Livestock Guarding Dogs

Integrating Livestock guarding dogs into a new livestock herd

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Key words: Livestock guarding dogs, *Canis lupus*, wolf management, sheep predation, prevention methods, non-lethal protection, Pyrenean mountain dog.

Preface

After a long period of searching for a bachelor thesis topic, I had the chance to come to Germany to work on Biofencing as a new, non-lethal protection method for sheep from wolf predation. After a period of uncertainty, Steffen Butzeck (LUGV) gave me inspiration for a new and a really interesting topic: Livestock guarding dogs.

This product could not have been made without the help of a lot of people who I would love to thank in this preface. First I want to thank my supervisors; Marius Christiaans from my university of applied sciences Vanhall-Larenstein and Steffen Butzeck from the LUGV with helping and supervising my thesis. Without their good comments it was not possible to deliver this thesis. I want to thank the shepherds; Kucznik, Neumann, Birkhold-Weise, Kaltschmidt, Henning and the shepherd from Bavaria for all their help and hospitality. Louise Liebenberg who uses livestock guarding dogs to protect her sheep against predators in Canada. Misses Menzel and their fallow deer for their enthusiastic response. Family Wehner, mister Müller, Jörg Hübner and Annett Hansemann with their alpacas. Mister Laundry for support from Switzerland. Mister May from LVAT and shepherds Uwe and Lutz for giving the opportunity to conduct an experiment in ''Groß Kreutz''. I am grateful to mister Körner for helping and supporting by this experiment and trusting me to use the wonderful dogs Maya and Jerry. From the LELF, doctor Jurkschat, for helping organizing the experiment. Andreas Piela who gave me the opportunity to come to Brandenburg at all. From the Netherlands I want to thank shepherd Willo Schellekens for his knowledge about sheep in the Netherlands. I want to thank for Bart Beekers, Elliot Taylor and Wim Tegels for giving extra comments to make my thesis better understandable.
Beside this I want to thank all the people from Wildpark Schorfheide for all the nice evenings I had there. I want to thank HNEE Eberswalde and their students and especially Sinay, for her support and thought exchange and helping with German. Uwe Peña for his good and interesting discussions about wolves.
Beside this I want to thank friends and family for their support from distance. But above all those important people, I want to thank especially my girlfriend Iris for all the support she gave me with everything.

Olaf van der Geest

Abstract

Unprotected livestock is defenceless against wolves in Brandenburg. Livestock guarding dogs seems to be an effective measure against sheep predation by wolves. Some shepherds have experiences how to raise and train a livestock guarding pup, but has a lack of knowledge of how to integrate an adult and trained guard dog. A protocol is desired by the ''Herdenschutzhunde A.G'' and the ''Landesamt für Umwelt, Gesundheit und Verbraucherschutz'', which contains guidelines about how to integrate an mature guard dog into a livestock herd which has no experiences with guard dogs. Different methods are used and combined to be able to design this protocol. A literature review about livestock guarding dogs, especially focussed outside Germany, helped gain some insight about integrating an adult guard dog into a sheep herd. As largest part of the data collection, interviews were kept in order to gather ideas and methods from livestock guarding dogs owners. Those semi-structured interviews were kept with eight shepherds, three alpaca owners and one owner of kept fallow deer. As last an experiment in cooperation with the ''Lehr-und Versuchanstalt für Tierzucht und Tierhaltung e.V.'' has been conducted to gain practical information about how to integrate two adult guarding dogs into a sheep herd. Besides this research about guarding dogs in Brandenburg, the possible use of guarding dog is analyzed in the Netherlands by holding one interview with a Dutch shepherd combined with analyzing the Dutch farming system.

Shepherds indicated that they had no experiences with integrating an adult guard dog and they recommended to use a similar strategy for integrating an adult dog as they had used for guard dog pups. There is a similar recommended approach of shepherds as for alpaca and fallow deer owners about how they would integrate a guard dog. Out of reports from Switzerland, some methods could have been gathered about integrating an adult dog. Most often a leash is used to guide the dog through the herd and let the sheep accustomed to the dog. In some reports, the dog were located in a separated fenced in place, so there was only smell and sight contact with the sheep. In most cases it takes up to 5 days before the sheep accepted the presence of the guard dogs inside the herd.

With a combination of those methods, a protocol is designed as result. In this protocol, it is important to consider what kind of guard dog, kind of sheep and kind of environment is present during the process, due to influence of those factors on the result of the integration process. Next, some actions which should be taken are explained. The most used material in the beginning of the process is a strong leash.

Purchasing two adult guard dogs (from 2000 Euro for two animals) and the price for a LGD expert for the supervision of the project (from 750 Euro), are the major costs of an integration process.

Two main issues were recommended by shepherds. Financial support for food expenses and as second, public awareness for the use of livestock guarding dogs.

Shepherds keep sheep on a similar way in the Netherlands as in Brandenburg. However, the Netherlands is more populated then most regions in Brandenburg.

On base of the results, it can be concluded that guarding dogs are an effective protection method for sheep against wolves. A good integration of guard dogs in a sheep herd, which have no experiences with guard dogs is possible, when there is a good understanding about sheep and guard dogs from shepherds. With the comeback of the wolf, it is necessary to think about prevention methods to protect sheep against predation by wolves. However, the use of guard dog will give challenges, but can be an effective method in the Netherlands.

Zusammenfassung

Ungeschütztes Vieh ist wehrlos gegen Wölfe in Brandenburg. Herdenschutzhunde scheinen eine effektive Methode zu sein, Schafe gegen Wolfprädation zu schützen. Einige Schäfer haben Erfahrungen mit der Erziehung und dem Training von Herdenschutzhundewelpen. Allerdings mangelt es an Erfahrungen, einen erwachsenen und schon trainierten Herdenschutzhund in eine Viehherde zu integrieren. Ein Protokoll, wie man einen erwachsenen HSH in eine Viehherde integriert, die zuvor keine Erfahrungen mit Herdenschutzhunden hatte ist von der „Herdenschutzhunde A.G“ und dem „Landesamt für Umwelt, Gesundheit und Verbraucherschutz“ gewünscht.

Um dieses Protokoll zu erstellen, wurden verschiedene Methoden angewendet und kombiniert. Eine Literaturstudie über Herdenschutzhunde, v.a. außerhalb Deutschlands, hat Einblicke, wie man einen erwachsenen Hund in eine Schafherde integriert, gegeben. Ein bedeutender Anteil der Datensammlung sind Interviews, die mit Besitzern von Herdenschutzhunden geführt wurden, um Ideen und Methoden zu sammeln. Um praktische Informationen zu gewinnen, wurde zusammen mit der „Lehr-und Versuchsanstalt für Tierzucht und Tierhaltung e.V.“ der Versuch durchgeführt, zwei Herdenschutzhunde in eine Schafherde zu integrieren, die bisher keine Erfahrung mit diesen hatte. Neben der Recherche von Herdenschutzhunden in Brandenburg, wurde ebenso der mögliche Einsatz von Herdenschutzhunden in den Niederlanden untersucht. Hierzu wurden niederländische landwirtschaftliche Strukturen untersucht und ein Interview mit einem niederländischen Schäfer geführt.

Da die interviewten Schäfer noch keine Erfahrung mit der Integration von erwachsenen Herdenschutzhunden hatten, schlagen sie die Verwendung einer ähnlichen Strategie, wie bei der Integration von Hundewelpen vor. Auch die Besitzer von Alpakas und Damwild empfehlen diese Vorgehensweise. Verschiedene Methoden, einen erwachsenen Herdenschutzhund zu intergieren, werden auch in Schweizer Berichten genannt. Meist wird anfangs der Herdenschutzhund mit einer Leine durch die Schafherde geführt, so dass die Schafe sich an den Hund gewöhnen. In einigen Berichten wird auch vorgeschlagen, die Hunde innerhalb eines Zaunes in der Schafherde zu halten, so dass nur Sichtkontakt und Geruchsaustausch mit den Schafen besteht. In den meisten Fällen dauert es bis zu 5 Tage, bis die Schafe die Herdenschutzhunde in der Herde akzeptieren.

Mit einer Kombination aus diesen Methoden wurde ein Protokoll erstellt. Einige Faktoren, wie die Rasse der Herdenschutzhunde, die Art der Schafe und welche Umgebung vorhanden ist, beeinflussen die Integration. Zunächst werden einige Handlungen erklärt, die für die Integration nötig sind. Der Kostenschwerpunkt liegt beim Kauf der Herdenschutzhunde (ab 2000€ für 2 Hunde) und bei den Kosten für einen Herdenschutzhunde- Experten (ab 750€ komplett). Das benötigte Material für die Integration ist eine starke Leine.

