A Systems-Thinking Based Evaluation of Predator Conflict Management on Selected South African Farms

by

Timothy V Snow

Submitted in partial fulfillment of the academic requirements for the degree of Master in Environment and Development in the Centre for Environment, Agriculture and Development, School of Environmental Sciences, University of KwaZulu-Natal

Pietermaritzburg, 2008

Declaration

I hereby certify that the research presented in this Masters Dissertation is my own original and unaided work, except where specific acknowledgement is given. No part of this work has previously been submitted in any form for any degree or diploma to any other university.

Signed

Timothy V. Snow.

Dedications and Acknowledgements

This work is dedicated to my wife, Janet,
who has always encouraged me to ignore the small obstacles of life
and to face the challenge of large obstacles with positive enthusiasm,
and to my sons Byron, Fergus and Kyle
who watched with amusement as Dad went back to school.

It is also dedicated to the memory of Hannes Stadler (2/2/1961 – 31/12/2007), for his vision towards improvement of predator conflict management systems, and his contagious enthusiasm.

Colleagues and friends who allowed their work and photographs to be used, are acknowledged with gratitude.

And to Life, for the opportunities and challenges it presents.

-oooOooo-

Patience and fortitude conquer all things. – Ralph Waldo Emerson.

Abstract.

The backbone of this study was a systems thinking based analysis of the management and control of predators as practiced in South Africa since the advent of Europeans in 1652. The first bounties were introduced for a variety of animal species in 1656. Many species became labeled as vermin and were persecuted, often with the intention of eradication. A variety of controls have been applied, of which many have not kept pace with contemporary thinking or technology, and which by simply killing predators fail to address the crux of the issue of predator – livestock conflict.

Many of the methods used cannot be applied to specifically remove an individual damage-causing animal. Considerable collateral ecological damage is inflicted by the killing of animals regarded as innocent bystanders. The objective of the analysis was to highlight the futility of temporary solutions which fail to resolve the conflict in the long term. These quick fixes frequently perpetuate an ecological imbalance which exacerbates the predator – livestock conflict.

The analysis used raw data from a questionnaire survey conducted by the Poison Working Group of the Endangered Wildlife Trust (EWT-PWG) (2003). The EWT-PWG intended to assess pesticide abuse as toxicant for predators by farmers, and to identify all control methods used. The data forthcoming was Cartesian in nature and a fixed snap-shot in time.

This study sought to identify the root cause of the conflict by applying systems thinking which added the dimension of cause and effect interrogation. The study categorised and described predator conflict management methods as lethal or preventative, and assessed each category in archetypal terms from a systems thinking perspective. It also sought to identify leverage points, or small changes which have profound effects, to stimulate a change in approach to human-predator conflict management.

In order to assess and illustrate the positive change brought about by application of preventative methods, a small group of farmers who had initiated changes in their predator conflict management over the five years subsequent to the EWT-PWG survey were selected from the original group for reassessment.

Through evaluation of predator conflict management methods from a systems thinking perspective, and by probing learning processes, the shortcomings or failure of inappropriate management responses to conflict situations were shown to exacerbate conflicts. Contrarily, it was illustrated that application of systems thinking and a process of addressing the root cause of conflict issues in predator conflict management, was a longer term solution. The study illustrated that application of long term proactive prevention and conflict avoidance principles, can offer long term solutions for predator conflict managers.

Keywords: Predators, conflict, lethal predator conflict management, proactive predator conflict management, systems thinking.

CONTENTS

List of Figures

List of Tables

Chapter 1 Introduction

1.1 Background

The author has worked in the fields of wildlife management and wildlife conflict management for several years and has had a growing perception that inappropriate management actions fail to resolve conflict issues. This perception guided the selection of the study theme and title of this document.

From analysis of the Endangered Wildlife Trust (EWT) Questionnaire survey (2003) done by the Poison Working Group (PWG), it became apparent that few farmers consider proactive predator conflict prevention as the solution to their continued stock losses. This entails application of proactive management interventions intended to prevent, avoid or minimize predator conflicts. It was felt that perhaps they had not considered or studied their predator conflict predicament fully and it was noted that a reliance on archaic predator conflict management methods still prevails. This study applied systems thinking principles to evaluate predator conflict management on selected South African farms.

Historically, the management and intentional extermination of so-called problem animals commenced in South Africa when Governor Jan van Riebeeck introduced the first bounty payments on lions, *wolves* and leopards in June 1656 (Stadler, 2007). The term problem animal is misleading, since the severity or extent of a problem may be based on an individual's perceptions, mindset or education. It may also refer to a full range of animals from ants to elephants. In fact, this term could be applied to any creature considered to be a problem to humanity. To narrow the scope of this 2008 study it was necessary to focus within the human-wildlife conflict context by restricting the definition of problem animals to predators which cause damage to livestock on farms. Defining human-wildlife conflict, Madden (2004) states that:

> "Human-wildlife conflict occurs when the needs and behaviour of wildlife impact negatively on the goals of humans... These conflicts may result when wildlife damage crops, injure or kill domestic animals…" (p 248).

Progressing through time, Stadler shows how more and more effort was made to exterminate not only predators, but other wildlife also. Stadler (2007) outlines how futile some of these efforts have been, since predation of small stock by predators persists to the present day. Derogatory names and terminology vilify many predators, calling them *roofdiere and roofvoels* – thieving animals, thieving birds and vermin. Some animal species were even categorized as problem animals in legislation. This abhorrence for predators is vividly described in the following passage selected from Carruthers (2001) in which a few selected words and phrases from the 1931 annual report of the National Parks Board were used in italics for additional emphasis,

> "Vermin were described in the most loathsome terms …deliberately designed to kindle hostility and hatred ... Crocodiles … were despised because they were *an animated trap, something lower than the meanest of reptiles* which made one's *flesh creep,* while hyena were referred to as *a hideous family*." (p 107).

When considered logically and from an environmental standpoint, not all humans are thieves and then similarly and almost certainly, not all individuals of a predatory species can be damage-causing animals in conflict with farmers. Surely management controls should aim at a damage-causing individual rather than extermination of that species as a whole? Madden (2004) writes:

> "Human-Wildlife Conflict, however, frequently involves … conflict between people who have different goals, attitudes, values, feelings, levels of empowerment, and wealth. … gaps in trust and communication over how to conserve wildlife and ensure the well being of people at the same time." (p 250).

It appears unfathomable that farmers persistently and dogmatically use predator management methods and systems which clearly do not work or which are just a quick fix, offering a short-lived reprieve from predation. It is clear from the questionnaire survey done by the Endangered Wildlife Trust (EWT) in 2003 that farmers suffer loss as a result of predators and their activities. It is also apparent

that many management actions applied are ineffective. Madden (2004) believes that biological science alone cannot provide understanding or solutions to the conflict, but that solutions have to address the perceptions about that specific conflict.

One would expect loss control efforts to be as targeted as possible, because bad management and poor methodology has been shown by De Wet (2007) to lead to aversion and avoidance by the damage-causing predator. Predators appear to be extremely intelligent and able to learn very fast from farmers' mistakes and adapt accordingly. Smithers (1983) records that a suppression of populations gives rise to a survival response, manifested by increased reproductive activity. He reports young black-backed jackal offspring supporting their parents to feed a subsequent litter of newborns. According to Smithers, irresponsible and random predator extermination leads to an ecological sink effect of vacant predator territories on a farm and thus a vacuum of available habitat for individuals of the same species. The result is an ecological imbalance and a farm with a constant animal influx or transit by unsettled and potentially damage-causing animals. Very often this imbalance results directly from persecution of predators by farmers. Madden (2004) suggests that a management technique or approach is more likely to succeed if incorporated into a full arsenal, or toolbox, of conflict mitigation strategies, with the ability to change and adjust as circumstances and conditions change.

Senge *et al* (1995) suggest a questioning technique of asking "why?" five times in succession to "drill down" to the core of an issue. In this way, the issue under consideration may be scrutinized. Why, if certain actions are detrimental to their own well-being, do farmers continue to relentlessly persecute predators? Do they perhaps not understand the systems, or the cause and effects of their actions? Why do they persistently apply inappropriate short term controls, or controls which will impact negatively on their livelihoods? Is it perhaps because of mistrust of the solutions offered by conservationists who have different perceptions of the problem? Why do farmers persistently repeat the mistakes of

their fathers and grandfathers? Is it perhaps because they are conservative traditionalists? Why are farmers so insular and single-minded that they do not try new methods and systems, so frequently suggested in the popular agricultural media? Why does this mindset persist? The best policy from all aspects appears to be to prevent conflict in the first instance, or alternatively at least to only remove damage-causing individuals as and when damage occurs.

What is it that makes farmers shy away from the use of different forms of fencing or night enclosures to exclude predators from their livestock? Why do they not seek solutions of greater permanence than the killing of predators as a short term solution? Why do they continue applying methods which provide only brief respite from conflict? It is proposed that they mistrust the research findings of the conservation fraternity and that Third Party facilitation as suggested by Madden (2004) could be applied:

> "Third party facilitation and other forms of expertise are often needed to ensure that stakeholders feel willing and able to work through processes that will lead to effective mitigation, allow stakeholders to draw from a wider body of resources and knowledge that may not be available locally, as well as to help trouble-shoot problems along the way" (p 255).

Madden (2004) expands that:

> "(Third Party) Facilitation is particularly advisable in cases where: (1) HWC mitigation expertise is not locally available, (2) conflict is particularly adversarial and characterised by mistrust among stakeholders, (3) the situation is extremely complex, or (4) communication between stakeholders has broken down." (p 255).

Management and control of damage causing animals is complex and difficult and requires meticulous attention to the finest details if success is to be achieved. Why do farmers not realise that their efforts are ineffective, and their measurement of success poorly identified? What critical link is missing in order to get farmers to embrace new thinking, to *prevent* predator conflict?

It is clear that haphazard work is not worthwhile, because problem animals avoid poor controls and this often exacerbates the imbalance and the conflict.

Gabrielson (undated) suggests that money expended on general predator campaigns is a waste of funds that might better be used for some other purpose.

There are many control methods, with a clear distinction between those which are lethal i.e. they kill animals, and non-lethal i.e. those which control by prevention, protection and aversion. From an environmental view a system of non-lethal proactive prevention and exclusion of problem animals coupled with livestock management and care is desirable. If a farm is effectively managed as a business activity, then surely the effectiveness and efficiency of the control measures applied should be evaluated for selectivity, skill requirement, cost, availability, time and labour cost required?

For example, the cost of control measures should surely be in proportion to the cost of the damage or loss caused, and success should surely be measured by reduced losses and increased profits, not by numbers of predator killed. Counting the number of predators killed becomes irrelevant if the predation and damage to livestock did not cease as a result of that action, and illustrates the futility of inappropriate management activities. Why do farmers not build in a loss factor for predation in their financial plan, as is the accepted norm for disease, climate, theft and other causes? Why do farmers not see the critical need to evaluate management correctly and effectively? Surely inappropriate measurements will induce behaviour and affect influential factors which drive the system in an unintended direction?

It appears that there are many more questions than answers, and the aim of this dissertation is to show that many systems are in operation within the field of human-predator conflict management, and these will be identified and analysed.

1.2 Literature overview

1.2.1 Literature overview on predator conflict management

Literature in the field of predator management on South African farms is extremely limited. In fact, wildlife management as a whole is a relatively new field of study, having commenced in the late 1960's and early 1970's, but developing rapidly as the wildlife industry expanded. Much work has been done in the United States of America, where organisations such as the US Fish and Wildlife Service and United States Department of Agriculture, Animal and Plant Health Inspection Service in Colorado research, monitor and publish their findings. The paper of Green et al (1994) is cited as an example. Certain comparisons can be drawn inter-continentally between closely related predator species, but definite proven solutions are lacking in this scenario. Australia, on the other hand, has an island situation, where most predators are introduced species, and where the widespread use of poisons for predator extermination is practiced. Animal Control Technologies, (2003).

Available information is predominantly located in general wildlife and natural history publications, but limited information on specific issues may be found in scientific papers, and a variety in popular magazines. Since these popular magazine articles are frequently written as informative items for the lay person and seldom based on scientifically substantiated research, their value remains questionable from both the quantitative and qualitative viewpoints.

The author sought to evaluate predator conflict management methods using systems thinking methodology. A further challenge in this regard was to study the systems thinking approach itself, to enable application to this dissertation. Daly *et al* (2006) consider many of these human-predator conflict methods to be detrimental to modern farming and ecological systems and believe that more modern alternate wildlife damage prevention systems may benefit the environment and reduce livestock loss.

This study therefore probes effectiveness of predator conflict management by using a systems thinking approach, with the intention to identify and to highlight leverage points which may be used to influence change.

1.2.2 Literature overview on systems thinking

It is important to note that systems thinking in this dissertation focuses on the application to predator conflict management. Generally, the process of systems thinking employs a multi dimensional process of analysis of cause and effect. It requires a process of questioning, measurement and situational analysis, to provide guidance to improve the situation. Hammer (2002) describes the scenario where people know that action is required to change the circumstances, but nobody knows what kind or form of action is needed, and likens this to driving while looking in the rear-view mirror. Hammer believes that careful situational analysis is needed firstly to extract the rationale and purpose for measurement. Secondly and perhaps more importantly, he feels that all measurements should link objectives to actions over which one has control. Only then, through this recognition of problematic measurements, may a problem be correctly identified. This in turn will lead to the correct management action being taken to rectify the problem and to solution of the problem as a whole. The above is applicable to a scenario where farmers measure the success of predator damage control by the number of predators killed, rather than by reduced livestock losses and hence improved profits. The continued measurement of predators killed creates the misleading impression of success. The contrary may be proven by continued stock losses without a notable change in profitability of the operation. It is when analyzing a scenario correctly and by measuring the correct parameters that a solution may be found. A process of asking *why* five times over is described by Senge *et al* (1995) and this is explained fully later in this chapter and fully in the dissertation, since the method is extensively applied to situational analysis.

1.3 **Problem Statement**

When considering the views of Stadler (2007) that predator conflict management systems applied over centuries have failed, the questions are raised as to why these methods have failed and why farmers continue to apply them. For this reason this study applies systems thinking processes to evaluate predator conflict management. The motive for evaluating known predator conflict management systems by application of a systems thinking approach, is the hope that this will provide a deeper understanding of such systems. This could provide better management methods, times and points in the system for evaluation of the effect of any interventions and leverage points for change. Leverage points may be defined as small interventions which have profound effects on scenarios. In chapters three to five it will be illustrated that the greater functional system, which consists *inter alia* of the interface between predators, prey, available habitats and livestock is misunderstood by many who seek to resolve the conflicts. It is tentatively suggested that inadequate analysis of the systems by farmers and conservation officials alike, may be a causal factor leading to this misunderstanding. Many of these methods are used persistently as quick fixes to kill predators. In most instances there is a lack of comprehension of the constantly occurring environmental interactions, which are concurrent with farming activities. Hammer (2002) explains the need to measure correct parameters, to measure those parameters correctly and to apply the correct solutions. In summary it is suggested that the reason for the lack of progress toward resolution of predator conflicts is that there is a weakness in the systems thinking process, if applied in predator conflict management at all.

1.4 **Research Objectives**

This assessment intends to analyse human-predator conflict management as practiced by selected small stock farmers in South Africa. The process of systems thinking specifically focuses on problems, phenomena, systems or management actions applied and highlights successes where appropriate

management interventions are disciplined and congruent with natural systems. Conversely it intends to demonstrate failure of interventions which ignore underlying natural forces and processes.

This research has three objectives:

a. Describe predator conflict management methods in archetypal terms from systems thinking literature.
b. Identify leverage points to stimulate a change in approach to human-predator conflict management.
c. Investigate the effectiveness of preventative and lethal predator conflict management methods when viewed from a systems thinking perspective.

1.5 Methodology overview

This 2008 study commenced with analysis of the Endangered Wildlife Trust questionnaire (EWT, 2003) which produced a dataset which is fixed in time. The data was based on perceptions of the farmer respondents who themselves were captive within the scenario of predator-livestock conflict. In order to analyse the predator / livestock conflict to identify leverage points for change, it became necessary to analyse the interrelationships between the highly variable suites of components.

The results of the EWT (2003) survey were used to selectively extract information. This enabled quantitative evaluation of issues such as the use of various predator conflict management methods used, and interpretation of the success or failure of the methods. From this data it was apparent that there were predator conflict issues, and that various attempts had been made to resolve the conflict. It was impossible however, from the EWT questionnaire, to identify whether those management actions were effective or not. This prompted the application of systems thinking processes, and the extensive use of the analytical principles proposed by Senge *et al* (1995). Systems thinking as described by

Richardson (1986) was applied to the analysis, since the intention of the analysis was to identify the most appropriate leverage points to effect positive change to the system.

The question of how to apply systems thinking to this 2008 study remained. In a quest for understanding of systems thinking in other disciplines, the literature search revealed a study of Grahn and Leyland (2004), who found that a high level of inclusion of pastoralists and their participation towards learning were critically important to the success of the project. They believe that individuals parties may agree with a solution offered, but because they feel excluded, they may obstruct the forward process. In response to this reading, it was decided to include study subjects in the quest for a solution. Eight farmers who responded to an Endangered Wildlife Trust (EWT) project questionnaire survey of 2003 (10% of the original sample) were identified for a second interview, based on their previous responses to the EWT questionnaire which had indicated use of a specific predator conflict management method. Only these eight farmers had made some innovative change to their predator conflict management systems. A structured telephonic interview (Appendix 2) was conducted with this sample. The methodology and management approach of the balance of the EWT questionnaire survey respondents was not re-assessed.

The three research objectives constantly guided the questioning process. The crux was to determine whether change had occurred, and to use probing systematic, analytical questioning as suggested by Senge *et al* (1995), to extract information relating to cause and effect of their management actions. By allowing a free speaking *ad lib* response to the question about predator conflict management change, it became possible to conclude whether the change in management methods by the respondent farmer had been in response to an analysis of cause and effect, or not. Subsequent questions on predator ecology and the environmental effects of management actions served to expand the discussion of cause and effect and the principles of systems thinking. This enabled understanding of the rationale for the change made by the eight selected

farmers, who readily discussed the predator conflict management methods which they had applied unsuccessfully in the past, and how their change to new methods had dramatic effects. Without exception respondents used the terms “cause and effect” and spoke of an analytic questioning process within their management. The management approach of the remainder of the EWT questionnaire survey respondents was not analyzed.

The questionnaire extracted descriptions of the specific predator conflict management methods. Subsequent questioning of management methods probed the reasons for change and helped to identify the leverage points which had stimulated a change in approach. Finally, this enabled comparison of the effectiveness of preventative and lethal predator conflict management methods when viewed from a systems thinking perspective.

1.6 Summary

This chapter introduced the concept of leverage points in the system. These are small changes which have profound effects, such as installation of fire alarms and fire extinguishers in kitchens as a method of stopping the fires quickly at source, before major damage is caused or entire buildings burn down. The chapter defined the problem which required further investigation. The literature overview illustrated the separation between the subject of predator conflict management and the subject of systems thinking. The research objectives were defined and the methodology explained the rationale behind rejecting the majority of respondents from the EWT (2003) questionnaire from further questioning in favour of a chosen group of eight farmers who had shown from their responses to be embracing new techniques for predator conflict management. Finally, the methodology proposed by Senge *et al* (1995), of asking the question, “why?” five times in succession, was introduced.

Chapter 2 Literature Review

This review covers three focal sections. These are legislation, to succinctly outline the legal parameters of predator conflict management methods, the predator conflict management methods themselves (including non-lethal prevention and lethal methods), and systems thinking.

2.1 Legislation

Legislation is a constantly underlying thread which sets the rules and parameters within which people conduct their daily activities. The author's interpretation of the Republic of South Africa (2004), National Environmental Management Biodiversity Act, Act 10 of 2004 (NEMBA) is that the use of various methods of control of damage-causing predators is restricted to permit holders. Only the black-backed Jackal *Canis meselomas* and the Caracal *Felis Caracal* are excluded from the list of Threatened or Protected Species, and it is therefore only these two species that may still be hunted and persecuted by the methods which have been used for centuries. The effectiveness of those methods were assessed but comments about legal issues are beyond the bounds of this study.

The regulations (issued in April 2007) under NEMBA prohibit a variety of activities, methods and devices which were formerly allowed. This indicates the precarious legal position in which farmers may place themselves by using certain methods of predator damage management, since a trap set for a jackal may easily catch a protected species such as an aardwolf of other non-target animal. This could be construed as application of an illegal or prohibited hunting method, and if charged for the offence, the court would be obliged to prove intent and/or negligence.

With regard to pesticides and chemicals, the Government Gazette N^{o} 13424, Regulation 1716 of 26 July 1991, prohibits the use of an agricultural remedy or

stock remedy for any purpose other than that specified on the container label or on the container.

2.2 Predator conflict management methods

2.2.1 Preventative management and non-lethal controls

Preventative management and non-lethal deterrents include cage traps, environmental management, seasonal calving or lambing, various fencing systems, prevention and repellent collars, and various scaring or deterrent systems. Each of these will be considered in turn.

The rationale behind use of non-lethal controls is that damage and conflict is prevented, and persistently threatening animals can be captured for relocation or subjected to humane euthanasia. Innocent animals may be released unharmed. Blom *et al* (1992) regard cage traps to be extremely selective for capture of certain predators because they merely contain or restrain an animal until the hunter gets to the cage. Snow (2002) found that cage traps were particularly successful for capturing Caracal, stray dogs and various other small carnivores, but not jackals, which very seldom enter these traps. Grobler (1986) suggests these traps may be set beside a path which is frequently used by a damage causing animal, or which leads toward a recent (fresh) kill as the damage causing animal may return. In a study by Moolman (1986), a one percent trap-night success was recorded (one Caracal captured per 100 nights, i.e. 10 cage traps X 10 nights = 100 trap-nights). Snow (2002) found that when stray dogs were identified as the cause of damage, much less attention to detail was required because domestic animals readily entered these traps.

Hodkinson *et al* (2007) suggest environmental management by adherence to conservation practices, recommended stocking rates and carrying capacities, since this promotes survival and retention of naturally occurring small game. These animals fulfil an ecological role as food buffer between the predators and

livestock and are the primary food source for many predators. This suggests that where persecution of small game is limited and the environment is more balanced, there should be less predation on livestock and for this reason farmers should avoid or disallow hunting of small game unless strictly managed.

Respondent 4 (2007) practices seasonal calving based on lunar phases and expects maximal fecundity of animals at the autumn equinox (*ca.* 22 March). He expects animals to calve following a 280 day gestation and he describes distinct calving phases:

- From 21 days before calving date up to expected calving date. These cows are harassed by predators and calf survival is low, since cows expend energy defending calves and may be attacked themselves.
- Cows that give birth from day 280 to day 301 are least subject to harassment by predators, and survival of calves is maximal. These cows form his core herd of breeding cattle.
- Cows which calve from day 22 to 42 after the first calf. These animals are subjected to some harassment by predators, and fewer calves survive.
- Cows which calve from day 43 to 64 after the first calf are harassed by predators and few calves survive. Respondent 4 sells these cows.

The purpose of this discussion is to illustrate the effect of animals calving or lambing *en masse*. Predators and scavengers may be present, hoping to clean up afterbirth or still-born calves or lambs and during the pre- and post calving periods. Predator demand may exceed food supply and lead to high predation pressure. During the peak calving period there is a surplus of food beyond predator requirements, and cows and calves enjoy the relative safety of numbers.

Seasonal timing of births is also relevant. Grobler *et al* (1984) stated that most Black Backed Jackal young are born from June to November. Stuart (1981) observed that births were from July to October. Grobler *et al* (1984) recorded that Caracal give birth to kittens in summer. Bowland (1990) schematically indicates

summer births and that young Caracal venture out, or part from their mothers during autumn, which places young, inexperienced Caracal into the hunting fields at the autumn lambing time. Smithers (1983) referred to the work of several authors, who noted Caracal pregnancies in August and September, birth of young in November and January and solitary young individuals from January to July. This implies inexperienced hunting animals in conflict with livestock at lambing and calving time when the prey animals are most vulnerable.

Note in Figure 1 that predation equals births at week 1, 13 and 14, (100% calf loss), week 2 and 12 experience 66% loss, and weeks 3 and 11 a 50% loss. This illustrates the relationship between cattle births and predation, and highlights the benefit of animals calving or lambing *en masse*. Note that this figure is not substantiated by research; it is merely an illustration based on assumptions drawn from comments of Respondent 4 (2007) and serves to illustrate a simplistic correlation between birth of young livestock and predation drawn from the discussion, and used to suggest that application of a system of seasonal livestock births may reduce losses.

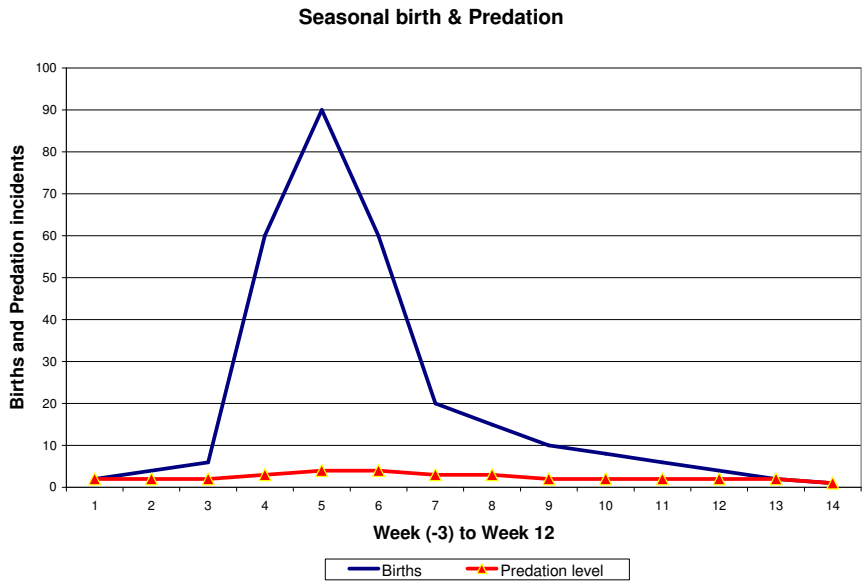


Figure 1. A simplistic correlation between seasonal livestock births and predation based on comments from Respondent 4 (2007).

Although expensive, fencing is a long term solution and the cost is much cheaper than potential and continued livestock losses. Grobler (1986) stresses the importance of fence maintenance. Snow (2002) cautions that open and badly hung gates will make the best fence useless by allowing access. Respondent 1 (2007) suggests that stock may lose condition when confined and also that this increases husbandry and veterinary costs. Respondent 5 (2007) believes that constant herding of sheep to night enclosures causes paths and erosion. From the view of these farmers, enclosing stock is costly and impractical in extensive farming operations, but systems thinking could possibly evoke a different response.

In their study of a community-based approach to mitigating depredation by snow leopards, Jackson and Wangchuk (2004) recorded a Village Corral Committee report that the villagers herded their sheep and goats into the new pen, locked the door and in the morning, there were tracks of a snow leopard all around the pen for two nights in a row but no animals were lost. They reported that villagers believed that the snow leopards reverted to their natural prey. Jackson and Wangchuk (2004) estimate that for every village pen made predator-proof, up to five snow leopards are protected from retaliatory killing.

Several forms of guard animals including donkeys, zebras and Anatolian shepherd dogs have been tried with varying degrees of success. The guard animal is defensive towards the stock, naturally aggressive towards the predators, or both. Predators are naturally deterred by dogs as guardians which also maintain a system of territorial marking. Smithers (1983) states that black-backed jackal *(Canis meselomas)* are territorial and will mark and defend their territorial boundary, but makes no reference to territorial behaviour by Caracal *(Felis Caracal)*. These are the two wild carnivore species regarded as most frequently in conflict with small stock farmers. The Anatolian Shepherd Livestock Guarding Dog project progress report of September 2007 reports a 91 percent success rate for placement of Anatolian Shepherd Guardian dogs during 2006. Florence (2002) states that a single guard animal may not adequately protect

livestock, but that several guard dogs may be necessary to patrol larger areas. Respondent 7 (2007) believes that placement of more than one Anatolian shepherd dog with a flock of sheep or goats undermines the desired bonding between the guardian and those protected, and also that the pack instinct in the dogs may lead to hunting of wildlife or attack on the animals they are intended to protect.

King collars are wide, adjustable PVC collars which were developed by the brothers, Grey and Larry King, who are sheep farmers in the Eastern Cape. They can be fitted to an entire flock of sheep and adjusted from time to time. Respondent 6 (2007) fits the small King collars to lambs at birth and adjusts them twice before removing them after weaning. King (2006) reports that the collars make it difficult if not impossible for a jackal to kill a sheep by biting at the throat, and this should condition jackals to not attack sheep. In comparing the King collars with other prevention systems, King considers these collars inexpensive, requiring fairly low maintenance, very easy to fit and adjust and readily available. Snow (2002) feels that because of the difference between feline and canine jaw structure and musculature, it may be possible for a Caracal to bite through a King Collar. Neither King (2006), nor Snow (2002) present evidence to substantiate this, but King (2006) collects damaged collars in an attempt to validate their effectiveness.

Respondent 8 (2006) suggests that the bell collars shown in Figure 2, and scent collars confuse and deter predators by invoking neophobia. This is because of the unnatural noise they make, or the human associated scent they exude. Provided they are used inconsistently but in conjunction with other methods and at lambing times when the risk of predation to livestock is at its highest, Respondent 8 regards the collars as highly effective. Respondent 8 (2007) and De Wet (2007) concur that neophobia is critically important in the application of predator deterrents.

