Total Score	-2.11	1.84	0.661	5.983	291	<0.001

On average, women disagreed less strongly than men with the hypothetical scenario of spending equal amounts of money on RGS protection as on burrowing owl protection.

On average, women believed more intensely than men that ferruginous hawks and burrowing owls depend on RGSs for survival. Women disagreed less strongly than men with the statement that RGSs should be protected.

3.3.3 Urban people

Overall, urban men held less positive attitudes than urban women (male $n = 87$, mean = 1.37, women $n = 82$, mean = 4.20, $t = 3.858$, $df = 167$, $p < 0.001$, standard error difference = 0.733). Men and women from the city differed in their evaluation of RGS protection. On average, both men and women disagreed with protecting RGSs but women disagreed less intensely. On average, women disagreed more intensely with recreational trapping and shooting than did men. Again, both men and women disagreed with spending equal amounts of money on RGS protection as on burrowing owls, but women were less intense in their disagreement (Table 26).

3.3.4 Those with no agricultural experience

Women had an overall attitude score that was significantly more positive when compared to the male population (male $n = 37$, mean = 1.30, female $n = 43$, mean = 4.63, $t = -3.403$, $df = 78$, $p = 0.001$, standard error difference = 0.979). Among those with no agricultural experience, both women and men disagreed with trapping/shooting RGSs as

an enjoyable recreational activity, but women were much more opposed to this behaviour than were men (Table 27). Women and men were on opposing sides of the scale in relation to RGS protection, although women were closer to the neutral point on the scale.

Table 26 Gender (male n=89, female n=82-84) differences in attitudes for adults from the city

Statement	Male	Female	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-0.52	-1.56	0.18	5.794	153	<0.001
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-0.94	-0.49	0.176	2.585	171	0.011
RGSs should be protected	-0.61	-0.07	0.17	3.136	169	0.002
Total Score	1.37	4.20	0.735	3.848	163	<0.001

Table 27 Gender (male n=37, female n=45,43 respectively) differences in attitudes for adults with no agricultural experience

Statement	Male	Female	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	-0.73	-1.67	0.26	3.589	53	0.001
RGSs should be protected	-0.51	0.02	0.24	2.277	78	0.026
Total score	1.30	4.63	0.974	3.419	77	0.001

Table 28 Differences in perceiving RGSs as problem animals between adult males (n=83) and females (n=69) from the city.

RGS contributions to problems	% Not a problem	% Minor problem	% Moderate Problem	% Major problem	Chi ²	<i>df</i>	<i>p</i>
Deplete crops							
Male	10	26	40	24	10.788	3	0.013
Female	4	19	27	49			

3.4 Gender differences within the adult population for the perceived severity of problems caused by RGSs

Overall problem scores were similar for men and women when compared according to rural versus urban or agricultural versus no agricultural experience. Those from rural areas did not differ by gender in rating the seriousness of each potential problem caused by RGSs. Women and men with agricultural experience were similar in their evaluation of ground squirrel problems. Urban men and women differed significantly in attributing the seriousness of one problem. Almost half of the women believed that crop depletion by RGSs was a major problem, whereas the “moderate problem” category held the highest percentage for the male population (Table 28). Those with no agricultural experience did not differ by gender in their perceptions of RGSs as problem animals for any perceived problem.

3.5 Gender differences within the adult population in knowledge about RGS biology

Overall knowledge scores between men and women without agricultural experience did not differ; however, for those groups with agricultural experience, men displayed significantly higher knowledge scores than did women (male $n = 211$, mean rank = 158.94, women $n = 90$, mean rank = 132.39, Mann Whitney $U = 7820$, $Z = -2.461$, $p = 0.014$). Rural men and women obtained similar overall scores, but urban men displayed higher overall knowledge scores than urban females (male $n = 89$, mean rank = 95.30, female $n = 83$, mean rank = 77.06, Mann Whitney $U = 2910$, $Z = -2.43$, $p = 0.015$).

Figures 15-22 display significant differences between the choices of all four categories in each of the knowledge questions whereas Tables 29 and 30 show correct versus incorrect responses in each of the knowledge questions. Women and men from rural areas held similar levels of knowledge, with the exception of the reproductive age of RGS females, where men chose the correct option more often (Figure 15) and the most common cause of natural mortality of RGSs where women chose correctly more often (Figure 16). Men with agricultural experience answered three questions correctly more often than women: number of litters per year per female (Figure 17), number of offspring per female, and the reproductive age of RGS females. As for the rural sample, women with agricultural experience answered the question about the most common cause of natural mortality correctly more often than men (Table 29, Figure 18).

Women and men from urban areas were similar in levels of knowledge with the exception of two questions. Number of litters per year per female (Figure 19) and reproductive age of female RGSs (Table 30) were answered correctly more often by men than women, and women picked "don't know" more often than men for both questions. Although both sexes in the urban population did not know the correct answer to the number of RGSs consumed by a family of ferruginous hawks, women were more likely to report not knowing the correct answer than men (Figure 20). Women and men with no agricultural experience did not differ in any of the knowledge questions.

Table 29 Differences in percentages of knowledge questions answered correctly by adult men (n=211) and women (n=90) with agricultural experience.

Knowledge questions	% answered correctly Male	% answered correctly Female	Chi ²	df	p
Number of litters in a year	41	18	14.872	1	<0.001
Number of offspring in litter	69	49	11.175	1	0.001
Reproductive age	46	18	21.388	1	0.001
Cause of mortality	69	88	11.544	1	0.001

Table 30 Percentage of knowledge questions answered correctly by male (n=89) versus female (n=83-84) adult respondents from the city

Knowledge questions	% answered correctly Male	% answered correctly Female	Chi ²	df	p
Number of litters in a year	18	5	7.382	1	0.007
Reproductive age	33	16	6.663	1	0.010

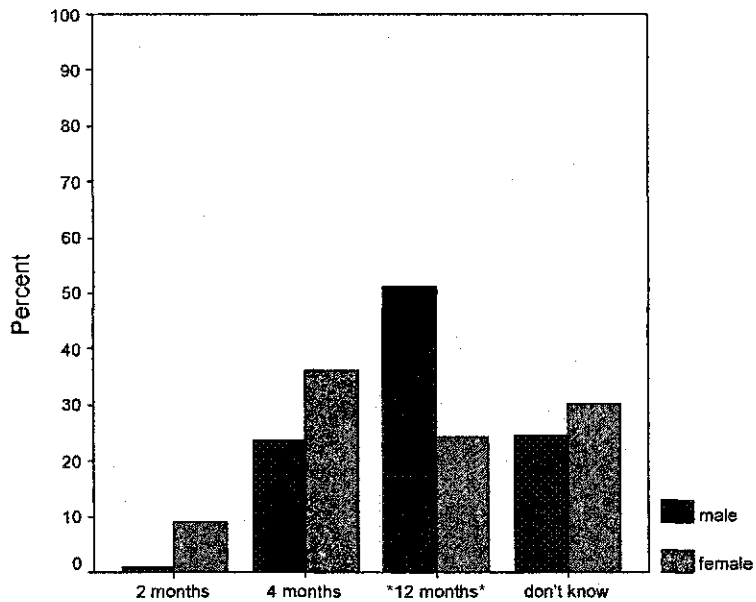


Figure 15: Gender differences (male n=131, female n=33) in responses to RGS age of reproduction for the rural adult population. $\chi^2=13.643$, $df=3$, $p=0.003$. *12 months* signifies the correct answer.

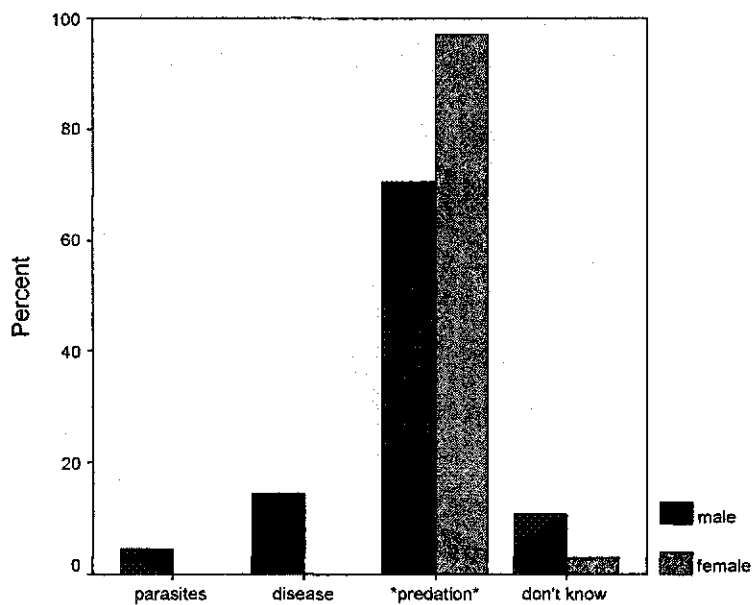


Figure 16: Gender differences (male n=131, female n=33) in response to the natural cause of RGS mortality for the rural adult population. $\chi^2=10.480$, $df=3$, $p=0.015$. *Predation* signifies the correct answer.

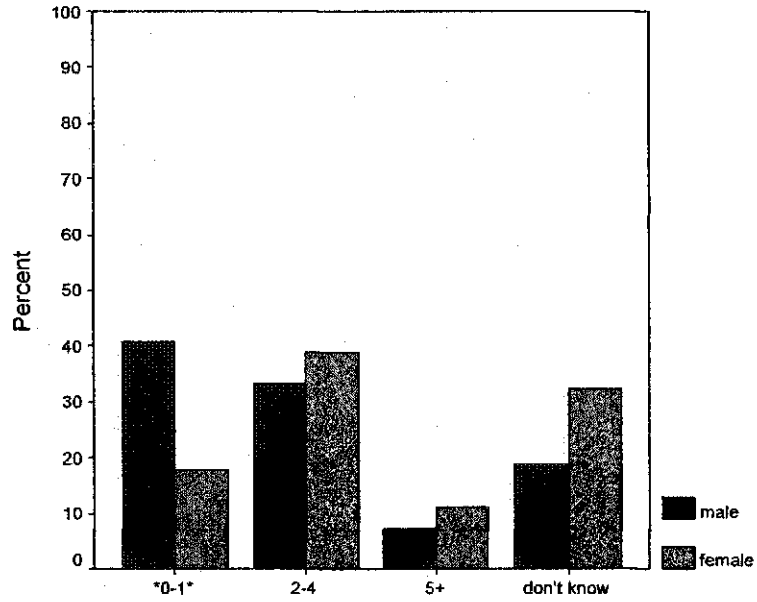


Figure 17: Gender (male n=211, female n=90) differences in response to the number of litters female RGSs have per year between adults with agricultural experience. $\chi^2=16.482$, $df=3$, $p=0.001$. *0-1* signifies the correct answer.