Finanzielle Unterstützung für Futter der Herdenschutzhunde und Öffentlichkeitsarbeit für den Einsatz von Herdenschutzhunden sind zwei meist genannte Wünsche von die interviewten Schäfer. Die Schafhaltung in Brandenburg und in den Niederlanden ist sehr ähnlich. Dennoch ist die Bevölkerungsdichte in den Niederlanden höher als in den meisten Regionen Brandenburgs.

Das Ergebnis dieser Arbeit ist, dass Herdenschutzhunde eine effektive Schutzmethode gegen Wolfprädation ist. Eine Integration von Herdenschutzhunden in eine Schafherde ohne Herdenschutzhundeerfahrung ist möglich, wenn die Schäfer Hintergrundwissen über Schafe und Herdenschutzhunde haben.

Mit der Rückkehr des Wolfes ist es wichtig, über Präventivmethoden nachzudenken, um Schafe vor Wölfen zu schützen. Der Einsatz von Herdenschutzhunden in den Niederlanden ist eine Herausforderung, kann aber eine effektive Methode sein.

Samenvatting

Onbeschermd vee is een aantrekkelijk doelwit voor wolven in Brandenburg, Duitsland. Er zijn resultaten waaruit blijkt dat waakhonden doeltreffend vee kunnen beschermen. Sommige schaapsherders hebben ervaring met het trainen van een waakhond pup, maar het ontbreekt hen aan kennis om een volwassen waakhond te laten integreren. De ''Herdernschutzhunde A.G'' en ''Landesamt für Umwelt, Gesundheit und Verbraucherschutz'' hebben behoefte aan een handleiding waarin beschreven wordt hoe volwassen waakhonden die géén ervaring hebben met schaapskudden kunnen worden geintegrereerd in de kudde.

Verschillende methoden zijn gebruikt om een handleiding als resultaat op te stellen. Gebruik makende van een literatuuronderzoek, voornamelijk literatuur buiten Duitsland, heeft inzicht gegeven over methodes die gebruikt kunnen worden om volwassen waakhonden te laten integreren. Het grootse gedeelte van de dataverzameling, bestond uit interviews met eigenaren van waakhonden. Deze ''semi-gestructueerde'' interviews waren bij, acht schaapherders, drie alpaca producenten en één eigenaar van gehouden damherten, gehouden. Als afsluiting van de dataverzameling, een experiment in samenwerking met de ''Lehr-und Versuchanstalt für Tierzucht und Tierhaltung E.V.''is uitgevoerd om praktisch informatie te verzamelen over hoe twee volwasse waakhonden te laten integreren in een schaapskudde.

Naast bovengenoemd onderzoek, is een verkennend onderzoek uitgevoerd naar de mogelijkheden om waakhonden in te zetten om schaapskudden in Nederland te beschermen tegen de mogelijk terugkomst van de wolf. Hiervoor is de schapenhouderij in Nederland geanalyseerd in combinatie met een interview met een ervaren schaapherder.

Met de combinatie van deze methodes is een handleiding opgesteld als resultaat. In deze handleiding worden eerst een paar afwegingen besproken, die moeten worden gemaakt voordat aan het integratie proces kan worden begonnen. Belangrijke stappen worden besproken in het tweede gedeelte. Als laatste word een kostenplaatje opgesteld die een indicatie geeft over de geschatte kosten. Ideeën en aanbevelingen over hoe waakhonden zouden moeten worden geïmplementeerd in het wolven managementplan van Brandenburg zijn tijdens de interviews ook verzameld. Daaruit kwam naar voren dat de kosten voor het voeden van waakhonden vergoed zouden moeten worden. Daarnaast bleek dat bekendheid over de inzet van waakhonden onder de mensen zou moeten worden gebracht.

Schapenhouderij wordt in Nederland op een vergelijkbare manier uitgeoefend als in Brandenburg. Daarentegen, is Nederland dichter bevolkt dan in tegenstelling tot Brandenburg. Gevolg hiervan is dat waakhonden vaker in aanraking komen met mensen.

Op basis van de resultaten, kan er geconcludeerd worden dat waakhonden een effectieve methode is om schapen te beschermen tegen predatie door wolven. Om een integratie van waakhonden in een schaapkudde met geen ervaring met waakhonden, goed te laten verlopen is goede kennis over waakhonden en schapen vereist. Daarnaast zijn het soort hond en schaap en de omgeving belangrijke variabelen om rekening mee te houden. Met de mogelijke terugkeer van wolven naar Nederland, moet er nagedacht worden over de bescherming van de Nederlandse schaapskuddes. Hierin zouden waakhonden een mogelijke oplossing kunnen bieden, waarbij er moet worden gerealiseerd dat dit ook eventueel gepaard kan gaan met problemen.

List of figures, tables and abbreviations

Abbreviations:
LGD: Livestock guarding dog
HSH: Herdenschutzhund
A.G: Arbeitsgruppe
MUGV: Ministerium für Umwelt, Gesundheit und Verbraucherschutz
LUGV: Landesamt für Umwelt, Gesundheit und Verbraucherschutz
LELF: Landesamt für Ländliche Entwicklung, Landwirtschaft und Flurneuordnung
LVAT: Lehr-und Versuchanstalt für Tierzucht und Tierhaltung e.V.
SRVA: Service romand de vulgarisation agricole
GzSdW: Gesellschaft zum Schutz der Wölfe

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1. Introduction

On behalf of University of Applied sciences VanHall-Larenstein, forest and nature conservation, this report will be written to show the bachelor qualities which are required to graduate. A bachelor thesis will be the end result of studying for 4 years.

In the beginning of the 1990's there was a conference to make a start for a wolf management plan. The purpose was to prepare the inhabitants of Brandenburg for the returning wolves. Wolves are dispersing from populations in Poland and in 2000, the first pack of reproductive wolves was in Sachsen and spread out to Brandenburg (S.Butzeck, LUGV, pers. comm. 16-7-2013). A wolf (*Canis lupus*) pack has shown up again in Brandenburg, Germany since 2009 (Ministerium für Umwelt, Gesundheit und Verbraucherschutz (MUGV), 2010).

The comeback of a big predator to a cultivated country like Germany will bring damage as well with it. Especially the absence of the wolf for some generation makes the problem even more complicated. Shepherds, but also other livestock producers have forgotten how to protect their livestock against large predators. The MUGV (2012) is saying that prevention is better than compensation. 363 animals kept by human are killed by wolves since 2007 (MUGV, 2012). Most of the killed animals were not, till not sufficient protected by prevention methods like electric fences or other measurements. Often sheep are victim of predation by wolves followed by fallow deer (Freistaat Sachsen, 2013; MUGV,2012). Besides that, prevention is not only better for financial aspects, for example in cases of valuable livestock like: rare livestock species, breeding animals or a lot of individuals. Prevention of damage increase the acceptance of the wolf in general. In addition, owners who keep livestock as hobby have most often an emotional connection with their animals (MUGV, 2012). Wolves learn fast, so it is important to protect livestock sufficient before a wolf got its first kill (Reinhardt & Kluth, 2007). Also it is of great importance to install sufficient prevention methods after a wolf attacked livestock, so there will be no habitation. However, it is unrealistic to protect all livestock from wolf predation by sufficient protection methods, but livestock producers located in ''wolf areas'' must be stimulated to take prevention methods. A financial compensation system for damage done by wolves is set up, to compensate livestock producers who have losses. Those damages is payed by the LELF, whereby LUGV helps to fill in the application form (S. Butzeck, LUGV, pers. comm. 16-7-2013). Also some financial support is available for livestock producers for the use wolf predation prevention methods (Reinhardt & Kluth, 2007).