Figure 2. Bell collars fitted to sheep (EWT, undated).

Another type of collar recently available and distributed on the South African market is the *Veldwagter*, which uses a movement sensor coupled to mobile telephone technology. Lötter (2006), the developer of this collar, states that if an animal which is fitted with a *Veldwagter* collar is chased, the movement sensor activates a call to the farmer's telephone, enabling him to react and investigate.

Lanterns and radios are mentioned by many farmers to create a disturbance or distraction, but neophobia is critical to success. From the farmers' perspective and applying a systems thinking approach, this system may offer a quick-fix respite from predation on his flock by confusing and repelling predators for a period of time (the gap between the present and the desired state of affairs). This allows for other, more permanent predation prevention methods to be applied or installed. It is also a system which is very quick and easy to put in place on a small scale.

2.2.2 Lethal control measures

Many lethal predator control methods are freely and readily available. Gin traps are sold in many farmers' cooperative stores. The most toxic agricultural chemicals can be bought from farmers' co-operative stores by the general public.

Marker and Dickman (2004) observed that predator removal seemed to be employed as a substitute for other management strategies such as the use of guarding animals or the enclosure of vulnerable stock, rather than being used as a last resort for the elimination of a specific animal causing repeated problems.

It appears that a goal of completely eliminating predators is a futile one. Connolly and Longhurst (1975) found that if 75% of the coyotes are killed each year, the population would be exterminated in slightly over 50 years. Their model suggests that coyotes can withstand an annual control level of 70% through compensatory reproduction.

To further demonstrate recruitment ability, these authors stated that if 75% control occurred for 20 years, populations would regain pre-control densities by the end of the fifth year after control was terminated. Furthermore, Windberg and Knowlton (1988) suggest that immigration, which was not considered in the Connolly and Longhurst model, can result in rapid occupancy of vacant territories.

Snow (2002) believes that hound packs, provided they are efficiently and effectively managed, may be effective to control damage-causing predators. Reasons suggested by Snow for the frequent failure of hunt packs include poor training, sideline hunting, lack of control over dogs and particularly the mindset of blanket predator extermination. Snow emphasises that dogs have to be put onto a fresh scent trail from a fresh kill. If unavailable at short notice he recommends that they should not be used, since after the scent from the fresh kill to the damage-causing culprit has faded the target specific focus and advantage of this method is lost, and a non-target animal will invariably then be killed. Pack sizes may vary but logically, the larger the pack the less controllable it is. (Wilke, pers. comm. 2007).

Viewed holistically, the value of this method hinges critically on the efficiency and

effectiveness of management, training and response time by the handler or dog-master. Snow (2002) believes random hunting of predators with hound packs is a waste of time and effort, and exacerbates the problem. For emphasis the reader is reminded of Gabrielson's (undated) sentiment, quoted earlier, to the effect that money expended on predator eradication is a waste of funds that could be applied better elsewhere.

Gin traps are generally considered to be extremely hazardous to non-target animals since it is impossible to ensure that they only capture specific animals. De Wet (pers. comm., 2007) believes that it is possible for a highly skilled trapper to modify these traps and set them to be target specific. De Wet is a predator trapper with more than 30 years experience. Stadler (2007) holds the general view that it is impossible to guarantee that one will trap only the specific damage-causing individual, and that gin traps are extremely hazardous to non-target animals. These are generalisations and it is hoped that this 2008 study will support these statements.

Schneekluth (undated) indicates that Terminator ® traps have a machine screw as the pivot on the trigger plate. The tension of this screw may be adjusted to a tension where the trigger mechanism will only release when a selected mass is applied to the trigger plate. In Schneekluth's manual, he suggests that these traps should not be set in paths or tracks, but aside from the thoroughfare. Regrettably many farmers fail to heed this advice, as is vividly illustrated by the photograph, Figure 3. The victim is an aardwolf *Proteles cristata,* caught in a gin trap near Magersfontein, Northern Cape.

Figure 3. Non-target aardwolf caught in a gin trap (Taylor, 2007).

Gin traps are frequently applied in an inhumane manner and not checked frequently. This statement is substantiated by analysis of results of the EWT questionnaire survey with regard to gin trap use in Chapter 4. Figure 4 shows the gruesome skeletal remains of an aardwolf left to decompose in an inhumane neck-break gin trap.

Figure 4. Aardwolf remains in a gin trap (Blom *et al.,* 1992).

Bowland *et al* (undated) state that use of these traps requires a considerable effort and expertise and are inhumane if not visited at least daily. This is illustrated above. Bowland *et al* also elaborate that an animal may be maimed and escape to become and even greater problem.

In terms of the National Environmental Management Biodiversity Act (2004), it is illegal to hunt threatened or protected game species with traps, but permissible to use certain traps to catch black-backed jackal and Caracal under certain permit prescriptions. Although speculative, it is quite possible that small game animals are captured and used as bush-meat by farm workers. When holistically considering the broader system, these traps appear to be non-selective, non-target devices which kill and maim thousands of innocent animals annually with an extensive environmental effect. A prey base reduction would increase pressure on domestic stock by predators in search of food.

Green *et al* (1994) describe the Coyote Getter as a spring loaded mechanical device which propels sodium cyanide into the mouth of an animal which pulls on it. Blom *et al* (1992) describe their function as similar to a trigger mechanism of a firearm. The devices consist of a ground peg which holds the device in position. The trigger portion clips into the ground peg. A scented bait head which contains a spring loader ejector (Green *et al*) or a .38 Special revolver cartridge loaded with sodium cyanide (Blom *et al*), screws onto the ejector or trigger portion. The scented bait head comprises wool or similar material which is tightly wrapped around it, then trimmed off to allow exit of the toxin. Finally it has some scent or taste attractant applied to it. When bitten and pulled by an animal, the cartridge fires and sodium cyanide is propelled into the animal's mouth. According to Blom *et al* (1992), coma and death of the animal follow soon afterwards.

Bowland *et al* (undated) reported on trials conducted at the University of Natal. A captive family group of four black-backed jackals, of which one adult animal pulled a blank (without toxin) coyote getter, did not approach the devices again during the subsequent 18 month period of the study. This was regardless of their

state of hunger or food deprivation. This is supported by a study of Blom *et al* (1992), which showed progressive avoidance of Coyote Getter devices by black-backed jackal, as illustrated in Table 1.

Table 1. Progressive avoidance of coyote getters (Blom *et al* 1992).

YEAR	Jackal encounters	Killed	Getters avoided	% avoidance
1985	34	18	16	47
1986	27	13	14	51
1988	66	5	61	92

Only strychnine may be used in meat baits and then only under a State Veterinarian's prescription and with a permit from a provincial conservation authority, Republic of South Africa (1973), Hazardous Substances Act, Act 15 of 1973, Republic of South Africa, (2004) National Environmental Management Biodiversity Act, Act 10 of 2004. The Endangered Wildlife Trust questionnaire survey (2003) found that agrochemical toxins were abused by farmers who poisoned carcases (22, 5%) or distributed poisoned baits (up to 30%). Verdoorn (2006) suggests that the bitterness of strychnine has probably been the main causal factor of bait avoidance. The use of other chemical poisons for this purpose is illegal and carries potential severe penalties, yet according to the Endangered Wildlife Trust, Wildlife Poisonings Database (2007), this method is still widely abused by many farmers. Berutti, Snow and van Zijl (2005) estimated that up to 470 000 game birds and waterfowl are killed annually by pesticide abuse.

At a wildlife conflict management meeting, De Wet (2007) used Table 2 to describe three historic poisoning programmes, by three different government officials. The total number of jackals in the area, either before or after poisoning events, was not indicated by De Wet, who suggested that this table illustrates progressive poison bait avoidance. The validity of both the statement and the data is questionable.

Table 2. A questionable illustration of progressive poison avoidance by black-backed jackals (De Wet, 2007).

YEAR	JACKAL/AREA	Sources cited by De Wet (2007).
1974	37 jackals killed on 2 farms	D. Willemse – *personal comment.*
1984	5 jackals killed on same farms	De Wet – Unpublished data
1987	1 jackal killed on every sixth farm	Steyn – Internal Dept. Vet. Service report, Louis Trichardt

Two types of Livestock Protection Collars (LPC's) have been used in South Africa. The old American McBride collar consists of two Velcro bands onto which two plastic sachets of poison are attached. These are shown in Figures 5 and 6. These collars contained the toxin carbofuran, and the new (post 2003) Protect-a-Lamb collars shown in Figure 7 are a more refined halter collar which contain sodium monofluoroacetate (also known as Compound 1080). Figure 8 shows how the collars are fitted to the sheep or lambs.

Figure 5. A McBride collar (Snow, 2002)

Figure 6. McBride collar fitted to a sheep (Verdoorn & Webster, 2007).

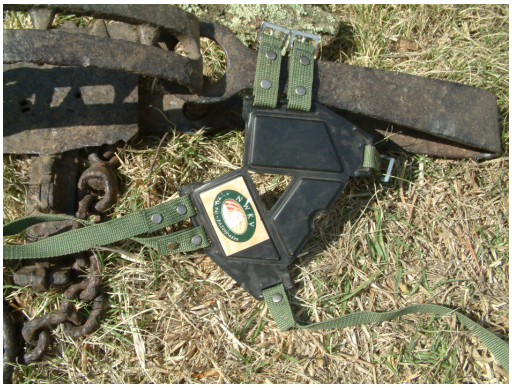


Figure 7. A P-A-L prototype Compound 1080 collar (Snow, 2002).

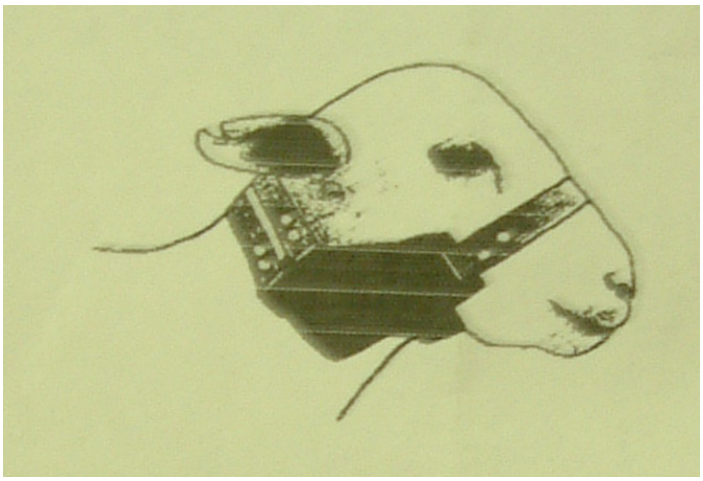


Figure 8. Protect-A-Lamb collar fitted. (P-A-L brochure, 2006).

Verdoorn (2007) cautions that spillage from punctured McBride carbofuran collars is extremely toxic to scavengers, and this is substantiated by data from the EWT – Poison Working Group's database of wildlife poisoning events (unpublished). Green *et* al (1994) describe the 1080 Livestock Protection Collar as a 'relatively new tool'. From the work of Atzert (1971) it was calculated very roughly that the lethal dosage of Compound 1080 is 12 to 200 times less toxic to American birds than it is to coyotes. Brown (1992) tested the effect of Compound 1080 at calculated dosages appropriate for black-backed jackals and observed no deleterious effect on a captive Bearded Vulture. No other South African field test data is available for sodium monofluoroacetate/Compound 1080. Connolly (1990), highlights that the greatest factor in favour of these livestock protection collars is that they will only kill a predator which is biting a sheep on its throat.

The toxicity of the compounds mentioned was investigated. Succinctly explained, toxicity is measured as the lethal dosage of a chemical compound to 50% of a laboratory trial population and expressed as the LD50 in milligrams per kilogram body mass. The LD50 value of carbofuran for dogs is 15 mg/kg and 2.5 to 5 mg/kg for Japanese quail, recorded by Tomlin, (1968). These values illustrate the highly toxic properties of carbofuran, specifically to scavenging creatures such as jackals and birds of prey. Conversely the Compound 1080 used more recently in poison collars appears to be safer from an environmental perspective since it appears more toxic to the target, primary predator than to post-predation scavengers. Tomlin (1968) does not offer LD 50 values for Compound 1080 for any species other than *Rattus norvegicus* at 0.22 mg/kg. Atzert (1971) indicates a LD 50 value of 0.2 mg/kg for the coyote, *Canis latrans* and a range from 1.25 mg/kg for a Golden eagle to <20 mg/kg for Turkey vultures. Without the extensive toxicology testing required to substantiate this comparison between toxins, the assumption is made that risks of toxicosis to non-target scavengers from Compound 1080 are less than if carbofuran were used. It is further assumed that this was the justification for the change of chemicals in these collars.

Many farmers revert to shooting, or employ others to shoot predators. Schoeman, *pers. comm.* (2007) stated that particularly black-backed jackals are called up by sound devices. Schoeman is a hunter who uses a filtered spotlight, described as a black light, at night and calls the jackals to within shooting range. Whilst these hunters may call up jackals in the area where stock losses are occurring, there is no guarantee that the animal shot is the damage-causing animal. In addition to this, because the hunters are most often paid according to the number of predators killed (Schoeman, 2007) it is likely that the measurement of success is flawed. This is because the measurement of success is by the number of predators killed and not by the cessation of damage or increased stock production and profitability.

2.3 Systems Thinking

Systems' thinking is a way of thinking which is based on the study of Systems Dynamics. Goodman (undated) describes systems thinking as a language used to communicate about complexities and interdependencies, and which is particularly useful for discussion and analysis of complex issues. He describes systems thinking as a visual language which aids precision, forces explicitness of mental models and allows examination and enquiry to diffuse the frequent defensiveness encountered in high level debates. Importantly, Goodman concurs with Hitchens (2005) that the principle of systems thinking is a multi-dimensional communication system as opposed to a linear, Cartesian system.

2.3.1 Systems Thinking and Conflict Management

This specific section was originally entitled, "Systems Thinking and Predator Conflict Management". However, Hemson (2003) was the only author located to have touched extremely fleetingly on the concept, but failed to discuss it fully in his entire doctoral thesis. Some literature from the USA does cover systems thinking and predators but is also limited. It became necessary therefore to

obtain a broader overview of conflict management in other fields before focusing on predator conflicts.

Senge *et al* (1995) explain systems thinking this way:

> "You won't be able to 'divide your elephant in half'. You can't redesign your system (the elephant) by dividing into parts; everyone must look at the whole together. Thus, you can't practice systems thinking as an individual – not because the discipline itself is difficult, but because good results in a complex system depend on bringing in as many perspectives as possible" (p 91).

This systems thinking concept is introduced to highlight the need for predator conflict managers to think laterally and to regard the subject holistically and beyond the small components with which they may deal routinely. The holistic view, or elephant in this study, is the full suite of predator conflict management methods. Each method is a component of the whole, and it is logical to reduce complex concepts into smaller components for ease of comprehension in a step by step process. However, those smaller components are part of the whole, and they need to remain that way. By understanding the smaller components as part of a larger entity, it becomes possible to see and understand by stepping away far enough from the picture to allow a full view, like looking at puzzle pieces fitted together.

Jones *et al, (*2005) suggest that individual perception is critically important in conflict management of any nature. They propose that most conflict management processes start with negotiations to clarify and define the conflict. Following this thought from looking at the whole picture, Senge *et al* (1995) state:

> "Don't look for leverage near the symptoms of your problem. Go upstream and back in time to ferret out the root cause." (p 92).

This amplifies the thoughts above. When a puzzle is viewed from a step back, but as a whole, it becomes possible to identify pieces which don't fit correctly, and then to make the adjustments required for correctness.

2.3.2 Cartesian (Linear) vs. Systems thinking

Hitchens (2005) suggests that thinking is a commodity which is not employed adequately. He believes that whilst Cartesian, or reductionist thinking works on simple linear issues it fails to address complex problems. Systems thinking on the other hand explains problems or scenarios in schematic, multi-dimensional diagrams of links and loops. In other words, a person applying systems thinking explains the system by viewing a full range of events or circumstances, and analyses and interprets the cause and effect interrelationships and reactions of components. Systems thinking can become rather complex and is thus better understood after breaking the components into more simplistic thought chains before combining the chains into a network of events, or causes and effects in causal loop diagrams.

To explain this more simply, we analyse an event as part of a pattern in a bigger picture, with the intention to understand the interrelationships holistically. This was expanded upon in section 2.3.1. For example, after an urban fire there is an investigation to determine the cause. The single event is related to other fires. How, where and why did they start? What were the causes? This interrogation leads the process to a better understanding and provides the opportunity for adaptations and changes by identifying leverage points in the system. These are small changes which have profound effects, such as installation of fire alarms and fire extinguishers in kitchens as a method of stopping the fires quickly at source, before major damage is caused or entire buildings burn down.

This transition from Cartesian thinking to systems thinking is diagrammatically illustrated in Figure 9. The first line in figure 9 shows straightforward reductionist thinking which uses static, simple models without interconnections. This system is simple and possibly even predictable by statistical analysis. The second line of the diagram progresses to linear cause and effect thinking. In this case the diagram illustrates a chain reaction, such as a line of dominoes falling, each toppling the next after the reaction is started. This line is based primarily on the

logic of energy/activity input being equal to energy/activity output, but fails to link the first and last dominoes. The third line shows a scenario consisting of a feedback loop, where the cause and effect chains loop back onto themselves. There is consistent interaction between variables. Hitchens (2005) points out that loops are not necessarily illustrated by a perfect circle since, being an illustration of reactions and inter-reactions. The causal loop could be ovoid or geoid in shape. This third scenario is the archetype most encountered in natural science, since the interactions and inter-relationships between components of the natural world are largely unpredictable. As an illustration, in an enclosure with a concrete floor and impenetrable sides it is predictable with a very high probability that a cat would catch and eat a mouse within a certain time. In a natural area, the cat may encounter vegetation and various obstacles which assist or hinder its hunting ability to the extent that it failed to catch the mouse which could well escape to live elsewhere, or survive only to be caught after a time delay.

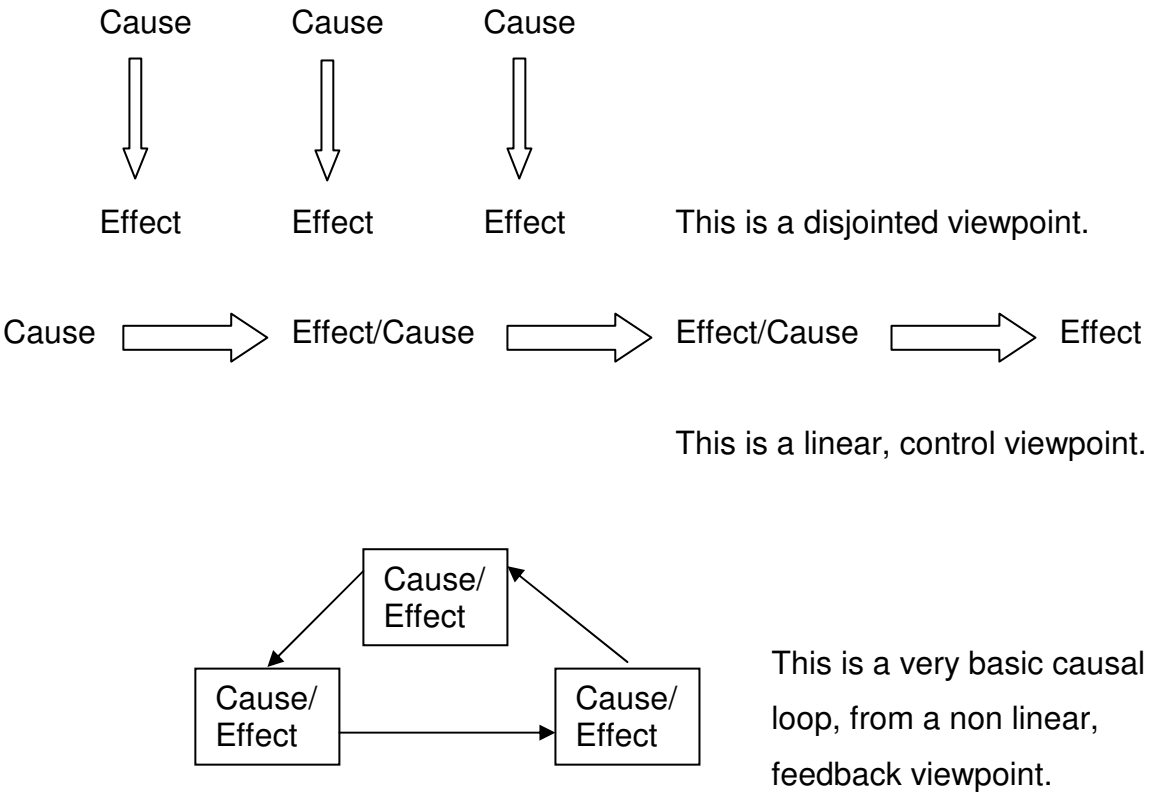


Figure 9. Illustrating progression from linear toward systems thinking. (Hitchens, 2005).

Discussing the difference between Cartesian and systems thinking processes, Hitchens (2005) compares an inanimate pile of stones and a human body. If a the number of stones in the pile is known and then a known number of stones are removed, the item, still remains a pile of stones and the number remaining in the pile may be calculated by deducting those removed. It is just a pile of stones which can be reconstituted to the original form at any time. Conversely, a human body cannot be eviscerated and re-assembled since the various parts function in a highly complex and interdependent interrelationship.

2.3.3 Archetypes

Senge *et al* (1995) define the Greek word *archetypos* to mean the "first of its kind". In the systems thinking context, the archetypes referred to are names attributed to various scenarios which recur regularly, and which become templates and tools used to construct, clarify or test systems thinking models. No two systems are exactly the same. Archetypes are useful to enhance communications and understanding between systems thinking the broad generic core of systems at work. Senge *et al* (1995) suggest that a blank causal loop diagram should be filled in gradually, by guessing and using intuition. As diagrams take shape, the simplified sections grow to enable more logical interpretation of the cause and effects of the components and their interrelationships. The arrows and influence are added until the archetype can be identified. Simply stated, archetypes are interpretations of system behaviour patterns.

2.3.4 Links and loops

Causal loop diagrams are used to illustrate scenarios and as a method to facilitate systems thinking. The diagrams consist of arrows connecting variables in a way that shows how one variable affects another. Causal Loop Diagrams are used as tools to illustrate and discuss scenarios, and a number of symbols are

used in these diagrams. Gray (2005) describes these as a form of language used in systems thinking, and the symbols predominantly used are shown in Table 3.

Despite being a proponent of situational analysis, Richardson (1986) suggests some shortcomings in causal-loop diagramming, both in their development and in explaining behaviour. He believes this is because causal-loop diagrams tend to simplify scenarios. They do not always consider the full series of linked background events and interrelated circumstances and functioning systems into consideration. These interrelated circumstances and underlying events often recede to obscurity when illustrated schematically. Richardson believes that people wishing to construct meaningful dynamic models should either avoid causal-loop diagrams or suggests that they should use them exceedingly carefully.

Bellinger (2004) indicates that a systems thinking approach facilitates analysis of cause- effect interrelationships.

Figure 10 illustrates the use of symbols and directional arrows graphically in a causal loop diagram. Unprotected livestock at top right of the diagram represents an increased food source for predators. This in turn adds to the attractiveness of the area for migrant predators and causes immigration to the area. Abundance of food leads to an increase of predator numbers on the farm. The increased number of predators may lead to a decreased food supply, reversing the flow and causing emigration from the unattractive habitat. Once a certain number of predators have emigrated, a time-gap occurs as the system balances. During this time-gap the food source may increase again and cause predators to immigrate. Hence, the constant cause and effect of variables can be interpreted.

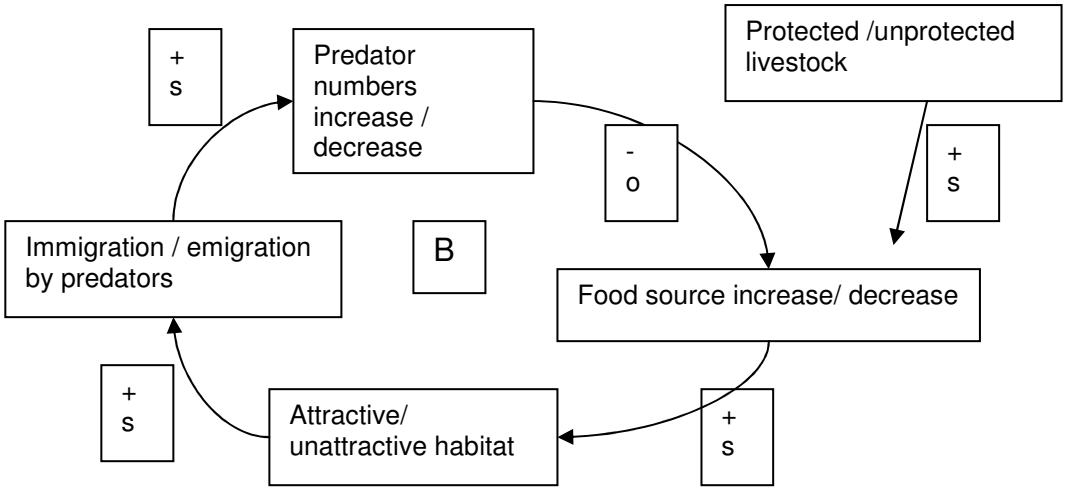


Figure 10. The use of letters or symbols in a causal loop diagram to indicate the direction and influence of variables in the system.

Each arrow in a causal loop diagram is labeled with an "s or plus symbol" or an "o or minus symbol." "S" or “+” means that when the first variable changes, the second one changes in the same direction. "O" or “-” means that the first variable causes a change in the opposite direction in the second variable. The arrows form loops, and loops are labeled with an "R" or a "B." When used, the "R" symbol denotes reinforcing, and the causal relationships within the loop create exponential growth or collapse. The "B" symbol represents balancing, i.e., the causal influences in the loop tend towards equilibrium. Causal loop diagrams may contain many different "R" and "B" loops, all connected together with arrows. By drawing these diagrams one begins to gain a deeper systems understanding and gain an array of perspectives.

Table 3. Key to meanings of symbols in Causal Loop Diagrams.

Symbol	Meaning
Arrow with “s”, or “+” symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y.
Arrow with “o”, or “–“ symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y.
“R” – see section 2.3.4.1	A reinforcing loop that amplifies change.
“B” – see section 2.3.4.2	A balancing loop that seeks equilibrium.
= or “Time gap”	A time, or other delay between the current status and the desired status

Source of Table: Senge *et al* (1995)

2.3.4.1 Reinforcing loops – small changes with great effects

In reinforcing loops an important variable increases, with exponential growth (a virtuous cycle). The opposite also applies where the important variable decreases and results in exponential collapse (a vicious cycle). A frequently used example is that of an investment subjected to compounding interest, without any withdrawal of capital invested. Senge *et al* (1995) use a “snowball effect” sketch in causal loop diagrams to illustrate reinforcing loops. In this document the symbol “R” is used to indicate a reinforcing loop.

2.3.4.2 Balancing loops – reaching stability, resistance and limits

Causal loop diagrams illustrating balancing loops show movement without delay toward a target, or else oscillation and hovering around a target with some delay, such as scenario described in the example in section 2.3.4. In this document the symbol “B” is used to indicate a balancing loop. Using a similar investment example, the loop would balance if accrued funds remaining were withdrawn as income, after allowing an inflationary increase in the capital investment and after expenses had been paid.

2.3.5 Stocks and flows, and delays between cause and effect

The amount of change that something undergoes during a particular unit of time is referred to as a flow, and systems thinking authors frequently draw comparison to water levels in a bathtub, or the seasonal rise and fall of water volume in a reservoir or stream.

Senge *et al* (1995) cautions one to not look for leverage near the symptoms of a problem, since a gap may be present between the cause and the effect. This gap may be a time lapse or the delay while a leverage point is found, but does not mean that the flow of the system stops at any given point. The system is dynamic and ever changing. Senge uses an example of a health care facility, where during peak periods the high patient numbers led to increased waiting times and reduced patient satisfaction. Dissatisfied patients complained and were reluctant to return. Management who were not conscious of mounting frustrations only realized a problem existed once patient numbers decreased by their avoidance of the centre after a time gap. Conversely during quiet times patients experienced reduced waiting times and greater satisfaction, and conveyed their satisfaction to others. Their satisfaction led to an increase in patient numbers and in turn reverted to the starting point of this cycle, where high patient numbers caused delays in the system. The message conveyed by the example was that a study of the situation led management of the health care facility to adjust their staff numbers and work times to suit patient needs or demands. By so doing, they reduced the “ebb and flow” fluctuations from the system.

2.3.6 Fixes that backfire and quick fixes

Senge *et al* (1995) describe this archetype very vividly. He suggests that lubricating a squeaking wheelbarrow wheel with water instead of oil is a fix that backfires, because the water lubricates the system and stops the squeak temporarily, but that the squeak recurs with increasing temporal frequency since

the water is an ineffective lubricant. This “fix that backfires” would continue until incorrect and inadequate lubrication led to system failure (indicated by a “-” or “o” symbol), or where the use of the correct lubricant changed our example of the squeaky wheel system (symbol “+” or “s”) toward a different archetype. In essence, fixes that backfire are temporary, ineffective solutions to problems which are successful for a short time, but because they are incorrect and ineffective, will fail after a time lapse and cause reoccurrence of the original problem. This archetype is encountered with alarming regularity in life as a consequence of management actions addressing the symptom without seeking out and addressing the cause of the problem.