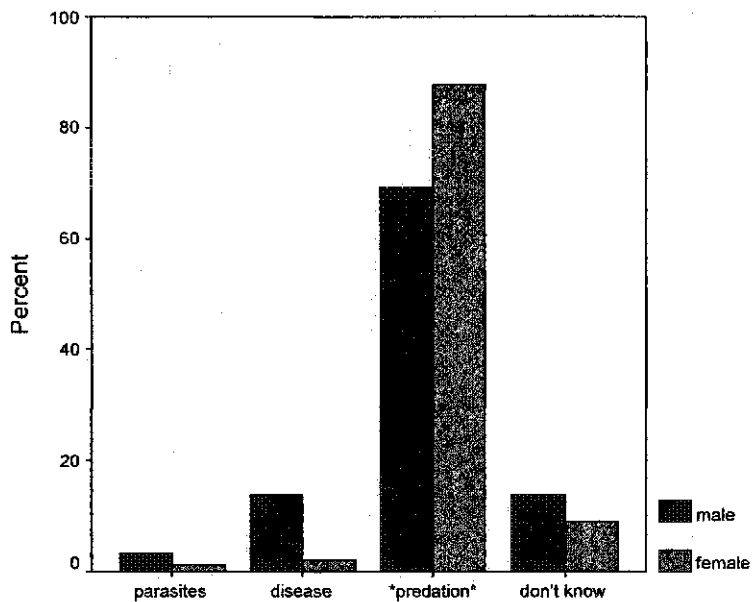


Figure 18: Gender (male n=211, female n=90) differences in response to natural causes of RGS mortality between adults with agricultural experience. $\chi^2=13.412$, $df=3$, $p=0.004$. *Predation* signifies the correct answer.

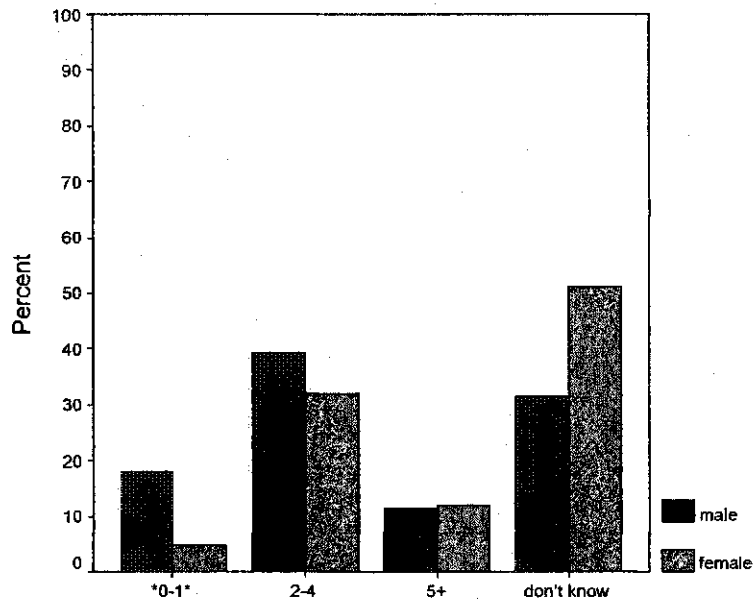


Figure 19: Gender (male n=89, female n=84) differences in response to the number of litters female RGSs have per year between adults from the urban population. $\chi^2=11.266$, $df=3$, $p=0.010$. *0-1* signifies the correct answer.

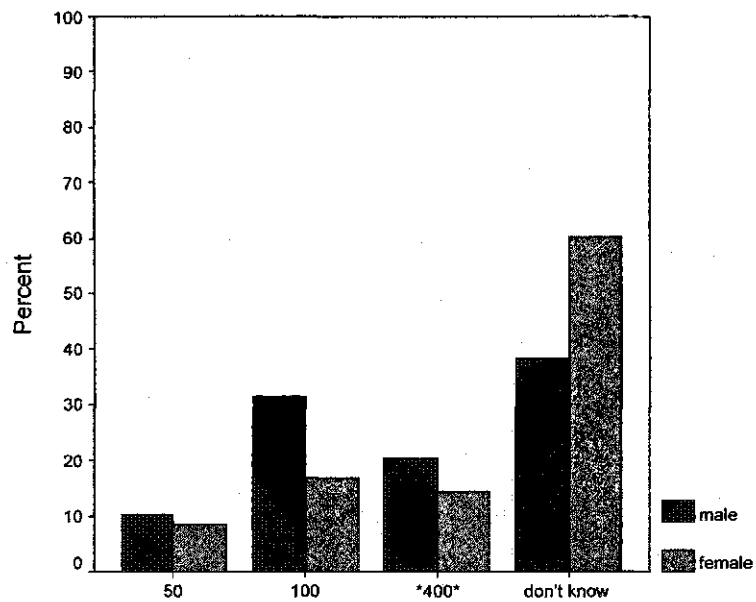


Figure 20: Gender (male n=89, female n=83) differences in response to how many RGSs a family of hawks can consume between adults from the urban population. $\chi^2=8.966$, $df=3$, $p=0.030$. *400* signifies the correct answer.

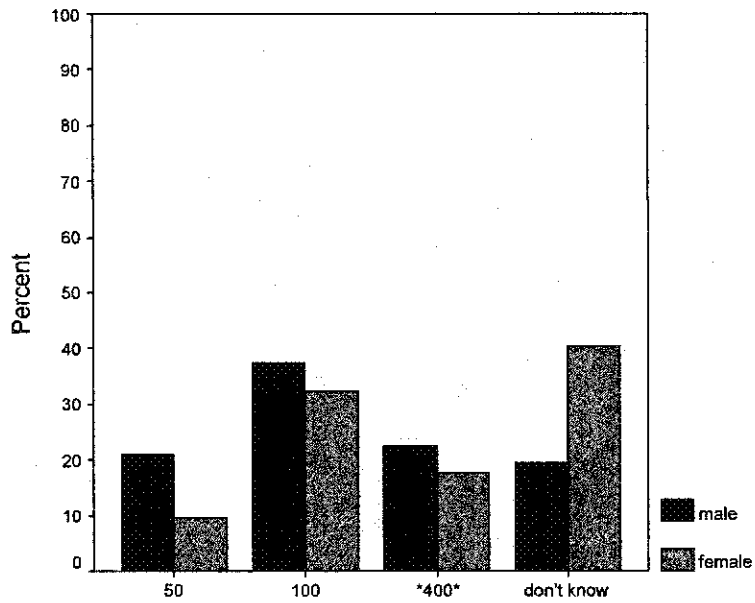


Figure 21: Gender (male n=67, female=62) differences in response to how many RGSs a family of hawks can consume between students with no agricultural experience. $\chi^2=7.979$, $df=3$, $p=0.046$. *400* signifies the correct answer.

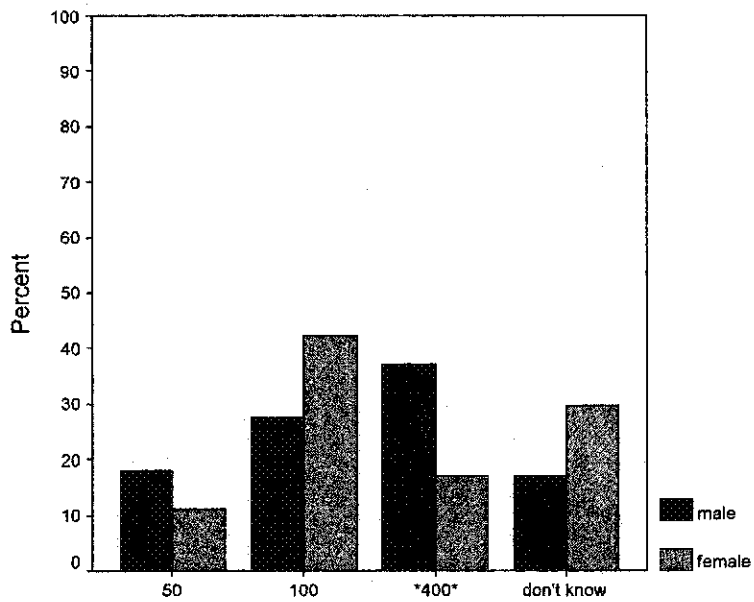


Figure 22: Gender (male n=94, female n=64) differences in response to how many RGSs a family of hawks can consume between students with agricultural experience. $\chi^2=11.690$, $df=3$, $p=0.009$. *400* signifies the correct answer.

3.6 Gender differences in the adult population for RGS management preferences

3.6.1 Rural people

Rural men and women responded differently when asked about management techniques in certain areas. Both men and women held the highest percentages for choosing lethal management in city parks. However, women picked alternative management methods more often than men (Table 31). Men preferred lethal management in national parks, whereas women favoured alternative management practices.

3.6.2 Those with agricultural experience

The majority of men preferred lethal management in city parks and outskirts of the city, whereas women were more evenly distributed over the different options presented for these areas (Table 32). Men were far more likely to agree with lethal management in pastures than women (84% to 66% respectively), who agreed with much less intensity. Although both sexes preferred lethal management on cropland, more women than men picked alternative and preservationist methods. Women strongly preferred preservation management in national parks, whereas twice as many men than women preferred lethal management in national parks. Men were almost equally distributed between lethal and preservation management practices in national parks (39% lethal to 40% preserve) (Table 32). Women preferred maintaining or increasing current

RGS numbers in city parks, cropland, and in rural areas whereas men favoured decreasing them (Table 33).

Table 31 Management preferences between adult men and women from farms or ranches

Area to Manage	Male			Female			Chi ²	df	p
	1	2	3	1	2	3			
City	77%	16%	7%	48%	36%	16%	9.917	2	0.007 n=male 122, female 21
National Parks	46%	19%	35%	23%	35%	42%	6.850	2	0.033 n=male 119, female 31

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 32 Management preferences between adult men (n=191-207) and women (n=84-89) with agricultural experience

Area to Manage	Male			Female			Chi ²	df	p
	1	2	3	1	2	3			
City	68%	23%	9%	38%	38%	24%	22.925	2	<0.001
Outskirts of city	68%	14%	18%	50%	25%	25%	8.747	2	0.013
Pastures	84%	10%	6%	66%	24%	10%	12.979	2	0.002
Cropland	88%	9%	3%	67%	23%	10%	18.529	2	<0.001
Rural areas	75%	14%	11%	52%	23%	25%	15.107	2	0.001
National Parks	39%	21%	40%	18%	29%	53%	11.976	2	0.003

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 33 Management preferences to increase or decrease RGSs in selected areas by adult men (n=200-207) versus women (n=84-87) with agricultural experience

Area to Manage	Male		Female		Chi ²	df	p
	1	2	1	2			
City	91%	9%	76	24	11.194	1	0.001
Cropland	97%	3%	90%	10%	5.771	1	0.016
Rural areas	88%	12%	75%	25%	7.968	1	0.005

1=management practice that will decrease or remove RGS numbers

2=management practice that will increase or maintain current numbers of RGS

3.6.3 Urban people

Women preferred alternative and/or preservation management methods more often than did men in the following areas: city parks, pastures, and cropland (Table 34). More specifically, women preferred preservation in city parks and green spaces, whereas men preferred alternative or lethal management in these areas. Men preferred lethal management in pastures more often than did women and men almost doubled women in their preference for lethal management on cropland. In comparison, women preferred increasing or maintaining RGS numbers more often than men did in city parks and in national parks (Table 35).