A good method is the use of guarding dogs to protect sheep against attacks of wolves and other predators (Kluth & Reinhardt, 2011). Those big dogs grew up with the herd and stay year round with ''their'' herd and protect it against all that threaten the herd.
In East and South Europe as well as in Asia and Africa sheep herders still use livestock guarding dogs to help them protecting their sheep (Gesellschaft zum Schutz der Wölfe (GzSdW), date unknown). In those areas sheep are taken up into the mountains in companion of guarding dogs, whereby a shepherd is not always present the whole week. The sheep are brought together into an enclosure or inside a barn in the evening (Landry, 1999).
Professional sheep (not hobby) producers in Brandenburg, keep sheep in fenced areas and are moved to different meadows every several days. In addition, sheep are also kept to maintain bigger size heath fields, where they stay for a longer time (S. Butzeck, LUGV, pers. comm. 23-4-2013; J. Körner ,shepherd, pers. comm. 14-7-2013). Some shepherds use guarding dogs, but it is not a

common protection methods yet (Kluth & Reinhardt, 2011, Schafzuchtverband 2013, Kontaktbüro Wolfsregion Lausitz, 2013). The dog breeds Maremma-Abruzzese and Pyrenean Mountain dog are most used for guarding sheep in a present farming system like pastures and landscape areas in Northeast Germany. They stay year round with the sheep and guard them. It takes around two years before a guarding dog puppy is efficient in guarding sheep against predators (Coppinger,1992; GzSdW, date unknown). This takes time, experience and costs which not all shepherds are able to spend. Hence, not all shepherd prefer to work with guard dogs as prevention method (S. Butzeck, LUGV, pers. comm. 23-4-2013).
There are not a lot of experiences how to integrate a trained guarding dog into a sheep herd, but there are some results which shows that it is possible (S. Butzeck, LUGV, pers. comm. 23-4-2013; Freitag, 2008). For shepherds it is important to know what they can expect before they start useing guarding dogs. For example the amount of time, money, and experience when they integrate an adult guarding dog into their herd (K.Kucznik, shepherd, pers.comm. 23-4-2013). While often only knowledge and experiences is available of how to raise and train a puppy to protect livestock. In addition, scientific knowledge and experiences are lacking about livestock guarding dogs by the management of guarding dogs as protection method in Brandenburg. It is desirable to have an overview about the available knowledge of the use of guarding dogs and a strategy how to manage the integration of adult livestock guarding gods into a new sheep herd.
This thesis tries to develop in cooperation with the ''AG Herdenschutzhunde '','' Lehr-und Versuchsanstalt für Tierzucht und Tierhaltung e.V'' and the ''Landesamt für Umwelt Gesundheit und Verbraucherschutz'' a strategy which gives more practical advices to approach this problem.

After a wolf sighting on 15km of the Dutch border, a dead wolf is found in the Netherlands on 4 July, 2013 (wolveninnederland, 2013).The Netherlands should start to think how to manage this large predator. Effective and fast utilizable prevention methods like livestock guarding dogs could be one of the solutions. In addition, to make this thesis applicable in the discussion about wolf management in the Netherlands, the knowledge gained in Germany will be applied to the Dutch situation. Those challenges leads to the following research question:

Research question:
''What is needed to integrate an adult and trained livestock guarding dog into a livestock herd wich have no experience with guard dog as an effective prevention method to reduce livestock predation by wolves in Brandenburg?''

Sub questions:

- How does guarding dogs deter sheep predation by predators?
- How do other parts of the world use guarding dogs (France, Switzerland, North America)?
- Are livestock guarding dogs effective in every farming situation?

How much costs a livestock guarding dog annual per year?
How to train young dogs into a efficient guarding dogs?
How to integrate a young guarding dog into a new sheep herd?
Is there a difference between the use of guarding dogs for different livestock?
What kind of management is needed for guarding dogs as prevention method?
Are livestock guarding dogs useful as a protection method in the Netherlands?
Are those sub questions sufficient to answer the head question?

Limiting conditions are time, money and availability of shepherds with guarding dogs. The timeframe of graduation expands five months. Within this period, fieldwork , analyzing of results, conclusions and a report must be made. There is no funding available for this project and everything is on voluntary base. An example, high cost for travelling can cause that some shepherds cannot been visited. Shepherds must be willing to support this research by giving their knowledge about guarding dogs. The desired protocol must be easy accessible for shepherds, so they can start using a protection method for their sheep.

In chapter 2, the different methods are explained. Chapter 3 contains general background information about wolves, livestock, livestock interaction with wolves and livestock guarding dogs in general. Chapter 4 is dedicated for livestock guarding dogs and information which was gathered out of literature and interviews. Information about integrating a guard dog is shown in chapter 5. Chapter 6 contains a protocol which can be directly used by shepherds for integrating adult guard dogs into a sheep herd. Sheep management and potential use of guarding dogs in the Netherlands is discussed in chapter 7. Chapter 8 contains conclusions and recommendations, whereby the last chapter discussion ends this thesis.

2. Methods

In this chapter the method will be presented which was used to answer the questions which are show in the introduction. In figure 1 a schedule is drawn about the connection between the different methods used in this research.

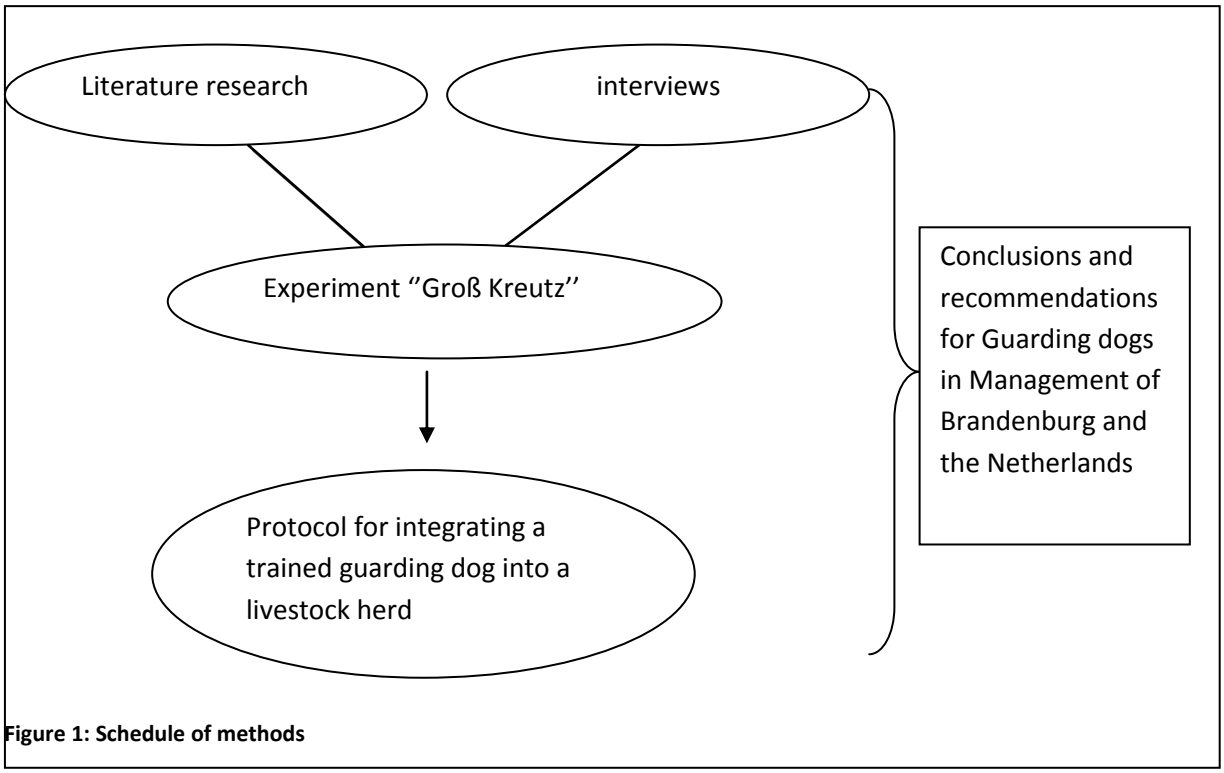

Figure 1: Schedule of methods

A literature review is conducted from references from different parts of the world. Most often the literature came from Switzerland and the United States of America. As well all kind of written information is used to gather information about livestock guarding dogs in general and specific about integrating an mature guarding dog. To get basic knowledge about sheep and their behaviour, books about sheep and sheepherding are used.

The second step was to obtain information by visiting and sending of semi-structured questionnaires by phone and e-mail to owners of active used guarding dogs. Those owners of active working guarding dogs were recruited by available contact information of the '' AG Herdenschutzhunde ''. Within this working cooperation, livestock producers had connection to more owners of guard dogs, whereby a larger number of people could be reached. Within those different kind of interviews, experiences and ideas about how to integrate an adult trained guarding dog is gathered.
In addition, general and practical knowledge is obtained during those discussions. As step aside, recommendations about how guarding dogs should be fitted in into a wolf management plan is gained. An example of a questionnaire can be found in appendix 1. Important to notice is that this questionnaire is used as a standardized form. During the visits, which took place outside in the field, most often it happened that there is deviated from the standardized form.