2.3.7 Limits to growth

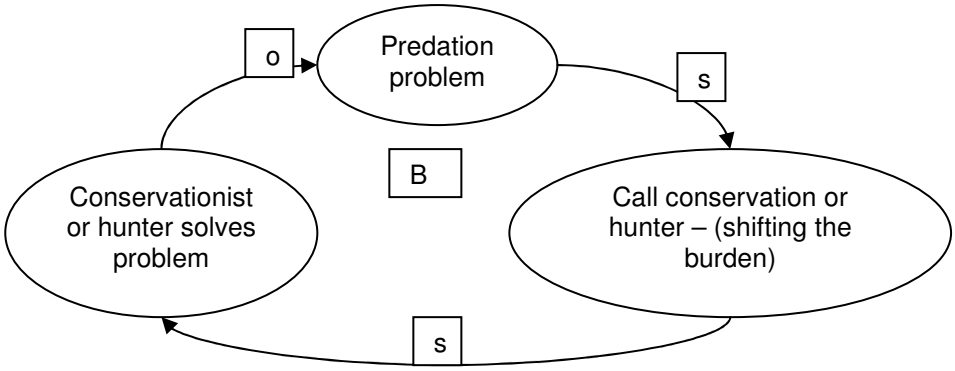
Senge *et al* (1995) again uses a vivid mind picture to illustrate this archetype, which he calls “picking the low-hanging fruit”. This implies a situation that is easy at first but which becomes increasingly difficult to achieve. The old adage that a new broom sweeps cleaner could be applied to a management situation where a new manager takes a fresh look at a system, applies a few small, fundamental, previously ignored or unnoticed, yet highly effective leverage changes, and achieves impressive results. The Limits to Growth scenario is ever-present. When growth slows down (or the fruit becomes too high), the time comes to review the situation, (use a stepladder to reach the fruit). The new manager’s performance slows.

During a rapid growth period, a delivery company may choose to pay big salary bonuses instead of expanding and growing by investment in more delivery capacity and staff. When it is later realized that delivery capacity is lacking, and that competitors are gaining a market advantage through greater delivery efficiency, the funds to effect a change may no be longer available. (Note the time lapses and the ebb and flow for each business).

This is not necessarily always a bad scenario. A small family business could reach a plateau of expansion where all family members are employed to their optimal efficiency and effectiveness, they are satisfied with what they have and that they choose stay as they are and not to grow further. They are content to allow others to pick the fruit which they find difficult to reach.

2.3.8 Shifting the burden

In an article entitled *"Shifting the Burden – Whose Monkey Is It?"* Gray (2005) refers to shifting the burden as a quick fix. His question, *"Whose monkey is it?"* is assumed to refer to the book, "*One Minute Manager Meets the Monkey"*, in which Blanchard *et al* (1989) describe a street musician whose monkey leaps onto the shoulder of a passerby. The monkey's leap illustrates a shift of responsibility, or duty of care for the monkey. The lesson conveyed is that managers should not accept responsibilities (the monkey) which others attempt to shed, nor should they "pass the buck" of their responsibility. Gray (2005) illustrates a quick fix or shifting the burden in three stages. The example used by Gray has been used as a template to suit the theme of this study as follows. A farmer experiencing predation on his livestock calls a conservation official or a predator hunter for assistance and the conservationist or hunter solves the problem, the quick fix which is a symptomatic response. This is illustrated by the causal loop diagram in Figure 11. The second stage of this example requires a time delay, where the farmer learns the corrective procedure by studying the "Best Practice Manual", to solve the problem as illustrated in Figure 12, as a systemic response to the predation problem. For convenience, Table 3, the key to meanings of symbols in Causal Loop Diagrams, is repeated. Both Figure 11 and Figure 12 are balancing loops.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 11. The symptomatic "Quick Fix" and "Shifting the Burden" (dependence). Source of Table: Senge *et al* (1995)

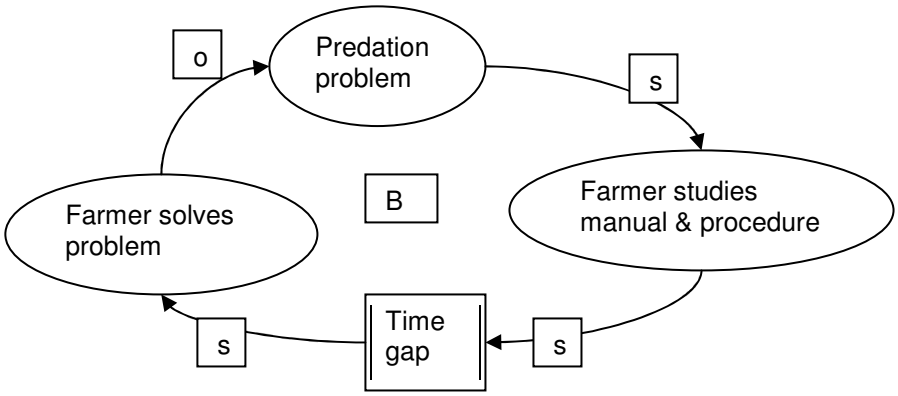
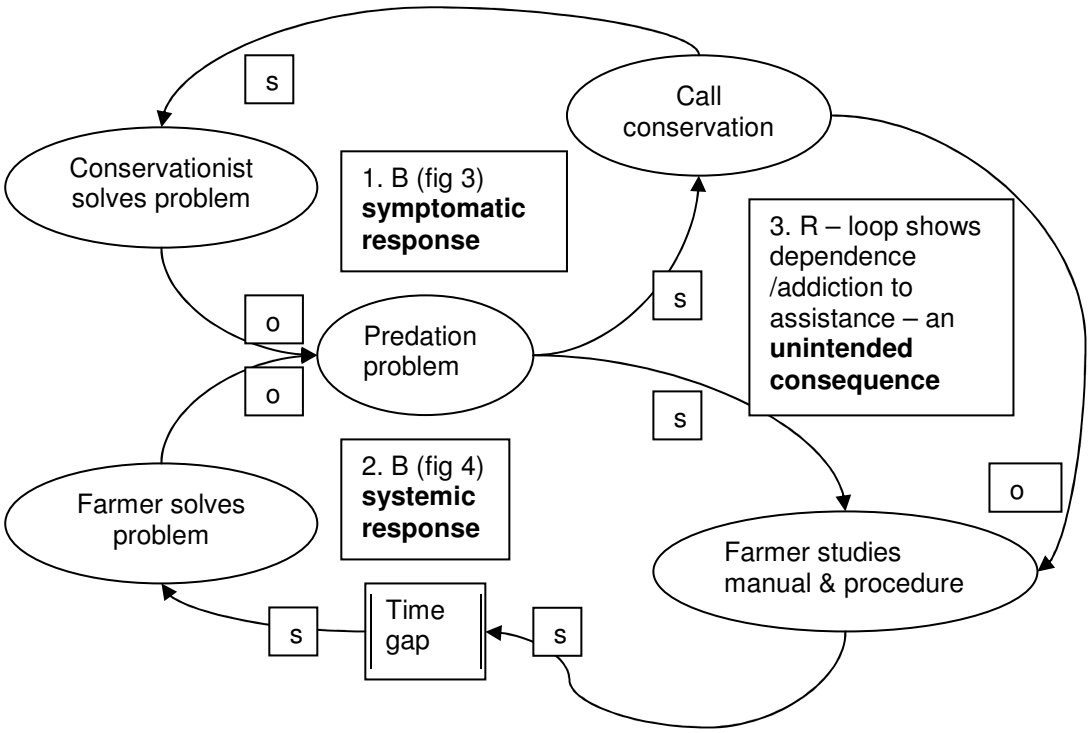


Figure 12. Solving the Problem systemically and breaking out of the dependence loop.

Since both of the above scenarios contain a predation problem it is possible to combine the loops, since the predation problem can trigger either of the

responses illustrated in Figure 11 and Figure 12. This illustrates that whilst the systemic solution is available, the farmer may still choose the symptomatic quick fix because of habit, dependence or addiction. This combination of responses is illustrated in Figure 13. The dependence or addiction shown in the reinforcing loop at the right may be described as an Unintended Consequence.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 13, Combining the balancing loops of symptomatic and systemic responses, and addiction to external assistance. Source of Table: Senge *et al* (1995)

2.3.9 Accidental adversaries

This archetype may also be linked with unintended consequences, if the support component becomes indispensable or the support user becomes addicted to whatever the support provides. In the scenario illustrated in Figure 5, dependence on others is an unintended consequence of persistent symptomatic reliance on the person for the effect or the solution provided. This gives rise to a long term reinforcing loop that occurs when the symptomatic solution predominates in the situation (see Figure 3: dependence) or is chosen in preference to the systemic solution.

As an example, in a trade scenario a wholesaler may sell a particular item at a highly competitive price. A chain store may purchase stock in bulk to lure customers into their stores with the special offer and with the hope that whilst they are there, they will purchase additional goods on impulse. The accidental adversity arises in the form of a smaller store which trades on a lesser scale in similar commodities, but because they do not have the storage facilities, they buy smaller volumes of this especially cheap item from the importer, and sell them at the same rate initially as the chain store, merely replenishing their supply more frequently from the wholesale supplier. Since they do not incur storage costs, they do not have to factor that into their price and as a result are able to sell the same items at a cheaper price than the chain stores' special offer price.

After a time delay customers realize that the item is cheaper at the smaller store and now choose to shop there because the perception exists that their prices are generally cheaper than the chain store. Neither party intended to compete with the other over the sale of this particular item. This is an unintended consequence of the larger store incurring storage costs which the smaller trader did not and makes the two trading entities become accidental adversaries.

2.3.10 Tragedy of the commons

Senge *et al* (1995) define the tragedy of the commons as a situation where individuals benefit from the sharing of a common resource. The tragedy in the system becomes apparent when the individual no longer receives a benefit, and the situation cannot be reversed by the individual. This often places individuals in conflict, and in studying conflicts between pastoralists and wildlife management, Grahn and Leyland (2004) found that involvement by communities and individuals in co-learning and participation to resolve the conflicts was a key aspect of success. Their process led to community members themselves identifying solutions to conflict, and over time formal agreements were developed and the traditional authority of elders was re-established. Using the pastoral grazing system to illustrate the tragedy of the commons, Grahn and Leyland found it is easy to explain, and they believe that individuals likewise found it easy to comprehend that the individual with the most livestock will derive the greatest benefit from the use of common grazing lands. Lack of a system of check and balances leads to inequitable use and distribution of the common shared resource, and this is what leads to conflict.

The two clearest indicators of pressure on a common resource which change simultaneously are firstly, total use, which rises sharply and secondly, individual gain per resource unit used, which peaks but then drops sharply. If this dynamic of unsustainable pressure by uncoordinated individual actions continues for too long, the total activity will also crash. Overgrazing and desertification have been used repeatedly to illustrate this archetype. To clarify this to urban people, Senge *et al* (1995) suggest that when a new highway is commissioned, the number of motorists using it to reduce the time taken to get to work will escalate until overuse leads to traffic jams. There is no way to resolve this other than for the authorities to build more highways to keep pace with population increases. Individuals alleviate their personal frustration by withdrawing to lesser used resources such as a different, but perhaps longer route.

2.4 Summary

The literature review chapter covered three focal points. Firstly the legislation which sets the norms and standards, or parameters within which farmers may manage damage-causing predators was reviewed. The second focal point was a review of the array of predator conflict management methods. To enhance understanding, the different methods available and in use by farmers were reviewed separately in the categories preventative management and non-lethal methods, and then lethal control methods. This component of the review enhanced understanding of the predator conflict management methods applied, and the circumstances and rationale for application of each method. Finally, the literature review probed systems thinking in conflict management. The distinction was made between linear thought processes and systems thinking, and a series of behavioural management archetypes were reviewed and described. This facilitated comprehension of the link between the predator conflict management methods applied, and the over-arching systems and processes.

Chapter 3 Methodology

In order to address the three research objectives it was necessary to investigate the predator conflict management methods and systems thinking of selected farmers, and also develop a clear understanding of systems thinking. To achieve this it was necessary to engage with farmers through this study, hereafter referred to as the 2008 study. The question arose of which farmers to address, and it was at that point that it was decided that the Endangered Wildlife Trust's Poison Working Group study (2003) hereafter named the EWT questionnaire survey, should be re-visited to extract the required information. Whilst positivist approaches require research design to be decided before data collection this was not possible if the EWT questionnaire survey responses were to be used. The method adopted for this research enabled aspects of the design to emerge as the study unfolded, and so in this sense it was anti-positivist. This method used the data available and collected additional data as required. More details of the methodology process follow in subsequent sections.

3.1 Origin of data

This 2008 study initially used raw data from the EWT (2003) questionnaire survey to analyse predator conflict resolution to quantify losses, to determine methods used, and identify reasons for success or failure, with emphasis that failure leads to agrochemical toxin abuse.

During 2001/2002 the EWT Poison Working Group (EWT-PWG) developed an assumption based on their wildlife poisonings database that the farming community was abusing agrochemicals for predator conflict management on a large scale (Verdoorn, 2007). Verdoorn recalls that the decision taken to probe the issue of predator conflict management was *ad hoc*, using a questionnaire drawn up by EWT-PWG staff. Furthermore, Verdoorn recalls the questionnaire initially contained a section which probed farmer opinion on the possibility of development of Single Lethal Dose poison baits for predator conflict

management, to probe the assumption that agrochemicals were being used illegally. Hence the EWT questionnaire was adjusted from the original format without academic or scientific inputs (Verdoorn, 2007), to the format attached as Appendix 1. No literature review was done, and no consideration was given to research design, sampling types or suitability of the questionnaire design (Verdoorn, 2007). Critical reading through the EWT questionnaire leads one to question the relevance of many questions.

The EWT questionnaires were completed in groups by captive audiences at farmer days. The researcher led the respondents through the questions, yet two percent of EWT questionnaire survey questionnaires were returned blank, with only names completed in a script which raised the possible explanation of illiteracy of those respondents. The EWT questionnaire spans 23 pages, and appears to not follow a logical sequence. Many questions in the EWT questionnaire are structured repetitively, which may have led to apathy in the completion by respondents. Despite flaws, the raw data captured by the EWT questionnaire survey provided valuable responses for the purpose of the 2007 - 2008 study.

The EWT questionnaire survey data was fixed in time, Cartesian, and offering no indication of cause and effects of predator conflict management actions, or the success or failure of such activities.

3.2 Choice of data collection method for the EWT (2003) questionnaire survey

The choice of data collection methodology for the EWT (2003) questionnaire survey was beyond the control of this dissertation.

3.3 Alternative choices of data collection methods

This 2008 study used raw data from the EWT questionnaire survey (2003) and which was kindly made available by the Endangered Wildlife Trust. This is subject to confidentiality, or to disclosure with respondents' permission only. The EWT (2003) questionnaire survey did not probe cause and effect of various predator conflict management actions on a time scale within agricultural and ecological systems.

This 2008 study respondents were selected because they had indicated a change of mindset from predator persecution to a conflict prevention management system which knowingly or unknowingly applied systems thinking in any form. A structured telephonic interview questionnaire (Appendix 2) was designed to identify predator conflict management methods used. In due course those methods were described in archetypal terms from systems thinking literature. Secondly, the 2008 questionnaire sought to identify leverage points which could stimulate a change in approach to human-predator conflict management. Finally, it sought to investigate the effectiveness of preventative and lethal predator conflict management methods when viewed from a systems thinking perspective.

3.4 Rationale for the choice of method

The EWT questionnaire provided a volume of raw data which had been collected at significant expense and which could provide many answers sought by this 2008 study. Welman *et al* (2005) suggest that positivist approaches require research design to be decided before data collection, but that was not possible in this case where raw data from a historic questionnaire survey was used. The only option available was anti-positivist with emergent design using data available and then collecting additional data as required.

The EWT questionnaire survey data presented a result which represents a single time frame, of what farmers did for the three years before the survey in a single picture or record of what the *status quo* was at the time. The results did not present any cause and effects, nor show whether one predator conflict management method was any better or worse than the next. It presented no pattern, nor logic, and extraction of data which were meaningful to gaining systems understanding was difficult.

Too many questions remained for an enquiring mind which was intent on understanding the systems at work. For example, the farmers may have used a particular predator conflict management control with a specific result in the first year. What then? Was the cause of conflict addressed, or not? Systems' thinking requires a longer term interrogation of the system to understand its dynamics, and it is for this reason that the repetitive, probing system of questioning suggested by Senge *et al* (1995) was applied.

3.5 Replication of the EWT 2003 questionnaire survey

The choice of farmers who completed the EWT questionnaire survey was randomised by the fact that they were invited to the series of nine farmer days hosted by the National Wool Growers Association (NWGA). All farmers attending the events were requested to complete the questionnaire, but only 80 of all attendees did so. In considering the possibility of a replication of the EWT questionnaire survey, it would be possible to make contact with most farmers, but for adequate scientific replication it would be desirable to select a new random sample of the same number of farmers across the same study area but for the purpose of the 2007-2008 study, replication of the EWT (2003) questionnaire survey was irrelevant.

3.6 Interviewees for the 2008 study

To gain deeper insights into the systems at work in the conflict, the eight selected farmers were contacted respondents telephonically to assess what, if anything had changed since the 2003 EWT questionnaire survey. This contact was possible without infringement of confidentiality and anonymity since the author remains in the employ of the Endangered Wildlife Trust, and the purpose of the second contact was explained. In terms the respondents' rights and anonymity, this was raised and each respondent informed that they could remain anonymous if this was their wish. None were concerned about continued anonymity and some are cited in the reference list or for personal comments.

Respondent 1 is a member of the KwaZulu-Natal "Problem Animal" committee of the National Wool Growers Association (NWGA) and farms extensively with approximately six thousand sheep.
Respondent 2 is a sheep farmer from the Eastern Cape who has developed the King Collar for livestock protection.
Respondent 3 has developed a motion detection device in a collar which employs cellular telephone communication technology to inform a farmer when his sheep move erratically at night.
Respondent 4 was identified from the EWT (2003) questionnaires for comment on seasonal calving and lambing issues.
Respondent 5 was identified following his writing of an article about Caracal in the popular magazine, Africa Geographic, as well as his experience on the Eastern Cape "problem animal" forum. Respondent 6 has remained in contact with the author since the initial questionnaire survey and has applied several proactive predator conflict management changes to his farm over this time. He also provided invaluable commentary about the use and application of hunt packs.
Respondent 7 is a national authority on the breeding and training of Anatolian Shepherd Dogs.

Respondent 8 is the owner of Protect-A-Lamb, which makes Bell, Smell and Livestock Protection Collars.

All respondents have applied their innovative solutions in some way in predator conflict management and this is elaborated in the concluding chapter.

3.7 The role of literature in this 2008 study

The author's disillusionment about the killing of damage causing animals as a solution to conflict was the primary rationale of this 2008 study. Despite the author's experience in the field, it was necessary to consult the literature for a fuller analysis of the subject and to support, validate or refute statements presented in alignment with the objectives of the study.

A point was reached during this 2008 study where a conscious decision was taken to adjust the methodology to enable application of the works of Bellinger (2004) and Senge *et al* (1995). This required a series of questions and follow up questions to probe responses and seek out the root causes of the conflict the responses from the interviewees. Such a questioning technique enables deeper systems understanding which was necessary to identify leverage points which could influence a change of predator conflict management systems for the better. Bellinger (2004) believes that the nature of the questions we ask greatly influences the appropriateness of the systemic understandings we develop. Hence it should be understood that the manner of questioning and the appropriateness of wording of the question can influence the answer. Consider the difference between, "Who was in town?" and, "Which small stock farmers from the New Farmers Association were present at today's livestock auction?" The need to ask questions carefully and precisely became important to tease out systems thinking from farmers responses. To achieve this, the method proposed by Senge *et al* (1995) of asking the question, "Why?" five times over in a focused manner, was applied. Section 3. 8. 1 elaborates on this questioning system.

3.8 The rationale for introducing a systems thinking approach to the research

The data extracted from the EWT (2003) questionnaire survey left too many questions for an enquiring mind. Difficulty of interpretation of the EWT (2003) questionnaire survey dataset led to a search for a different manner to utilise the available information, and it was at that point that the principle of system thinking was introduced.

Senge *et al* (1995) suggest that rural people are able to learn and comprehend systems thinking readily, because they learn naturally about the cycles of cause and effect that make up the greater systems of seasons and life on the farm. From this point of departure one may assume that farmers would readily understand systems thinking and the network of cause and effect of the various system components if this were illustrated for them.

Simple and clear diagrams, with appropriate explanatory words are useful to enhance communication and comprehension. A simply explained picture which is correctly interpreted and understood, may be worth a thousand words. Flow diagrams and links and loops are often used in meetings to show cause and effect, and the completed sketches make it easier to depict and understand the how the various components are interdependent or inter-related.

3.8.1 Identification of leverage points and the five "Why's?"

One technique to uncover systems at work is to repeatedly question actions and results, or cause and effects to identify the root cause. To enable this, and root cause analysis, Senge *et al* (1995) recommend a process or technique which they call *The Five Whys*. To begin this process, one identifies a symptom and asks the first *why* about that, recording the response and repeating the process through five successive *why* questions. Responses are written down and

clustered around the parent question, for subsequent discussion to trace back to the root cause of each. These authors' advice is to avoid blaming others since this can derail the process. The process does not merely ask the question *why* five times. After the first response, the question *why* is asked about that response, and then again of the subsequent responses until the process has been repeated five times. The Five Why's technique was invaluable during the 2008 study to develop an emerging understanding of systems at work in predator conflict management.

As an example of this system in practice, issues were probed along this theme:

> Question 1. Why is there human-predator conflict?
> Answer 1. Because predators kill farmers' livestock.
> Answer 2. Stock can't be enclosed.
> Answer 3. Jackals are breeding faster than ever
> Answer 4. "Somebody to blame" doesn't control them.

Each question may have multiple responses, which should be written down as indicated, and clustered around the parent question to enable subsequent discussion, which identifies the root cause. Hence:

> A1.1 Why do the predators kill livestock? We then ask *why* about that response and subsequent responses until the *why* has been repeated five times. This helps to retrieve the facts of the matter more accurately. To illustrate this we ask:
> A2.1 Why can't stock be enclosed? It's too expensive.
> A2.2 Why is it expensive? It causes erosion because livestock repeatedly follow the same paths to the enclosure and when confined diseases such as foot-rot increase.
> A2.3 Why can erosion and disease not be managed? I am still repairing previous erosion damage, and foot-rot management is costly and time consuming.

A2.4 Why is the prevention of conflict by enclosure not preferred, since the management and control of predation is far more complex? The fencing materials, labour and shepherding costs are prohibitive.

A2.5 Why are these alternative preventative methods not considered for implementation in a gradual manner, as they can be afforded and despite the cost, before stock losses reach unacceptable levels? They are leverage points that could change the system dramatically. Why not consider modern, portable enclosures which circumvent the hindrances listed?

It is hoped that this 2008 study will indirectly answer Question A2.5.

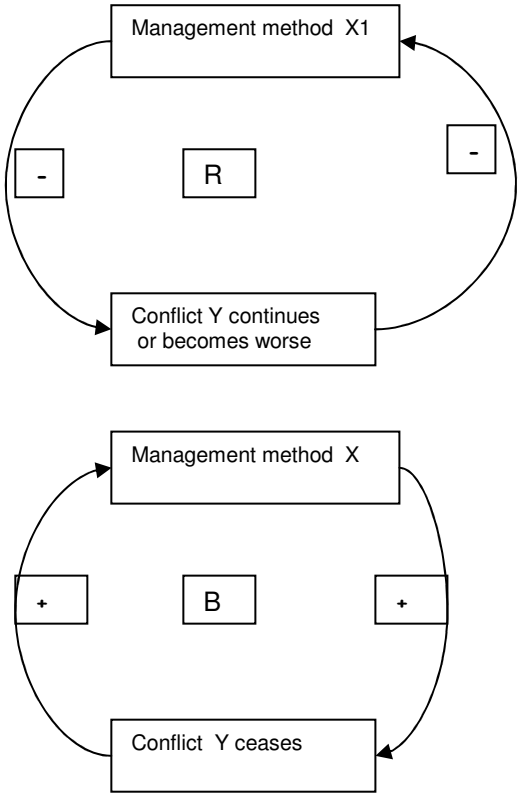
3.8.2 Uncovering the systems thinking process

The farmer who believes he is suffering predation on his livestock needs to follow a structured decision making approach, supported by as much information as is available. The first objective of this 2008 study was to identify the problem symptom correctly to understand the systems at work. To achieve this it was necessary to use a methodology of leading discussions with respondents to identify recurring scenarios over a period of time, as well as to identify the causes of conflicts accurately. The next objective was to record previous management actions. This is shown in Figure 14 where the positive symbols indicate a causal link between the two variables and where change in the one variable causes a change in the other variable in the same direction, or where variable 1 adds to or increases variable 2.

In reinforcing loops an important variable increases with exponential growth (a virtuous cycle). The opposite also applies where the important variable decreases and results in exponential collapse (a vicious cycle). A frequently used example of exponential growth is that of an investment subjected to compounding interest, without any withdrawal of capital invested. The symbol “R”

is used to indicate a reinforcing loop. In Figure 14 the farmer continues to apply an inappropriate management system.

Causal loop diagrams illustrating balancing loops show movement either without delay toward a target, or oscillation and hovering around a target with some delay. The symbol “B” is used to indicate a balancing loop. Using a similar investment example, the loop would balance if accrued funds remaining were withdrawn as income, after allowing an inflationary increase in the capital investment and after expenses had been paid.



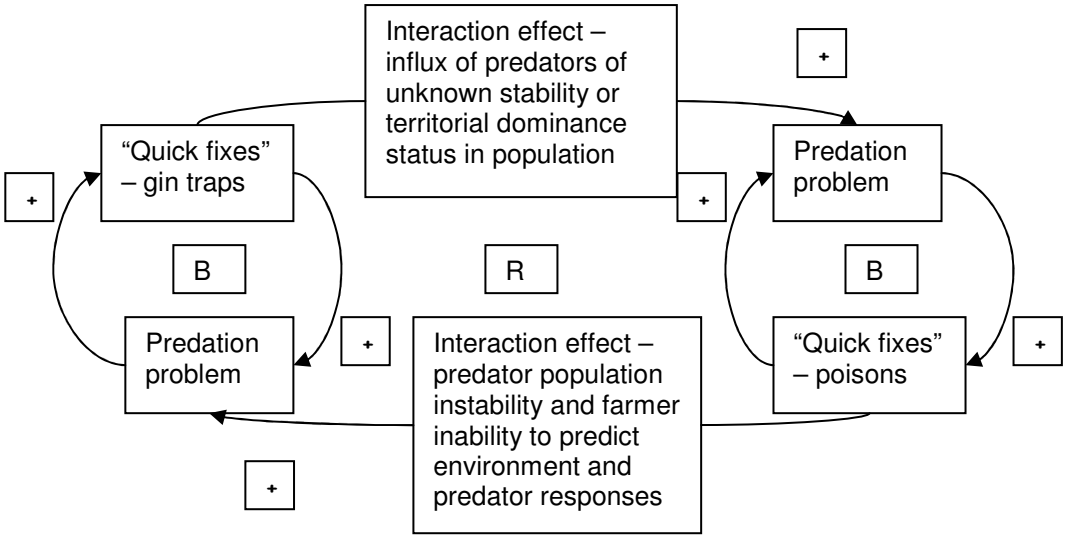
Symbol	Meaning
Arrow with “s”, or “+” symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with “o”, or “–“ symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
“R”	A reinforcing loop that amplifies change
“B”	A balancing loop that seeks equilibrium
= or “Time gap”	A time delay between the current status and the desired status

Figure 14. Generalised schematic diagram of reinforcing and balancing loops. Source of Table: Senge *et al* (1995)

The third objective in this methodology was to reconsider foregoing management to identify the undesirable side effects of previously implemented actions, because it was assumed that the actions would have some effect on the farm

and predator environment. The response of nature to management actions was termed “environmental compensation”. This term was invented for the purpose of this dissertation to describe the constantly dynamic and unpredictable response of the natural environment to actions taken by farmers. As explanation, the status of an individual predator in the territorial dominance and social hierarchy is unknown to the farmer who kills it. Consider the difference between the social and territorial response of the predator population to the death of an animal which was the dominant territorial predator, against the social and territorial response of the population to the death of a vagrant animal. There would be an environmental compensation, but this would differ according to prevailing circumstances as in this explanation.