3.6.4 Those with no agricultural experience

Women most preferred preservationist management in the outskirts of the city, whereas men most preferred lethal management (Table 36). Regarding cropland, women preferred alternative management and men preferred lethal management. The majority of women wanted RGS numbers to remain constant or to increase in the outskirts of the city, whereas men wanted them lethally managed (Table 37). More men than women wanted RGSs lethally managed in city parks and green spaces.

Table 34 Management preferences for adult men (n=87-88) and women (n=82-84) from the city

Area to Manage	Male			Female			Chi ²	df	p
	1	2	3	1	2	3			
City	36%	49%	15%	21%	40%	39%	13.735	2	0.001
Pastures	52%	31%	17%	32%	44%	24%	7.133	2	0.028
Cropland	60%	31%	9%	34%	46%	20%	12.214	2	0.002

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 35 Management preferences to increase or decrease RGSs in selected areas by adult men (n=87-88) versus women (n=82) from the city

Area to Manage	Male		Female		Chi ²	df	p
	1	2	1	2			
City	85%	15%	61%	39%	12.826	1	<0.001
National Parks	42%	58%	26%	74%	5.361	1	0.021

1=management practice that will decrease or remove RGS numbers

2=management practice that will increase or maintain current numbers of RGS

Table 36 Management preferences between adult men (n=36) and women (n=43,45) without agricultural experience

Area to Manage	Male			Female			Chi ²	df	p
	1	2	3	1	2	3			
Outskirts of city	42%	25%	33%	7%	26%	67%	14.744	2	0.001
Cropland	56%	36%	8%	24%	53%	22%	8.761	2	0.013

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 37 Management preferences to increase or decrease RGSs in selected areas by adult men (n=36, 37) versus women (n=43, 45) without agricultural experience

Area to Manage	Male		Female		Chi ²	df	p
	1	2	1	2			
City	78%	22%	56%	44%	4.703	1	0.030
Outskirts of city	67%	33%	33%	67%	9.132	1	0.003

1=management practice that will decrease or remove RGS numbers

2=management practice that will increase or maintain current numbers of RGS

3.7 Gender differences in the student population for those with no agricultural experience

Overall attitude scores were similar for male and female students with agricultural experience. Only one significant difference was found in attitudes for students with no agricultural experience (Table 38); females disagreed with trapping and shooting RGSs as a recreational activity, whereas men agreed slightly. Students differed by gender in their perception of the level of one problem: males thought that plague was “not a problem” or a “minor problem” (57%) whereas females thought that plague was a “major” or “moderate problem” (74%) in relation to RGSs (Table 39).

Males and females without agricultural experience were similar in their knowledge scores. Neither sex knew the correct answer regarding the numbers of RGSs consumed by a family of hawks in one season, but females answered “don’t know” more often than men (Figure 21).

The majority of females favoured alternative or preservation-oriented management methods in city parks, on residential lawns and on cropland, whereas men preferred a combination of lethal and alternative methods for city parks and residential lawns. The majority of males favored lethal management on cropland (Table 40). A vast majority (72%) of females suggested preservationist-oriented management in national parks, whereas just over 55% of males preferred preservation and close to 45% preferred decreasing RGS numbers through lethal traditional methods or alternative control methods.

Table 38 Gender differences in attitudes in the student population without agricultural experience (n=129)

Statement	Male average	Female average	Standard error difference	t	df	p
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	0.03	-1.21	0.247	5.040	118	<0.001

Table 39 Gender differences in the perception of problems attributed to RGSs by students without agricultural experience (n=129)

RGS contributions to problems	% Not a problem	% Minor problem	%Moderate Problem	% Major problem	Chi ²	df	p
Plague							
Male	33	24	20	22	11.778	3	0.008
Female	11	15	35	39			

Table 40 Management preferences between gender (male n=64-65, female n=59-60) in students without agricultural experience

Area to Manage	Male			Female			Chi ²	df	p
	1	2	3	1	2	3			
City	26%	51%	23%	5%	58%	37%	10.874	2	0.002
Lawns	47%	50%	3%	25%	61%	14%	8.646	2	0.013
Cropland	68%	32%	0%	42%	50%	8%	11.639	2	0.003+
National Parks	17%	28%	55%	2%	27%	72%	8.885	2	0.012

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

+2 cells have less than 5

3.8 Gender differences in the student population for those with agricultural experience

3.8.1 Attitudes toward RGSs

Males with agricultural experience displayed negative attitudes when compared to females with agricultural experience (male $n = 94$, mean = -1.98 , female $n = 64$, mean = 0.77 , $t = 3.247$, $df = 156$, $p = 0.001$, standard error difference = 0.845). Females and males were on opposite ends of the rating scale for the question about trapping or shooting RGSs as enjoyable. On average, females were between “neutral” and “somewhat disagree” and males “somewhat” to “strongly agreed” that trapping and shooting RGSs is an enjoyable recreational activity. Males and females disagreed with allocating equal funds to RGSs and burrowing owl rescue efforts as well as on protecting RGSs. Females held significantly weaker (less intense) attitudes toward the two statements than males (Table 41). No differences between males and females regarding problem perception were found.

3.8.2 Knowledge about RGS biology

Overall knowledge scores were similar when comparing students by gender. The numbers of RGSs consumed by a family of ferruginous hawks was answered correctly more often by males with agricultural experience than by females with agricultural experience (Table 42). Also, a higher percentage of females answered “don’t know” to this question (Figure 22).

Table 41 Gender (male n=94, female n=64) differences in attitudes in the student population with agricultural experience

Statement	Male	Female	Standard error difference	<i>t</i>	<i>df</i>	<i>p</i>
Trapping and/or shooting RGS are enjoyable recreational activities (for me)	1.23	-0.25	0.218	6.803	110	<0.001
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGS	-1.47	-0.72	0.186	4.034	98	<0.001
RGSs should be protected	-1.11	-0.56	0.185	2.974	156	0.003

Table 42 Percentage of knowledge questions answered correctly by student males (n=94) versus females (n=64) with agricultural experience

Knowledge questions	% answered correctly	% answered correctly	Chi ²	<i>df</i>	<i>p</i>
	Male	Female			
Hawks consume	37	17	7.414	1	0.006

3.8.3 Management preferences

Males most preferred lethal management in city parks and on residential lawns whereas females preferred alternative management methods in both areas (Table 43). On city outskirts, the majority of males prefer lethal management whereas females were split between lethal and preservation management. Males prefer to manage RGSs in national parks using traditional lethal techniques (30%), although out of all options presented the majority of men and women prefer preservation methods, 41% and 54%, respectively. The option to decrease RGS numbers in city parks, residential lawns, and the outskirts of the city was strongly supported by both sexes, but females are less intense, as indicated by the lower percentage, in their support than males for these specific areas (Table 44).

Table 43 Management preferences between gender (male n=92-94, female n=58-62) for students with agricultural experience

Area to Manage	Male			Female			Chi ²	df	p
	1	2	3	1	2	3			
City	47%	40%	13%	21%	53%	26%	11.721	2	0.003
Lawns	70%	26%	4%	31%	55%	14%	23.076	2	<0.001
Outskirts of city	63%	12%	25%	41%	17%	42%	6.810	2	0.033
National Parks	30%	28%	41%	12%	34%	54%	7.511	2	0.023

1=lethal management (poison, fumigation, and shooting)

2=alternative management (capture and relocation, introduction of predators)

3=preservation (leaving them in areas, introduction of more RGS)

Table 44 Management preferences to increase or decrease RGSs between gender for students with agricultural experience (n=150-156)

Area to Manage	Male		Female		Chi ²	df	p
	1	2	1	2			
City	87%	13%	74%	26%	4.314	1	0.038
Lawns	96%	4%	85%	15%	4.955	1	0.026
Outskirts of city	75%	25%	59%	41%	4.436	1	0.035

1=management practice that will decrease or remove RGS numbers

2=management practice that will increase or maintain current numbers of RGS

3.9 U of L web-posted qualitative analysis

The following analysis is based on a collection of qualitative information solicited from the University of Lethbridge community via the University website. It was designed to directly question management methods and perceptions toward RGSs on the University of Lethbridge campus. The purpose of this survey was to reveal, explore and confirm the spectrum of beliefs about RGSs, and to validate some of the assumptions upon which this study is based. These assumptions are:

- 1) RGSs are considered to be pests, so inhumane treatment is seen to be acceptable.
- 2) Polarized attitudes and behaviours are often exhibited by residents of the prairies (some like RGSs, some hate RGSs).
- 3) RGSs are believed to be overpopulated.
- 4) RGSs are seen to cause extensive damage (both aesthetic and economic).
- 5) RGSs are believed to be a health hazard to humans.

Although the results cannot be used to generalize to people across the prairies, they provide some insight into different perspectives on the RGS. Qualitative information was gathered from written comments provided by respondents. The survey consisted of five brief questions:

Should RGSs be killed on campus?

Should they be killed if they pose a health threat to humans?

To control RGS numbers, do you agree with the use of poisoned grain?

Fumigants?

Please suggest other management methods (open ended question).

Additional comments regarding this issue (open ended question).

The majority (63%) of respondents (n = 227) disagreed with killing RGSs on campus but those that agreed (37%) were more forthright making additional written comments (60%) regarding the issue. The majority of respondents opposing lethal management on campus made comments that could be categorized as related to humane and ethical treatment of animals. Ecologically-based arguments were also cited. Poisoning methods to manage RGSs were especially opposed by respondents who felt these methods could have adverse ecological effects. People against lethal management preferred capture and relocation as a management method. Alternative more “natural” methods of control were also suggested, such as increasing or encouraging natural predators and experimenting with natural deterrents. Several respondents argued that RGSs are native and have a long ecological history; since they “were here before us,” they should therefore be given consideration and have a right to live here. Respondents also argued that RGSs are an important part of the prairies and are a part of the natural landscape. Some suggested allocating protection to RGSs. Those against lethal management of RGSs on campus justified their position through ethical or humanistic arguments, some of which were also ecologically based.

Among those that supported killing RGSs on campus, 41% agreed with lethal management because RGSs pose a health risk on campus (Appendix C). That leaves more than half with alternate arguments, many of which were based on the aesthetic

degradation of campus grounds or on the argument that RGSs are pests. Health risks included the spread of disease, disease reservoirs, students breaking their legs, or RGSs as the cause of car accidents because they run onto the road. As expected, respondents expressed polarized attitudes toward RGSs.