In total five shepherds have been visited in Germany and one questionnaire was conducted by phone. Three owners of alpacas have been interviewed, whereby one by mail. Furthermore one owner of fallow deer and guarding dogs has been ask by mail about integrating guarding dogs into a fenced in fallow deer herd in the end.

All those different ideas and experiences of how to integrate an adult guarding dog are gathered and divided in three different groups. The first group contains information about ideas and experiences of integrating guard dogs into a sheep herd in Germany. The second group shows experiences and ideas from outside of Germany. At last, ideas and experiences considered about fenced game and alpacas were gathered in the 3th group.

With this experiences and ideas as background, an experiment in cooperation with the LVAT and Mister Körner was carried out to gather practical information about integrating two adult guarding dogs into a sheep herd, which is not familiar with guarding dogs. For more detailed information see chapter 5.2.2.

To be able to make statements about livestock guarding dogs in the Netherlands, an understanding must be developed about how sheep herding is organized in the Netherlands. For this one shepherd has been visited to gain knowledge about sheep herding management. A semi-structured interview (see appendix 2) was used to get information applicable for the use of guarding dogs. Hence, literature have been used to get an understanding of the Dutch farming situation.

3. Background information

To understand the idea behind livestock guarding dogs, some background knowledge is necessary. In this chapter general background knowledge is presented which is related to wolves, livestock, livestock interaction with wolves and guarding dogs.

3.1 Wolves

3.1.1 Status of the wolf in Brandenburg

Wolf management has to be attentive on law regulations. The following national and international law regulations are important (MUGV,2012):

- Washington species (Appendix II) and Berner convention (Appendix II)
- EG ordinance 338/97 (Appendix A) and the FFH directive 92/43/EGW (Appendix II, prioritised species, and Appendix IV, Art. 12 and 16)
- Federal nature protection law (notably protected species by § 7 (2) Nr. 13
- Animal protection law
- Brandenburg Nature protection law

This means that the wolf is totally protected in Germany and is not allowed to be killed, disturbed or expelled. Hence, the breeding and rest places of wolves are not allowed to be disturbed or destroyed.

Rarely, exceptions in individual situations are possible in the following cases.

- major damage in agriculture, forestry, fishery, water management or other big economic harm
- protection of local flora and fauna
- for purposes of research, teaching, education or resettlement of these purposes of breeding of artificial propagation
- in interest of public health, public security, including national security of the civilian population, or the significant beneficial effects on the environment
- other imperative reasons of overriding public interest including such a social or economic nature

Those exceptions are only possible when there are no other reasonable alternatives available. By allowing exceptions, the conservation status of the wolf must not decrease.

3.1.2 Background information of wolves in Germany

This chapter is a summary of ''Leben mit Wölfen'' from Reinhardt & Kluth, 2007.
The wolf is the biggest member of the family of canids (*Canidea*). This canid can grow till 80kg, but in average the wolves of the German/Polish wolf population are around 40kg and have shoulder height of 75cm. The rule can be adapted that males are bigger than females. Often wolves do not get older than 13 years in the free living space. A wolf pack consist of parent animals and offspring of the last year. Territory area of a German wolf pack expand 250-350 km². Wolves are adapted on hunting at wild living ungulates. Translated to the situation in Brandenburg this means roe deer (*Capriolus capriolus*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), sometimes fallow deer (*Cervus dama*)

and mufflon (*Ovis ammon musimon*). However only 0,6% of the diet of wolves exist out of livestock (see figure 2).

Wolves hunt on the prey which can be killed the easiest, which are old or young. Lonely wolves can cover great distances like 80km in a day.

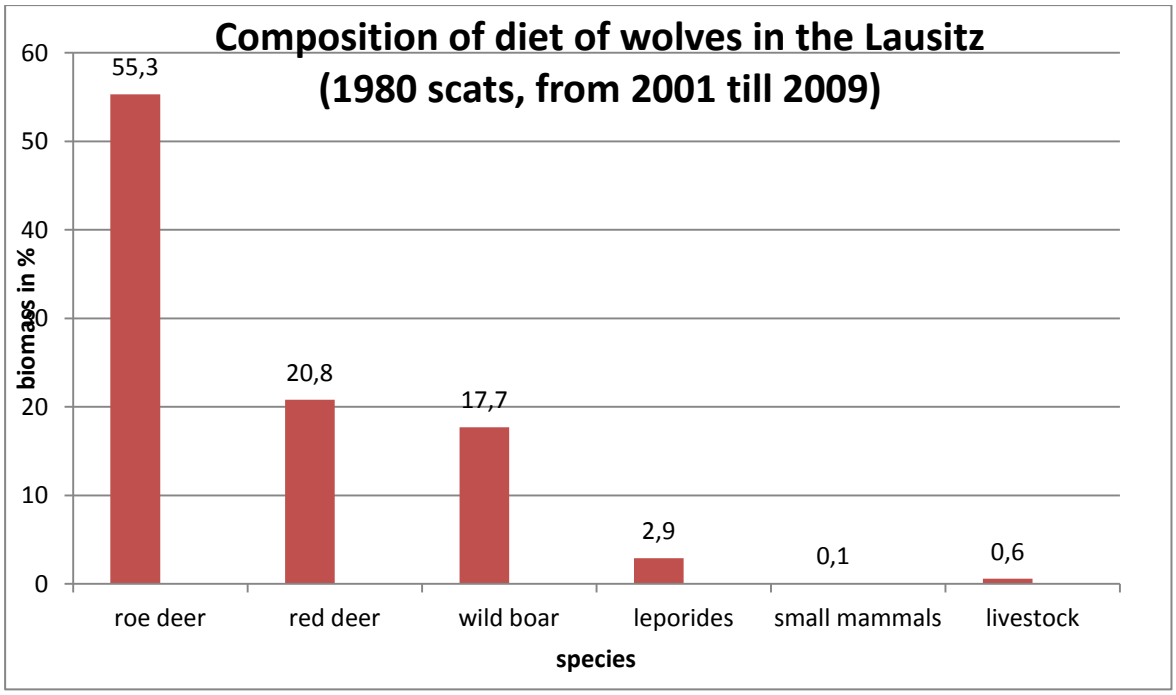

Figure 2: Composition of diet of wolves in the Lausitz. Source: C.Wagner, M.Holzapfel, G.Kluth, I.Reinhard und H.Ansorge, Wolf (Canis lupus) feeding habits during the first eight years of its occurrence in Germany.- Mammalian Biology (2012)

Dispersion of wolves in Germany

The wolf population was once spread out over the entire Northern hemisphere. By direct and indirect human influence wolves were exterminate in many parts of its natural spreading. Because of protection by German and international law the wolf was able to make a comeback in Eastern Europe and spreading its area to Germany (MUGV,2011). In Brandenburg , officially nine wolf packs are at the moment (see figure 1). These packs are part of the mid Europe flatland population (Wolfsregion-Lausitz, 2013).

Figure 3: Dispersion of wolves in Germany and Poland. Source: Kontaktbüro Lausitz

Numbers and developing of wolves in Germany

Since the wolves arrived in the Southeast part of Brandenburg, the population only expanded. As far as known wolves reproduced at least 54 wolf puppies from 2009-2012.Twelve individuals were killed by several causes (shot, car collision) in Brandenburg (MUGV,2012).

3.2 Livestock in Brandenburg

Brandenburg is covered by 35 % of forest, however even 49% (131.960 ha) of the total area of Brandenburg is used for agriculture activities (Umweltbundesamt, 2013) There are three main groups of livestock which are kept outside on pastures: cattle, horses and sheep together with goat. Besides those domestic animals game (fallow and red deer, wild boar) are kept within fences. In the following part, some basic figures will be introduced about livestock in Brandenburg. All numbers are provided by LELF, Tierzuchtreport Berichtsjahr 2012, except for fallow deer or when separately noted.

Sheep and goat

The numbers of house sheep (*Ovis orientalis aries)* decreased with 34 % since 2003 (797.000 individuals). Whereby the number of sheep is growing again since 2011 ,because of a collapse within the number of sheep in 2011. The total amount of goats (*Capra hircus)* grew since 2003 72% (8762 individuals). The amount of different sheep breeds are increasing and are used by professional sheep producers in Brandenburg. Common sheep breeds are ''Merino'', ''Schwarzkopf'', ''Bentheimer Landschaf'' and ''Skudden''. Most breeders of goats choose for ''Thuringer wald'' goat. Farmers with a small amount of sheep are decreasing.

Grazing of sheep and goats is often used as a tool for landscape maintenance. The nature areas grazed by sheep and goats in Brandenburg was 1470 ha in 2012. 1297 ha of dikes were grazed by sheep and goats in 2012. Sheep have the highest potential to be killed by wolves, especially when not sufficient protected. For more information see chapter 3.3.