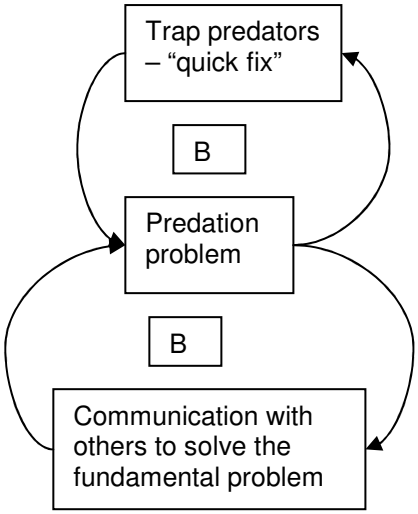
In attempting to probe the root cause of predator conflicts on farms, the *Five whys* principle of Senge *et al* (1995) was used during interviews. If the symptom was new, the discussion revolved around how to deal with it, but if it was recurring then the preceding management actions were pursued. The reason for this component of the discussions was to illustrate that further erroneous action could exacerbate the problem by adding to a vicious reinforcing spiral, and this could be compounded by the effect of unknown and unpredictable environmental compensations of natural forces. Figure 15 attempts to illustrate environmental response to predator conflict management actions.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 15, Environmental compensation for the farmer's actions. Source of Table: Senge *et al* (1995).

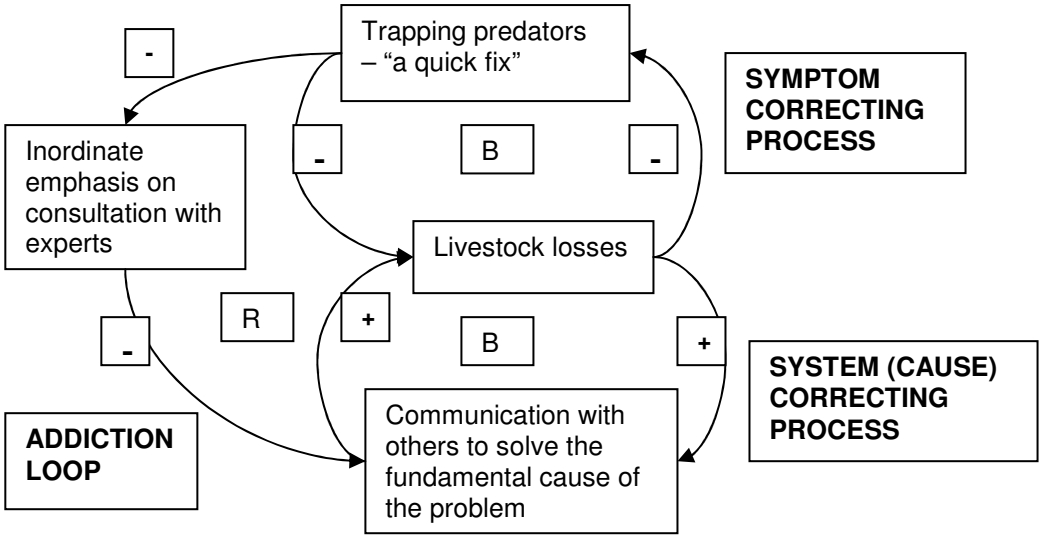
The fourth objective in this methodology was uncovering the systems and processes to admit and accept the undesirable effects caused by previous management actions, and then seek a solution to address the problem more fundamentally. This meant the farmer had to read a manual, consult the local conservation official or consult a predator conflict management expert as illustrated in Figure 16.



Symbol	Meaning
Arrow with “s”, or “+” symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with “o”, or “–“ symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
“R”	A reinforcing loop that amplifies change
“B”	A balancing loop that seeks equilibrium

Figure 16. The farmer breaks away from the quick fix cycle and seeks alternative solutions to the fundamental problem. Source of Table: Senge *et al* (1995)

In a structure of “shifting the burden”, as described in detail in Chapter 2, section 2.3.5.5, there are often side effects of the quick fixes that worked in the past, that may undermine the viability of the fundamental solution. These historic quick fixes can lead to a spiral of dependency which is illustrated in figure 17. In the example used above, the cause could be an excessive dependence on meeting with others, rather than focussing on the fundamental solution at hand.



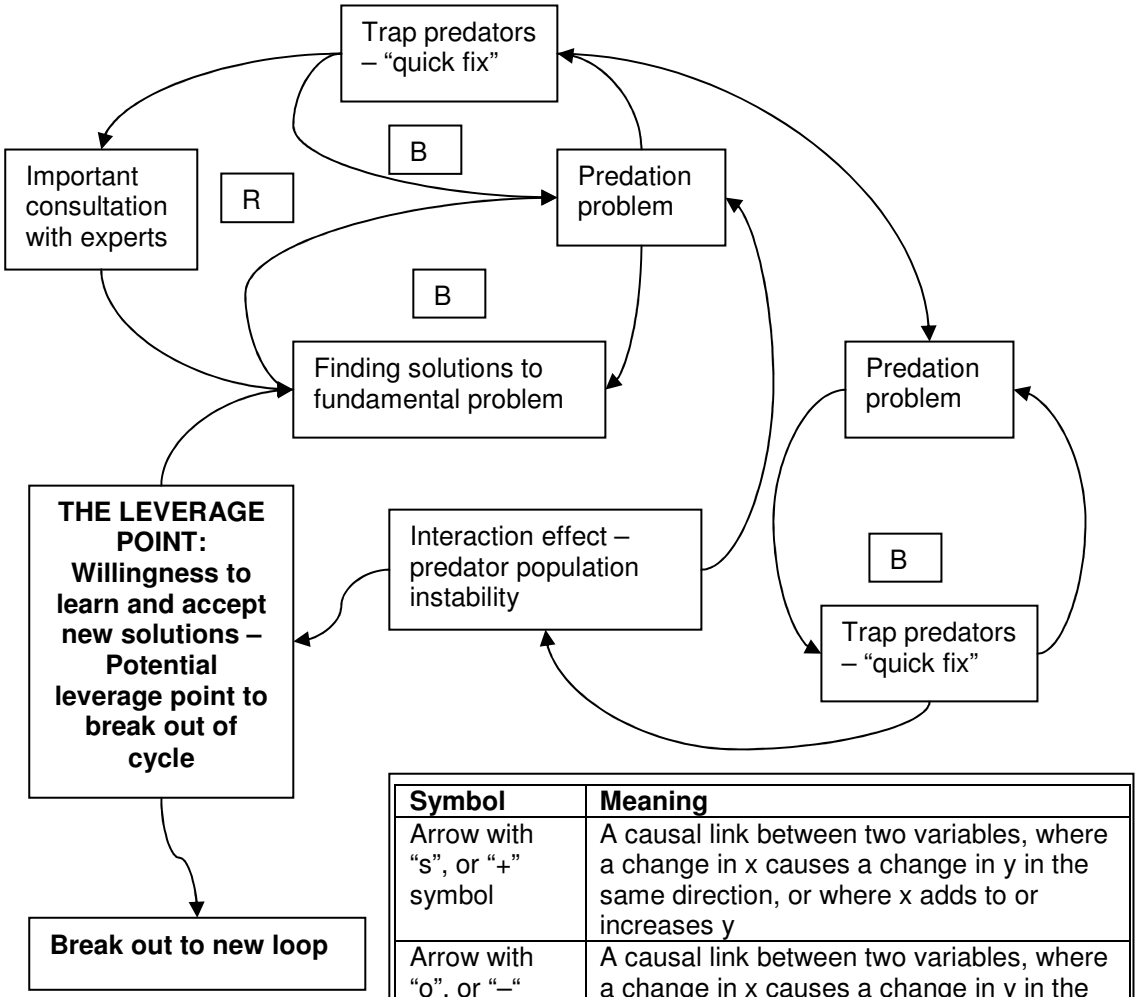
Symbol	Meaning
Arrow with “s”, or “+” symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with “o”, or “–“ symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
“R”	A reinforcing loop that amplifies change
“B”	A balancing loop that seeks equilibrium
= or “Time gap”	A time delay between the current status and the desired status

Figure 17. Symptoms, systems and addiction, and breakaway from the quick fix symptom correction scenario. Source of Table: Senge *et al* (1995)

The fifth objective in this methodology was to seek interconnections between the various interactions and the fundamental solutions. This enabled identification of obstacles by mapping out the process in which all actions were shown and the effects of one variable on another could be considered. This meant that even when several parties were involved, their interactions and effects on the system as a whole could be mapped out.

This linked to the sixth objective of identifying leverage points, or small actions with large effect which could break the cycles of symptomatic actions where systematic actions were needed. In Figure 18, these leverage points are highlighted by use of a bold font. Leverage points are stages in a system where

small changes have a big effect and which change the action from treatment of a symptom, to treatment of the actual cause.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 18. Leverage points to break out of a quick fix and a vicious cycle. Source of Table: Senge *et al* (1995)

3.9 Theoretical assessment of predator management methods used

The EWT (2003) questionnaire survey presented an opportunity for this 2008 study by allowing for questioning of the subject more holistically, and enabled

application of systems thinking to analyse predator conflict management as applied by the questionnaire respondents. Had the EWT questionnaire been unavailable, a whole new questionnaire survey would have been required. This would have entailed definition of the aim of the study, the literature review, the design, decisions about sampling methods, analysis of the suitability and validity of the questions and the survey method itself, the selection and structuring of questions to accurately extract the desired responses, and reconsideration of the ethics of many questions asked by the EWT questionnaire. On revisiting the EWT questionnaire however, it was realized that so many questions had been posed, that it had actually gathered responses far in excess of the requirements of what this specific study sought to analyse. The key lay in analysis of the causes and effects of each predator conflict management method, and by application of systems thinking to each method.

3.10 Summary

The decision process and methodology employed by the 2007-2008 study was described in this chapter. Five years passed since the EWT (2003) questionnaire survey. During this time, the predicament of some farmers may be worse, some may have experienced no change, and some will be in a better predicament. The EWT (2003) questionnaire survey merely recorded actions and activities without questioning cause and effect of those actions and activities. The purpose of the 2007-2008 study was to evaluate systems thinking in predator conflict management and to achieve this, extracted a small sample of farmers from the original EWT respondent group for interview. The 2008 interviews were done telephonically and with visits where possible. This questionnaire is attached to this document as Annexure 2.

Chapter 4 Analysis of Results

4.1 Introduction

In this chapter the predator management issues raised by the EWT (2003) questionnaire survey were evaluated from a systems thinking perspective and with consideration of this 2008 literature study (section 1). Preventative management and non-lethal deterrents were considered. The lethal controls were similarly discussed, allowing some comparisons. Farmer responses were considered against the literature findings of this 2008 study. An attempt was made to understand how identification of predators was done by farmers, as this was the subject of a specific question in the EWT questionnaire survey. The timing of predation was analysed with the hope that a leverage point for stock loss reduction could be found. In addition, an attempt was made to quantify losses. The 2008 study viewed the loss figures reported by the EWT (2003) questionnaire survey, but avoided statistical analysis of loss figures. The reason for this is because there were significant variations in losses and in the valuation of those losses reported by the EWT questionnaire survey respondents. Consequently the losses were recorded as reported and the value indicated as reported. In order to obtain some perspective, it was hoped to obtain production and loss figures for sheep farmers from the National Wool Growers Association. Such figures regrettably do not exist. A project to accurately quantify small stock losses is running at the University of the Free State at time of writing, and hence that data is also as yet unavailable. Systems diagrams were used for illustrative analysis of management actions and extensive use is made of systems diagrams and flow diagrams to illustrate and support discussions.

In the interest of clear understanding, certain terminology and concepts were found to require clarification. As discussed in detail in Chapter 1, Madden (2004) suggested the term problem animal is misleading, since the severity or extent of a problem is based on an individual's perceptions, mindset or education. From the broader definition, the term may be inclusive of a full range of animals from

ants to elephants, in fact any creature which humans may consider to be a problem to them. It was considered important to be aware of the widely divergent and perhaps ill-informed responses to the EWT (2003) questionnaire survey. One respondent to the EWT (2003) questionnaire survey included lions, spotted hyenas and African wild dogs to his list. None of the species listed were likely to occur outside of game reserves in the survey area and his farm was a considerable distance from any reserve. Perhaps as those species are predators, he considered them to be problem animals? Reference to locally occurring damage-causing predators would appear to have been more appropriate terminology for the EWT (2003) questionnaire. Further illustrating this point, several respondents to the EWT questionnaire survey appear to have based their mindset on incorrect information since aardwolf were recorded as a problem. Enigmatically, this species is insectivorous and lacks carnassial dentition to enable a carnivorous diet. Aardwolf visit carcasses to feed on maggots and other insects. Many other species are incorrectly targeted as damage-causing by farmers, and their ecological roles have similarly been investigated and explained in literature.

The method Senge *et al* (1995) of asking *why* five times was explained fully and demonstrated in section 3. 8.1, and was used extensively to probe predator conflict management to seek the leverage points desired. Provided it is used honestly and realistically, this system may be invaluable for identification of the root cause of a problem.

4.2 Predator conflict management from a systems thinking perspective

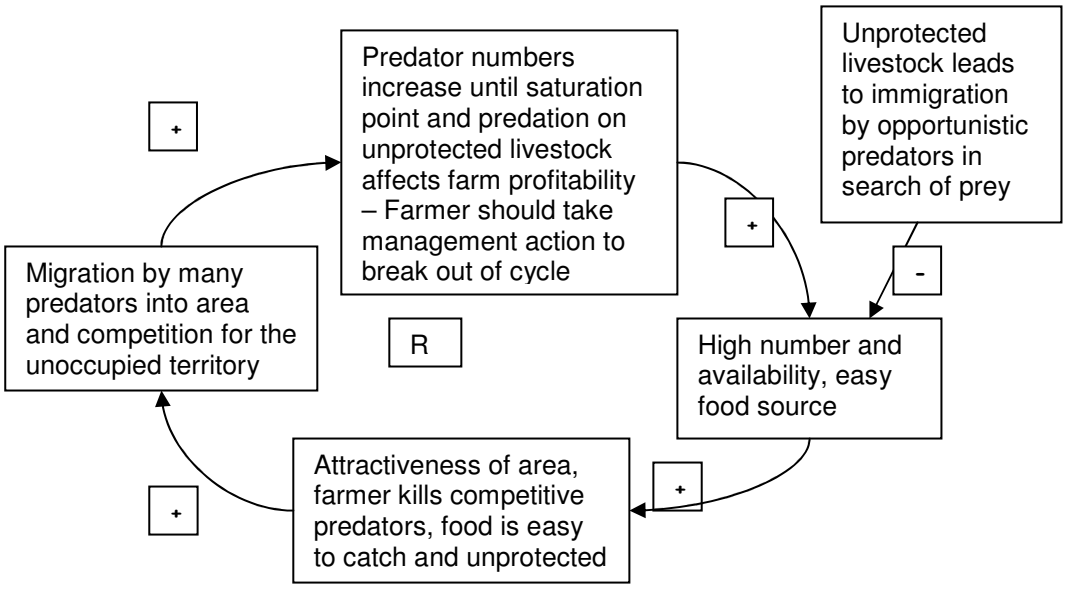
Considering predator conflict management from a systems thinking perspective, a farmer who views the system holistically should surely strive for environmental stability on his farm. This also implies a need to aim for a balance between predators and their natural prey. The farmer should also desire a profitable farm through appropriate management of predator conflicts. To achieve this, the

decision making process should focus on his objective in a structured and orderly manner.

As part of this process the appropriateness of every method and the method description in terms of the systems thinking archetypes should be analysed. For example, a pre-considered and deliberate quick fix may be applied. For example, movement of a sheep flock to a safer place on the farm is a quick fix which would address the symptom. But this would allow time for application of a permanent solution, such as building predator-proof fencing to address the cause. One must also assume that that the farmer identifies the damage-causing predator before selecting a control method or responding. Should the farmer misidentify the damage causing animal and as a result apply an inappropriate response, then predation on his livestock would not necessarily cease. Removal of a territorially dominant animal may exacerbate the predation problem and lead to a vicious cycle. However, correct identification and targeted removal of a specific damage-causing animal could lead to a cessation of livestock losses, and that is the desired state the farmer seeks.

The following flow diagrams are used to illustrate a set of causal relationships. As explained in Chapter 2, Table 3 under sub-heading 2.3.3, the arrows indicate the direction of influences, and the + and - symbols indicate positive or negative influence. Hence, in this figure one may interpret that where opportunities for predators to find prey are plentiful, with no internecine competition and no conflict from territorially protective, defensive animals, the predator population increases. The population cycle continues in a state of positive accrual, indicated by a positive symbol until predator saturation per defendable territorial area and food scarcity. At this point the reinforcing loop becomes balanced. As living space and food availability decreases the negative symbol appears. Where the farmer has removed the food source by protecting his stock and making predation difficult and where predators revert to natural prey sources, the direction of the cycle is reversed as the systems corrects itself. The negative reinforcing loop may also become balanced. Since it is difficult to measure environmental health and

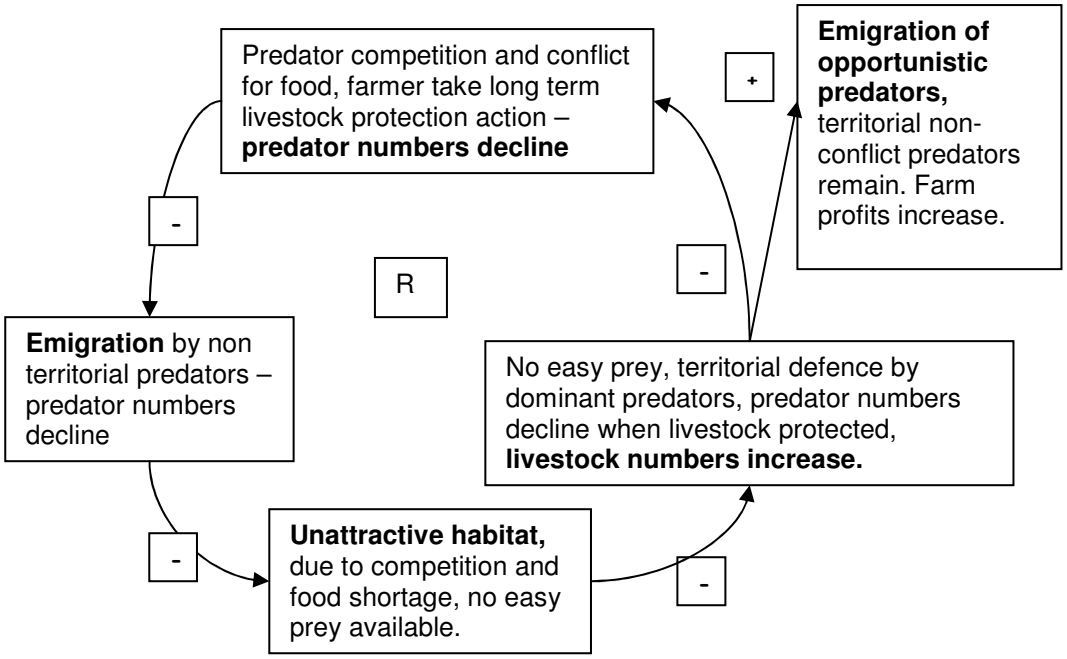
stability generally, farm profitability is used as a measurement of success. This is illustrated in figures 19 and 20.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 19. Influx and increase of predators and predation where livestock are unprotected. Source of Table: Senge *et al* (1995)

Similarly, the same systems diagram may be used to indicate a reversal of the trend in the case of effective predator conflict management.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 20. Declining predator numbers due to stock protection and reduced prey availability. Source of Table: Senge *et al* (1995)

In Figure 20, the predator population decreases as non-territorial, subordinate predators migrate out of the habitat which has become less attractive. Alternatively they remain transitory and the population of settled predators stabilises. Provided the territorial population does not cause damage, they maintain and defend their territories against immigrants and hence provide an ecologically balanced system. This is considered appropriate management.

When killing a territorial predator the farmer faces a potentially 50:50 chance with regard to the replacement animal in that territory, i.e., damage-causing *vs.* not

damage-causing. This could be any ratio. The point is that the habits of the immigrant predator are unknown, and the 50:50 ratio suggested is based on a yes/no possibility. The logic of this discussion is also then that where no predator damage is experienced by a livestock farmer, he should continue to protect his livestock. Simultaneously to this he should nurture the ecologically stable predator population which defends his farm (the predator territory) from transient and potentially damage-causing predators. To achieve this, the farmer should apply the process described in section 3.9.2 to enable selection and application of correct and appropriate management actions. This also implies that appropriate farm management practices should include environmental care and conservation of the species which make up the predators' natural diet and which are important for maintenance of an ecological balance.

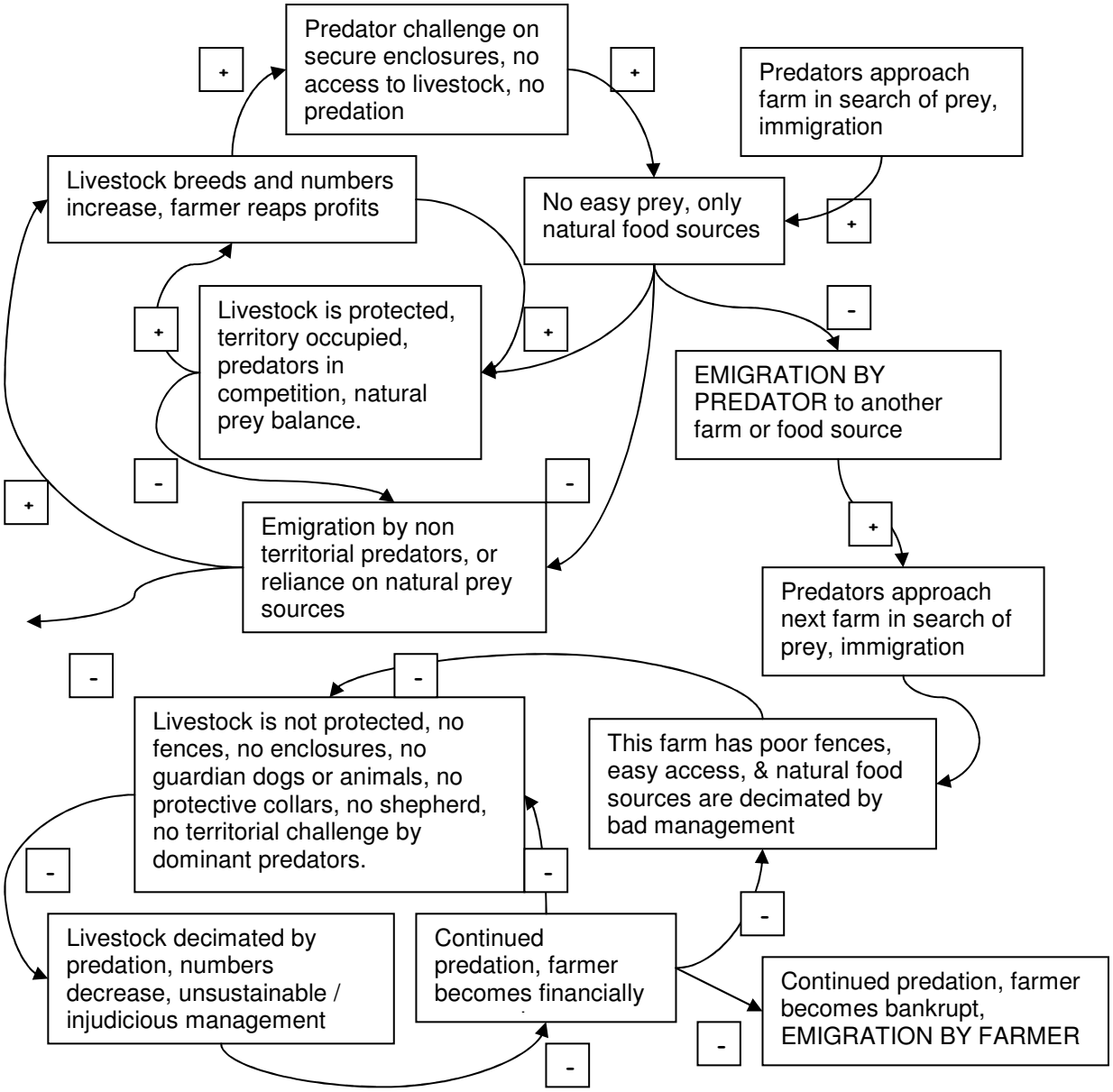
4.3 Discussion of preventative management and non-lethal deterrents from a systems thinking perspective

Analysis of each and every preventative management method or non-lethal deterrent is beyond the scope of this 2008 study. Whilst many methods and deterrents are mentioned, the focus of this section is the general principle of preventative management. As suggested before, a quick fix of moving sheep to a safer area may be applied to allow time for the cause of the problem to be addressed. By building and maintaining adequate fences and night enclosures the farmer makes it more difficult for predators to reach his stock. He is addressing the cause, i.e. Predators attack unprotected livestock. The farmer builds predation prevention systems in response to a need. In this example identification of unprotected livestock as the reason for predation gives rise to the need for a predator-proof fence. The system applied may not always be foolproof because misunderstanding of the holistic system may confuse the decision processes, but the influence of the fence on the system will be of reduced losses. Addition of a secure night enclosure should cause an even greater loss reduction.

The negative arguments presented by Respondent 5 and Respondent 1 as raised in detail in Chapter 2, section 2.2.1 are relevant but the converse question should also be raised. Why, with modern electric fencing technology, can farmers not construct temporary (non-permanent) night enclosures closer to where the sheep graze, and include a foot-bath and veterinary treatment facility at the enclosure? These positive steps are leverage points which counteract both negative arguments. The promotion of livestock protection using fencing, enclosures and night enclosures is a critical leverage point.

Through personal communications and interviews it was established that the authors Respondent 7 (2006), Respondent 2 (2006), Respondent 8 (2006) and Respondent 3 (2006) cited in this 2008 study, are all farmers who have realized the futility of ineffective predator management or short term interventions. Respondent 7 breeds, trains and distributes Anatolian Shepherd dogs. Respondent 2 manufactures and distributes King Collars. Respondent 8 makes and sells bell, smell and poison collars. Respondent 3 has designed the movement sensing mobile phone collar. All describe how small changes (leverage points) to systems can have a marked influence in reduction of livestock losses. As innovative farmers who have studied the predator system and its effect on livestock and invested considerable intellectual property and finances into development of the systems they believe in, they are pioneering leaders which other farmers could and should follow. One has to question why other farmers appear so reluctant. The views and methods promoted by these leaders should be grasped by conservation authorities and they should be invited to promote their ideas at every opportunity.

By using a flow diagram, Figure 21, the cause and effect of non-lethal deterrents are illustrated. This is a set of causal relationships, with the arrows indicating flow direction and the symbols indicating whether the relationship or influence between variables is positive or negative.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 21. Cause and effect of non-lethal predator conflict management scenarios and the inter-relationships. Source of Table: Senge *et al* (1995)

4.4 Discussion of lethal controls from a systems thinking perspective.

Regardless of the method chosen by a farmer to manage predation damage, it is essential that there should be an understanding of the underlying systems and the cause and effect associated with the various actions. As illustrated in section 3.9.2, and Figure 17, the symptom is frequently addressed rather than the cause. The predator is killed rather than addressing the ecological balance, or implementing preventative systems and methods which reduce or eliminate the conflict in the long term. If a management action fails to terminate conflict and stock loss and rather exacerbates the situation then surely that action can be described as a quick fix, or a fix that backfires and regarded as inappropriate?

The use of hound or dog packs needs careful consideration and understanding because if the window of opportunity (time gap) has passed, then the use of dogs is not logical. Identification of the damage-causing animal is important, because hounds will not pursue stray or feral dogs, which were identified as damage-causing by 8, 8 percent of respondents in the EWT questionnaire survey. The success or failure of this method depends on the rational management and understanding of each and every scenario by the dog master. An apathetic, incorrect or inflexible decision may be inappropriate with detrimental outcomes, especially where random hunting and killing of predators exacerbates the problem by disturbing predator population dynamics. The archetype applied to this control method is a quick fix although since timing is absolutely critical, it could potentially be an effective conflict management system if correctly applied.

When approached again for this study in 2007, Respondent 6 (2007) who was respondent 40 in the EWT (2003) survey indicated very strong support of new methodology and thinking. This respondent has applied King collars to his flock since 2003 and has improved his farm fences to the extent that predation is no longer a problem of significance to him. In his response to the 2003 EWT questionnaire survey Respondent 6 (2007) indicated that a hound pack was based on his or his neighbour's property up to eight times per annum, and

frequently spent up to five days per event randomly hunting predators without success (40 hunt days per annum). Respondent 6 recorded duiker, hares and other wild antelopes as non-target animals caught by the hunt pack. This opportunistic and unsuccessful hunting indicates that the hunt pack was incorrectly used, possibly to justify their continued retention by those who failed to understand the system at work.

To support this point, reference is made to Chapter 2 where Snow (2002) recommended that hounds should only be used to pursue an individual damage causing animal from a fresh kill. In validation of this recommendation, Grobler *et al* recorded that Black Backed Jackals will defend a territory. Applying this information to the description by Respondent 40 (2003) of a pack of hounds hunting for up to 40 days per annum without success, one must conclude that the area has become devoid of any black-backed jackal. Should the hunting with the hound pack cease, then immigration and colonisation from other areas by other jackal may be possible and likely, with anticipated negative impacts on the livestock population. Respondent 6's 2007 and 2008 situations are reported later.