A broad spectrum of lethal management was suggested by those in favour of killing RGSs on campus (poison, gas, bow and arrow, shooting, clubbing, running them over with motorized vehicles, and predator introduction). Several comments were related to trapping, shooting or clubbing as enjoyable recreational pastimes. Several respondents identified themselves as farmers or from rural areas. Overpopulation and RGS numbers being “out of control” were also concerns mentioned by several respondents. A shooting derby and monetary allocation for each RGS shot was recommended. Cropland and pasture damage was a concern even though U of L does not have either of these habitats. Again, these responses were completely generated by respondents and were not provided in predetermined categories. Those who supported lethal management of RGSs on campus viewed RGSs as pests that are a health threat or as causing aesthetic damage to university grounds.

Rural-urban differences in how RGSs are perceived were mentioned by some of the respondents through written comments. One respondent suggested that the negative attitudes displayed toward RGSs are due to a high “rural” population at the University. Results found in this small sample were similar to those from my larger survey of the city

of Lethbridge and surrounding rural areas, confirming and validating the choice of statements for the questionnaire.

CHAPTER 4

Discussion

4.0 Discussion

All hypotheses but one were supported in this study. Rural people did perceive RGSs more negatively, as more of a problem, and supported lethal management practices more often than urban people. Generally, women were more tolerant of RGSs, held more positive attitudes, and supported lethal management less often and less intensely than men. Rural people and those with agricultural experience did have more accurate knowledge of RGS biology than urban people and those with little agricultural experience. One unexpected outcome from these analyses, however, revealed that those who knew the extent of RGS interconnectedness to other species also held a more positive attitude toward them. The hypothesis that students would hold a more pro-environmental orientation and therefore would display more positive attitudes and support alternative management practices than the adult population was not supported.

4.1 Attitudes, management and education

Heberlien (1989) insists that studying attitudes is important for “environmental managers because attitudes provide 1) information about public support and beliefs, 2) information about goals necessary to set standards, and 3) information about the current and future behaviour of relevant parties” (p. 37). In order to gain this information and to effectively implement any resource management program, a variety of social scientists

(e.g. historians, political scientists, psychologists, economists, sociologists, geographers) are needed to provide the necessary holistic outlook. Furthermore, the study of demographic characteristics and attitudes can lead to the development of a more effective audience-targeted education program. Jacobson and Marynowski (1997) reiterate that public education can be used as a tool to improve behaviour toward nature, reduce vandalism, and influence policies (from Cable & Knudson 1983, cited in Jacobson 1990). The demographic characteristics linked to attitudes in this study provide a number of challenges for education. These are discussed in detail in the education segment on management programs.

4.2 Beliefs and attitudes that are most likely to influence behaviours

Beliefs that are formed from personal experience are resistant to change, even when opposing information is presented. Urban people's beliefs regarding RGSs are more loosely defined than rural people's beliefs suggesting more flexibility and acceptance to change when presented with information. Educational programs regarding RGSs would be most effective for this particular demographic group.

Questions that were based on ecology revealed that both rural and urban people selected the neutral option most often, indicating either apathy or lack of knowledge. Rural people were more negative than people from the city overall (although not significantly on all questions) and believed that other animals were less dependent on RGSs.

Strong, intense, salient attitudes are hard to change and persist over time. Such entrenched attitudes present a challenge to future educators and wildlife management personnel who will inevitably be faced with addressing declines in prairie wildlife. The preservation of species in danger of extirpation from the prairies, such as the burrowing owl, swift fox, and black-footed ferret, will continue to pose a challenge to stakeholders involved in wildlife management and preservation. As demonstrated in my study, RGS biology is misunderstood. Ecological knowledge, such as the importance of RGSs in the food web as habitat creators and soil conditioners, needs to be communicated to the general public. As a result, this lack of knowledge presents difficulties for conservation efforts and management. Informal conversations revealed that rural people view those who do not control RGSs on their land as not tending to the land and as being lazy or irresponsible. In addition, the opposing attitudes between rural and urban people on this topic will continue to escalate as urban centres continue to expand into rural areas. If utilitarian and preservationist minded advocates become more vocal and organized regarding the issues surrounding RGSs, government personnel will have to respond.

Through their literature review, Chaiken and Stangor (1987) emphasise that attitude strength and crystallization play a role in the relationship between attitudes and behaviour. However, confidence and certainty in attitudes may also be important contributors to shaping behaviour. For example, when attitude strength is high, consistency of behaviour that corresponds to the attitude also increases. Studies by Reading and Kellert (1993) and Tesser and Schaffer (1990) suggest that direct experience enhances attitude-behaviour response and produces stronger evaluation by respondents.

The results presented in this study support and add credibility to these claims. Again, people from rural areas, who are likely to have direct experience with RGSs, hold strong crystallized attitudes toward RGSs when compared to urban respondents. The rural respondents are more uniform in their support for lethal management and evaluated problems caused by RGSs in similar ways.

Deciding between lethal and non-lethal management techniques requires social acceptance for the methods presented and biological information to develop options (Wittmann et al., 1995). Social, political, economic, and biophysical fields are just some of the perspectives that need to be included in wildlife management (Bath, 1988). McAninch (1993) suggests that intentions and behaviour studies are needed in addition to other forms of ecological research in perceived overpopulated wildlife management. Human dimensions wildlife research is necessary and should be pro-active, not crisis driven (Bath, 1988). In the case of the RGS, social acceptance levels need to be determined so that places where RGSs would be tolerated can be allocated to them and to the species that depend on them.

4.3 Why are RGSs considered pests?

Social constructionist theory can be used as general explanation for how perceptions of wildlife develop within a sub-culture or a demographic group. It seems that in areas where RGSs are most prevalent, which are rural areas, people perceive them most negatively. The negative values and attitudes are reinforced culturally, and through

negatively perceived encounters from living or working in close proximity to RGSs. Those in the agricultural field, for example, feel as if they have to compete for land and crops with the abundant animals. This view is reinforced through interacting with others in their community. This could be explained as a social “milieu” within which similar values, attitudes and eventually behaviours are developed. Social constructionism provides an explanation at the social level for why RGSs are considered to be pests, but value-attitude-behaviour theory provides explanations for individual values, attitudes and behaviours. Consequently, social constructionism provides the setting for the study but will not be discussed in further detail.

Value-attitude-behaviour model provides a context to describe and place these results. Acquired values and attitudes contribute to behaviours such as how RGSs are managed, and are expressed through recreational pursuits that include trapping and shooting RGSs. RGSs are less likely to be viewed as important animals because of the combination of the cultural milieu and personal experiences of rural residents or workers.

4.3.1 Affective responses

To reiterate, value-attitude-behaviour theory holds that strong beliefs may result in affective responses. RGSs contributing to the western feel of an area can be considered an affective statement because it questions the symbolic value of RGSs. Emotional or affective responses are theoretically linked to beliefs. Urban people weakly agreed and rural people weakly disagreed with the statement. These attitudes were not

intense; people did not feel strongly either way. When people were asked if RGSs were native to the prairies, however, intense agreement was expressed from both rural and urban populations. This is a strong, well-defined or salient belief. Although the RGS resided in the prairies prior to European settlement and are admittedly accepted as “native,” they are not considered to be symbolically indicative of the “west.” The definition of “native” is evaluated differently, it seems, than bringing a “western feel to an area.”

Women with agricultural experience agreed more than men that RGSs bring a western feel to an area. Although rural women are exposed to RGS damage, have opportunities to observe damage first hand, and live in a similar cultural milieu as men, they tended to evaluate this affective statement more positively, indicating underlying differences in values and beliefs toward RGSs. Women evaluated the statement more positively than men indicating that they attribute some meaning and significance to RGS presence on the prairies. These results could be explained in part by the demographic information of the population sampled. Rural female respondents were much younger than male respondents and research shows that younger people tend to be more animal rights oriented (Bjerk et al., 1998). Also, the majority of respondents from rural areas were male suggesting that providing information on RGSs was deemed a male preoccupation.

Students agreed less intensely than adults that RGSs are native animals to the prairies. Admitting that RGSs are native may indirectly imply that they deserve some

positive attention due to their ecological significance and due to their close ties to the land, although this logic was not followed among the adult populations.

4.3.2 Problem perceptions

Most people living in southern Alberta should have had numerous direct experiences with RGSs. Urban people probably experience fewer negative encounters with RGSs than rural dwellers. Rural people, especially those involved in agriculture, are exposed to RGSs more often than urban people, and may have witnessed the negative impacts of foraging and burrowing activity closer to their land and dwellings.

Data regarding RGS populations, actual economic damage (crop depletion), and leg injuries caused by RGS burrows to livestock and humans are not known. However, due to biological and ecological similarities between prairie dogs and RGSs, some general overlapping conclusions can be made. In regard to prairie dogs, ranchers perceived financial losses to be much greater than they were and, when confronted with this finding, maintained their position and did not change their mind (Reading & Kellert, 1993). Presence of prairie dogs did not cause a significant reduction in weight gain or in weight loss in steers during wintertime, summer, or annually (O'Meilia et al., 1982). Alberta Agriculture suggests that damage to crops and machinery by RGS burrows and foraging is relatively low for the entire province, but may be high on some individual farms or in specific areas (Bourne, 1999). Conover and Decker (1991) found that there was more concern regarding wildlife damage overall in 1987 than in 1957. This may be

explained by the expansion of agribusiness that maintains an increasingly narrowing margin of loss.

The rural population considered RGSs to be a greater problem than did the urban population. Overall, rural people perceived RGSs negatively compared to urban people. Of all the problems presented, overpopulation and crop depletion were the most intense attitudes held by both rural and urban people. However, rural people viewed overpopulation and crop depletion by RGSs as significantly more of a problem than did urban people. Rural people may have experienced more exposure to damage caused by RGSs and may have been socialized within a culture that reinforces RGS pest status. That RGSs are perceived as problem animals is supported by other research. For example, Zinn and Andelt (1999) found black-tailed prairie dogs were perceived negatively by people who lived in close proximity to prairie dogs. The respondents in that study associated prairie dogs with damage to landscaping, disease and damage to farms more than did the general population; also people living in close proximity to prairie dogs were more likely to view them as unattractive and useless pests (Zinn & Andelt 1999).

Compared to adults, students held similar attitudes toward RGSs, but perceived them to be more of a problem than did adults. One explanation could be that students responded to the survey (consciously or unconsciously) in a way that would support lethal management and justify their agreement with trapping and shooting RGSs for

enjoyment. An alternative hypothesis may be that students simply have less knowledge about RGSs than adults.

Agriculturally-experienced students considered crop depletion and overpopulation to be major problems more often than those without agricultural experience. However, those with agricultural experience will most likely be the people who share their land with RGSs or make current and future management decisions. Therefore aggressive management of RGSs can be expected in the future.

Women with or without agricultural experience did not differ in their overall perception of RGSs as problems. Men from these differing demographic groups did differ in their perception of problems. Women from the city or from farms perceive problems no differently than men from the same areas. Urban women did rate crop depletion as a “major problem”, whereas more men felt it was only a “moderate problem”. Overall, even though RGSs were considered as much of a problem by women as men, women appear to be more tolerant toward RGSs when evaluating statements regarding attitude and management. A possible explanation could be that women are socialized to be less aggressive and more nurturing.