Fences game and alpaca

There is not a lot of information about fallow deer and alpaca in Brandenburg. Within fenced game, fallow deer take the largest part, they increased from 1970 individuals to 6250 individuals from 1994 till 2012 (Jurkschat, 2012). There are 56 individuals killed by wolf since 2007 till 1-6-2013 (LUGV, 2013).

Cattle

In general in Brandenburg the number of cattle farms and amount of cattle are lightly decreasing. Cows for producing milk are most important. Cattle with the age from 12 to 24months take the second largest proportion in the amount of cattle. 551.3 thousand individuals of cattle are present in Brandenburg. In total there are 39.600 individuals of cattle younger than one year in Brandenburg, which would be the favourite prey of wolves when calves go out of fences.

Reinhardt & Kluth (2006)concluded that most often cattle is stationed outside on. Cows have often a strongly herd instinct and protect their calves active against predators. Cows and calves are not often predated by wolves because of ability body size and defences instinct. In total five calves were predated since the comeback of wolves to Brandenburg (LUGV, 2013).

Horses

An estimation indicate that there around 30.000 horses in Brandenburg. A big part is generating an alternative income. As well it is important for the attractiveness of the rural areas for education, tourism. There are no cases known that wolves predated on horses (LUGV, 2013)

3.3 Interaction between livestock and wolf

3.3.1 Conflict potentials in Brandenburg

The comeback of the wolf to Germany causes different kind of conflict potentials. For the following text, the wolf management plan of Brandenburg is used as reference (MUGV, 2012).

Hunting

The main prey of wolves are free living ungulates. Some hunters see the wolf therefore as a direct concurrent. The wolf can have impact on the behaviour of their prey. It is not proven yet that the occurrence of wolves decrease the game population in Brandenburg. However, wild living mouflon (*Ovis orientalis*) in Brandenburg have no natural defend mechanism towards wolves and cannot sustain in a system with wolf. With the changing of the behaviour and possible decreasing of the mouflon population, the farm for hunting can decrease as well.

Problem wolfs/ habituation, hybrids

Attacks by healthy wolves to human only occur when habituation is involved. ''Problem wolves'' are acting on a problematic way because of experiences. It is not recorded in genetics. Situations like easy accessible recycle bare rubbish, animal carcasses and sheep bounded to a metal pin can create experiences, which stimulate the development of ''problem wolves''. In contradiction of bears, wolves are developing less faster into a ''problem wolf''. Hybridization of wolves and dogs can cause a problem when this hybrid is not raised in a wolf pack. This situation can result in a hybrid which have a highly aggression potential if it is in human hands.

Livestock predation

Unprotected livestock is an ''easy ''meal for predators like wolves. In Brandenburg till 1-6-2013, there were 93 cases of damages caused by wolves or where a wolf attack could not be excluded. In those 93 cases, 316 sheep, 4 goats, 5 calves and 56 fallow deer were killed by wolves or had to be killed because of their injuries. The state of Brandenburg paid 63.632 Euro as compensation for those damages caused by wolves. In addition, especially hobby keepers have an emotional connection with their animals, which makes the loss of their livestock extra painful. There is a weak correlation between the size of the wolf population and the amount of damage which is done by wolves. The correlation is stronger between the different kind and amount of taken prevention methods and the damage rate done by wolves. However using prevention methods like the use of wolf-lasting fence, accommodation in barn during night or the use of guarding dogs makes keeping livestock more expensive, but there are subsidies available for financial support (MUGV, 2012).

3.3.2 Prevention methods for livestock predation in Brandenburg

The main aim of predator control is to minimize the damage caused by large carnivores like wolves (NRDC, 2013). Predator control can be divided into: lethal and non-lethal methods (Landry, 1999). As read in Chapter 2.1.1, wolves are totally protected by law in Brandenburg. Because of the total protection, lethal methods for predator control are not possible (yet) to limit predation by wolves on livestock. Non lethal protection methods cannot guarantee 100% safety of the livestock.
Below, some prevention methods which are recommended by the MUGV (2012) are explained.

Fences

The method which is most often used against wolves, are fences. Wolves jump rarely over fences in contradiction with dogs. There are different kind of fences with can vary.

For eclectic fences it is really important to connect the fence properly to the ground. The strains must be tighten and provide with sufficient electricity (minimum 2500 V). The fences must be at least 90cm high. In other parts of Europe 110cm high fences are recommend. The visibility of the fence by wolves and game can be improved by adding plastic stripes.

Woven wire fences, which are not connected with electricity, can be either cover dig into the ground for at least 40 cm. Another method is that wires cover around 1m ground on the outside of the fence and must be fixed to the ground.

Another solution could be one extra strand with electricity 20cm above the ground. When wolves already learnt to jump over fences, a barrier tape can be added 30cm above the fences. Those strings don't have electricity, but function as an optic barrier.

Fladry

Fladry can be a short time solution (see Fig. 2). Wolves don't trust the flaps, because they move with the wind. Because wolves can get accustom fast on this prevention method, it can be only used for some days.

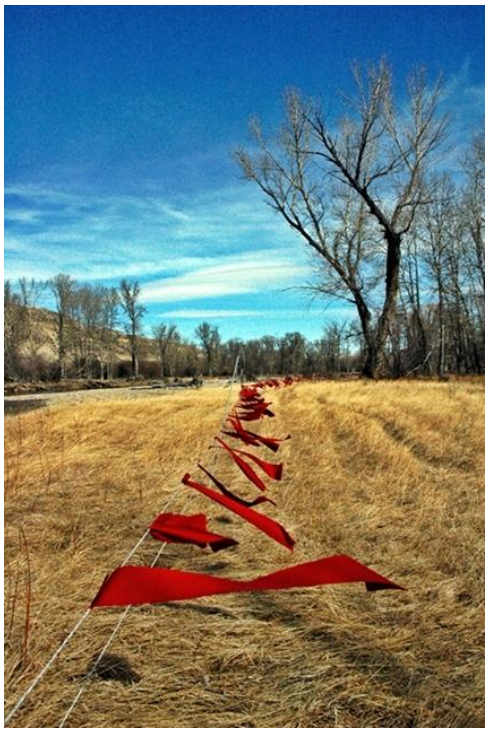

Figure 4: Fladry. source: http://sciencetrio.wordpress.com

Guard animals

There are different kind of animals to protect livestock. Besides guarding dogs, donkeys and llamas can be used for defence of livestock. Those animals stay as well year round with the herd and guard the sheep herd.They are easy to integrate and don't need extra effort, except food (Blanché & Jaeger, date unknown).

3.4 Background information about guarding dogs

3.4.1 History of livestock guarding dogs

Livestock guarding dogs (LGD) find most likely their origin in the hills of what is nowadays called Turkey, Iraq and Syria 6000 years ago. The developing of guard dog was likely to be continued as well from this region (De la Cruz, 1995).This is not remarkable, because the first domesticated sheep came from this region 1000 years earlier. The first dogs were brown, grey and black coloured, due to the similar coloured sheep which they protected. The reason for similar colours for sheep and their guard dog, was the idea of less disturbance for the sheep. The first guard dogs were probably brought by nomadic shepherds to Europe in the 6th century (De la Cruz, 1995).

During the Roman empire, white wool was favoured. In this time, consequently breeding of white sheep also meant a change of the colour of the fur of the guard dogs. This resulted in the presence of guarding dog breed like ''Great Pyrenees''. The British started to classify different breeds of guard dogs in the begin of the 19th century (De la Cruz, 1995). Since then, the International Canine Federation registered at least 47 different breeds of guarding dogs. Not all breeds which are described by breed organisations are recognized by the International Canine Federation (Rigg, 2001).

With the decrease and extinction of wolves in many countries, the guard dog also disappeared from many regions as well (Landry, 1999). In regions where wolves were still present, shepherds continued with using LGD's to protect their sheep against carnivores (Landry, 1999).
In Eastern Europe the number of LGD declined during World War I and II. In those regions tradition and knowledge about how to use LGD's got lost. It occurred that dogs were used wrong and not accepted as prevention method by shepherds and public. This trend caused high mortality numbers among guarding dogs. After the 1950's special rescue plans were developed to maintain some LGD breeds in those regions (Rigg, 2002).