Predation caused farmers to establish a hunt pack. Whether their decision was correct or incorrect could be debated at length and inconclusively. To facilitate understanding, the Five why's method as proposed by Senge *et al* (1995) and described in detail in Chapter 3, section 3. 8. 1 is used to scrutinize the decision:

1. Why did this group of farmers commence a predator management programme? In response to livestock losses.
2. Why did they lose livestock? It was unprotected.
3. Why was it unprotected? The costs of fencing and kraaling were not affordable.
4. Why did they choose a hunt pack as control method over other methods? The choice was based on their predominantly English ancestral manner of fox hunting and it received government subsidy.
5. Why did they persist despite the method causing social division in the

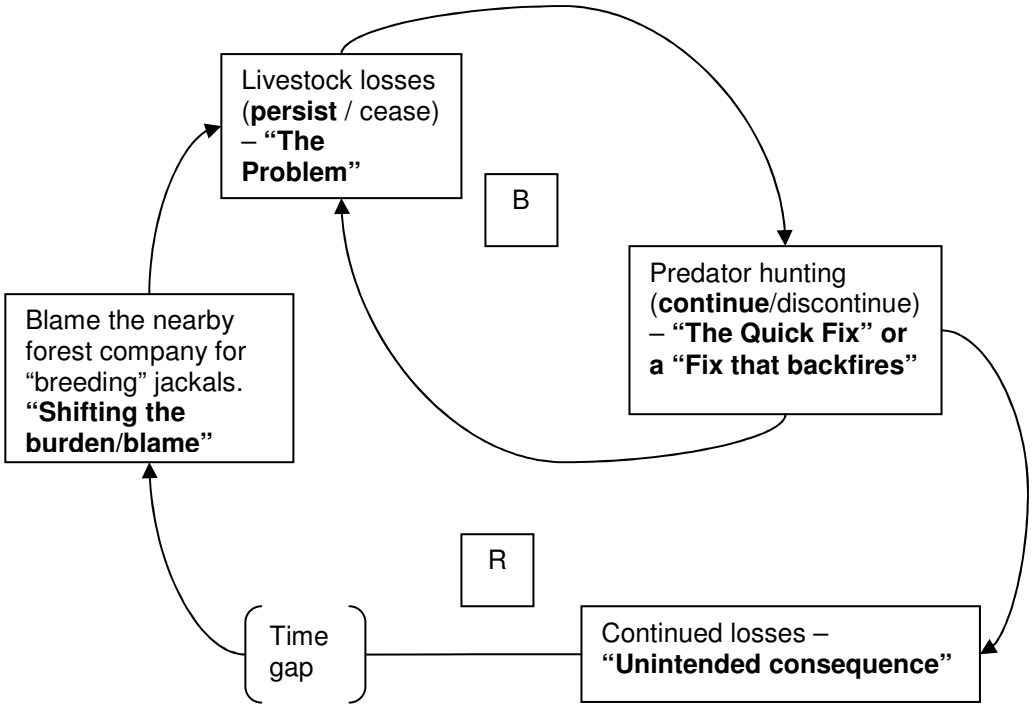
community? Legislation forced compliance and larger, wealthier farmers applied peer pressure.

To reach to the core of the issue, the questioning process was continued…

6. Why did the farmers continue after capture of targeted damage-causing predators ceased? The huntsman justified his existence on the number of predator skins claimed for bounty. This would have misled farmers to believe they were achieving success, with extermination as their aim, when in fact the continued hunting exacerbated the issue.
7. Why did they use the number of animals killed as a measure of success? They did not understand predator ecology or population dynamics. Measurement of the number of predators killed was inappropriate as it gave an incorrect perception of success.

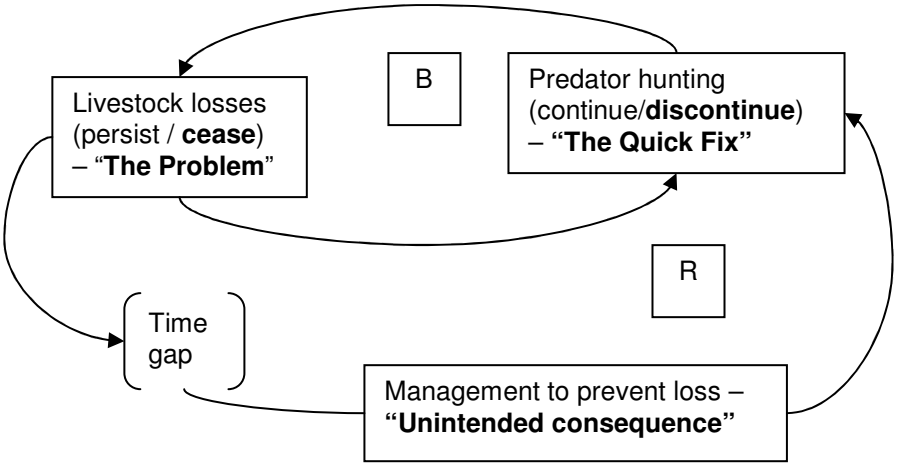
Hammer (2002) stresses the need to consider measurement of targets, goals or achievements very carefully to ensure that one is measuring effectively and that the result of the measurements provides the answers that were sought. In other words, what was the next step? Did the farmers question the fact that despite killing many Jackals and Caracals, the problem had not stopped? Reduced predation and reduced loss, or an increase in profits should have been their measure.

Analysis of this scenario from a systems thinking perspective could draw out a “Fixes that backfire” or a “Shifting the burden” archetype. Comparison of these archetypes is illustrated in Figures 22 and 23.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

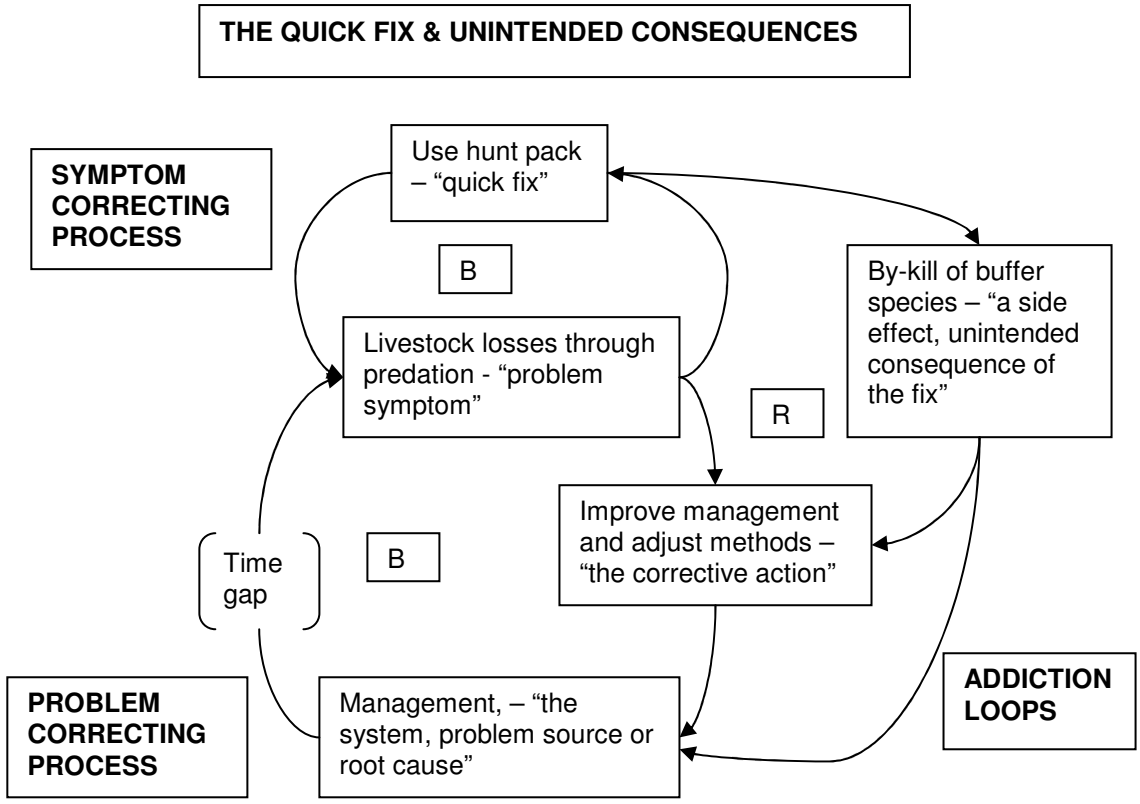
Figure 22. Continued predator persecution and problem persistence, evoking a number of systems thinking archetypes. Source of Table: Senge *et al* (1995)



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 23. Discontinued hunting, a cessation of the problem, but a need for increased alternative, more appropriate management. Source of Table: Senge *et al* (1995)

The effect of continued application of a hound pack as a control method is a quick fix, or a fix that has backfired or failed. It amounts to opportunistic and random predator extermination. This has led to non-target hunting of other animals which form the prey base for predators in a natural system. This was described by Respondent 6 (2007) in a repeat interview. Predicting future effects, should the random predator persecution cease and in this scenario where the prey base is compromised, it may be predicted that predators would have a detrimental effect on livestock. A causal loop diagram, applying the archetype "shifting the burden" follows in figure 24.

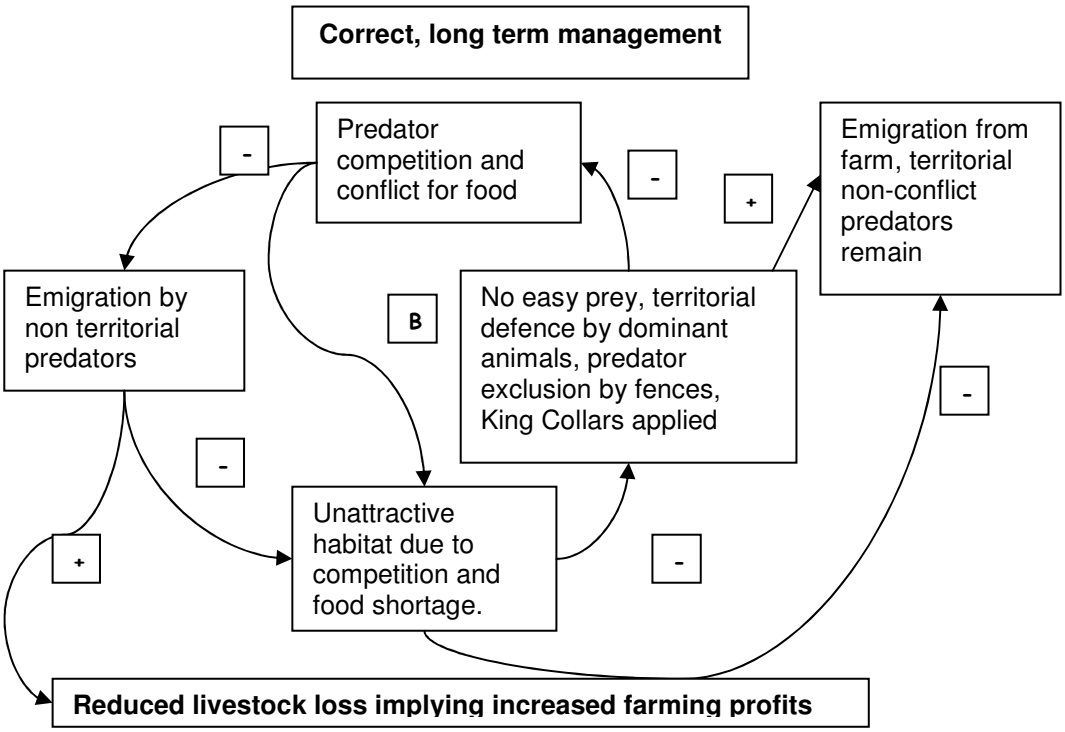


Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 24. The hound pack as control method, illustrating the archetypes Quick Fix and Unintended Consequences. Source of Table: Senge *et al* (1995)

When approached for confirmation and comparison of the scenario five years ago with that of the present, Respondent 6 (2007) stated that he has proactively changed his farming operation slightly by improving fences as a long term intervention and he has also fitted King Collars to his flock. Even though the collars are not worn throughout the year, in combination with secure fences they provide effective protection to his sheep. His scenario is illustrated by a causal

loop diagram, figure 25. Respondent 6 now hears black-backed jackal calling at night yet does not experience significant losses from predation, and any losses are within acceptable limits.

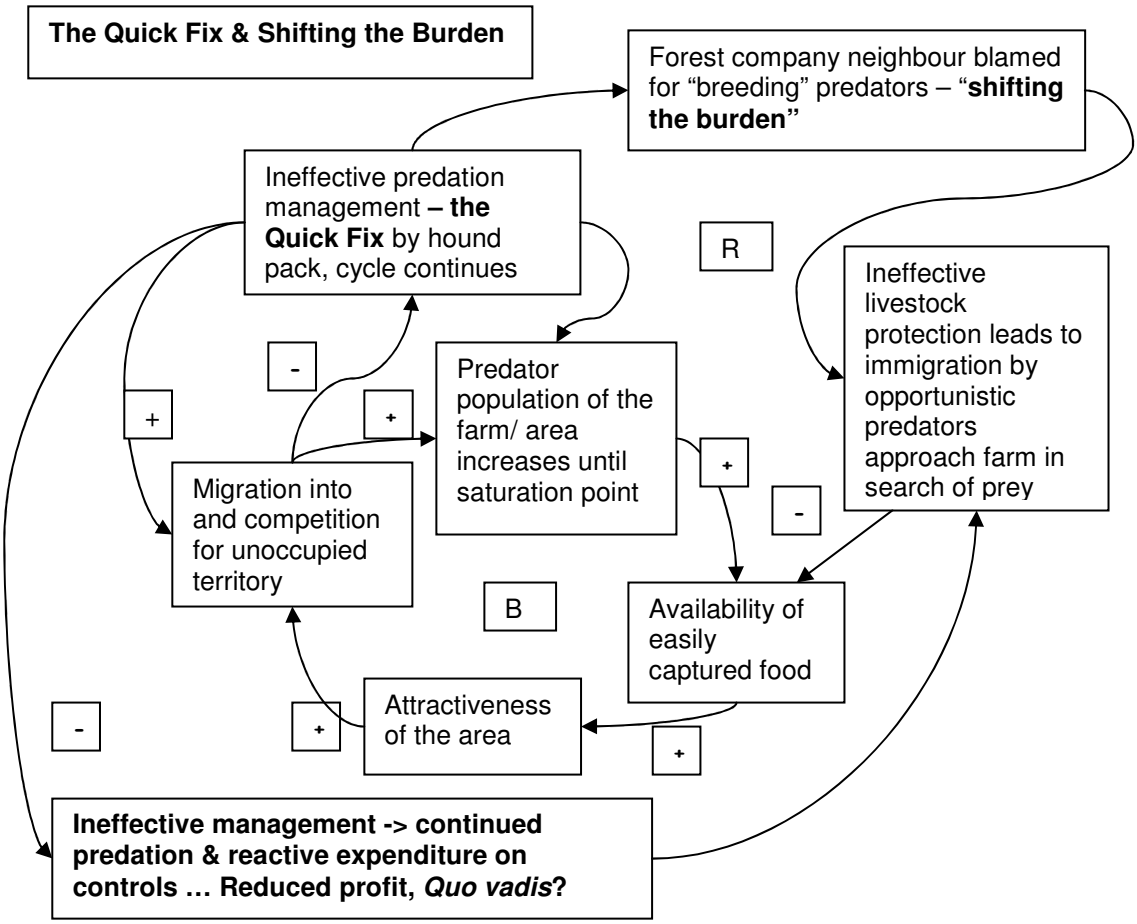


Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 25. Correct, long-term management. Source of Table: Senge *et al* (1995)

When questioned about the activities of the hunting pack, Respondent 6 reported that a pair, plus two other single black-backed jackals had been killed by the pack during 2007 on neighbours' farms. No preventative measures exist and the neighbour still loses lambs on a regular basis. None of them have implemented any long term preventative measures to resolve predator conflicts. All still rely solely on the hunt pack as their primary, reactive defence against predation. As

shown in Figure 22, Respondent 6's neighbours continue to blame the forestry company and others for allowing jackals to persist on their properties, shifting the blame and basing their predator management on the unsubstantiated assumption. The localities of predator kills by hounds were not recorded. This implies a perpetuating reinforcing loop in terms of systems thinking, locking his neighbours into a vicious cycle as illustrated in figure 26.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 26. The Quick Fix and Shifting the Burden with Respondent 6's **of** neighbours trapped in a vicious cycle. Source Table: Senge *et al* (1995)

Eighty percent of the farmers questioned during the EWT questionnaire survey used gin traps as part of their suite of control or management methods. Of those using these devices, 50% had received training, yet all reported capture of non-target animals. Surely this should have been an indication to them that the method was not target specific and that collateral environmental damage is the norm rather than an exception? A further 30% of respondents indicated they had not been trained and the remaining 20% did not respond. Inaccurate, inconsistent, or non response was problematic for accurate presentation of results. Gin traps are considered to be an opportunistic quick fix or a fix that backfires with zero predictability. It is a hit and miss method especially when traps are set in inappropriate locations. Experienced trappers may have knowledge and the field experience which enables slightly more selective placement of traps (note this is not more selective trapping), but based on the high number of non-target animals trapped, it is proposed that the average person sorely lacks these skills. Less than half of the farm workers with trapping responsibilities had any training. Checking of traps was done with variable frequency as shown in figure 27. The method is regarded as inappropriate and ineffective for long term resolution of predator conflict management.

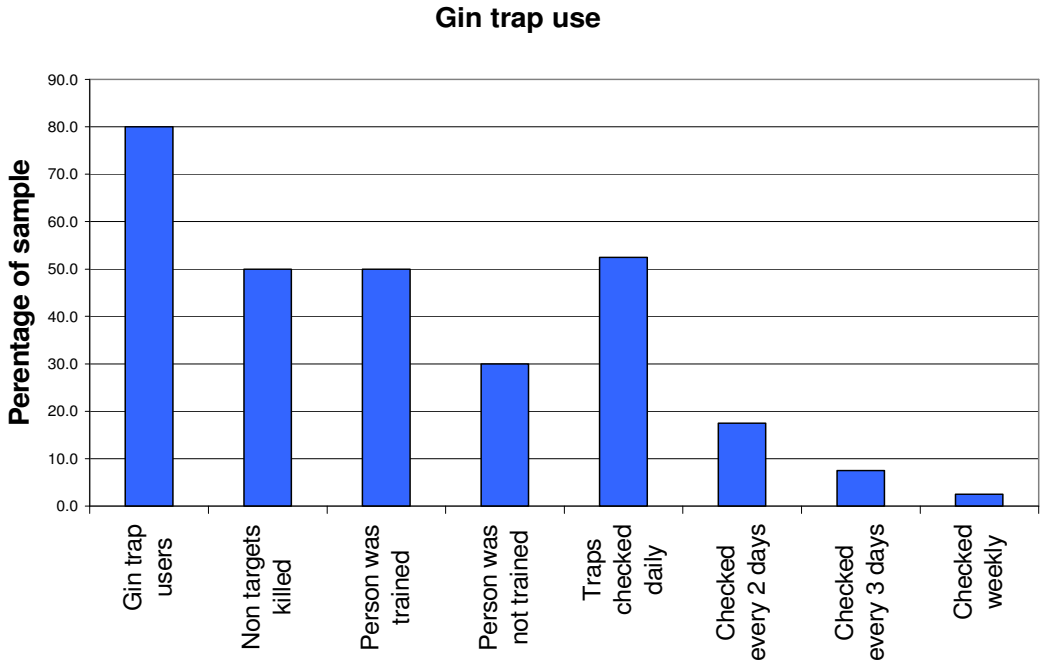


Figure 27. EWT questionnaire responses to gin trap use, non-target kills, level of training and checking frequency.

Coyote getters are another non-selective and non-specific control device. Any carnivore which pulls on the head of the device will be shot in the mouth with sodium cyanide. The method is opportunistic and unpredictable and cannot offer a certain resolution of a negative scenario where damage is being caused to livestock. It was clearly indicated in Table 1, Chapter 2, and section 2. 2. 2, that Black Backed Jackals progressively avoided these devices. The same criticism of gin traps applies to these devices. They cannot be set in a target specific manner.

Legal application of poison baits by farmers is difficult because the only legal toxicant, strychnine, is strictly controlled by legislation. Twenty percent of respondents to the EWT questionnaire admitted to illegally poisoning carcasses and 22, 5 percent used home-concocted poisoned meat baits. Thirty percent used unregistered and illegal Schneekluth 1080 baits. This highlights the lack of enforcement of legislation referred to in Chapter 2, section 2.1, to regulate

agricultural chemical sale and acquisition by farmers.This illegal poisoning must bear the same criticism as that of gin traps and coyote getters. The poisoned meat baits are neither selective nor target specific toward an individual damage-causing animal. Poisoning is a quick fix that causes massive collateral environmental damage. The EWT initially suspected farmers of agricultural chemical abuse and the EWT questionnaire of 2003 validated and quantified the extent of agro-chemical abuse by farmers in South Africa.

Whilst target specific to a predator which attacks livestock, the older poison collars containing carbofuran were more hazardous environmentally than the newer 1080 collars. This statement relates to toxicity of the chemicals used, which were subjected to a very brief investigation in the literature review. Despite the harsh and negative connotations of poisons, of all lethal methods to control damage-causing animals which were analysed, the use of poison collars was the only method which was considered 100% target specific and certain to only kill a predator which attacks livestock. Because of this a poison collar may be regarded as an effective solution to stop predator damage. All other control methods are potentially lethal to predators *per se* but none can be described as the solution or as target selective and target specific. None other than a poison collar can be applied to only remove the damage-causing animal. This system is illustrated in a flow diagram, figure 28.

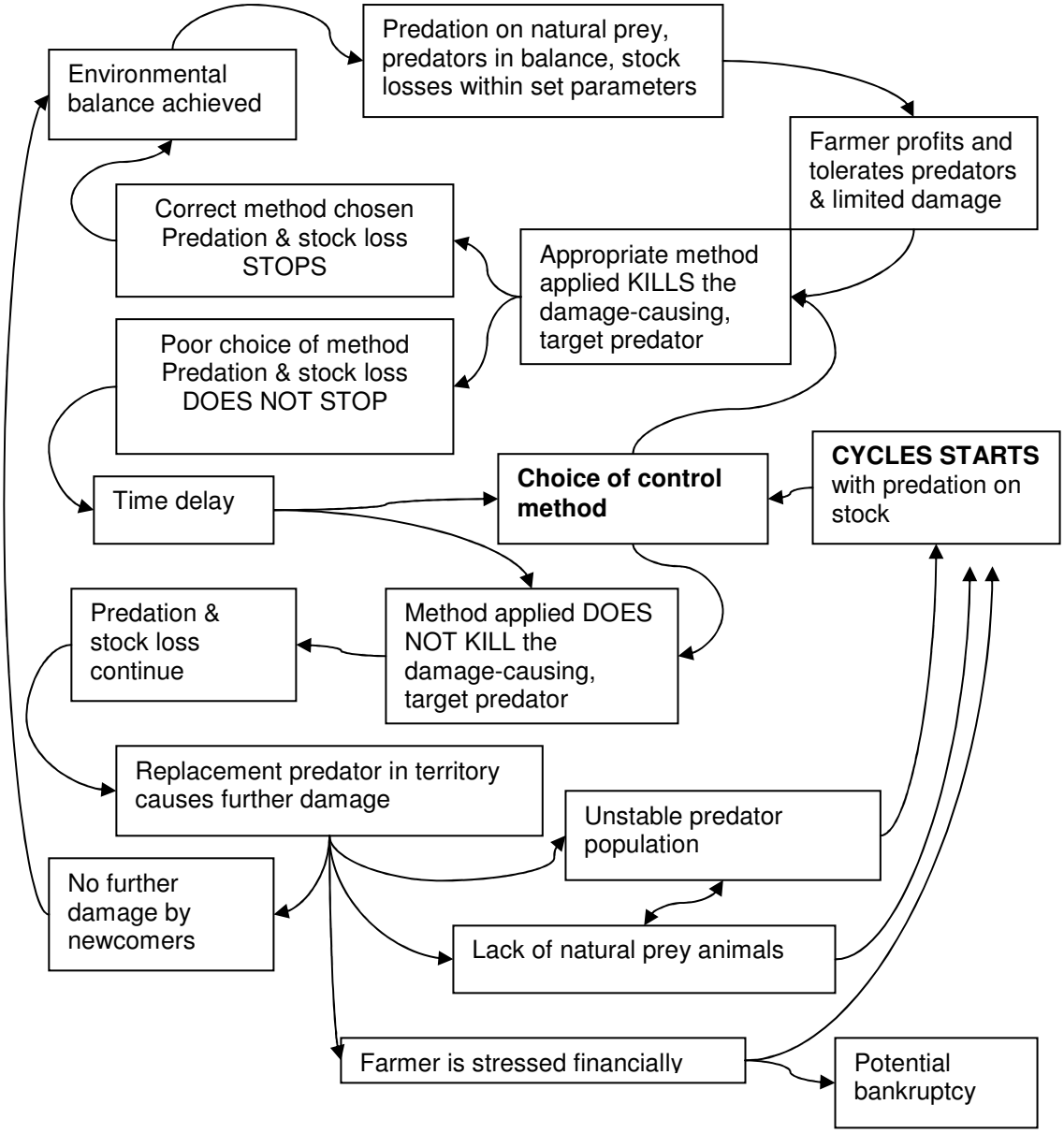


Figure 28. A flow diagram illustrating appropriate and inappropriate lethal control decisions, responses, and consequences.

4.5 Contrasting Farmer responses against Literature findings

4.5.1 Identification of the predators by farmers

Farmer's perceptions of the potential of various predator species to cause damage were assessed by the EWT questionnaire survey, where farmers were requested to rate the damage causing potential of each species on a scale of 1 to 5. For the purpose of the 2008 study, the EWT questionnaire survey data was simplified into damage causing or not, and the percentage of farmers who felt that a species was damage causing is illustrated graphically in Figure 29. The Caracal and black-backed jackal were the two species considered to cause most damage. Stray or feral dogs and stock theft were also regarded as a problem by respondents.

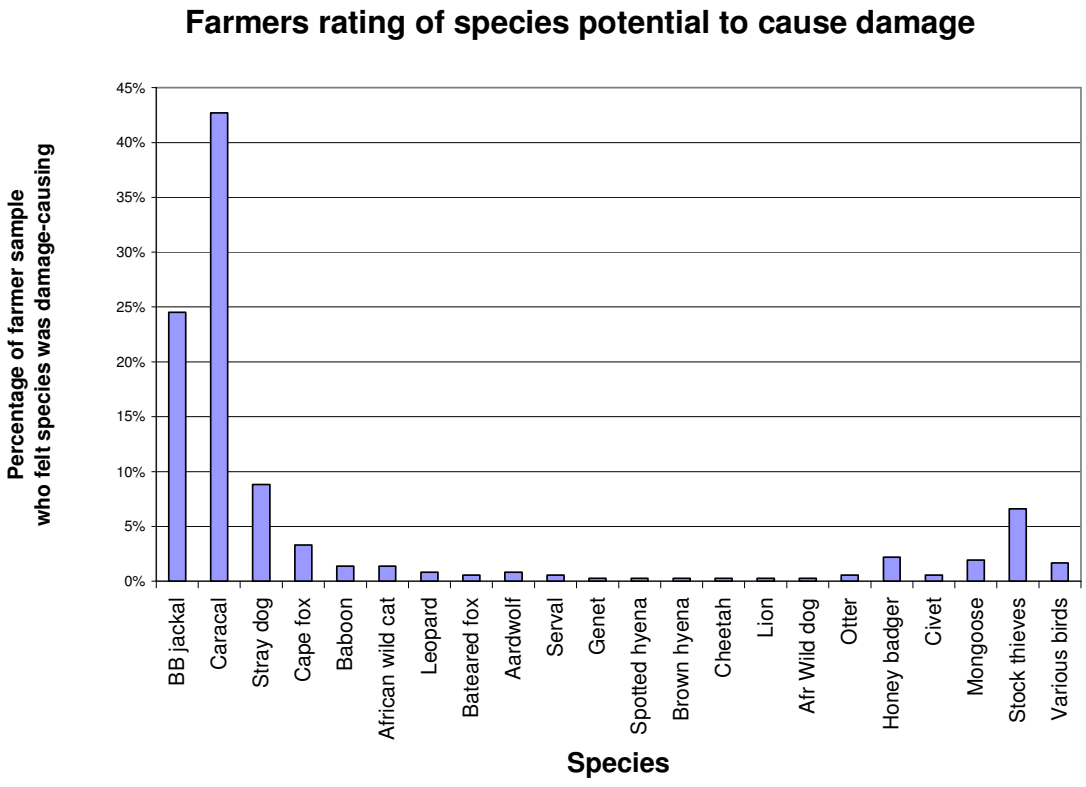


Figure 29. Percentages of EWT (2003) farmer sample who believed species were damage-causing

4.5.2 Timing of predation

Figure 30 indicates the timing and the average number of sheep lost, as reported by the sample of farmers questioned (EWT, 2003). Two clear peaks are apparent, coinciding with the autumn and spring lambing seasons as practiced by farmers who participated in the questionnaire survey. This implies vulnerability of unprotected new-born lambs to jackals which are feeding young pups during both spring and autumn. Young Caracals leave their mothers during autumn and this places young, inexperienced Caracal into the hunting fields at the autumn lambing time. It is enigmatic that so few farmers make the association between spring and autumn lambing seasons and increased losses despite this very clear association.

Additional adequate protection and management during high risk periods of lambing or calving is a very clear leverage point for reducing predation, stock theft loss and other conflict.