Few people knew that only the males store seeds. People believe both males and females hoard seeds. Because only male RGSs store seeds, misconceptions about seed storing behaviour may indicate that people perceive more crop consumption and damage due to storage behaviour than actually occurs. Underestimating the numbers of RGS

consumed by hawks also indicates that, indirectly, people perceive RGS numbers to be higher than they actually are or that there are fewer predators than previously present to consume them. Misunderstanding the levels of dependence on RGSs as a food source may lead to the perception that, if RGS numbers are not controlled by humans everywhere, their population numbers will explode to uncontrollable numbers. One possible explanation for the negative attitudes toward RGSs could be because of overestimated crop consumption rates. This corresponds with the finding in this study that RGSs are considered a major problem because of perceived excessive crop consumption and overpopulation.

Limited information is available on actual numbers of RGS populations and RGS individuals that act as reservoirs for plague. One source of information suggests that plague and other diseases that could be passed to humans from RGSs are limited to one or two cases in 50 years across the prairies (Roy & Brown, 1943). These numbers are difficult to verify because a variety of wildlife, such as ruminants and rodents other than RGSs, also act as reservoirs for rocky mountain spotted fever, tularemia, and plague by acting as hosts to ticks and fleas that later transfer the diseases to humans. Nevertheless, current incidences of the diseases found in humans that could possibly be traced to RGS reservoirs are minimal. In my study, female students felt that plague was a more serious problem than male students did. Students without agricultural experience saw plague as a "major" or "moderate" problem, whereas adults saw it as "not a problem" or a "minor problem." For adults and students with agricultural experience, students see plague as a "major" or "moderate problem" more often than do adults, who see it as "not a problem"

or a “minor problem.” These misconceptions could be corrected through education programs, and specific results could help target the identified demographic groups in need of further education.

Physical health hazards caused by burrows, such as fractures, may also be attributed to RGSs. The majority of adults evaluated burrows causing bone fractures to livestock and humans as “not a problem” or a “minor problem.” Based on this information, burrows causing fractures cannot be used as part of the explanation for the negative attitudes that exist toward RGSs in the adult population. Future research needs to concentrate on collecting data on actual numbers of fractures to livestock from burrows connected to RGSs. Ranchers with cattle on pastures may feel differently toward this issue than other farmers or feedlot owners and workers.

On the other hand, fractures may be part of the explanation for why students believe RGSs are “problem” animals. Students with agricultural experience felt that livestock breaking their legs is a “major problem” more often than students without agricultural experience. Adults with no agricultural experience rated horses breaking their legs on RGSs burrows as a “minor problem” or “no problem” compared to students who evaluated it as a “major” or “moderate problem.” For adults and students with agricultural experience, students felt that horses, livestock, and humans breaking their legs is a “major” or “moderate problem” more often than adults who saw them as “not a problem” or a “minor problem.” As demonstrated here and by McAninch (1993) and Brown et al. (1978), the perception of problems caused by particular animals is not

always a reliable predictor of attitudes and behaviours (management) toward those animal. Attitudes are a better indicator of management preferences or other behavioural aspects toward the animal in question than perceptions of problems caused by the animal. If the attitudes expressed in this study by the rural population are an indication of the future treatment of RGSs, a bleak future exists for the animal.

4.4 Findings in light of norms, values, attitudes, and behaviours

Vaske and Donnelly (1999), among others, suggest that salient attitudes and actions stem from values that are part of one's identity and that, even through objective information, they are extremely difficult to change. However, keeping in line with the argument of Jones et al. (1999), variables such as a changing demographic or outside influences which may be preservation-oriented, come into play and lead to a diversification of views and ideologies. Jackson (1965) referred to social organizations that had less defined and broader acceptability of norms, as more open to ideas and thereby able to foster creativity and new ideas more easily than social organizations that defined norms in a narrow crystallized, intense fashion. Promoting educational efforts that would require creative experimentation with alternative and preservationist management methods may therefore prove difficult in rural areas that hold intense and crystallized norms and attitudes toward RGSs. For example, students (especially males with agricultural experience) believe that RGSs reproduce at higher rates than is biologically possible. This may result in unnecessarily high invasive lethal management practices. These perceptions of high reproductive rates lead to unrealistic beliefs about a

population explosion. This may help to explain, at least in part, why RGSs are viewed as an overpopulated species and economic threat, and why attitudes toward RGSs are more negative for male students with agricultural experience.

Bjerke et al. (1998) found that the perceived population size of an animal species, and not the empirically determined or 'actual' population size, is important to how those animals are valued. A study on wolves in Norway indicates that people believe the wolf population to be large and a significant predatory threat to domestic animals when, in fact, wolf numbers are so low that they are likely incapable of much predation at all (Bjerke et al., 1998). Indeed, the wolf may completely disappear from this area if conservation efforts are not implemented. In my study, farmers were less likely than non-farmers to perceive humans as the cause of interference with RGS population numbers even though rural people are more likely to kill RGSs than urban people. If one accepts responsibility for reducing population numbers, one may feel obligated to reverse that trend or may feel that s/he will be held accountable by interest groups or by government agencies. Denial by rural people of an overall decrease in RGS numbers may act as a mechanism to protect current livelihoods and management methods. Farmers may be less likely than non-farmers to perceive humans as the cause of interference with RGS population numbers even though rural people are more likely to kill RGSs than urban people.

Reading and Kellert (1993) suggest that contemporary extinction problems are often the result of socio-economic and political forces. Attitudes displayed toward RGSs

affect how they are valued and whether their numbers will decline. The findings here suggest that negative attitudes toward RGSs are linked to support for aggressive and lethal management initiatives. In this case, it appears that negative attitudes translate into corresponding behaviours. Therefore, the ecological importance of RGSs cannot be emphasized enough, especially to those willing to learn about them.

Situational and personal constraints affect behaviour, so perhaps even strong attitudes can be manipulated. Attitudes are often adjusted to “please” the audience (Chaiken & Stangor, 1987). These attitudes, rather than true feelings, are strategically expressed, but some of these attitudes may eventually become internalized. Rural people may be reluctant to express positive attitudes toward RGSs if an audience with negative attitudes surrounds them and the opposite may be true for urban people surrounded by an audience with positive attitudes.

4.4.1 Protectionist and utilitarian value orientations

The rural population disagreed intensely with the two statements that addressed protection: RGSs should be protected, and, if money was spent on protecting the burrowing owl, equal amounts should be spent on protecting the RGSs. Presumably these attitudes have been formed from personal experience, and are socially reinforced. Some research indicates that rural people display utilitarian attitudes that are human oriented and view animals as objects to be used by humans (Tremblay & Dunlap, 1978). This explanation has been dubbed as the “extractive-commodity theory” because it

proposes that rural residents are utilitarian minded due to their dependence on extracting natural resources (Jones et al., 1999). The urban population weakly disagreed with the protection statements and chose a variety of responses. The urban population was heterogeneous in its beliefs, and where heterogeneous beliefs exist there is more freedom to explore alternative options. For example, the urban public may be more receptive to experiment with management strategies alternative to traditional lethal management such as poison.

Other researchers found women were less likely to accept destruction of mountain lions in residential areas, even though they perceived greater risk associated with the animal (Zinn & Pierce, 2002). Similarly, in my study, female participants held negative attitudes toward RGSs but they displayed higher tolerance levels than men through less agreement with lethal management practices. They were strongly opposed to trapping and shooting RGSs as a recreational pursuit, indicating a moralistic tilt, whereas males from rural areas tended to agree with the statement. Similar results have been explained by arguments such as the “ethic of care” based on the assumption that, since women have traditionally been the primary caregivers, they are deemed to possess higher levels of sensitivity and transfer it toward living creatures (Baker, 1996; Lauber et al., 2001; Miller et al., 1998; Ozanne et al., 1998). The different ways in which girls and boys are socialized could also explain why women display more sensitivity and oppose aggressive lethal management methods.

Women with agricultural experience were less opposed to allocating protection to RGSs than men with agricultural experience. The rural sample was mostly comprised of men, therefore the answers represent a male-biased opinion. Agriculture continues to be a predominantly male field. Men mostly manage and tend the land so wildlife management decisions are also currently male dominated (Davidson & Black, 2001).

As expected, rural people preferred lethal management practices more than urban people, who preferred alternative or preservation techniques. This discrepancy was expected based on the commodity-extractive theory which is similar to the utilitarian value orientations discussed earlier and on results found in similar studies (Jones et al., 1999). Both rural and urban people wanted to decrease RGS numbers in all areas; however, urban people wanted to maintain or increase RGS numbers in national parks whereas rural people wanted to decrease them. The national parks policy is to protect natural areas and to encourage public understanding, appreciation and enjoyment of these areas as well as to leave them unimpaired for future generations (Parks Canada, 2003). It seems that even though RGSs are native, some people prefer lethal management in national parks where the mandate is to protect wildlife.

One study suggests that city people want to target only individual offending animals that cause damage or pose a threat to humans, whereas rural people want to poison and shoot as many as possible (Kellert, 1985). Other researchers have found that urban people displayed more humanitarian, ecologically-oriented management preferences, whereas farmers were more domineering, anthropocentric and utilitarian-

oriented (Bennett & McBeth, 1998; Reading & Kellert, 1993). In addition, people with protectionist-oriented attitudes were less likely than utilitarian-oriented individuals to accept destroying a mountain lion in a residential area (Zinn & Pierce, 2002). My study shows that urban people choose humanitarian alternatives and preservationist management preferences more often than rural people who choose traditional lethal methods.

Coinciding with preferences expressed by adults, students with agricultural experience displayed a preference toward lethal management when compared to students without agricultural experience. Mixed results were found for management preferences by students, suggesting that opinions regarding management in some areas are flexible, complex, undefined and scattered. The implications of this finding are that education efforts may influence this demographic group. In particular, students may more easily accept alternative ecological approaches to management. Students with agricultural experience preferred preservation management surrounding the city and alternative management in city parks, whereas adults with agricultural experience preferred lethal management for both areas.

Women with agricultural experience indicated, just as men did, that they favoured lethal management in most areas, although they were less strongly opinionated (lower %s) in choosing lethal management. Urban women preferred alternative or preservation management methods in several areas more than men. Urban women preferred increasing or maintaining RGS numbers in city parks and in national parks, whereas men

wanted to decrease RGS numbers. Women appear to have greater tolerance for RGSs and are willing to allocate some spaces to RGSs. If a management plan that considers the female perspective is developed in the future, alternative and protectionist management methods may be considered; however, if men continue to dominate the agricultural field, alternative and preservationist management techniques will not be supported, at least for privately owned farmland.