3.4.2 Use of livestock guarding dogs

Livestock guarding dogs are large size dogs which can be effective in protecting livestock against attacks of large carnivores (Ostavel et al. 2009; Urbigkit & Urbigkit, 2010; VerCauteren et al. 2012; Andelt & Hopper, 2000; Andelt, 1999; Coppinger et al. 1983; Coppinger et al. 1988). From origin, livestock guarding dogs are used traditionally in remote regions where sheep were grazing in the mountains during summer. In winter sheep return to meadows or barns in the valley (Landry, 1999). With the comeback of large carnivores, especially the wolf to less remote areas, LGD are also used in modern farming systems in lowlands (MUGV, 2011).
Livestock guarding dogs stay year round with the livestock herd. It can defend the herd against predators like: wolves (*Canis lupus*), brown bears (*Ursus Arctos*), lynx (*Lynx lynx*), stray dogs (*Canis Familiarus*), eagles (*Accipitridae*) , raven (*Corvus corax*)(Agridea, 2006; Lorenz, 1989),wolverines (*Gulo gulo*)(Hansen & Bakken, 1999) and in North America also against species like coyote (*Canis latrans*)(Green et al. 1984;Andelt & Hopper, 2000;Hulet et al., 1987), bobcat (*Lynx rufus)* and mountain lions (*Felis concolor*) (Smith et al. 2000; Andelt, 2004).Guard dogs are also used in Africa to protect the herds there against the big amount of different kind of predators (Marker et al. 2005).

Different kind of breeds can be used for protecting livestock (Rigg, 2001; Blanché & Jaeger, date unknown). They origin from different countries.

- Maremma-Abruzzese from Italy
- Great Pyrenees from France
- Spanish Mastiff from Spain
- Komondor from Hungary
- Anatolian Mastiff from Turkey
- Central Asian Shepherd from Russia.
- Karakatchan from Bulgaria.
- Yugoslavian Shepherd Dog from former Yugoslavia
- Tornjak from Coratia .
- Tatra Mountain Dog from Poland
- Cão da serra da Estrela from Portugal

3.4.3 Working principles of protection of dogs

Effective guarding dogs must show three basic behaviours: attentive, trustworthy and protective (Lorenz & Coppinger, 1996).

Attentive

A guard dog has the ability to get attached to other animals (Landry, 1999).Therefore, a guard dog stays permanent with ''its'' herd. Attentive dogs stay with the sheep herd and so causing less problems in the surroundings in comparing with roaming (not attentive) dogs (Lorenz et al. 1986).

Trustworthily

The dog can be left alone with the livestock herd because of the absence of predatory behaviour. In addition, the dog have the ability to show an investigative and submissive behaviour towards livestock with which it is raised (Landry, 1999). A trustworthily guard dog should never interrupt the daily activities of the livestock which it is protecting. It must not injure it at all (Coppinger et al. 1983).

Protective

Guard dogs are selected because of the skill to react on things which are not routine. The protective behaviour, which a guard dog shows is called approach and withdrawal, because it shows contradicting behaviour. It approaches a predator with barking whereby the tail is raised as a sign of dominance and aggression. Meanwhile it has the ears laid back, which indicate submissive behaviour (Coppinger et al. 1983).

Everything which is out of routine, will be defended by the guard dog by barking and impressing behaviour. Only when it is necessary, a guard dog reacts with aggressive behaviour. Because of the presence of the LGD, predators like wolves cannot perform their normal hunting activities and leave those protected herds alone (GsZdW, date unknown).

Reaching maturity

There is not an exact age when guard dogs reach maturity and are ready to be able to protect a sheep herd effective. Green and Woodruff (1999) set up the following criteria to estimate if a guard dog is matured and can be assumed as an sufficient guard animal:

- Male dogs (and sometimes females) use raised-leg urinations rather than squat urinations to scent- mark
- Scent marking (urination and defecation) becomes more deliberate and marks are concentrated near the periphery of a pasture
- Barking at novel stimuli becomes more predictable and direction oriented
- Dogs are active more frequently and for longer periods
- Dogs become more interested in the sheep than in the handler
- Deliberate patrolling activities increase in frequency and duration

Dog-Sheep daily routine

The guard dog continues stay with the herd, where it needs to achieve a task (J. Körner, shepherd, pers. comm. 23-4-2013; GzSdW, date unknown).

The dogs can investigate the pasture either can sleep while the sheep are feeding (Green & Woodruff, 1999). When a guard dogs is walking through the herd, sheep should not move away from the dog. The dog should be able to lie in the middle of the herd (K. Kucznik, shepherd, pers. comm. 1-05-2013). The dog will learn when disturbances from predators are likely to occur (evening and early morning hours) and will be actively patrolling or is on alert at a selected location. A dog will often rest with the sheep, but is normally quickly attentive by any disturbance. It can appear that sheep learn to return to the dog when they are threatened by predators (Green & Woodruff, 1999).

4. Livestock guarding dogs

In this chapter, useful information will be shown about livestock guarding dogs. This is a mixture of literature studies, interviews and own experiences. The subchapters will contain information about working principles, effectiveness, costs and an introduction of different breeds. Additional there is some information about the current situation of livestock guarding dogs in Brandenburg.

4.1 Effectiveness against large carnivores

Guarding dogs as a protection method never can guarantee 100% safety for the livestock (Landry, 1999). Moreover, effectiveness of guarding dogs can be considered as a relative term, where it is hard to measure exactly how many sheep would have been killed with or without dogs. In addition, livestock guarding dogs can be still effective when there is a sheep killed by wolves, as where a wolf may have had killed more sheep with the absence of a guard dog (Smith et al. 2000).
Coppinger et al. (1988) summarized that when using a LGD, the loss of livestock can decrease between 11-93% in the USA. Notably, predation can reduce with the use of guard dogs in different kind of management system (see table 1). Attention-grabbing is, that guarding dogs are effective towards coyotes, bears, mountain lions and bobcats, but may be less effective towards wolves in North America (LGD get killed by wolves) (Andelt, 2004; Bangs et al. 2005). There is one case known that wolves killed guard dogs in Europe (Mertens & Schneider, 2005).

Management System	No Predation		Reduced Predation		Increase or No Change	
	No	%	No	%	No	%
Ranches	12	**16**	46	**61**	17	**23**
Farm/Ranches	18	**11**	113	**72**	26	**17**
Farms	190	**22**	559	**63**	132	**15**
TOTAL	220	**20**	718	**64**	175	**16**

Table 1: Reduction rates of LGD in different management systems (Coppinger et al. 1988).

In Eurasia and Africa, similar results are accomplished. In Africa, it seems to be that 70% of the farmers have no losses anymore after placement of a LGD (Marker et al. 2005). Whereas in Europe, guard dogs seem to be effective as well.
Observations from Poland showed that after using LGD's, predation can be abruptly stopped (Nowak, 2004). In Slovakia LGD's don't deter predation, but lower the number of sheep, which got killed by wolves (Rigg, 2004). Rigg (2004) noted that in Slovakia, the management also plays an important role in the inefficiency of guarding dogs.
In Northeast Germany, guard dogs are efficient in protecting sheep towards wolves (M. Kaltschmidt, shepherd, pers. comm. 7-5-2013; J. Körner, shepherd, pers. comm. 23-4-2013; F. Neumann, shepherd, pers. comm. 24-4-2013). Though, those shepherds accented that they and their dogs had to learn how to be efficient in deterring sheep predation by wolves. Experiences show that electric fences in combination with guarding dogs is a highly efficient protection method in Germany (Kluth & Reinhardt, 2011). Experiences from interviewed shepherds indicate also similar results (F. Neumann, shepherd, pers. comm. 24-4-2013;M. Kaltschmidt, shepherd, pers. comm. 7-5-2013).
In Poland same indications are observed as in Germany (Smietana, 2005; Nowak, 2005).
In Southern Europe, comparable research has been done on the effectiveness of LGD and wolves (Ribeiro, 2004). The presence of guard dogs in Portugal decreased the predation of livestock by the

endangered Ibarian wolf (Canis lupus signatus) in 60% of the cases with 10-40%. While Ribeiro & Petrucci-Fonseca (2005) measured a decrease in 75% of the cases.
The use of livestock guarding dogs in Scandinavia is relatively new (Otstavel et al. 2009; Hansen &Bakken, 1999), while livestock and predators have a coexistence since 1978's (Wabakken et al. 2001). In Finland the introduction of LGD as an protection method seems to be promising (Otstavel et al. 2009). In Norway the use of guard dogs indicates lower predation rates by bears, but it seems not to be sufficient for the traditional way of keeping sheep (Hansen & Smith, 1999).