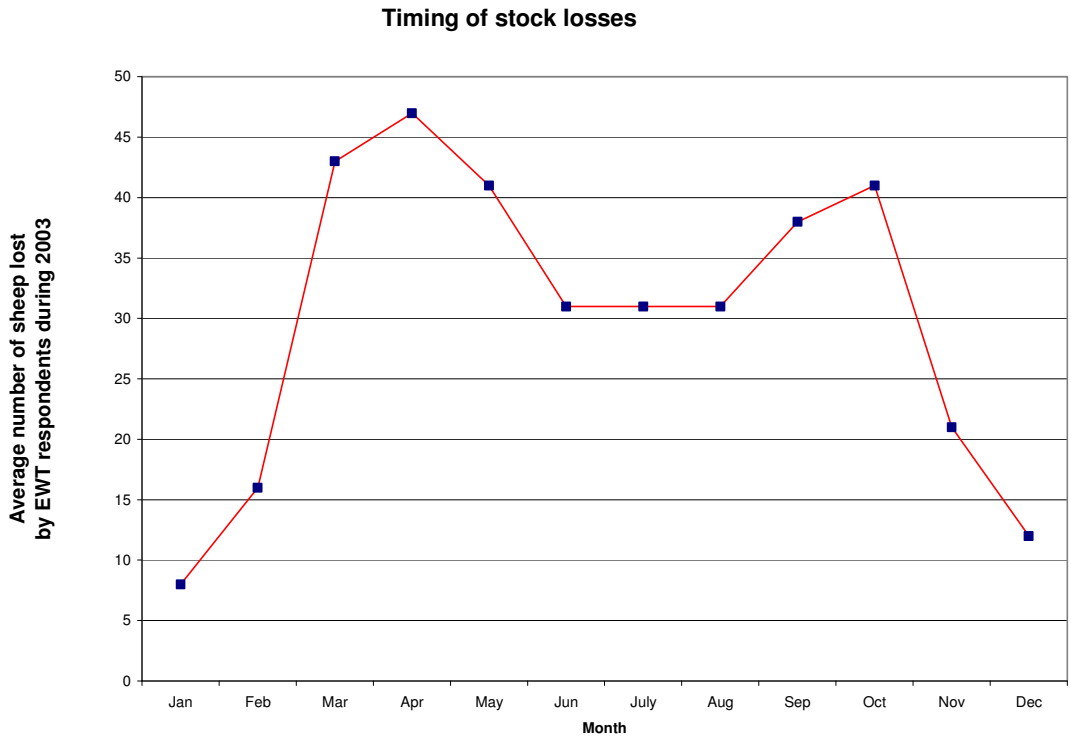


Figure 30. Timing and severity of stock losses.

4.5.3 Quantifying the losses

Figure 31 shows the total number of livestock lost by respondents per species over the three years covered by the questionnaire (EWT, 2003). Sheep and lambs are clearly shown to be the most vulnerable livestock type and this may illustrate a need for the additional protective measures suggested by this 2008 study. Specific attention is drawn to the study of snow leopards and stock protection by Jackson and Wangchuk (2004) as described in detail in Chapter 2. Goats, goat kids and cattle were less affected by predation, but the design of the EWT questionnaire precludes analysis to determine the reason for this. One may therefore presume that goats are wily, agile and have a tendency to use their horns in defence, and that cattle are large and generally only attacked by smaller predators during calving and calving difficulties. From figure 31 it is evident that sheep and lambs are the most vulnerable of all livestock to predators and that they should be afforded much greater care than other livestock forms.

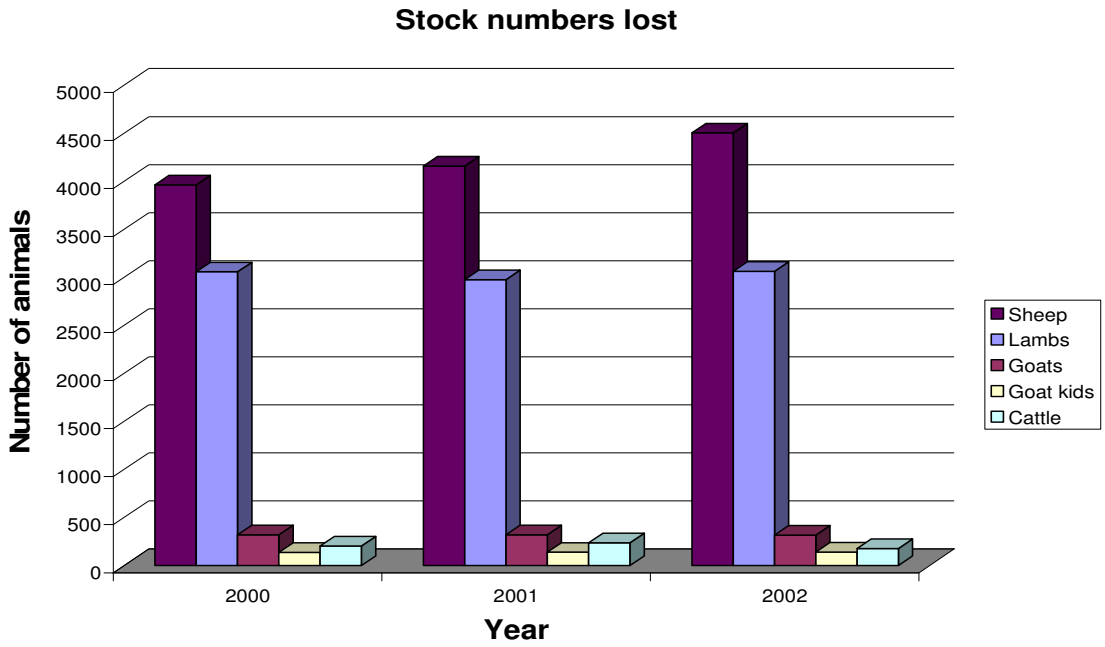


Figure 31. Livestock types and numbers lost by respondents from all causes over three years.

4.5.4 Placing a financial value on the losses

Respondents to the EWT questionnaire survey did not adhere to a standard cost per livestock type or unit, and 25 percent of the respondents indicated they did not keep accurate records. This casts doubt on the validity of the information provided. Figure 32 however shows the approximate value of livestock losses. As indicated in section 4.1, no accurate national or provincial figures exist for comparison. The rationale behind valuation of losses was to illustrate at least that losses are considerable. It also suggests that if farmers were to proactively invest capital in preventative measures then those measures would have considerable measurable financial benefits in the longer term with regard to loss reduction. It is suggested that farmers may be reluctant to spend money to prevent losses since they are entrenched in a reactive system.

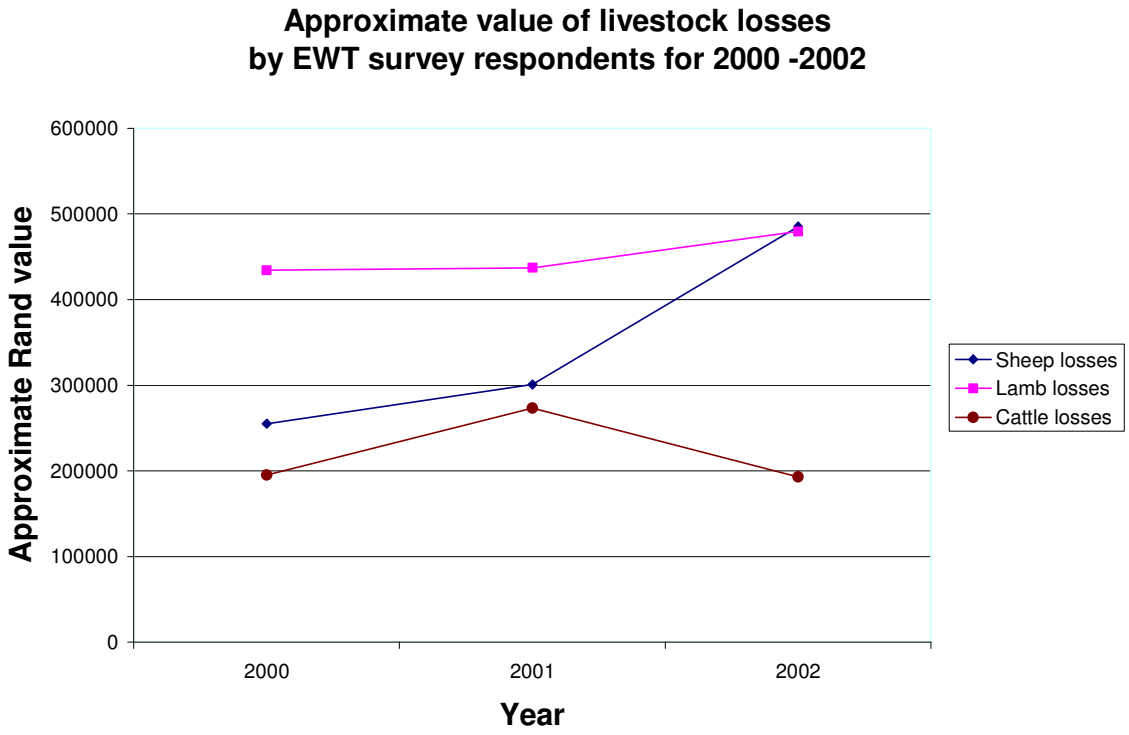


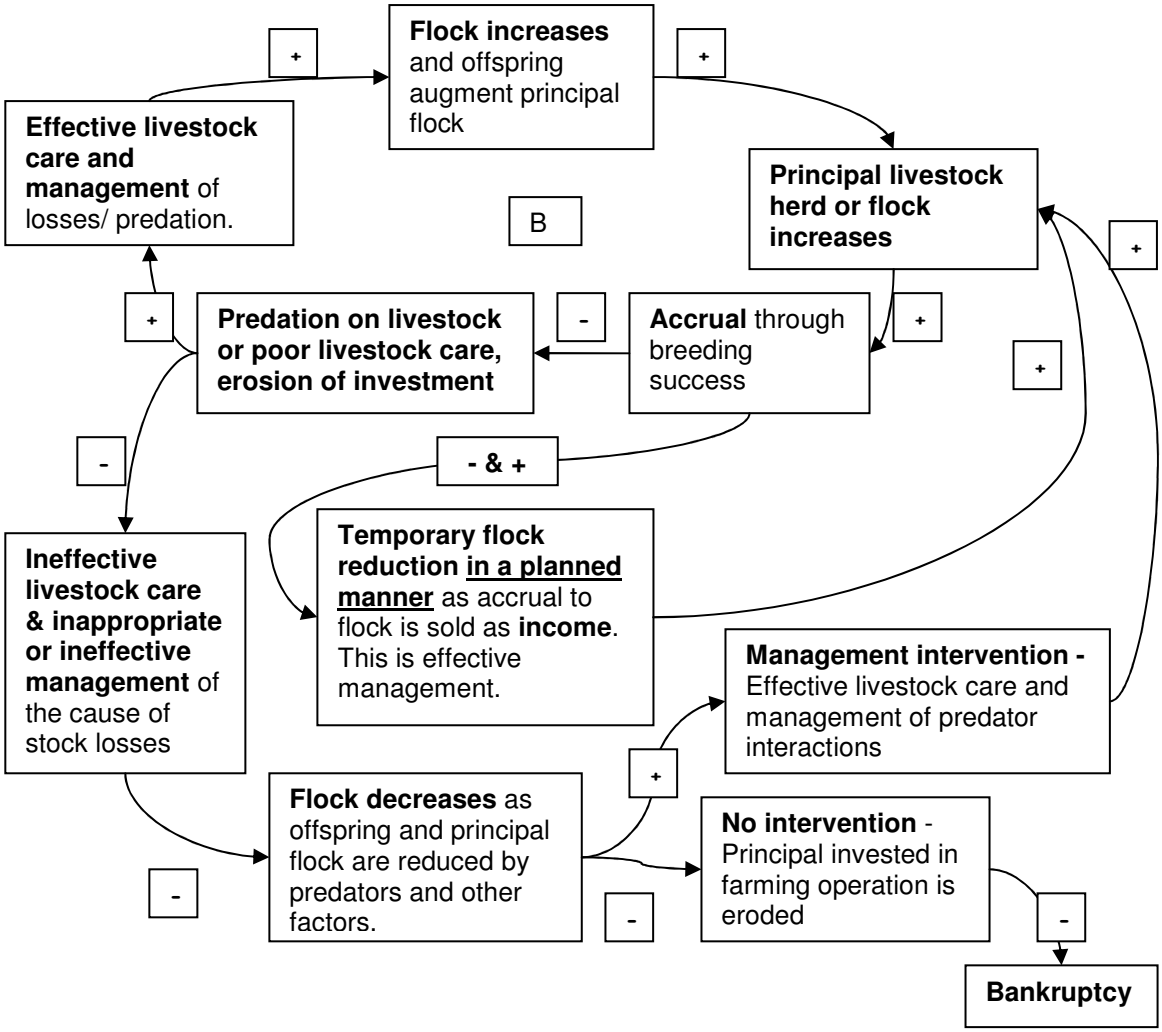
Figure 32. Approximate Rand value of livestock losses from 2000 to 2002 by EWT questionnaire survey respondents.

It was apparent from interaction with farmer-respondents that the issue of human-predator conflict management is highly emotive, and that a degree of irrational over-reaction towards predators and predation occurs. From readings on the subject of systems thinking we know also that because of time delays, balancing loops often overcompensate before correcting. Because of time delays and overcompensation, systemic solutions often result in things getting worse before they get better. The need for controls should be directly related to the amount of damage and the cost of the control effort in the long term should never exceed the value of the loss. A loss factor for predation should be allowed for in the farmer's financial plan, as is the accepted norm for disease, climate, stock-theft and other causes. Cost-benefit analyses may illustrate that proactive interventions are frequently less expensive to the farmer than reactive management.

4.5.5 Using systems diagrams for analysis of management actions

Systems thinking principles have been illustrated in this study, by applying this approach diagrammatically with causal-loop and flow diagrams. Many control methods or management actions have been assessed and discussed and conclusions drawn with regard to appropriateness. From an environmental view a system of exclusion of damage causing predators, coupled with enhanced livestock husbandry, management and care are desirable. The measures which are presently applied appear to be not equally effective, nor equally appropriate.

In Chapter 2 it was suggested that management and damage control measures applied should be evaluated for efficiency and effectiveness and measurement of success should be by reduced losses and increased profits, not by number of predators killed. In addition, analysis using a systems thinking approach indicates that proactive prevention is a solution for the greater proportion of conflicts. Figure 33 illustrates the influences of differing management actions within the same system. It highlights the outcomes of those actions and illustrates the value of the use of such diagrams to explain such scenarios to farmers.



Symbol	Meaning
Arrow with "s", or "+" symbol	A causal link between two variables, where a change in x causes a change in y in the same direction, or where x adds to or increases y
Arrow with "o", or "–" symbol	A causal link between two variables, where a change in x causes a change in y in the opposite direction, or where x subtracts from or reduces y
"R"	A reinforcing loop that amplifies change
"B"	A balancing loop that seeks equilibrium
= or "Time gap"	A time delay between the current status and the desired status

Figure 33. Influences of management actions. Source of Table: Senge *et al* (1995)

4.6 Summary

This chapter illustrated the need for farmers to practice effective analysis of the cause and effect of predator conflict management actions, to avoid exacerbation of the problem through ill-conceived decisions and activities.

Incorrect or misidentification of the cause of the conflict and the consequences were discussed in extensive detail. This misidentification and subsequent poor decision support is a major stumbling point for many farmers. It leads them to wastage of time and effort by addressing the wrong issues or attempting to fix that which is not broken. Correct identification of the original problem is critical if the correct solution is to be found to address the cause rather than the symptom. The entire farm management decision process may be influenced by application of systems thinking and by adapting to changing circumstances appropriately.

This was the rationale for assessing appropriateness of the various conflict management methods. It was also the reason for attempting to identify archetypes which could indicate flaws in management and for seeking leverage points to initiate changes. The farmers interviewed in the 2007-2008 study substantiated the assumption that leverage points (or small changes with big effects) could be identified to bring about substantial changes to predator conflict management on farms. Through their changes in actions, methods and management activities, they illustrated that application of systems thinking to predator conflict management is a realistic target, and that the multi-dimensional thought process of systems thinking can support decisions about predator conflict. A broad education and support programme for farmers is crucial to bring about the changes suggested by this 2008 study.

Chapter 5 Discussion and Conclusions

5.1 Introduction

The objectives of this 2008 study were to analyse predator conflict management methods from a systems thinking approach and to extract leverage points for change, with the stated objectives to:

a. Describe predator conflict management methods in archetypal terms from systems thinking literature.
b. Identify leverage points to stimulate a change in approach to human-predator conflict management.
c. Investigate the effectiveness of preventative and lethal predator conflict management methods when viewed from a systems thinking perspective.

From analysis of the EWT questionnaire survey (2003), it became apparent that very few farmers consider proactive predator conflict prevention as the solution to their continued losses. It was felt that perhaps they had not considered or studied their predator conflict predicament fully. Figure 34 shows the predation prevention methods applied by farmers. It is intended in this chapter to discuss the predator conflict management methods applied from a systems thinking perspective, to indicate positive potential or to reveal flaws in the methods used by farmers.

Application of systems thinking principles by this 2008 study illustrated reliance by the majority of the EWT (2003) questionnaire survey respondents on “quick fixes” and “fixes that failed”, rather than reliance on long term predator conflict prevention methods as practiced by the eight respondents revisited for the 2008 study. Consideration of each individual method in archetypal terms would have been repetitive, thus for the purpose of the discussion the methods were clustered.

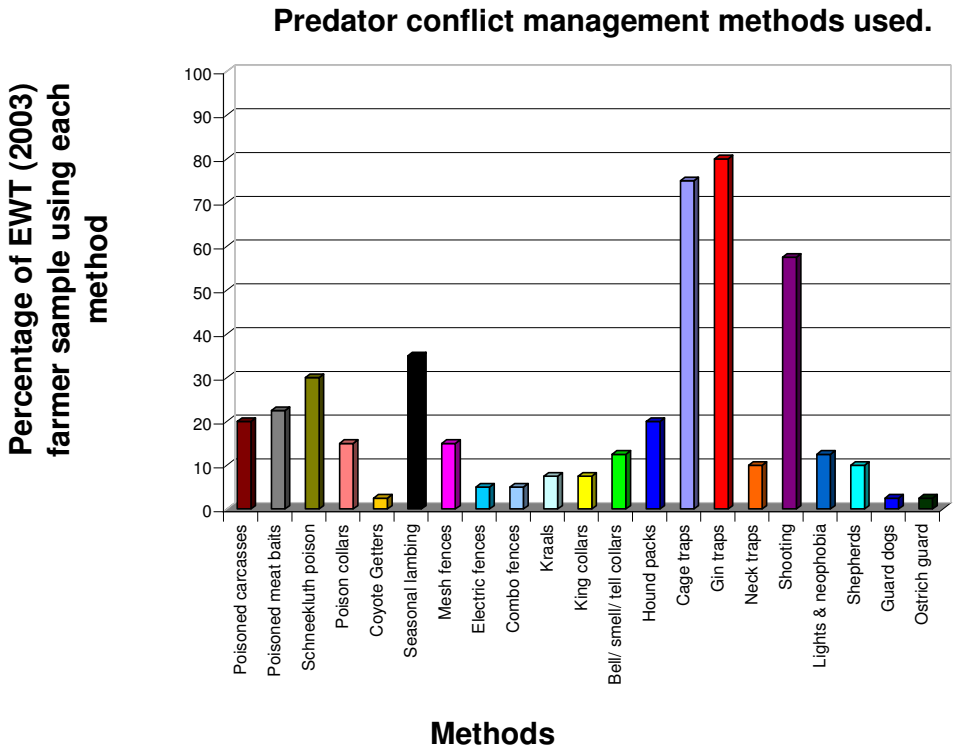


Figure 34. Percentage of farmers using various predation prevention methods (EWT, 2003).

From figure 34, it is clear that the most favoured predation management methods used by respondents to the EWT (2003) questionnaire survey were gin traps (80%), cage traps (75%) and shooting (57. 5%). Although De Wet (2007) believed that it may be possible to be target specific when shooting or trapping with cage traps, the skill of the person applying the method was considered critical to ensure target specificity. Of concern was the reliance by 20% of respondents on poisoned carcasses and by 30% on the Schneekluth 1080 poison baits. As suggested in section 4.5.2, the use of adequate fencing combinations and enhanced protection and management during high risk periods of lambing or calving is a very clear leverage point for reducing predation, stock theft loss and other conflict. Hence it was considered strange that only five to 15 percent of the EWT (2003) questionnaire survey respondents relied on secure fences and fencing combinations to proactively protect their livestock and 2. 5% of respondents used guardian animals. The conclusion drawn from figure 34 and

supporting data was that the majority of respondents to the EWT (2003) questionnaire survey used quick fix methods in response to predator conflicts, and a low percentage relied on proactive conflict prevention methods. The 2008 study indicates that livestock protection and conflict prevention methods are clear leverage points which potentially could have profound effects to reduce livestock losses, especially during the peak lambing periods illustrated in figure 30, section 4.5.2.

5.2 Describing predator conflict management in archetypal terms

5.2.1 Poisons and pesticides as lethal management methods

For the purpose of this discussion, the methods which employed poisons or pesticides were grouped, and included poisoned carcasses, poisoned meat baits, Schneekluth poison baits, and Coyote Getters, but excluded P-A-L poison collars. All these methods were regarded as quick fixes, or fixes that failed in an unstable reinforcing loop of oscillation around an unsuccessful predator extermination objective. These methods fail because there is constant replenishment of the predator population from adjacent areas. Some proponents of poisons, such as De Wet (2006) considered that poison could be applied in a manner which was more targeted towards specific predatory species. The conclusion reached by this 2008 study was that regardless of the actions taken by the farmer, it appeared impossible to target a specific, damage-causing individual with poisons. It also seemed unlikely that any farmer would possess skills equivalent to or matching those of individuals who had studied and trapped damage-causing animals professionally. Surely if predators, scavengers and carnivores are randomly killed, and the specific, individual, damage-causing predator remains at large, the cause of the conflict remains unaddressed and unresolved? The constant quick-fix killing of predators is a symptomatic management method which provides temporary respite, without any longer term relief that addressing the causal factors would bring about.

The application of poisons may offer the farmer a brief reprieve but not terminate predation. The methods of using poisons in carcasses, coyote getters and in any form of bait were considered to be quick fixes which temporarily reduced predator population numbers but which ultimately failed. This was because the important variable, predation, was accelerated up or down as the predator population was decimated and which subsequently boomed as a survival response. Without human intervention the population would stabilise ecologically, with the damage causing animal/s continuing predation on the livestock. Without any long term preventative intervention to address the cause of the problem, this cycle could continue infinitely. Poisons and pesticide abuse was considered a reinforcing loop since predation increased or decreased exponentially in response to predator conflict management actions.

Poison and pesticide use were also described as Fixes that Backfire, since the problem situation initially improved but subsequently deteriorated over a short term, without reaching a state of equilibrium. This could also become a Tragedy of the Commons scenario, where the impact of one farmer's action in reducing his losses could induce the behavioural changes described by Blom *et al* (1992) in Table 1, and De Wet (2007) in Table 2, Chapter 2.2.2, by causing poison avoidance in a greater area or district. This also creates a scenario where neighbouring farmers could become Accidental Adversaries, since the one caused predator population instability, with potentially detrimental effects on his neighbours and his district.

5.2.2 Hound packs

The *modus operandi* of the hound pack investigated was to conduct hunts over an area in response to, but often some weeks after predation. This indicated a strong probability that non-target predators were hunted since predators killed were not located by a scent-link to the site of predation, but by a random hunt over one or several farms. The method was not supported by all farmers, since

the random hunting was considered an intrusion and an infringement on individual rights on farms where other methods were applied.

This 2008 study categorised the hound pack method as a Quick Fix, destined to become a Fix that Backfired, since it aimed at predator extermination rather than predator damage prevention or management. By hunting across adjacent properties, by implication, the farmer using the hunt pack displayed the archetype of Shifting the Burden and blaming others for allowing any predators, and accusing them of harbouring predators, whether damage-causing or not. This scenario was illustrated by a causal loop diagram in Figure 26, section 4.4.

5.2.3 Shooting

Three different formats of predator shooting were found to exist and the differentiation was by the person who carried out the hunting. The first was where a farmer allowed recreational hunters to hunt predators. These hunters were regarded as those who sought predator hunting as a means to vent their blood lust. They were considered to lack the skills and patience required and ill equipped for the task. Since their forays into the hunting field were mostly regarded as social and often conducted as a group, the hunts lacked the humane, professional and ethical behavioural patterns required for success. This form of predator shooting was categorised as a quick fix, destined to fail, since any predator sighted was considered a target, regardless of whether it killed stock or not. During discussions the emotional comparison was drawn between this form of hunting and the injustice of detention or the death penalty without trial.

The second form of predator hunting was practiced by the farmer himself. This was likely to be slightly more target specific because of the farmers knowledge of his farm and the locality of predation, but also likely to be a quick fix that failed, since the farmer would be emotionally affected by predation and likely to shoot predators on sight.

The third form of shooting was where a farmer employed a professional hunter to shoot a predator or predators. There was a marked difference between singular and multiple predator removal. The singular removal implied selection and shooting of a targeted individual predator by means of some selection process and was considered a longer term solution by removal of a damage causing animal. This would also have allowed the farmer the time gap required for application of further conflict prevention and avoidance methods. Contrarily, the multiple predator shooting was considered a quick fix, destined to fail. This was because elimination of the problem by temporary eradication would create a vacuum area (and a scenario similar to application of hound packs). This would offer the farmer temporary respite from predation until recolonisation of the area by an influx of predators displaced from elsewhere. Regrettably due to the cost of employing a professional hunter, the trend was toward multiple predator shootings per hunting event.

In summary, hunting was only considered effective as a solution if and when a specific damage causing animal was hunted. Even then, the solution was a quick fix of the symptom, yet it provided the farmer a temporary respite during which the cause of the problem could be addressed. All other types of shooting were regarded as quick fixes and fixes that backfired since they addressed the symptom but not the cause of the problem.

5.2.4 Trapping

Figure 27 in section 4.4 illustrated the findings of the EWT (2003) survey that 80 percent of respondents used gin traps, and 50 percent of those caught non-target animals. By their own admission thirty percent of trappers were untrained. Only 52 percent of the trappers checked their traps daily.

The author's interpretation of these results was that despite the fact that modern society regards gin traps as inhumane, the application of these traps by farmer

respondents continues in a half-hearted and apathetic manner. Clearly, since the EWT 2003 survey recorded that 50 percent of respondents caught non-target animals, the method was a random quick fix and a limit to growth of the farmer's livestock flock or herd. This conclusion was reached since random gin trapping not only maimed or killed non-target predators, but constantly disturbed the ecological system and other environmental interactions by killing and maiming innocent bypassing animals, which may have been part of the natural prey base. The use of gin traps was considered to be a fix that backfires and a factor causing ecological instability without addressing either the symptoms or the cause of the predator conflict.

From the literature study, cage traps were only considered effective for the capture of Caracal and other felids and for stray dogs. Where a sufficient number of cage traps were applied at the site of predation and a predator was captured and destroyed, the system was considered to be a quick fix of the symptom, yet it provided the farmer a temporary respite during which the cause of the problem could be addressed. Recalling from section 2.2.1, that Moolman (1986) recorded one capture per one hundred trap-nights, the farmer would require several traps to improve his chance of successful capture of the damage-causing animal. Since Caracal (specifically males) were reported by Moolman to be highly mobile, the longer the time duration between predation and capture of the damage-causing animal, the greater the possibility of a random capture of a non-target predator. The method may be an effective manner of addressing a predation problem, since the physical and dental condition of a captive predator may indicate likelihood of predatory behaviour. This could influence whether it is destroyed humanely or released *in situ*. Translocation of captive predators may be a shifting of the burden, since the short term quick fix exists but fails to fundamentally correct the real problem. This is because a predator which is accustomed to killing livestock may be inclined to do so regardless of its location, and translocation of the predator merely translocates the problem. In addition to this, translocation disregards the population dynamics of the release area, and such relocation may have a disturbing and detrimental effect on the resident

population in the release area. In other words, as translocation of a damage-causing animal does not necessarily consider the animal population dynamics of the recipient or release locality, such action may merely equate to translocation of a problem.

5.2.5 Neophobia

When considering the simple definition of neophobia, or the fear of new things, it is clear that in a holistic systems thinking scenario, neophobia only works when newly applied. If bells, lights, collars and scents were to be regularly used, they would not be new, the predators would become accustomed to them, and the efficacy of the predators' neophobic reaction would become lost. The intention of neophobic repellents was therefore considered a deliberate quick fix, as described in detail in section 2.3.5.3, and illustrated in figure 11, to allow time for a farmer to adjust and take corrective actions to avoid continued predator conflicts.

All forms of predator conflict management which applied neophobia were considered to be quick fixes. The intention of these methods was not to stop predation, but merely to distract and deter the predator. Another way of viewing this was that occasional predators would be deterred for long enough that they would move to easier opportunities, or they would switch back to their diet of natural prey animals.

5.2.6 Protection devices and techniques

Protection in the forms of King collars, shepherds and guardian animals were all seen as long term methods to address the cause of the predator conflict. Hence these methods were considered as a Balancing loop, with the farmer moving towards a target of reduced predator conflicts without delay, even though oscillation in the form of occasional predation might still occur.