Female students without agricultural experience favoured preservation and alternative management methods and males favoured traditional lethal management. No increase or maintenance of RGS numbers was supported in any area by either sex, but females were less unified in their responses than males. Female students with agricultural experience were less uniform in their choices in management than male students. These gender-based results echo those found in adult populations, indicating that females are more tolerant, less utilitarian, and more moralistic toward RGSs than are males. Research on socialization within the family suggests that values, attitudes and behaviours are learned through the family unit and as a result are very similar (Baker, 1996). Although I expected the younger generation to display more tolerant and ecologically-based attitudes, it is not surprising that their orientations are similar to those of their parents.

Overall, attitude scores for students were similar to those of adults. Students with agricultural experience disagreed more often than adults with black widow spiders using RGS burrows for shelter, indicating that students with agricultural experience may be

even less ecologically-oriented than adults in the same category. However, no differences were found in any of the other ecological attitude questions, indicating that there is little support for the statement that students with agricultural experience are less ecologically-oriented than adults.

4.4.2 Shooting and trapping as recreational pursuits

Trapping and shooting RGSs as an enjoyable recreational activity could be considered a behavioural question that stems from a utilitarian value orientation. On the issue of testing behaviours through self-reporting methods, Chaiken & Stangor (1987) warn that self-inflated positive evaluations may occur. The trapping and shooting question did not solicit “environmentally” inflated self-evaluations because people openly admitted to it. This may indicate that trapping and shooting RGSs as recreation is a socially accepted behaviour in the rural community; therefore, the need to inflate “environmentally” acceptable behaviour is not needed but responses could be inflated to fit into what is considered acceptable by the rural community. This finding coincides with other research that found urban people or non-farmers were more tolerant and protectionist toward wildlife than rural people (Bennett & McBeth, 1998; Kellert, 1985; Layden et al., 2001; McIvor & Conover, 1994; Wittmann et al., 1995). Shooting and trapping as a recreational pursuit solicited stronger more intense agreement by students with agricultural experience than by adults with agricultural experience. Students may have more time to engage in trapping and shooting RGSs for recreation.

One common thread was found throughout all comparisons of women and men. Women were more strongly opposed to recreational trapping or shooting RGSs than men in all demographic comparisons (rural, urban, agricultural experience, no agricultural experience). This is an intense attitude and belief. Generally, women perceived the problems caused by RGSs to be just as severe as did men, however trapping and shooting were not evaluated to be as enjoyable, indicating that women may be more tolerant of and empathetic towards RGSs. Zinn and Pierce (2002) suggested that women are more likely to assign rights to wildlife and are therefore less likely to be supportive of lethal management or recreational practices.

Students with agricultural experience reported stronger agreement with trapping and shooting RGSs for entertainment than adults with agricultural experience. Also, adults without agricultural experience were more opposed to this behaviour than students without agricultural experience. This suggests that students are less moralistic, empathetic, or sensitive when it comes to animal suffering. Oral comments made after students completed the questionnaire provided further confirmation for these results.

4.4.3 Attitude and behaviour

Recreational activity preference is another variable that influences attitudes toward the environment (Jackson, 1987). Alberta respondents who reported that they participate in appreciative activities, such as hiking and canoeing held a stronger preservationist attitude, whereas those who participate in consumptive and mechanized

activities held a pro-developmental attitude (Jackson, 1987). Perhaps encouragement in outdoor appreciative activities on the prairies will lead to further appreciation of ecological preservation, which may extend to RGS appreciation. The prairie ecosystem has been heavily used and altered because of farming and ranching activities. The land may be widely viewed as utilitarian, leading to less appreciative type of recreation. For example, in Alberta, people participate in appreciative recreation (hiking, camping) most in mountainous regions.

4.4.4 Knowledge and attitudes

General biological knowledge scores were low overall, but rural dwellers knew significantly more about RGS biology than urbanites. Those with agriculture experience or who were farmers correctly answered more biology questions. Questions related to hibernation, habitat, diet and reproduction were more likely to be correctly answered by rural people. Similar findings of rural people scoring higher than urban people on biology-based questions have been found by others (Heberlein 1989; Zinn et al., 1998). Also, the accurate knowledge levels of rural people may reflect the greater likelihood they have direct contact with RGSs and more observation opportunities. It is likely that respondents gained information about RGS from personal experience. The majority of respondents in a study on prairie dogs indicated that they gained information about prairie dogs from personal experience (Reading & Kellert, 1993).

The two questions that addressed RGS importance as prey received few correct answers by all adults; however, urban residents agreed more often than rural residents that other prairie species are dependent on RGSs. This lack of knowledge from both urban and rural populations, of RGS importance in the prairie ecosystem, has serious implications for the future health of this ecosystem. The species that depend on RGSs will be negatively affected if aggressive lethal management toward RGSs is the resulting behaviour from this lack of knowledge.

Rural women and women with agricultural experience were more ecologically-oriented as indicated by their apparent greater awareness of RGS-dependent species. Women agreed more than men that ferruginous hawks depend on RGSs and that burrowing owls depend on RGSs for survival. Rural men answered one biology-based question more correctly than women, but women from rural areas and women with agricultural experience knew the answer to causes of natural mortality more often than men. Among adults and students without agricultural experience, adults tended to underestimate RGS consumption by hawks, indicating more accurate ecological knowledge of RGS and hawk dependency by the students.

Men with agricultural experience answered three biology questions correctly more often than women. Perhaps because men, rather than women, especially those from rural areas, are agriculturalists, they have made more accurate observations regarding some aspects of RGS biology. To manage RGSs effectively men require knowledge about reproduction. Women seem to have a better grasp on RGS interconnectedness

within the ecosystem. One explanation could be that women have been found to consider more criteria in their reasoning (Lauber, Anthony & Knuth, 2001). Men focus on solving the problem whereas women have been found to consider the context of an action as essential.

Urban men answered two biology (reproduction) questions correctly more often than women, whereas women chose “don’t know” more often for those two questions and for one additional question: both sexes were incorrect when asked about the numbers of RGSs consumed by ferruginous hawks. Men were more confident in their knowledge levels even when they did not choose the correct answer. Tesser and Schaffer (1990) reported that attitudes based on personal experience and high confidence levels are well defined and harder to change even when they are factually incorrect. Therefore, attitudes of men toward RGSs will be harder to change because men have more defined responses than women and their beliefs are more likely based on personal experience.

Student and adult knowledge scores were the same, even when they reported having no agricultural experience, but students with agricultural experience scored lower on biological knowledge than adults with agricultural experience. Adults were more likely to indicate that they did not know. Students with agricultural experience answered more questions correctly more often than students without agricultural experience. These results may indicate that adults have had more time and experience to learn about RGSs. As found in the adult population, students with agricultural experience may also have had more exposure to RGSs than students without agricultural experience. Students were

more confident in their knowledge levels, even on questions that they answered incorrectly. This could be an indication of stronger more defined beliefs and the egocentric views of teenagers.

Knowledge-attitude links

Those who knew how many RGSs are consumed by hawks also believed that RGSs are necessary for hawk survival. Dependency of burrowing owls on RGSs was also believed to be higher by those who answered the hawk question correctly. Those who answered the ecological knowledge questions correctly were more likely to agree with attitude statements related to other animal dependency on RGSs. The link between knowledge and positive attitudes can be interpreted in two ways: 1) those with more ecological knowledge hold positive ecological attitudes toward RGSs partly because of this knowledge and 2) positive ecological attitudes promote further knowledge attainment.

General environmental knowledge and environmental attitude are directly and significantly related (Arcury, 1990). Educational efforts may be one way to relay information regarding the importance of RGSs as habitat and prey providers. The educational efforts will not result in positive attitudes for all, but will present the building blocks for positive attitudes. Arcury (1990) suggests that an increase in knowledge leads to further interest in environmental issues and promotes additional self-education. Contradictory to this finding, Zinn and Andelt (1999) found a negative correlation between knowledge about prairie dogs and a positive attitude. That is, people who were

more knowledgeable about the biology and ecology of prairie dogs also believed that they are a pest or problem animal (Zinn & Andelt, 1999). Jones et al. (1999) found that in rural communities within close proximity to conservation areas, national parks, outdoor recreation parks and related sites, people tend to display an increase in pro-environmental attitudes. They predict that rural support for protective environmental values will continue to increase because of reasons such as: rural attachment to place, the changing demographics of rural communities and because of a more diversified population composition. This study does not support those findings but the rural areas were not close to popular conservation areas or national parks. In relation to RGSs, environmental attitudes are quite negative for the rural population.

4.4.4 Overall gender differences

Women from farms or with some agricultural experience expressed more positive attitudes (or less negative attitudes) than men, but perceptions of RGSs as problem animals similar to men. Rural women know less about RGS biology than men do and preferred lethal management in most areas. They were, however, less unified in their support for these methods. These women did not display the intense negative attitudes toward RGSs that men did. Agriculture remains a male-dominated occupation; therefore, lower knowledge levels possessed by women could be partially explained by less time spent in the field observing RGSs. Furthermore, negative attitudes expressed by men could be the result of more exposure to conflicting interests between RGSs and agriculturalists. Women were also less unified in their agreement toward lethal

management practices than men. Rural women disagreed with recreational trapping and shooting of RGSs, again, supporting previous findings in related literature. Ozanne et al. (1999) suggest that women are socialized to have greater awareness of the consequences of their actions thereby display higher levels of environmental concern.

4.4.5 Overall student differences

Previous behaviour is a good predictor of future behaviour, and behavioural intentions are influenced by attitude (Chaiken & Stangor, 1987). The aforementioned statement provides a good reason for using current attitude and behavioural intentions of students to predict future attitudes that may translate into behaviours toward RGSs.

Students with and without agricultural experience expressed trends similar to those of adults regarding values, attitudes and behavioural differences. When differences on individual questions were found, students often held more intense (stronger) beliefs. This is the opposite of what was expected. Some research indicates that rural demographics are changing due to an increase in education and more transient lifestyles thereby increasing exposure to different ideologies (Jones, Fly, Talley, & Cordell, 2003). Based on this information, I had expected that the younger generation might be less utilitarian-minded and more ecologically-oriented because of exposure to varied ideologies at school. However, it appears that values and attitudes are not changing toward RGSs in these particular rural communities among the younger generation perhaps because the communities remain, for the most part, socially homogeneous.

4.5 Hypothetical management plan developed from information given by respondents

If a hypothetical management plan were developed for each area listed in the first section of the questionnaire based on management practices suggested by each demographic group (e.g. urban-rural, male-female) it would reveal the complexity of public preferences. Jackson (1965) suggested that populations which hold intense agreement toward an issue (high % of people pick a particular option), display little opposition when action is taken to implement initiatives supporting the view. Based on these criteria it is useful to know the level of public agreement toward controversial practices such as those related to wildlife management. Dualistic attitudes toward RGSs exist between rural and urban respondents (Table 45). If the suggested management techniques agreed upon by the respondents were to be used to guide actual management practices, the outcomes would affect the prairie ecosystem negatively. Rural people are much more traditional in their preferences toward management and would prefer to lethally manage RGSs in every area mentioned. RGSs need some areas where their presence will be tolerated if future healthy populations and other wildlife that depend on them are to survive.