In North America, livestock producers rated no particular guard dog breed or sex better in comparing with other breeds (Green & Woodruff, 1988). In contradiction, Andelt (1999) found that producers who used multiple breeds, rated Akbash more effective then Great Pyrenees and Komonder.
As written before, attentiveness is one of the three important characters to be an effective guarding dog (Lorenz et al. 1986; Landry, 1999). Coppinger et al. (1983) found out that there are differences in how producers rate attentiveness of different breeds. Maremma-Abruzzese were rated as the most attentive breed and Anatolian were rated less attentive.
Using more dogs per sheep, with a minimum of two dogs, increases the effectiveness of the dogs (J. Körner, shepherd, pers. comm. 23-4-2013; Urbigkit &Urbigkit, 2010; Andelt & Hopper, 2000; Andelt, 1999). When a wolf pack attacks a sheep herd, at least two dogs are necessary to be able to counter attacks from different sides (J. Körner, shepherd, pers. comm. 23-4-2013).

The effectiveness of guard dogs can decline for several reasons:

Guard Dog
Green et al. (1994) indicate that a guard dog is not necessarily less effective over time, but that is reasonable to presume that there is decrease of effectiveness for dogs which are getting older. Important factors which can decline the years when a dog is effective are: rough weather, distance of travelling a day and frequently encountering predators. There are also indications that guard dogs change their behaviour and are so less successful (Andelt & Hopper, 2000).

Predators
Producers in America indicate that predators learned to outsmart the dog. Also an increase of number of predators can cause an increase of sheep predation, whereby a guard dog is present (Andelt & Hoper, 2000).

4.2 Livestock guarding dogs in farm management

Time for training a guard dog during the first two years, cover most of the time spent specific for a guard dog (see chapter 5.1).
Dogs need around 800gram for food a day. Sheep are prohibit by law to consume dog food (Uwe, shepherd, pers. comm. 28-5-2013). There must be looked after that sheep are not able to eat dog food. When sheep are curious, a shepherd must stay to make sure that the guard dog eats its food, without that sheep consume it (J.korner, shepherd, pers. comm. 24-5-2013).
To insure the health of the guard dog, deworming treatments must take place several times a year. In addition, vaccination against pathogens is important and must been done once a year (Blancé & Jaeger, date unknown).

4.3 Costs of guarding dogs

The price of purchasing a guard dog depends on breed, age and pedigree (Agridea, 2006; Green et al. 1984; Landry, 1999). In Switzerland prices for pups varies from 400-1000 Swiss franc (± 320-800 Euro), where dogs from 1,5- 2 year costs between 1200-1600 Swiss franc (± 970-1295 Euro) (Agridea, 2006). In America, buyers of guard dogs spend in average around 450 dollar (± 340 Euro) to purchase a pup (Green et al. 1984). Information out of interviews with shepherds in Germany, prices of guard dog puppies balance around 1000-1200 Euro with maximum of 1500 Euro. Depending if the adult guard dog is castrated or used for breeding, a guard dog costs between 3000 and 5000 Euro. From an age of seven till eight, the price of a guard dog can decrease (J. Körner, shepherd, pers. comm. 23-7-2013).

In Europe calculations of annual cost per year are in average around 800 Euro (Landry, 1999; Agridea, 2006). Those calculations cover expenses for food and veterinary costs. However, in America guarding dog owners pay around 250 dollar for annual maintenance (Andelt, 1995).
In America they examined as extra the time expenses a guard dog takes for a livestock producer. Those expenses cost about 350 dollar a year and covers time which is need to work with the dog (Andelt, 1995; Green et al. 1984).

Shepherds in Germany estimated that annual maintenance (food and veterinary costs) of guard dogs takes in between 300 and 1000 Euro a year per dog (J. Körner, shepherd, pers. comm. 24-5-2013;D. Müller, alpaca producer, pers. comm. 22-5-2013; Fam. Wehner, Alpaca producer, pers. comm. 17-5-2013). This huge difference between costs for annual maintenance is due to high variations in health care. All owners of guarding dogs indicated that a guard dog eats around 800 gram a day, whereby in the first year a pup needs more expensive and nutritious food to develop a good bone structure (Henning, shepherd, pers. comm. 23-5-2013).

The costs can lower substantially when a guard dog lives longer so it can protect and safe sheep for a longer period (Lorenz et al. 1986).

4.4 Benefits and disadvantages of guarding dogs.

In this subchapter some benefits and disadvantages are summarized in table 2 and discussed.

Benefits	**Disadvantages**
Effective method to lower sheep predation by predators	Subjective to illness
Keep other animals out of fence, which can destroy fence or cause other problems	High mortally during first year
Less stress for shepherd, when knowing herd is protected	Roaming a lot, problems with neighbours
When close to property, also defends home	Can hurt sheep, when young
Dogs can get more effective by time	Can harasses other wildlife
Sheep are more calm, so can gain more weight	Knowledge of guard dogs is necessary
Protect against robbery of fence, energy clock and sheep	Requires an financial investment

Table 2: Benefits and disadvantages of the use of guarding dogs

Smith et al. (1989) reviewed the benefits and potential problems of the use of guarding dogs in America. According to Webber et al. (date unknown) sheep move more, but more slowly when a guarding dog is present. In addition, sheep are more stressed when predators are around, which can cause loss of weight. This does not occur when guarding dogs are within the pasture.

Fences are less destroyed by wildlife when guard dogs are present. Next, wild boar are not able to come in the fenced area to feed on the pasture, which cause a lot of damage as well (Uwe, shepherd, pers. comm. 26-5-2013).

Lorenz et al. (1986) examined that almost half of the guard dog puppies died before they reached an age of 38 months. Half of the deaths were caused by accidents and one third by culling pups for inappropriate behaviour.

4.5 Livestock guarding dogs in Brandenburg

In Brandenburg the use of livestock guarding dogs as a sheep protection method against wolves is relatively new. Fifty dogs of the breed Pyrenean mountain dog and Maremma-Abruzzese were in use end of 2008 (MUGV, 2010). Meanwhile, around twice as much livestock guarding dogs are protecting sheep herds in Brandenburg (K. Kucznik, shepherd, pers. comm. 19-5-2013). Guard dogs are not only used for protecting sheep in Brandenburg. Equally, different kind of livestock (fenced game, alpacas) receives protection by dogs. As said before, Pyrenean Mountain dog and Maremma-Abruzzese are most used in Brandenburg. Other breeds which are used are: Turkish Akbash, Croatian Tornjak, Caucasian Shepherd Dog and Sarplaninac from Yugoslavia.

The ''AG Herdenschutzhunde '' (founded in October 2012) is an organisation which gather users of livestock guarding dogs to share information among (potential) members. Moreover they work together to get costs for dog food and veterinarian financed by the ministry of Brandenburg. Beside this, the ''AG Herdenschutzhunde'' wants to coordinate the proper breed of guarding dogs. They want to set up requirements to determine the quality of dog breed and training (Peuker, 2012). The ''AG Herdenschutzhunde'' is involved in the wolf management plan of Brandenburg. According to the wolf management plan (2012) the ''AG herdenschutzhunde'' should make minimum standards for wolf secure livestock keeping.

Figure 5 : 'Herdenschutzhunde A.G'' after meeting 23 march 2013. Source: Frank Hahnel

Blanché and Jaeger (date unknown) set up an concept for the use of guarding dogs in Brandenburg. This concept covered themes like next to general information about guard dogs also breeding, expertise centre and a mobile protection team with guard dogs.

4.5 Provisional conclusion about livestock guarding dogs

Guard dogs seem to be an effective method in Europe and America to protect sheep against predators (chapter 4.1). It can reduce predation by wolves down to 0%. In addition, guard dogs can have extra benefits like solving problems with wildlife (chapter 4.3). The purchase of guarding dog and the annual costs varies in price. Health care can raise the costs explosive. Guarding dogs require financial investments for over many years, but can earn money back when protecting a sheep herd for several years (chapter 4.2). In Brandenburg the use of guarding dogs is developing. Shepherds who use guarding dogs are organized into an ‘‘Arbeitsgruppe’’ , which means a more professional approach start to grow (chapter 4.4). In East Germany, the most used guard dog is the Pyrenean mountain dog. This dog is adapted on the East German situation, where interaction between guard dog and public is important.

5. Integration of Livestock guarding dogs into livestock herds

This chapter will go into theoretical and practical information about integrating guard dogs. In the first subchapter, the process for integrating of a pup into a livestock herd is shown. In chapter 5.2, tables are presented of the gathered integration methods followed by a diary and important conclusion of the experiment ''Groß Kreutz''.