5.2.7 P-A-L poison collars

In systems thinking terms, the use of these poison collars was classed as being in a Balancing loop and in environmental equilibrium, since the application in response to predation on livestock was 100 percent target specific. This was because the collar had to be punctured by a damage-causing predator biting the throat of a sheep or lamb. Whilst predation remained variable there was balancing loop movement towards a target of reduced predation and elimination of specific damage-causing individuals without time delays.

5.2.8 Protection

From an ecological viewpoint, animal proof fences are not ideal since they prevent movement of wildlife for feeding, breeding and other ecological functions. However, lambing or calving areas set aside on a farm specifically for this purpose were considered feasible, especially if the area was a planted pasture. The principle of separation was viewed as an ideal method for avoidance of conflict. Figure 1 in section 2.2.1 simplistically illustrated the correlation between livestock births and predation and implied that greater protection of newborn animals would have a marked reduction of availability of easy prey for opportunistic predators. The principle is described by a reinforcing loop with the predation variable declining exponentially. Many reasons or rather excuses, were offered by certain 2007/2008 study sample farmers as to why enclosures were not acceptable by them. The primary reasons were that enclosure causes additional erosion from trampling and path formation, and increased disease in confined animals. None could argue the fact that secure enclosures reduced predator conflicts.

5.3 Identifying leverage points to stimulate a change in approach to human-predator conflict management

This 2008 study sought to use systems thinking methodology to identify leverage points to indicate possibilities for change. The livestock losses recorded by the EWT (2003) questionnaire survey were a result of a combination of causal factors, including birth problems and defects, climatic factors, diseases, stock-theft and predation. The rationale behind the EWT questionnaire survey was that farmers have been experiencing livestock losses for centuries in South Africa, and whilst many forms of so-called problem animal management have been applied, few have met with long term success.

The first leverage point identified was that by building and maintaining adequate fences and night enclosures, farmers could make it more difficult for predators to reach livestock and this would minimise losses. Whilst such fences and enclosures might not always be foolproof, it was felt that the influence of the fence on the system would be of reduced losses. By the added use of secure night enclosures an even greater reduction could be achieved. The argument by Respondent 5 (2007) that herding of stock to night enclosures causes erosion was valid, as was the argument raised by Respondent 1 (2007) that parasite loads and diseases such as foot-rot increased when sheep were confined. These attitudes were contrary to a spirit of improvement. The converse question to these respondents had to be raised. Why do farmers not construct night enclosures closer to where the sheep graze, and include a foot-bath and veterinary treatment facility at the enclosure? Why could they not construct temporary, moveable holding enclosures using modern electric fencing technology? The costs would be less than the cost of continued losses, and would thus be offset over time by increased profits.

The second leverage point identified was that if farmers employed shepherds with dogs to alert them of a predators approach, either alone or in combination with night enclosures, the system could repel even persistent predators. The

Anatolian Shepherd Livestock Guarding Dog Project report of September 2007 reported no further losses after placement of the Anatolian shepherd dog, and this substantiated the views of Respondent 7 (2006). The use of guarding animals, specifically Anatolian shepherd dogs, is the second leverage point identified.

The third leverage point identified was the use of preventative methods and methods based on the principle of neophobia. King (2006) reported reduced losses using the armour approach of King Collars. Steenkamp (2006), Steenkamp (2007) and De Wet (2007) described neophobia in predators and the resultant repellent effect of bell collars, or of bell collars with attached scent blocks. Respondent 6 (2007) adopted the use of King Collars after the EWT questionnaire survey of 2003 made him aware of them, and when interviewed during the 2007 survey, he reported an extreme decline in predation losses. All types of collars investigated led to reduction of losses. Hence, the use of poison collars, protective collars or collars reliant on neophobia was identified as a third leverage point.

The fourth leverage point to reduce losses was that of an alarm system coupled with deterrents to stock thieves and predators. Respondent 3 (2007) described how a motion activated cellular telephone call could alert a farmer of livestock disturbances. Lanterns, radios and other disturbances triggered neophobia in predators and raised suspicion by stock thieves that kraaled stock may be guarded. All methods reduced losses and all were considered to be positive interventions.

Regardless of which system is used, whether alone or in combination with others, all appear to have a marked potential for reduction of livestock losses. It must be stressed that by means of personal communications it was established that most respondents to the 2007/2008 study had realized the futility of management or controls which did not consider predator ecology and the holistic system. As innovative farmers who studied the predator system and its effect on

livestock and invested in development of the management systems that they believed in, they are beacons of hope which other farmers could follow. Why do other farmers appear so reluctantly lethargic to follow? All of these preventative methods have been identified as leverage points to prevent conflict.

The old adage that where there is a will, there is a way was demonstrated by the eight innovative farmers who were telephonically interviewed or revisited during 2007 and 2008. Without exception they experienced livestock predation but they all realized that conventional predator extermination did not stop predation on their farms. They all concluded that proactive interventions reduce or eliminate stock losses and they all agreed that prevention is the cure.

An additional point of discussion raised was that of communication, education and trust. Whilst probing the perceived lack of environmental education amongst farmers, the author noted that Welman *et al* (2005) discuss sources of non-scientific knowledge, listing authority, peer opinion, tradition, debating and accidental observation as such sources. Peer pressure from a wise man has much value, but peer pressure from a fool is worthless. The author believes from personal experience that farmers tend to base their views on such non-scientific knowledge and hence are often skeptical of new innovations, and mistrust the messenger who brings the information. An underlying mistrust appears to exist between conservation officials and farmers, due to their apparently opposing beliefs. Enigmatically both parties are land managers with concern for the environment. Third Party Facilitation to educate and enlighten farmers may unlock all of the identified leverage points. Conservationists should support every effort by farmers who develop solutions for others, and provide encouragement and every possible opportunity for the exchange of new predator conflict management systems that work.

5.4 Conclusions

In order to investigate the effectiveness of preventative and lethal predator conflict management methods from a systems thinking perspective adequately, Figures 21, 28 and 33 in sections 4.3, 4.4, and 4.5.5 respectively were revisited to facilitate the discussion. Figure 21 illustrated the cause and effect of a number of non-lethal predator conflict management scenarios and the inter-relationships between them. The first scenario commenced with resident predators which were not in conflict, and the approach by a nomadic, vagrant /non-territorial predator. The scenario was described as a long term dynamic suite of interlinking balancing and reinforcing loops. There were constant cause and effect interactions, even including sporadic predation conflicts. The land manager constantly analysed and managed each conflict situation by addressing the causes and implementing long-term remedial actions to prevent re-occurrence. However, because the livestock was protected as well as possible, and so generally unavailable, the vagrant predators encountered paucity of easy food but adequate natural food sources. In addition, the vagrant was challenged by the territorial predators, firstly for territorial dominance and possession, and secondly for the naturally available food sources. Local, territorial predators were tolerated by farm management in their natural situation and for the defensive role they played, but were managed effectively if they caused livestock damage in excess of pre-defined limits of tolerance. This implied that the area could have encountered limited losses within the pre-defined limits, but this was constantly monitored, and the area protected, defended and territorially occupied. Intruders either had to fight for territorial dominance and survival on the natural resources in that area, or emigrate in search of food and a safer existence. Conflict avoidance through implementation of adequate prevention efforts was considered a critically important leverage point for the reduction of predator conflicts.

Contrarily, in the second scenario illustrated in figure 21, the vagrant, damage causing predator encountered little or no preventative protection as contemplated

above. There were also no territorially defensive predators due to a kill-all policy of quick-fixes and fixes that backfire and the farm management reaction was inappropriate and in a reinforcing downward loop, or vicious cycle. The outcome of this inability to apply appropriate management responses in the manner described above, was continued predator (and environmental) instability. Conflict and economic loss continued, and the situation had the potential to lead towards financial instability and emigration by the farmer through bankruptcy.

Figure 28 in section 4.4 illustrated both appropriate and inappropriate lethal control decisions and illustrated cause and effect by showing the consequences of the decisions. As in figure 21 in section 4.3, the figure 28 cycle started with predation on livestock and the choice of either an effective or an inappropriate predator management method by the farmer. Where the incorrect and ineffective method was chosen and applied, the specific damage-causing predator was not removed and stock losses continued. Furthermore when farmers killed non target predators, a territory became vacant and internecine competition was reduced. This led to an influx of replacement predators, which exacerbated the predation problem.

Three scenarios emerged. The first followed the set of quick-fixes or fixes that backfired. The lack of natural prey and the unstable predator population continued the cycle as a reinforcing loop, and the vicious cycle of instability returned the farmer to his choice of management methods. In the second reinforcing loop, the farmer could have faced financial ruin, but this would have pre-empted his return to the choice of management methods. In the third scenario, the farmer benefited from good fortune. Through an environmental influence beyond his control, the balance stabilised in the balancing loop to a level within his loss acceptance parameters. This scenario had the potential to revert to a reinforcing loop and spiral the farmer down to a continuation of loss, because the cause of predation remained unaddressed and was still subject to an unstable decision support system.

In figure 33, section 4.5.5, key points were highlighted intentionally to illustrate the cause and effect of the management actions applied. With all farmer respondents questioned, there was a basic assumption that their expectation was of livestock accrual through breeding success. Any predation on livestock was taken as an indicator of poor livestock care and amounted to an erosion of the farmer's investment. The farmer response was important and the decision was a choice of effective vs. ineffective management, or in terms of systems thinking, whether the farmer had addressed the symptom or the cause. In the upper balancing loop of figure 33, where the farmer took the correct decision and the cause was addressed, the effect of predation was reduced to minimal and acceptable levels. The flock increased by effective breeding and the farmer profited.

In the lower part of figure 33, an ineffective quick fix management action was implemented, and the symptom was addressed rather than the underlying cause. In this case there was no long term attention to the cause and the predation problem continued. The effect was that offspring and breeding livestock were stressed, injured or killed, and this eroded the farmers' principal capital investment in his livestock. At this point of the reinforcing loop, or vicious cycle the farmer faced the next decision. That decision was either to continue applying quick fixes, fixes that backfired or other ineffective management actions, or to find a long term exit from the reinforcing loop through an effective management intervention. Finally, the farmer could remain ignorant of his predicament and continue shifting the blame until the lack of effective intervention led to total erosion of his livestock investment and bankrupted the farming operation.

This 2008 study initially probed the Endangered Wildlife Trust survey of 2003. The EWT data was found to be Cartesian and fixed in time, and not enabling adequate analysis for the desired study objectives. As a result, a sample of farmers was selected from the EWT dataset for re-questioning on the basis that they had reduced or prevented predator conflicts through management. Regardless of the system applied all respondents in the 2007/2008 study

indicated reduced losses after they realised the futility of short-term quick fix management. All indicated that they had made a conscious decision to consider their farming systems holistically within the ecological environment. Their decisions all rested on the simple premise of farming and cohabitation with nature and predators. They all believed that this could be achieved by applying conflict prevention and reduction techniques, rather than persist with unsuccessful attempts the eradicate predators and dominate nature.

The first leverage point identified was the use of fences and night enclosures to minimise losses. The use of guarding animals, specifically Anatolian shepherd dogs, was the second leverage point identified. The use of poison collars, protective collars or collars reliant on neophobia was a third leverage point. Other devices causing neophobia constituted the fourth leverage point to reduce losses. Whether alone or in combination with others, all appear to have had a marked potential for reduction of livestock losses. These leverage points identified in this 2008 study were established by the decisions and actions taken by the selected farmers to reduce predator conflict and livestock losses, and by the positive results they achieved.

In conclusion, by applying systems thinking principles to predator conflict management, this study illustrated that there are several leverage points which could enable farmers to break out of the vicious cycle of predator damage and inappropriate management responses which perpetuate the problem, and which have been the pattern in South African for more than 350 years. But will farmers embrace this new idea of applying systems thinking to predator conflict management? Will they admit that certain management practices are quick fixes that do not solve the problem? Many proactive preventative methods proposed might not eliminate conflict altogether, but they reduce losses dramatically to within tolerance thresholds, and should make financial sense to a farming business enterprise. The old saying is to the effect that prevention is better than cure and from this study it appears that Prevention is the Cure.

.

References

Animal Control Technologies. (2003). FOXOFF Part 1. *Foxes in Australia.* Videotape. Animal Control Technologies, Somerton, Victoria, Australia.

Atzert, S.P. (1971). *A review of sodium monofluoroacetate (compound 1080). Its properties, toxicity and use in predator & rodent control.* Special scientific report. Wildlife no. 146. Washington, D.C.

Bellinger, G. (2004). *Introduction to Systems Thinking*. http://www/systems-thinking.org/intst/int.htm. Accessed on 9 August 2007.

Berutti, A., Snow, T. V., & van Zijl, N. (2005). *Deliberate poisoning: The biggest threat to Gamebirds.* Wingshooter, Volume 11, No 3, p 12 – 16.

Blanchard, K., Oncken, W., & Burrows, H. (1989). *One Minute Manager Meets the Monkey.* ISBN 0688103804. William Morrow & Company.

Blom, J. J., Brand, D. J, Heard., H. W, de V. Kritzinger., J, Scott, W. M., and Stadler, J.C. (1992), *Kaaplandse Natuurbewaring – Probleemdierbeheer-handleiding, Maart 1992,* Unpublished manual.

Blom, J. J. (2007). Personal comment. Department of Environmental Affairs, Free State Province.

Bowland, A. E. (1990). *Predator Control Training Course, Spioenkop Public Resort.* Unpublished notes for Natal Parks Board staff. University of Natal, Pietermaritzburg.

Bowland, A. E., Mills, M. G. L., and Lawson, D. (undated). *Predators and farmers*. ISBN 0 620 17097-2. The Penrose Press, Johannesburg.

Brown C.J. (1992). Test of compound 1080 in the poison collar on a captive vulture. *Internal report*. Ministry of Wildlife Conservation & Tourism of Namibia. Windhoek.

Brown, C.J. (1992). *Test of Compound 1080 from a poison collar on a captive vulture.* Vulture News 29: 19-26.

Carruthers, J. (2001). *Wildlife & Warfare: The life of James Stevenson-Hamilton.* University of Natal Press. Pietermaritzburg.

Cheetah Outreach & De Wildt Cheetah & Wildlife Trust. (2007). *Anatolian Shepherd Livestock Guarding Dog Project: Progress Report.* Wild Cheetah Program. Unpublished report, September 2007.

Connolly, G. (1990). *The Livestock Protection Collar*. In: Predator Management in North Coastal California: proceedings of a workshop held in Ukiah and Hopland, Calif., March 10-11, 1990. (Eds: Guisti, G. A., Timm, R. M., & Schmidt, R. H.), University of California, Hopland Field Station Publication 101.

Connolly, G. E. and Longhurst, W. M. (1975). *The effects of control on coyote populations.* Div. of Agric. Sci., Univ. of California Davis. Bulletin 1872.

Daly, B., Davies-Mostert, H., Evans, S., Friedmann, Y., King, N., Snow, T., and Stadler, H. (Eds). (2006). *Prevention is the Cure. Proceedings of a workshop on holistic management of human-wildlife conflict in the agricultural sector of South Africa.* Endangered Wildlife Trust, Johannesburg.

De Wet, M. J. & Curle, D. B. (Undated). *Probleemdier Jagklubs in die Transvaal, Unpublished report.*

De Wet, M. J. (2007) Personal comment. Animal Damage Control Institute, Hoedspruit, Mpumalanga.

Endangered Wildlife Trust (2007). *Poison Working Group, Wildlife Poisonings Database from 1997-2007*. Unpublished. Endangered Wildlife Trust. Johannesburg.

Endangered Wildlife Trust Questionnaire Survey (2003). Unpublished, Endangered Wildlife Trust, Johannesburg.

Florence, R. (2002). *Predator FAQ.* http://www.18james.com/rural/predator.html. Accessed 24/11/2007.

Gabrielson, I. N. (undated copy). *Predator Control and Predator-Prey Relationships.* Oryx 140 – 143.

Goodman, M. (undated). *Systems Thinking as a Language.* In The Systems Thinker™, Volume 2, Number 3, © Pegasus Communications. http://www.thesystemsthinker.com/tslang.html accessed on 24/11/2007.

Grahn, R., and Leyland, T. (2004). *Complimentarity between Community-Based Animal Health Delivery Systems and Community-Based Wildlife Management? An Analysis of Experiences Linking Animal Health to Conflict Management in Pastoralist Areas of the Horn of Africa*. http://www.iucn.org/bookstore/HTML-books/SSC-OP030-ahead/Chapter%2018.html, accessed 24/11/2007.

Gray, D. E., (2005). *Shifting the Burden – Whose Monkey Is It?* Developer Systems and Software Series. http://www.donaldegray.com/tiki_download_file.php, accessed on 24/11/2007.

Green, J. S., Henderson, F. R., and Collinge, M. D. (1994). *Coyotes: Damage Prevention and Control Methods.* In Prevention and Control of Wildlife Damage – 1994. United States Department of Agriculture, Animal and Plant Health Inspection Service, Colorado.

Grobler, J. H., Hall-Martin, A., and Walker, C. (1984). *Predators of Southern Africa.* Macmillan, Johannesburg.

Grobler, J. H. (1986). *The Caracal (African lynx) or 'rooikat'.* Wildlife Management - Technical guides for farmers. (Ed. Rowe-Rowe, D.T.) Teeanem Printers, Pietermaritzburg.

Hammer, M., (2002). *Why Leaders Should Reconsider Their Measurement Systems* - Leader to Leader, No. 24, Spring 2002. Peter Drucker Foundation. http://www.pfdf.org/leaderbooks/l2l/spring2002/hammer.html - top. Accessed 24/11/2007.

Hemson, G. (2003). *The Ecology and Conservation of Lions: Human-Wildlife Conflict in semi-arid Botswana.* PhD Thesis, University of Oxford.

Hitchens, D. K., (2005). *System Thinking.* http://www.hitchins.net/ Accessed 24/11/2007.

Hodkinson, C., Komen, H., Snow, T., and Davies-Mostert, H. (2007). *Predators and Farmers.* Endangered Wildlife Trust. Johannesburg.

Hygnstrom, S. E., Timm, R. M., & Larson, G. E. (1994). *Prevention and Control of Wildlife Damage*, University of Nebraska- Lincoln/ US Department of Agriculture.

Jackson, R. M., and Wangchuk, R., (2004). *A Community Based Approach to Mitigating Livestock Depredation by Snow Leopards.* Human Dimensions of Wildlife 9: 307 – 315. IUCN Publications Services Unit, Cambridge.

Jelinski, R. C. & Jowsey, J. R. (1983), *Coyote Predation on Sheep, and Control by Aversive Conditioning in Saskatchewan,* Journal of Range Management 36(1), January 1983.

Jones P.S., Young J., and Watt, A.D., (2005), (Eds). *Biodiversity conflict management, a report of the BIOFORM project*. www.nbu.ac.uk/bioforum accessed 11/11/2007.

King, L. (2006). In Daly, B., Davies-Mostert, H., Evans, S., Friedmann, Y., King, N., Snow, T., and Stadler, H. (Eds): 2006. *Prevention is the Cure. Proceedings of a workshop on holistic management of human-wildlife conflict in the agricultural sector of South Africa.* Endangered Wildlife Trust, Johannesburg.

Lötter, P. (2006). *The use of cell-phone technology to prevent stock losses: the "Veldwagter Veediefstal Alarm".* In Daly, B., Davies-Mostert, H., Evans, S., Friedmann, Y., King, N., Snow, T., and Stadler, H. (Eds): 2006. *Prevention is the Cure. Proceedings of a workshop on holistic management of human-wildlife conflict in the agricultural sector of South Africa.* Endangered Wildlife Trust, Johannesburg.

Madden, F. (2004). *Creating Coexistence between Humans and Wildlife: Global Perspectives on Local Efforts to address Human-Wildlife Conflict.* Human Dimensions of Wildlife 9: 247 – 257. IUCN Publications Services Unit, Cambridge.

Marker, L., and Dickman, A. (2004). *Human Aspects of Cheetah Conservation: Lessons Learnt from the Namibian Farmlands.* Human

Dimensions of Wildlife 9: 297 – 305. IUCN Publications Services Unit, Cambridge.

Martin, F. (1997). Fencing – “Shocking” plan works, *Farmers Weekly,* August 8, 1997.

Moolman, M. (1986). *Aspekte van die Ekologie en Gedrag van die Rooikat (Felis caracal) in die Bergkwagga Nasionale Park en op Plase Daaromheem. Pelea*, 1986 (5) p 8 to 21.

Republic of South Africa. (1947). *Fertilizers, Farm Feeds, Stock Remedies & Agricultural Remedies Act, Act 36 of 1947*. Government Printer, Pretoria.

Republic of South Africa. *Government Gazette No. 13424* (26 July 1991). *Regulation No R 1716.* Government Printer, Pretoria.

Republic of South Africa (1973)*, Hazardous Substances Act, Act 15 of 1973*. Government Printer, Pretoria.

Republic of South Africa (2004), *National Environmental Management Biodiversity Act, Act 10 of 2004*. Government Printer, Pretoria.

Respondent 1. (2007). Personal Comment. Sheep and wool farmer. Underberg KZN.

Respondent 2. (2007). Personal Comment. Sheep farmer and developer of protection collar, Bedford, Eastern Cape.

Respondent 3. (2007). Personal Comment. Sheep farmer and developer of motion sensing collar. Jansenville. Eastern Cape.

Respondent 4. (2007). Personal Comment. Holistic cattle farmer. Ladysmith, KZN.

Respondent 5. (2007). Personal Comment. Sheep farmer, Bedford, Eastern Cape.

Respondent 6. (2007). Personal Comment. Sheep farmer, East Griqualand.

Respondent 7. (2007) Personal Comment. Anatolian guardian dog breeder and trainer. Middelburg. Eastern Cape.

Respondent 8. (2007). Personal comment. Small stock farmer, Beaufort West, Cape.

Respondent 40. (2003). Personal Comment. Sheep farmer, East Griqualand.

Richardson G. *System Dynamics Review 2* (no. 2, Summer 1986). http://www/systems-thinking.org/intst/int.htm. Accessed on 9 August 2007.

Senge, P. M., Roberts, C., Ross, R. B., Smith B. J., and Kleiner, A. (1995). *The Fifth Dicipline Fieldbook.* Nicholas Brealey Publishing, London.

Schneekluth, P. (undated). *Wenke vir die doeltraffende stel van slagysters en die gebruik van lokmiddels en aas.* Unpublished notes. Peter Schneekluth, Ongediertejagter, Prins Albert, Cape.

Schoeman, P. (2007). Personal Comment. Professional predator hunter. Ladysmith, KZN.

Smithers, R. H. N., (1983). *The Mammals of the Southern African Subregion.* University of Pretoria, Pretoria.

Snow, T. V., & Verdoorn, G. (2001). *Proactive Prevention of Wildlife Poisonings in South Africa through Collaborative Problem Animal Management.* In: The Risks of Toxicosis from Pesticides and Pollutants in Raptors and Wildlife in Israel. Eds. Shlosberg, A., & Bahat, O. Society for the Protection of Nature in Israel, Tel-Aviv.

Snow, T. V. (2002). *Responsible Problem Animal Management*. Farmers' Weekly series, February to April 2002.

Stannard, C. (2006). In Daly, B., Davies-Mostert, H., Evans, S., Friedmann, Y., King, N., Snow, T., and Stadler, H. (Eds): 2006. *Prevention is the Cure. Proceedings of a workshop on holistic management of human-wildlife conflict in the agricultural sector of South Africa.* Endangered Wildlife Trust, Johannesburg.

Stadler, J. H. (2007). Personal Comment. Wildlife Damage Management specialist. Cape Nature.

Steenkamp, E. (2006). In Daly, B., Davies-Mostert, H., Evans, S., Friedmann, Y., King, N., Snow, T., and Stadler, H. (Eds): 2006. *Prevention is the Cure. Proceedings of a workshop on holistic management of human-wildlife conflict in the agricultural sector of South Africa.* Endangered Wildlife Trust, Johannesburg.

Stuart, C. T. (1981). *Notes on the mammalian carnivores of the Cape Province of South Africa.* Bontebok 1: 1-58.

Taylor, J. (2007). Personal communication. john@bestcape.co.za.

Tomlin, C. (1968). (Ed) *The Pesticide Manual.* The British Crop Protection Council and The Royal Society of Chemistry. (10th edition, 1994). The Bath Press, Bath.

i. United States Department of Agriculture, Animal and Plant Health Inspection Service. (1995), Tech Note. Animal Damage Control. *The Livestock Protection Collar*. Aphis. September 1995.

Verdoorn, G. H. (2006). Personal Comment. Environmental toxicology and chemical consultant. Johannesburg.

Welman, C., Kruger, F., & Mitchell, B. (2005). *Research methodology*. Third Edition. Cape Town: Oxford University Press Southern Africa.

Wilke, R. (2007). Personal Comment. Wildlife Damage Management official. Free State Department of Environmental Affairs.

Windberg and Knowlton (1988), as cited by King, L. (2006) in Daly, B., Davies-Mostert, H., Evans, S., Friedmann, Y., King, N., Snow, T., and Stadler, H. (Eds): 2006. *Prevention is the Cure. Proceedings of a workshop on holistic management of human-wildlife conflict in the agricultural sector of South Africa.* Endangered Wildlife Trust, Johannesburg.

Appendices

1. EWT Problem Animal Management Questionnaire.
2. Change assessment questionnaire.

Appendix 1.

Problem Animal Management Questionaire.

This questionnaire is designed to provide answers to the questions asked about the rationale for the use of poisons for Problem Animal Management. Please answer questions as fully as possible. If a question is not applicable to you, please indicate that. Please add any additional comments which you think are of value. The Poison Working Group depends on your inputs as a reliable source of information. We are grateful for the time which you have allocated to participating in this project.

Your details:

Farmer's name – *Boer se naam*

Address - *Adres*

Telephone - *Telefoon*

E Mail – *e pos*

Farm size - *Plaasgrote* **Hectares – *hektaar*.**

Part 1. *Deel 1.* Quantify Losses – *Quantifiseer verliese.*

1.1 How many animals do you farm with? State number of each. / *Met hoeveel diere boer u? Meld asb. die getalle van elke sort.*

Year/ Jaar	Sheep/ Skape	Goats/ Bokke	Cattle/ Beeste	Other/ Ander
2001				
2002				
2003				

1.2 What number of small stock have you lost over the past 3 years? / *Hoeveel kleinvee het u oor die afgelope drie jaar verloor?*

Year	Sheep	Lambs	Goats	Kids	Cows	Calves
2001						
2002						
2003						

1.3 What is the financial value of the loss annually? (Approximate figure in Rands) / *Skat asb die geldwaarde van u jaarlikse verliese*

Year	Sheep	Lambs	Goats	Kids	Cows	Calves
2001						
2002						
2003						

1.4 On what basis do you calculate the value per animal / loss? Tick one. / *Op watter basis skat u die waarde per dier?. Merk net een blokkie.*

Meat / auction value	
Unachieved potential value of lambs/kids/calves	
Own estimated value	

1.5 Do you keep accurate records? / *Hou u akkurate rekords?*

Yes/ Ja	
No/ Nee	

1.6 What number of animals do you expect to lose annually, and to which cause? / *Hoeveel diere verwag u om jaarliks te verloor, en om watter rede?*

	Birth	Climatic	Disease	Theft	Predator	TOTAL
	Geboorte	*Klimaat*	*Siekte*	*Diefstal*	*Roofdier*	
Sheep						
Lambs						
Goats						
Kids						
Cows						
Calves						

1.7 What number of animals did you lose in 2001, and to which cause? / *Hoeveel diere het u gedurende die 2001 seisoen verloor, en aan watter oorsaak?*

	Birth	Climatic	Disease	Theft	Predator	TOTAL
	Geboorte	*Klimaat*	*Siekte*	*Diefstal*	*Roofdier*	
Sheep						
Lambs						
Goats						
Kids						
Cows						
Calves						

1.8 What age class? Please write in numbers in the appropriate block/s./ *Watter ouderdomsklas? Skryf die getalle in die gepaste blokkie.*

	0 – 3 months	3 – 6 months	6 – 12 months	Adult
Sheep				
Goats				
Other				

1.9 At what time/s of year (or lambing season), or age does predation by problem animals occur? Please rank the seasonal loss according to the following scale: / *Watter tyd van die jaar of seisoen is die ergste probleemdier tydperk? Dui 'n waardeskatting aan volgens die skaal hieronder.*

Animals lost	none	1 to 3	4 to 10	More than 10
Ranking/ *Rang*	0	1	2	3

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
When is your lambing season, *U lamseisoen?*												
Loss scale *Verlies skaal*												

Part 2/ *Deel 2:* Problem animal identification – *Identifikasie van die Probleemdier.*

2.1 How do you identify problem animals? (Tick in boxes). / *Hoe identifiseer u die probleemdier? (Merk boksies)*

	Dog	Jackal	Caracal	Other
Guess / Raaiskoot				
Farm worker / Plaaswerker				
Conservation officer / Natuurbewaring				
Problem animal hunter / Probleemdierjagter				
Seen at a carcass / By karkas gesien				
Seen killing stock / Gesien vee doodmaak				
From hair on fence / Van hare op heinings				
From spoor / Van spore				
From feeding patterns / Van vreetpatroon				

2.2 Please describe any other method of identification. / *Beskryf asb enige ander identifikasiemetode.*

2.3 Which predators cause the most losses to you? Give each predator listed a score from 1 (low) to 5 (high).
Watter roofdiere veroorsaak die meeste verliese. Ken punte vir elkeen toe vanaf 1 (laag) na 5 (erg).