Decisions on wildlife management are most often based on social anthropocentric criteria rather than on biological information (Donnelly & Vaske, 1995).

Table 45: The most common management preferences between the adult population and the student population which could be indicative of future management preferences.

	Adult Attitudes		Student Attitudes	
	Urban	Rural	Agricultural Experience	No Agricultural Experience
City parks and green spaces				
Overall	45% Alt	71% Lethal	46% Alt	53% Alt
Male	49% Alt	77% Lethal	47% Alt	51% Alt
Female	40% Alt	48% Lethal	58% Alt	58% Alt
Residential Lawns				
Overall	50% Alt	73% Lethal	54% Lethal	54% Alt
Male	46% Alt	75% Lethal	70% Lethal	50% Alt
Female	55% Alt	55% Alt	55% Alt	60% Alt
Surrounding City				
Overall	45% Preserve	79% Lethal	55% Lethal	56% Preserve
Male	39% Preserve	83% Lethal	63% Lethal	55% Preserve
Female	51% Preserve	67% Lethal	42% Preserve	58% Preserve
Pastures				
Overall	42% Lethal	93% Lethal	79% Lethal	50% Lethal
Male	52% Lethal	94% Lethal	85% Lethal	58% Lethal
Female	44% Alt	87% Lethal	71% Lethal	39% Lethal
Cropland				
Overall	47% Lethal	94% Lethal	80% Lethal	56% Lethal
Male	60% Lethal	96% Lethal	86% Lethal	68% Lethal
Female	46% Alt	84% Lethal	71% Lethal	50% Alt
Rural Areas				
Overall	40% Preserve	85% Lethal	60% Lethal	48% Preserve
Male	36% Lethal	88% Lethal	68% Lethal	43% Preserve
Female	47% Preserve	70% Lethal	48% Lethal	53% Preserve
National Parks				
Overall	65% Preserve	41% Lethal	46% Preserve	64% Preserve
Male	58% Preserve	46% Lethal	41% Preserve	55% Preserve
Female	74% Preserve	42% Preserve	54% Preserve	73% Preserve

< or = to 50% is considered a weak attitude due to even spread across options selected or due to split between two options presented, 50-59% is fairly strong attitude agreement, >60% is strong, intense attitude agreement. Based on the norm theory proposed by Jackson (1965)

Alternative= introduce predators

Preservation= capture and relocate or leave current numbers without intervention

Lethal= shoot, poison.

Adults (urban n=174-165, rural n=149-164), Students (agricultural experience n=154-158, no agricultural experience n=120-129)

A large part of this social criterion reflects public attitudes and how much the animal is valued by people. If the negative attitudes expressed toward RGSs continue a very bleak future awaits RGSs and the prairie ecosystem.

4.5.1 Management Programs

As Miller et al. (1994) suggest for black-tailed prairie dog and I suggest for the RGS, it seems expensive and ineffective to start saving individual species such as the burrowing owl once they drastically decline in numbers. A proactive management plan would preserve species that depend on RGSs by securing RGSs as their food and habitat source and concentrate on repairing the ecosystem. Species that are dependent on RGSs, and perhaps more valued by humans (e.g., hawks), would then be buffered from major population collapse. This translates into money saved, which would otherwise be used to save declining numbers of individual species (e.g., burrowing owl) because of the RGS declines. Even more important are the numerous benefits that RGSs bring to the prairies to which we cannot attach a price tag. Another benefit of maintaining healthy RGS numbers is that they contribute to our understanding of the intricacies of the prairie ecosystem.

A program that encourages protection of the prairie ecosystem using various strategies is necessary. Education alone will not result in positive attitudes toward RGSs, but if it is coupled with legislation and incentives, more people might be persuaded to share the land with RGSs. Reading and Kellert (1993) suggest three ways to employ a

successful program: law enforcement (power, authority, penalties), enticement through monetary means (compensation, incentives, conservation easements), and persuasion through education (use people from similar cultural and socioeconomic background to convey the message) (Reading & Kellert, 1993). I modify these suggestions and use several holistic long-term management plan suggestions from Miller et al. (1994) and apply them to the case of the RGS.

1) Legal protection

According to the results of this study, rural residents would heavily oppose any legal protection related to RGSs. An estimated 80% of original native prairie has been converted for agricultural purposes and, in comparison to other ecoregions in Canada, the prairie has a high proportion of threatened or endangered wildlife (Prairie Conservation Forum, 1997). On privately owned land, conservation easements are now being introduced. Legislation, such as protected areas legislation and the Species At Risk Act (SARA), could be used to protect prairie land and RGSs (Environment Canada, 2000). With the help of human-wildlife interaction studies, such as this one, SARA could be used to sustain current RGS numbers or increase them in socially and ecologically compatible areas. Special attention needs to be given to wild areas and pastures that sustain a wide array of wildlife. RGS's important role in maintaining the ecosystem is essential for other wildlife such as aerial and terrestrial predators as well as for animals that depend on their burrows for habitat and shelter. RGS burrowing and grazing habits are beneficial for native vegetation and soil. Miller et al. (1990) suggest that an

accountable policy needs to include criteria that will monitor species that are indicative of diversity.

2) Habitat preservation

The prairie ecosystem is the most altered in the country (Prairie Conservation Forum, 1997). A shift in management practices toward habitat protection may be difficult based on the negative attitudes and management preferences reported by those in rural areas. Short-term management practices, such as poisoning wildlife and vegetation, will not preserve habitat; what is needed are long-term environmental and economic goals. Several studies show that it is not economical to poison burrowing rodents (Collins, 1994; Hansen & Gold, 1977; Miller et al., 1994; O'Meilia et al., 1982). Public lands managers must cease using poison because the environmental and fiscal costs of poisoning are simply too high (Miller et al., 1990). Threatened species require and will continue to require government assistance and therefore more expense, so public education and rewards to increase environmentally-sensitive behaviour, especially from the agricultural industry, are important (Miller et al. 1990). In the case of the RGS, private landowners involved in crop production and in the livestock industry need to be targeted through a combination of education, legislation and initiatives. Lee and Henderson (1989) warn that certain policies prevent landowners from protecting or preserving prairie dogs by charging costs of poisoning to landowners who do not eliminate prairie dogs. Although the Canadian provinces do not provide financial support for ground squirrel eradication on private farm land, a considerable amount of public

money is spent on ground squirrel eradication in urban centres (parks, universities, public playing fields etc.) and on education and research on ground squirrel management which focuses on eradication methods (Bourne, personal communication, June 2001).

3) Conservation initiatives aimed at farmers

Farmers indicated that they want to be reimbursed for damage caused by RGSs. Tax breaks, monetary incentives, and other initiatives such as cash reimbursements could be made available to people who practice sustainable agriculture and who share their land with wildlife. In order to protect wolf and grizzly bear populations, monetary compensation for livestock killed by these predators were made available to farmers and ranchers in Canada. The strength of strychnine poison made available to farmers has already been decreased by the federal government for Alberta and other provinces, but “emergency” registration of stronger poisons occurs when farmers demand it. Product marketing assistance could provide free publicity for those farmers that support RGSs (or other more positively viewed animals) on their land.

The urban population disagreed with financially reimbursing farmers for the damage caused. The financial burden of sustaining RGSs should not be solely imposed on the farmer. Studies regarding actual crop damage caused by RGSs would be necessary before monetary reimbursement could be implemented. If changes are to occur, fiscal responsibility for the prairie ecosystem needs to be shared by the general public not by the farmer or rancher alone.

4) Education

Education plans are becoming an important tool for ecosystem management personnel (Jacobson & Marynowski, 1997). Jacobson and Marynowski (1997) suggest that “understanding the knowledge, attitudes, behaviors, and sociodemographic backgrounds” (p. 779) will lead to an education program that will effectively fill conceptual gaps. Educational efforts that concentrate on the importance of Richardson’s ground squirrel within the interdependent ecosystem of the prairies are needed. This becomes evident with the result found here, that people who hold negative attitudes toward ground squirrels are neutral or do not know about the interconnectedness of RGSs to the prairie ecosystem. The problem for education is that the negative attitudes tended to be more intense than the positive attitudes. The paradox for this study is that education efforts would be least effective for rural men in particular, but this demographic group is most involved in RGS management. Rural men are most likely to affect RGS habitat but were also unaware of the dependencies that exist between RGSs and other wildlife of the prairies.

Demographic variables could be used to construct special focus education workshops at appropriate levels as well as provide direction for the education program. This study demonstrates that rural participants will be most resistant to education programs if targeted at RGS biology or ecosystem preservation. Rural people may be less willing to change currently held misconceptions regarding RGSs. Urban participants who had less intense attitudes and opinions may be more open to education programs,

and thus attitude change. An important variable for this study is the rural-urban distinction. Rural-urban distinctions in attitude toward the environment were also found by other researchers (Kellert, 1985; Steel et al., 1994; Tremblay & Dunlap, 1978).

Reading and Kellert (1993) found that farmers believed that they had higher levels of knowledge about prairie dogs than the general population, even though their scores were not significantly higher than the general public. Farmers' attitudes were more intense and therefore harder to change. Reading and Kellert (1993) warn that more information and education may not result in a change in attitudes. Education may help for people with low knowledge and moderate or undeveloped attitudes and values but not for those who feel that their opinion is supported by personal experience (Reading & Kellert, 1993). This information is useful because specific demographic groups identified throughout this study such as urban respondents with weak attitudes and little knowledge of RGS biology may respond to an educational program, which would in turn promote positive attitudes and therefore behaviour toward RGSs. Hence, those without agricultural experience, women and urban residents of southern Alberta would most likely benefit from education programs aimed at conservation of prairie wildlife, whereas rural people would be more resistant to change and not accept information on this topic. Again, the predicament is that intense attitudes are held by those who display negative attitudes toward RGSs.

One finding in this study suggests that this predicament may be overcome. Regardless of locale, sex, or occupation those who answered the biology questions

related to predation dependencies correctly were also more likely to express positive attitudes toward RGS interconnectedness to other species. These relationships are limited because this was not the focus of this study, but these preliminary findings are very interesting. These results suggest that educational efforts should focus on the interconnectedness of RGSs in the prairie ecosystem. At this time it is unclear whether positive attitudes lead to greater knowledge of RGS interconnections or whether knowledge of RGS interconnections lead to positive attitudes. Future studies that explore knowledge of ecological links of RGSs to attitudes toward RGSs would provide answers to these questions.

Unfortunately, out of all the knowledge questions those relating RGSs to other species were answered least correctly most often and attitude questions on RGS interconnectedness to other species were for the most part negative. Further study to determine whether the respondents feel apathy or simply lack knowledge about RGS interdependency could help determine where education is needed to promote awareness of issues facing prairie ecosystems.

Higher levels of biological knowledge about RGSs did not decrease people's support for eradication or lethal management; rather it was associated with increased support for lethal management, suggesting that biological knowledge does not necessarily promote positive attitudes. Perhaps knowledge of ecological dependence between RGSs and hawks, for example, would increase positive attitudes. Residency (rural/urban) and exposure to agriculture, rather than knowledge levels, were dependent factors for

management preferences. Similarly, levels of knowledge about black-tailed prairie dogs were found to be positively correlated with a preference to eradicate/poison prairie dogs rather than to relocate them (Zinn & Andelt, 1999). Direct experience with nature/wildlife is associated with increased knowledge attainment (Brooks et al. 1999; Dottmann-Easler & Pease, 1999). In this study, contradictory to some other findings, the overall increase in knowledge does not equate to positive attitudes.

Similarly, Brooks et al. (1999) suggest that in order to make environmental education programs more effective, they should be targeted to groups based on participants' direct experience and knowledge of the ecosystem. Unfortunately, numerous studies indicate that public environmental knowledge is low (Arcury, 1990; Jacobson & Marynowski, 1997). For example, most concern is limited to animals that are attractive and emotionally appealing (Jacobson & Marynowski, 1997); however, ecological knowledge that these attractive animals require other, perhaps less attractive animals for survival, seems to be lacking. Species such as prairie dogs, wolves and RGSs as found in this study, are often perceived as pests and are likely to be "persecuted" (Bjerk et al. 1998; Zinn & Andelt, 1999), even though they are critical to the survival of other "more valued" species and to the ecosystems they encompass.

4.6 Future research

There is an apparent need to focus on identifying further ecological links that exist on the prairies. For example, do similar relationships exist between RGSs and other

grazers as were found between prairie dogs and bison? Furthermore, what are the relationships between vegetation types and RGS grazing patterns? What are the ecological links between RGSs and species that co-evolved on the prairies? Research related to actual economic damage caused by RGSs and human perceptions of overpopulation is necessary. Do ranchers differ from farmers in their perception of the number of fractures that can be attributed to RGSs?

Polarized rural-urban differences regarding RGSs are complex and need further study. Qualitative research of people's attitudes may clarify some of the results of this study. For example, where would rural people support RGS habitat? Under which conditions would urban people be willing to reimburse farmers for damage caused by RGSs?

4.7 Conclusion

An intricate and complex relationship exists between people's understanding of the biology of RGSs, their perceptions of economic threats, and attitudinal factors. Because Richardson's ground squirrels evolved over thousands of years on the prairies, their adaptation to the prairies and intricate interrelations with surrounding life forms are strong. This research provides a baseline for human attitudes toward RGSs for several demographic groups in southern Alberta. Articles written for the general public often refer to ground squirrels as pests or vermin whereas management-oriented journals such as the *Journal of Range Management*, up until very recently, focused on their eradication

rather than their ecological significance. Contemporary research suggests that an attitude shift in the scientific (academic) community is taking place because research is focusing on the ecological significance of species previously viewed primarily as agricultural pests.

In order to conserve the prairie ecosystem and threatened animals from extinction, local support, as well as socio-economic, cultural and political factors must be considered. Previous attempts at conservation of similar species (prairie dog) failed due to public disapproval. Before attempting to save species that are endangered or threatened, such as burrowing owls, we must save the environmental conditions that are needed for their survival (e.g., food and habitat sources) and this requires an attitude change toward certain native species, such as the Richardson's ground squirrel, that create these conditions.

5.0 Appendix

Appendix A Questionnaire and mail-out letter



As a resident of southern Alberta you can help us learn more about current knowledge and attitudes toward the Richardson's ground squirrel (gophers). Most people refer to Richardson's ground squirrels as gophers but their official name, Richardson's ground squirrel, will be used throughout the survey. The information that you provide will be helpful in determining future management and education plans regarding Richardson's ground squirrels. Your participation and honesty are essential for the success of this study.

In order for the results to represent the attitudes and knowledge of southern Albertans it is extremely important that each questionnaire is completed and returned. Please fill out the survey without asking for advice from anyone else. Please remember that your participation is voluntary and that you have the option to quit at anytime. If you feel uncomfortable answering any questions you have the option to refuse to answer or participate.

You may be assured of complete confidentiality. On a separate piece of paper you have the option to include your name, address (electronic or residence), and telephone number or any of the options presented. We will separate the information identifying you from the questionnaire so that your answers will remain completely anonymous. Please do not feel obligated to reveal your identity if you are not comfortable doing so.

The results of the knowledge portion of this questionnaire will be made available to you at your request. Please keep this page for your own reference. If you have any questions about the administration of this questionnaire please call the Office of Research Services at the University of Lethbridge at (403) 329 2747. I will also be happy to answer any questions that you might have. Please write or email.

Thank you for participating in this study. Please answer the following questionnaire even if you are not very familiar with Richardson's ground squirrels.

Adela Tesarek
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Section A.

In this section we would like to learn about potential problems that you might have experienced with Richardson's ground squirrels (gophers) and your opinion regarding specific management methods.

1. In the table below, six management practices for Richardson's ground squirrels are presented (poisoning and/or fumigating etc.). Please check **one** box per row to indicate which management practice you support for the location indicated at the start of the row.

	Poison and/or Fumigate	Shoot them	Capture and Relocate	Introduce Natural Predators	Leave them alone	Re-introduce them
In city parks and green spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residential lawns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Surrounding the city (outskirts)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Farm land (pastures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Farm land (crop)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rural areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National and Provincial Parks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other ()	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. When many people think of Richardson's ground squirrels, they think of problems they cause for humans. Below are listed seven of these problems. For each problem, please check **one** box to indicate your rating of the seriousness of the problem.

Richardson's ground squirrels....	Major Problem	Moderate Problem	Minor Problem	Not a Problem	Don't know
Carry the plague and transfer it to humans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cause horses to break their legs in the burrows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cause livestock to break their legs in the burrows	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cause economic damage by depleting crops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Destroy residential flower beds, lawns, and/or vegetable gardens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pose a health risk to kids or adults breaking their leg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Over populate (too many multiply too quickly)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section B.

In this section we would like to learn how you feel about the Richardson's ground squirrel.

3. Please check the box which most closely matches how you feel about the statement.

	Strongly agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Strongly disagree
Richardson's ground squirrels give a traditional Western feel to the area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Richardson's ground squirrels are native animals to the prairies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trapping and/or shooting Richardson's ground squirrels are enjoyable recreational activities (for me)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Richardson's ground squirrels are less common now than in the late 1800s due to human interference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If money was spent on protecting the burrowing owl, equal amounts should be spent on protecting Richardson's ground squirrels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ferruginous hawks directly depend on Richardson's ground squirrels for survival	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Burrowing owls directly depend on Richardson's ground squirrels for survival	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Richardson's ground squirrels should be protected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Black widow spiders use Richardson's ground squirrel burrows for shelter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Farmers/ranchers should be reimbursed for the damage caused by Richardson's ground squirrels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section C.

In this section we would like to learn more about how much you know about the biology of Richardson's ground squirrels.

Please check the correct answer that completes each statement. If you do not know the answer to the question please indicate this by writing 'don't know' by the question.

4. Richardson's ground squirrels most prefer to live in _____.
- Cultivated fields that are not irrigated
 - Grazed pastures
 - Irrigated crop land
5. Richardson's ground squirrels are mainly _____.
- Carnivores (meat eaters)
 - Omnivores (both meat and plant eaters)
 - Herbivores (plant eaters)
6. In southern Alberta the first Richardson's ground squirrels usually appear above ground in a) _____ and the last Richardson's ground squirrels usually disappear around b) _____.
- a) January, b) August
 - a) March, b) October
 - They are above ground at all times of the year (weather permitting)
7. a. Each female produces _____ litter(s) per year.
- 0-1
 - 2-4
 - 5+
- b. Each litter has about _____ baby ground squirrels.
- 1 or 2
 - 7 or 8
 - 14 or 15
8. The Richardson's ground squirrels begin to reproduce at the age of _____.
- 2 months
 - 4 months
 - 12 months
9. The most common cause of natural mortality for the Richardson's ground squirrel is _____.
- Parasites
 - Weakened immune system by disease
 - Predation by hawks, badgers, coyotes etc.
10. A family of ferruginous hawks can consume up to _____ Richardson's ground squirrels in a season.
- 50
 - 100
 - 400
11. _____ Richardson's ground squirrels store seeds underground for the winter.
- Male
 - Female
 - Both male and female

Section D.

This last set of questions will help us to learn a little more about you. Please remember that this information will be kept strictly confidential.

12. Have you had any exposure to agricultural activity for 12 months or more during your lifetime?

- No
- Yes. If you answered yes please indicate the field
 - Horticulture
 - Ranching
 - Farming
 - Other field _____

13. Please indicate your sex:

- male
- female

14. Where are you from? (check one)

- Alberta
- British Columbia
- other Canadian province: _____
- U.S.A
- other country: _____

15. Please indicate which age group you are in (check one)

- under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

16. Please indicate the highest level of education that you have completed (check one)

- elementary school
- secondary school
- technical/vocational school
- some post-secondary (university or college)
- completed university degree
- post-graduate degree

17. In what type of place do you live? (check one)

- Farm or ranch
- Rural acreage
- Village or town
- City

Thank you for taking the time to complete this survey. Your efforts are greatly appreciated.

Appendix B Response rates of farmers

Closest Town to Farmers Surveyed

Town	Surveys returned/mailed	Return rate
Coaldale	13/59	22%
Fort Macleod	16/38	42%
New Dayton	9/25	36%
Carmengay	20/42	48%
Monarch	12/50	24%
Nobleford	16/50	32%
Enchant	25/80	31%
Coalhurst	20/52	38%
Stirling	20/66	30%
Raymond	32/78	41%
Picture Butte	10/56	18%
Magrath	8/20	40%
Barons	24/75	32%
Overall return rate for the rural sample	236/691	34%

Appendix C: Qualitative responses of those who agree with lethal management of RGSs on campus.

Qualitative arguments of those in agreement with lethal management on campus	Related comments/Justification given
RGSs are a health risk	<ul style="list-style-type: none"> -people could break their legs on burrows -cause car accidents by running out on the road -RGSs are disease reservoirs and spread disease to humans
RGSs are pests	-pests need to be controlled/eradicated
RGS burrows are the cause of aesthetic damage around campus	<ul style="list-style-type: none"> -destroy grass -make campus look ugly -money spent on improving aesthetics of university grounds is wasted because 'gophers' destroy it all by burrowing activity
Management methods suggested	Examples and comments
Lethal management	Poison, gas, bow and arrow, shooting, clubbing, running them over with motorized vehicles, predator introduction, shooting derby for monetary gain was suggested
<p>Comments: Trapping, shooting and clubbing 'gophers' was referred to by some as an enjoyable recreational pastime. Reasons given for lethal management were that RGSs are overpopulated on campus and that their numbers are 'out of control'. Justification given for managing RGSs on campus was that they damage pasture and cropland.</p>	

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