Black Backed Jackal/ Rooijakkals	
Sidestriped Jackal / Witkwasjakkals	
Caracal/ Rooikat	
Stray dogs/ Rondloperhonde	
Staff dogs - Arbeider honed	
Bat eared fox/ Bakoorjakkals	
Cape fox/ Draaijakkals	
Aardwolf	
Serval/ Tierboskat	
Genet/ Muskeljaatkat	
Spotted hyena/ Gevlekte hyena	
Brown Hyena/ Strandwolf	
Leopard/ Luiperd	
Cheetah/ Jagluiperd	
Lion/ Leeu	
African wildcat/ Groukat	
Wild dog / Wildehond	
Otter	
Honey badger/ Ratel	
Civet/ Sivetkat	
Baboons/ Bobbejaan	
Mongoose/ Meerkat	
Humans/ Mense	
Other/ Ander	

Part 3, Deel 3. Effectiveness of controls/*Effektiewiteit van Probleemdierbeheermethodes*.

3.1 What problem animal management methods have you used, and which are effective in the long term?
Watter van die volgende probleemdierbeheer metodes het u gebruik, en wattter is in die lang termyn doeltreffend?

	1998	1999	2000	2001	2002	Works-*Werk*	*Werk nie -* , Does not work	Don't know – *Weet nie.*
Poisoned carcasses / Vergiftigte karkas								
Poisoned baits / vergiftigte vleisblokkies								
Schneekluth 1080 baits / lokase								
PDB-1 Poison collars / Gifhalsbande								
Coyote getter/ Foxbuster / Gifskieters								
Seasonal lambing / Seisoenale lamtyd								
Mesh fencing / Sifdraad								
Electric fencing / Elektriese omheinings								
Combination fences / Kombinasieheinings								
Night kraals/ enclosures / Nagkrale								
King collars / King halsbande								
Bell & other collars / klokkie- & ander halsbande								
Hound pack / Honde								
Walk-in cage trap / Vanghokke								
Gin/leg-hold trap / Slagysters								
Neck traps / Nekslagysters								
Shooting / Skiet								
Night lights, radios / Ligte, radios snags								
Shepherds / Skaapherders								
Guard Dogs Waghonge								
Other animals / Ander wagdiere								

Part 4/*Deel 4*: FROM THIS POINT ONWARDS ONLY ANSWER THE QUESTIONS ABOUT THE CONTROL METHODS WHICH YOU USE. *BEANTWOORD VAN HIER AF SLEGS DIE VRAE OOR DIE BEHEERMETHODES WAT U GEBRUIK.*

4.1 Poisoned carcasses/ *Vergiftigde karkasse.*

4.1.1. Have poisoned carcasses been used on your farm or in your immediate district in the past? If so when? / *Is daar van vergiftigde karkasse op u plaas , of in u omgewing, in die verlede gebruik gemaak?*

Yes		If Yes, continue.
No		If No, go to next

1998	1999	2000	2001	2002

4.1.2. What poison was used? (Please state the name). *Watter gifsoort? (Meld asb. die naam)*

TRADE NAME *Handelsnaam*	ACTIVE INGREDIENT *Aktiewe bestandeel*	DOSE PER CARCASE *Dosis per karkas*

4.1.3. Where did you buy or get the poison from? / *Waar het u die gif gekry of gekoop?*

Shop/ *Winkel*	Co-op/ *Kooperasie*	Friend */ Vriend*	Neighbour */ Buurman*	Other / *Elders*

4.1.4. How was the poison dosage measured? *Hoe het u die gif doseering gemeet?*

4.1.5. What species and number of predators were killed? */ Watter spesie roofdiere en hoeveel van elk is dood?*

Poison 1. *Gif 1*

SPECIES/ *Specie*	1998	1999	2000	2001	2002

Poison 2. *Gif 2*

SPECIES / *Spesie*	1998	1999	2000	2001	2002

Please write on the back of the form if more than 2 types of chemical were used. *Skryf asseblief agter op die vorm indien daar meer soorte gif gebruik is.*

4.1.6. Did the predation cease?/ *Het die predasie gestaak?*

Yes/ Ja	
No/ Nee	

4.1.7. What non-target animals or birds were killed, and what number? *Hoeveel "Nie-teiken" diere of voels is gedood ?*

SPECIES/ *Specie*	NUMBER/ *Getal*

4.2 Poisoned baits/pills/meat baits – *Giflokase/pille/vleisblokkies*.

4.2.1 Have poison baits been used on your farm or in your immediate district in the past two years? *Is daar van giflokase op u plaas of in u distrik in die afgelope twee jaar gebruik gemaak?*

Yes		If Yes, continue.
No		If No, go to next.

4.2.2. If home- made, what poison was used? */ Indien "tuisgemaak", watter gif is gebruik ?*

TRADE NAME *Handelsnaam*	ACTIVE INGREDIENT *Aktiewe bestandeel*	DOSE PER CARCASE *Dosis per karkas*

4.2.3. Where was the poison acquired, and how much did you get?/ *Waar het u die gif gekry, en hoeveel het u gekry?*

Shop/ *Winkel*	Co-op/ *Kooperasie*	Friend/ *Vriend*	Neighbour / *Buurman*	Other/ *Elders*

4.2.4. Who recommended the poison and the method? / *Wie het die gif en die methode aanbeveel?*

Name/ *Naam*

Organisation / *Organisasie*

What dosage of poison per bait?/ *Hoeveel gif per lokaas?*

POISON – *GIF*	DOSAGE – *DOSIS*

4.2.5 What size bait block?/ *Hoe groot is die vleisblokkie?*

4.2.6. How many blocks did you make? / *Hoeveel blokkies het u gemaak?*

4.2.7. How many blocks per hectare/ kilometer of road or fence-line?/ *Hoeveel blokkies per hektaar/ kilometer pad of heining?*

4.2.8. Was the poison bait placed at specific target areas. i.e. where losses were occurring?/ *Het u die lokaas by spesifieke teiken gebiede geplaas, m.a.w. waar verliese gebeur het?*

Yes	
No	

4.2.9. How did you select the bait stations? / *Hoe het u die stelplekke gekies?*

Target - problem area / *Teiken - probleemgebied*	
Territory of known predator / *Bekende roofdier territorium*	
Other method / *Ander metode*	

4.2.10. What predators were killed and how many per bait station? / *Watter roofdiere is gedood, en hoeveel per stelplek?*

	NUMBERS	*GETALLE*	
SPECIES – *SPESIE*	Event 1	Event 2	Event 3

4.2.11. Did the predation cease? / *Het u verliese gestaak?*

Ja	
Nee	

4.2.12. What non-target animals and / or birds were killed, and how many? *Watter "nie-teiken" diere of voels is gedood, en hoeveel per stelplek?*

SPECIES – *Spesie*	NUMBER - *Getal*

4.3 Schneekluth 1080 Baits – *Schneekluth 1080 gifpille.*

4.3.1. Have these baits been used on your farm or in your immediate district in the past two years?/ *Is hierdie pille of op u plaas of in u distrik, in die afgelope twee jaar gebruik?*

Yes / *Ja*		If Yes, continue.
No / *Nee*		If No, go to next.

4.3.2. Do they work?/ *Werk die pille?*

Ja	
Nee	

4.3.3. How did you select the bait stations? / *Hoe het u die stelplekke gekies?*

Target - problem area / *Teiken – probleemgebied*	
Territory of known predator / *Bekende roofdier territorium*	
Other method / *Ander metode*	

4.3.4. What predators were killed and how many per bait station? / *Watter roofdiere is gedood, en hoeveel per stelplek?*

	NUMBERS	*GETALLE*	
SPECIES – *SPESIE*	Event 1	Event 2	Event 3

4.3.5. Was the predator killed the targeted problem animal, i.e. did the predation cease after it was killed? / *Was die roofdier wat gedood is wel die probleemdier. D.w.s.. Het predasie op u vee daarna gestaak?*

Ja	
Nee	

4.3.6. What was the target predator? / *Watter roofdier is as teiken uitgeken?*

Jackal - *Jakkals*	
Stray dog - *Rondloperhond*	
Caracal – *Rooikat*	
Other – *Ander*	

4.3.7. What non-target animals and / or birds were killed, and how many? *Watter "nie-teiken" diere of voels is gedood, en hoeveel per stelplek?*

SPECIES – *Spesie*	NUMBER - *Getal*

4.3.8. Do you have any suggestions to improve this method? *Het u enige voorstelle om hierdie metode te kan verbeter?*

4.4 PDB-1 Poison Collars – *Gifhalsbande.* (Toxicollars, LPC collars, McBride Collar)

4.4.1. Have you used these collars? – *Het u hierdie halsbande gebruik?*

Ja		If Yes, continue.
Nee		If No, go to next

4.4.2. What poison/toxicant did they contain?- *Watter gif het hulle bevat?*

Carbofuran - *Karbofuraan*	
Compound 1080 – *Tien-tagtig*	
Don't know – *Weet nie*	

4.4.3. Did you try them - *Het u die metode probeer -*

As a "stand - alone" method – *die halsbande alleenig*	
together with another method – *saam met 'n ander metode*	
With King or other collars – *Met King- of ander halsbande*	

4.4.4. Do they work for you? – *Het die metode vir u gewerk?*

Yes	
No	

4.4.5. If not, why? – *Indien nie, waarom nie?*

Management problems - *Bestuursprobleme*	
Weather – *Weersomstandighede*	
Other – *Ander*	

4.4.6. What was the cost per collar? – *Wat was die prys per halsband?*

4.4.7. Was the user equipped to work with the poison collar, in terms of operator safety and the disposal of damaged collars/ animals killed? *Is die verbruiker toegerus om met gifhalsbande te werk, i.v.m. operateurveiligheid en die verwydering van beskadigde halsbande en vergiftigde diere?*

Yes	
No	

4.4.8. Did you encounter secondary poisoning of scavengers, birds of prey and vultures, and if so, how many? *Was daar enige sekondere vergiftiging van aasdiere, aasvoels of roofvoels?*

SPECIES – Spesie	NUMBER - Getal

4.5. Coyote getter (M44) - *Gifskieters*

4.5.1. Have you used this method? – *Het u hierdie metode probeer?*

Ja		If Yes, continue.
Nee		If No, go to next

4.5.2. Where did you attend training and who presented the course? – *Waar het u die kursus bygewoon, en deur wie is dit aangebied?*

4.5.3. Where did you get your "getters"? – *Waar het u die "getters" gekoop?*

4.5.4. Did you try them as: *Het u die "getters" gebruik as:*

A "stand - alone" method – *Net die getters alleen*	
together with another method – *Saam net 'n ander metode*	

4.5.5. Do they work? – *Werk hulle?*

Yes	
No	

4.5.6. Was the user equipped to work with the poison collar, in terms of operator safety and the disposal of damaged collars/ animals killed? *Is die verbruiker toegerus om met gifhalsbande te werk, i.v.m. operateurveiligheid en die verwydering van beskadigde halsbande en vergiftigde diere?*

Yes	
No	

4.5.7. What was the approximate cost of the training course per person? – *Wat het die opleiding per persoon gekos?*

R

4.5.8. Did you encounter secondary poisoning of scavengers, birds of prey and vultures, and if so, how many? *Was daar enige sekondere vergiftiging van aasdiere, aasvoels of roofvoels?*

SPECIES – *Spesie*	NUMBER - *Getal*

4.6. Flock Management : Seasonal lambing or calving – *Kudde bestuur: Seisoenale lam- of kalktyd.*

4.6.1. Have you tried this as a means of reducing losses? – *Het u seisonale lamtyd probeer om verliese te probeer verminder?*

Ja		If Yes, continue.
Nee		If No, go to next

4.6.2. What is the conception percentage of your flock? – *Wat is die besettingspersentasie van u kudde?*

1998	1999	2000	2001	2002

4.6.3. What is the lambing percentage of your flock? – *Wat is die lampersentasie van u kudde?*

1998	1999	2000	2001	2002

4.6.4. What is the weaning percentage of your flock? – *Wat is die speenpersentasie van u kudde?*

1998	1999	2000	2001	2002

4.6.5. Does seasonal lambing help to reduce loss of stock? – *Speel seisoenale lamtyd 'n rol in die vermindering van veeverliese?*

Ja – Yes	
No – Nee	
Don't know	

4.7 Fencing - pig / mesh wire – *Sifdraad of varkdraad*

4.7.1. Do you use mesh fencing? – *Gebruik u sifdraad of varkdraad?*

Yes		If Yes, continue.
No		If No, go to next

4.7.2. What is the extent of the enclosure? (Approximate hectares, acres or morgen) – *Hoe groot is die kamp (akker, hektaar, morg).*

4.7.3. What was the cost per kilometre? – *Hoeveel het dit per kilometer gekos?*

R

4.7.4. Are problem predators excluded? – *Hou dit die probleemdiere uit?*

Yes	
No	

4.8. Fencing – electric – *Elektriese omheining*

4.8.1. Do you use electric fencing – *Gebruik u elektriese omheinings*?

Yes		If Yes, continue.
No		If No, go to next

4.8.2. What is the extent of the enclosure? (Approximate hectares or square metres) – *Hoe groot is die kamp (akker, hektaar, morg).*

4.8.3. What was the approximate cost per kilometre? *Hoeveel het dit per kilometer gekos?*

R

4.8.4. Are problem predators excluded? – *Hou dit die probleemdiere uit?*

Yes	
No	

4.9. Fencing – combination - *Kombinasie heinings*

4.9.1. Do you use combinations of fencing? – *Gebruik u kombinasieheinings?*

Yes		If Yes, continue.
No		If No, go to next

4.9.2. Please briefly describe the combination: *Beskry asb. die kombinasie*

4.9.3. What is the extent of the enclosure? (Approximate hectares or square metres) – *Hoe groot is die kamp (akker, hektaar, morg).*

4.9.4. What was the approximate cost per kilometre? – *Hoeveel het dit per kilometer gekos?*

R

4.9.5. Are problem predators excluded? – *Hou dit die probleemdiere uit?*

Yes	
No	

4.10. Night enclosure – kraaling - *Nagkrale*

4.10.1. Do you keep your stock in a kraal at night? *Slaap u vee snags in 'n kraal?*

Yes		If Yes, continue.
No		If No, go to next

4.10.2. What is the extent of the enclosure? (Approximate hectares or square metres) – *Hoe groot is die kamp (akker, hektaar, morg).*

4.10.3. What was the approximate cost per kilometre? – *Hoeveel het dit per kilometer gekos?*

R

4.10.4. Are problem predators excluded? – *Hou dit die probleemdiere uit?*

Yes	
No	

4.10.5. What other management problems have you experienced as a result of kraaling? *Watter ander bestuursprobleme het as gevolg van die gebruik van krale ontstaan?*

Compaction by trampling – *Kompaksie vertrapping*	
Erosion – *Verspoeling*	
Increased parasite loads – *Hoer parasite beladings*	
Other disease or problems – *Ander siektes of probleme*	

4.11. King collars – *Halsbande* (King Brothers)

4.11.1. Have you tried these collars? *Het u hierdie halsbande probeer?*

Yes		If Yes, continue.
No		If No, go to next

4.11.2. Did you try them - *Het u die metode probeer -*

As a "stand - alone" method – *die halsbande alleenig*	
together with another method – *saam met 'n ander metode*	
With poison collars – *saam met gifhalsbande*	

4.11.3. Do they work for you? Do they work for you? – *Het die metode vir u gewerk?*

Yes	
No	

4.11.4. If not, why? – *Indien nie, waarom nie?*

Management problems – *Bestuursprobleme*	
Weather – *Weersomstandighede*	
Other – *Ander*	

4.11.5. What problems have you encountered with these collars? *Het u enige ander probleme met die halsbande ondervind?*

4.12. Bell - and other types of collars – *Klokkie- en ander tipes halsbande*

4.12.1. Have you tried these collars? *Het u hierdie halsbande al probeer?*

Yes		If Yes, continue.
No		If No, go to next

4.12.2. Did you try them as: *Het u hulle*

a "stand - alone" method – *alleen gebruik*	
together with another method – *met 'n ander metode gebruik*	

4.12.3. Do they work for you? – *Werk hulle?*

Yes	
No	

4.12.4. If not, why? – *Indien nie, waarom nie?*

Management problems – *Bestuursprobleme*	
Weather – *Weersomstandighede*	
Other – *Ander*	

4.12.5. What problems have you encountered with these collars? *Het u enige ander probleme met die halsbande ondervind?*

4.13. Hound pack - *Jaghonde*

4.13.1. Are you a member of a formal hunt club, or do you have your own hounds? – *Is u lid van 'n jagklub, of besit u u eie trop jaghonde?*

Own dogs – *eie honde*		If any dogs are used, continue.
Hunt club – J*agklub*		If no dogs are used, go to next

4.13.2. How many dogs, and of which breeds? – *Hoeveel honed en watter sort is dit?*

Breed – *Soort*	Number - *Getal*
Bloodhound – *Bloedhond*	
Foxhound – Voshond	
Greyhound – *Windhond*	
Wolfhound – *Wolfhond*	
Irish terrier – *Steekbaard terriers*	
Jack Russell - *Jack Russell*	
Crossbreeds – *Kruisings*	
Other – *Ander*	
Don't know – *brakke*	

4.13.3. How well trained are the dogs? – *Hoe goed is die honde opgelei?*

Young dogs running with experienced – *jong honde saam met geleerdes*	
Only experienced & fully trained – *slegs geleerdes met ondervinding*	

4.13.4. What method of hunting is used? – *Hoe word gejag?*

All dogs start & run together – *Alle honde jag terselfdetyd*	

Dogs put down at different stages – *Honde jag op verskillende stadia*	

4.13.5. What is the response time to a call-out? – *Hoe gou nadat u vee verloor het word daar gejag?*

Immediate response from a fresh kill – *Dadelik op 'n vars spoor*	
The next day – *Die volgende dag*	
When they finish the present hunt – *Na voltooing van huidige jagtog*	
Variable – *Afwisselend*	

4.13.6. How many hunts are conducted per year? - *Hoeveel jagte word per jaar onderneem?*

4.13.7. What non-target animals are killed, and how many are killed per annum? – *Hoeveel "nie-teiken" diere word jaarliks gedood?*

SPECIES – *Spesie*	*Getal*	UNKNOWN

4.13.8. How successful is the method in terms of man-days / dog days, or cost per problem animal killed? – *Hoe suksesvol is hierdie metode, gemeet in man-dae, honde-dae, of in koste per probleemdier gedood?*

Problem species- *Probleemdiersoort*	No. Killed	Cost/kill	Mandays/kill

4.14 Cage / walk - in traps - *Vanghokke*

4.14.1. Do you use cage traps? – *Gebruik u vanghokke?*

Yes		If Yes, continue.
No		If No, go to next

4.14.2. Please indicate the approximate cost of the traps. – *Hoeveel kos die hokke min of meer?*

4.14.3. Who sets the traps? – *Wie stel die hokke?*

Problem Animal Hunter - *Probleemdierjagter*	
Farmer – *Boer self*	

Farm worker – *Plaasarbeider*	
Other – *Ander*	

4.14.4. Has the person attended training? – *Het die persoon opleiding ontvang?*

Yes	
No	

4.14.5. Where are the traps set, and who determines this? – *Waar word die hokke gestel, en wie maak hierdie besluit?*

At random – *Blindeweg*	
Along boundary fence – *Teen grensdrade*	
Around kraal – *Rondom krale*	
At carcass – *Rondom karkasse*	
Selected target site – *Gekose teikengebied*	
Elsewhere – *Elders*	

4.14.6. How often are they checked? – *Hoe gereeld word hokke besoek?*

Daily – *Daagliks*	
Every 2 days- *Elke twee dae*	
Every three days – *Elke drie dae*	
Weekly – *Weekliks*	
Longer timespan – *Langer termyn*	

4.14.7. What non-target animals are killed, and how many are killed per annum? - *Hoeveel "nie-teiken" diere word jaarliks gedood?*

SPECIES – *Diersoort*	No. – *Nr.*

4.14.8. How successful is the method in terms of man-days or cost per problem animal killed? - *Hoe suksesvol is hierdie metode, gemeet in man-dae, of in koste per probleemdier gedood?*

Good, within 24 hours – *Goed, binne 24 uur*	
Fair, 2 to 3 days – *Redelik, 2 tot 3 dae*	
Average, up to 1 week – *Gemiddeld, tot 'n week*	
Poor, more than 1 week – *Swak, langer as 'n week*	

4.15. Gin / leg hold traps, - *Slagysters*

4.15.1. Do you use gin traps? – *Gebruik u slagysters?*

Yes		If Yes, continue.

No		If No, go to next

4.15.2. Please specify the make & type used if possible. – *Meld die maak en tipe indien moontlik.*

4.15.3. Where did you get them from? *Waar het u die slagysters gekry?*

4.15.4. Who sets the traps? – *Wie stel die slagysters?*

Problem Animal Hunter - *Probleemdierjagter*	
Farmer- *Boer*	
Farm worker – *Plaasarbeider*	
Other – *Ander*	

4.15.5. Has the person attended training? – *Is die persoon opgelei daarvoor?*

Yes	
No	

4.15.6. Where are the traps set? - ? – *Waar word die slagysters gestel, en wie maak hierdie besluit?*

At random – *Blindeweg*	
Along boundary fence – *Teen grensdrade*	
Around kraal – *Rondom krale*	
At carcass – *Rondom karkasse*	
Selected target site – *Gekose teikengebied*	
Other – *Elders*	

4.15.6. How often are they checked? – *Hoe gereeld word slagysters besoek?*

Daily – *Daagliks*	
Every 2 days- *Elke twee dae*	
Every three days – *Elke drie dae*	
Weekly – *Weekliks*	
Longer timespan – *Langer termyn*	

4.15.7. What non-target animals are killed, and how many are killed per annum? - *Hoeveel "nie-teiken" diere word jaarliks gedood?*

SPECIES – *Diersoort*	No. – *Nr.*

4.15.8. How successful is the method in terms of man-days or cost per problem animal killed? - *Hoe suksesvol is hierdie metode, gemeet in man-dae, of in koste per probleemdier gedood?*

Good, within 24 hours – *Goed, binne 24 uur*	
Fair, 2 to 3 days – *Redelik, 2 tot 3 dae*	
Average, up to 1 week – *Gemiddeld, tot 'n week*	

Poor, more than 1 week – *Swak, langer as 'n week*	

4.16. Neck traps

4.16.1. Do you use Neck traps? – *Gebruik u nek-slagysters?*

Yes		If Yes, continue.
No		If No, go to next

4.16.2. Please specify the make & type used if possible. – *Meld die maak en tipe indien moontlik.*

4.16.3. Where did you get them from? *Waar het u die nekslagysters gekry?*

4.16.4. Who sets the traps? – *Wie stel die slagysters?*

Problem Animal Hunter - *Probleemdierjagter*	
Farmer- *Boer*	
Farm worker – *Plaasarbeider*	
Other – *Ander*	

4.16.5. Has the person attended training? – *Is die persoon opgelei daarvoor?*

Yes	
No	

4.16.6. Where are the traps set? - ? – *Waar word die slagysters gestel, en wie maak hierdie besluit?*

At random – *Blindeweg*	
Along boundary fence – *Teen grensdrade*	
Around kraal – *Rondom krale*	
At carcass – *Rondom karkasse*	
Selected target site – *Gekose teikengebied*	
Other – *Elders*	

4.16.6. How often are they checked? – *Hoe gereeld word slagysters besoek?*

Daily – *Daagliks*	
Every 2 days- *Elke twee dae*	
Every three days – *Elke drie dae*	
Weekly – *Weekliks*	
Longer timespan – *Langer termyn*	

4.16.7. What non-target animals are killed, and how many are killed per annum? - *Hoeveel "nie-teiken" diere word jaarliks gedood?*

SPECIES – *Diersoort*	No. – *Nr.*

4.16.8. How successful is the method in terms of man-days or cost per problem animal killed? - *Hoe suksesvol is hierdie metode, gemeet in man-dae, of in koste per probleemdier gedood?*

Good, within 24 hours – *Goed, binne 24 uur*	
Fair, 2 to 3 days – *Redelik, 2 tot 3 dae*	
Average, up to 1 week – *Gemiddeld, tot 'n week*	
Poor, more than 1 week – *Swak, langer as 'n week*	

4.17. Shooting - *Skiet*

4.17.1. Do you shoot predators on your farm? – *Skiet u roofdiere op u plaas?*

Yes		If Yes, continue.
No		If No, go to next

4.17.2. Who does the shooting? – *Wie doen die skietwerk?*

Problem Animal Hunter - *probleemdierjagter*	
Sport hunter - *Sportjagter*	
Farmer – *Boer*	
Farm worker / manager – *Plaasbestuur / werker*	
Friends – *Vriende*	

4.17.3. Is it specific to the problem animal, or are any predators shot? – *Word probleemdiere spesifiek geteiken, of word enige roofdiere gejag?*

Problem animal targeted – *Probleemdier geteiken*	
All predators are shot – *Alle roofdiere word geskiet*	

4.17.4. Is the problem animal called up with a sound / calling device? – *Word die probleemdier met 'n klank of roepaparaat geroep?*

Yes	
No	

4.17.5 Does predation cease immediately thereafter? – *Staak die predasie onmiddelik daarna?*

Ja	
Nee	

4.17.6 For how long does it cease? – *Vir hoe lank duur die staking?*

1 week	
8 to 14 days	
15 to 30 days	
1 to 3 months	
3 to 6 months	
Longer	

4.18. Night lights, radios, hooters etc – *Ligte, radios, toeters ens.*

4.18.1. Have you tried these deterrents? – *Het u enige van hierdie afskrikmetodes probeer?*

Yes		If Yes, continue.
No		If No, go to next

4.18.2. Does it work? – *Werk enige daarvan?*

Yes	
No	

4.19. Shepherds - *Herders*

4.19.1. Do you use shepherds? - *Gebruik u herders?*

Yes		If Yes, continue.
No		If No, go to next

4.19.2. Are they – *Is hulle*

Point-to-point herders – *punt na punt herders*	
Full day with the flock, then flock sleeps out in the veld – *Heeldag by die kudde/trop, dan slap die trop in die veld*	
Full day with the flock, then flock is kraaled - *Heeldag by die kudde/trop, dan word die trop gekraal*	
Full-time with the flock (24 hours)? – *Voltyds by die skape*	

4.19.3. Are they cost effective in terms of loss prevention/ reduction? – *Is hulle koste-effektief in terme van verliesvermindering of voorkoming?*

Yes	
No	

4.20. Guard dogs living with stock – *Waghonde wat saam met die vee woon.*

4.20.1. Have you tried guard dogs? – *Het u al waghonde probeer?*

Yes		If Yes, continue.
No		If No, go to next

4.20.2. What breed of dog? – *Watter sort hond?*

Anatolian, or specific breed – *Anatolies, of 'n spesefieke sort.*	
Border collie – *Border kollie hond*	
Staff dogs – *Plaaswerkers se honde*	
Other breed – *Ander soort*	

4.20.3. Where did you get the dog/s? – *Waar het u die hond/e gekry?*

Breeder – *Teler*	
Self bred – *Self geteel*	
Elsewhere – *Elders*	

4.20.4. Is the method successful? – *Is die metode suksesvol?*

Yes	
No	

4.21. Other "guard" animals – *Ander "wag" diere* .

4.21.1. Have you tried guard animals? – *Het u al ander "wag" diere probeer?*

Yes		If Yes, continue.
No		If No, go to 1080 section.

4.21.2. What type? – *Watter sort?*

Ostriches – *Volstruise*	
Zebras - *Sebras*	
Donkeys – *Donkies*	
Other (name the type) – *Ander (noem die sort)*	

4.21.3. How many per hectare/ camp? – *Hoeveel diere per hektaar/ kamp?*

	Number	Per ha	Per camp
Ostriches			
Zebras			
Donkeys			
Other			

4.21.4. Is the method successful? – *Is die metode suksesvol?*

Yes	
No	

END.

Thank you for the time and effort to complete this questionaire.

Appendix 2

Change Assessment Questionnaire.

- A telephonic survey of eight farmers selected from the EWT-PWG survey.
    1. Eustace
    2. King
    3. Lötter
    4. Mitchell-Innes
    5. Pringle
    6. Scott
    7. Stannard
    8. Steenkamp

Apart from this list, repondents are referred to by number, except where reference is made to published material.

- Explain the follow up is for M EnvDev mini-dissertation.

1. Are you willing to participate in this follow-up research? Yes/No. *If No, terminate call with thanks, if Yes, continue.*

2. Do you recall the EWT-PWG questionnaire survey of 2003? Yes/No. *Summary if required i.e., if answer is No.*

3. Anonymity is assured. Do you wish to remain anonymous as per the agreement with the Endangered Wildlife Trust? Yes/No. *Explanation of ethical considerations.*

4. Has your predator conflict management changed since then? Yes/ No.

5. How? *Brief response request.*

6. Are the methods you now apply compatible with predator ecology, i.e. Do you consider the effect of your actions on the environment in the long term? Yes/No. *Brief discussion.*

7. Have you heard of systems thinking, or cause and effect? Yes/No. *Explain if required.*

8. Have you applied these principles to your predator management? Yes/ No

9. Have those effects been positive / negative?

10. Please explain briefly. *Not more than 10 key bullet points. (Keep respondent going by using 5 Why technique)*

    a.

    b.

    c.

    d.

    e.

    f.

    g.

    h.

    i.

    j.

Thank you for your participation.