5.1 Integration of a pup into livestock herd

Guarding dog are no pets, which stay with people. The training and integration takes place within the sheep herd (Lorenz, 1989). The exact time frame for socialisation phases varies among breeds and individuals (VerCauteren et al. 2012). It would be most optimal when pups are born among ewes (Landry, 1999). When a dog is not born among ewes, an ideal time for placing a puppy is eight weeks after birth. Due to social attachments, it gets more difficult after the dogs age of 16 weeks. Socialisation to sheep must be done precisely. The knowledge about the development of a puppy must be understood (Laundry, 1999). From about four to five months, it is important that the dogs stays full time with the sheep to establish and improve the bonding with sheep (GzSdW, date unknown). It must neither play with human or other dogs, except with an older guarding dog.

Bonding guarding dogs to cattle is similar as with bonding to sheep. To socialize pups to cattle, the researchers housed recently weaned pups individually at an age of 6-10 weeks in a 2x4m pen within in a 8x8m pen with two calves. They continued to introduce LGD pups with the calves at an age of seven months into larger pastures with more livestock (VerCauteren et al. 2012; Gehring et al. 2011). Gehring et al. (2011) familiarized the pups and calves to the pastures and cows by locating them in pens of 5x5m within the pasture. Besides this, the pups were walked daily on a leash around the inside of the pastures. This was continued for 10-14 days before both calves and pups were released into the pastures.
However, it is also possible to introduce pups, which are raised within a flock of sheep, into herd of calves and cattle at the age of 3-6 months (VerCauteren et al. 2012).

Beside sheep and cattle, it is possible to bound and integrate pups to other animal species like: goats, horses, pigs, llamas, ostriches or other bird species (GzSdW, date unknown).

5.2 Integration of an adult into a livestock herd

When adult guard dogs are well raised, they are bonded with sheep (see chapter 3.4.3 for guidelines to estimate if a dog reached maturity). For integrating a guard dog into a sheep herd, the challenge is to get the sheep bonded to dog. Sheep are prey animals and see everything as a predator, even humans are seen as possible threats in first instance (Simmones & Ekarius, 2001).

In this chapter as first the results specific about the integration of adult guarding dogs out of literature research and interviews will be shown. The results are divided in three groups; experiences from Germany, experiences from abroad and experiences with different kind of livestock. As second, an experiment ''Groß Kreutz'' is explained with a diary.

5.2.1 Gathered methods from interview and literature study for integrating LGD in Germany

Information about how to integrate an adult LGD is gathered in two different ways in Germany. A report shows the process of an integration of three adult LGD's on a sheep farm in the North of Brandenburg in 2009 (Freitag, 2009). Table 3 shows an overview of seven shepherds who have been interviewed and ask about their experiences and thoughts about integrating a trained LGD into a new sheep herd. Four out of seven shepherds are members of the ''AG Herdenschutzhunde''(see chapter 4.3) and come from Brandenburg. Within this organisation the members have contact with each other and information is shared among members. Remaining shepherds came from Bayern, Sachsen and Thüringen. All shepherds have experiences with integrating guard dogs puppies into a sheep herd. Special references are Frank Neumann and Uta Freitag, because of their experiences with integrating adult guard dogs into an sheep herd with no experiences with guard dogs. Frank Neumann is head of the ''Schnelle Eingreiftruppe'' in Sachsen, which is a fast mobile herd protection group. He and his guard dogs protect attacked sheep herds with guarding dogs and help integrating new dogs (F. Neumann, shepherd, pers. comm. 24-4-2013). In the first column the name and date of when the interview took place is shown. The second column shows the method the shepherds would use for integrating an adult guard dog, where in column three the required material is written down. In the last column the experiences is summarized the different shepherds have with guard dogs.

Name and date	Proposed method	Required material	Experiences with integrating LGD
J. Körner, 23-4-2013	LGD's on the leash, anticipate on the reaction of the herd; depending on reaction, different steps can be taken	leash	Started with LGD's in 2006; owner of 16 dogs; all raised as puppies within a sheep herd; farm in wolves area
K. Kucznik, 1-5-2013	LGD's in strong small fence of 10x10m with some extra sheep (yearlings) in middle of pasture; other sheep are watching; extend with more sheep for some days, then release all.	strong LGD proof fence of wood or metal, electric lint within	Started in 2004; Owner of 8 LGD's; Chairman of ''AG HSH''
B. Brikhold-Weise, 2-5-2013	no exact idea; only light is important	N/A	Owner of some LGD's; farm in wolves area
M. Kaltschmidt, 7-5-2013	LGD's first together with lambs in a separated fence; add yearlings; add 20 sheep per day	special fenced area for LGD's and sheep	Started in 2005; owner of 8 LGD's; farm in wolves area

Shepherd from Bavaria*, 7-7-2013	LGD's in a barn with 20 sheep- mixture of yearling, adult and goats; 1 week later integrate in herd	extra fence in barn for LGD's and sheep	Started in 2011; owner of 2 LGD's (breed: Mastin Espanol)
A. Henning, 23-5-2013	LGD's together with yearling in barn with light on; after some time integrate in herd	extra place in barn for sheep and LGD's	started in 2010; owner of 5 LGD's
F. Neumann, 24-4-2013	1st day: LGD on leash, walking through herd; LGD tied to solid object close to water; 2nd day: off the leash; 3rd day: 2nd LGD free; in the night back on a chain at solid object	chain, leash, solid object in surrounding of water	Responsible for the ''Schnelle Eingreifftruppe''; this team protect attacked sheep herds with dogs and help integrating new LGD
U. Freitag, 3-2009	1st day: LGD's on a chain; 2nd day: LGD's free in the herd; 3rd night: LGD's free in the herd	leash, solid object to connect dog to it	Member of ''Herdenschutzzentrum'' in Switzerland

Table 3: Proposed methods from experienced shepherds with guard dogs in Germany

***Shepherd Bavaria want to stay anonymous**

Because of experiences with integrating guard dog puppies of most shepherds instead of adult guard dogs, they could most often only give rough indications. They based their rough indications of how to should integrate an adult guard dog, on their experiences with integrating puppies.
Most shepherds recommended to use a similar strategy as which they used for young guarding dogs. Four shepherds would integrate the LGD inside a barn in a special fence (Henning, Kaltschmidt, Kucznik, shepherd from Bavaria). Those separated fences differ between the proposed methods of shepherds. Misses Kaltschmidt, shepherd from Bavaria and Mister Henning recommended to just put the dog in the available wooden fences in the barn. Mister Kucznik suggested to make those separate fences extra secure, so that the dog cannot get out. According to mister Kucznik this should been done by adding electric wires.
In addition, this should occur with special selected sheep. For this, often yearling or a mixture of different ages classes is recommended, because they are more curious and therefore less afraid.
One shepherd (Birkhold-Weise) indicated to have no experiences with an integration of a guard dog and could not give any proposed methods, but assumed that light is key opponent in the success of to get sheep accustomed to a guard dog, due to visibility. Mister Henning also suggest to leave the light on during the night in the barn, to let the sheep accustom to the guard dog.
Two shepherds which are experienced, use a leash to guide the guard dogs through the herd and pasture (Freitag and Neumann). As second step, they bind the dogs to a solid object so the sheep can get used of the guard dog. Mister Neumann recommends to bind the guard dog close to the water, so the sheep have to drink. This continues for three days till all dogs are integrated. For more exact information see Appendix 3.

5.2.2 Gathered methods from interview and literature study for integrating LGD outside Germany

Switzerland

The farming system in Brandenburg (Germany) is differing from Switzerland. Because of the mountains, the sheep are grazing in mountain pastures without restriction of fences during the summer months (Landry, 1999). For collecting methods outside Germany, literature and reports were used and gathered in table 4. Not all reports distinguish sheep breeds. In Switzerland common and typical sheep breeds are: ''Walliser Schwarznasenschaf'', ''Weisses Alpenschaf'', ''Charolais'', ''Braunköpfiges Fleischschaf'' and ''Schwarzbraunes Bergschaf'' (Landwirtschaft.ch, 2013; St. Gallischer Schafzuchtverbandes, 2013).

Switzerland developed a mobile herd protection team, which include trained guard dogs, electric fences and 3 experts on this topic (Hildbrand, 2013). All references from integration came from ''Herdenschutzzetrum'' in Jeizinen with their mobile protection team and so have experiences with integrating adult guard dogs into a sheep herd. After their integration process, a report is written with details about the integration (Hildbrand, 2013). In almost any case it is sure that a Maremma-Abruzzese is used as guard dog. Besides this protection team, Agridea (2006) published a manual about livestock guarding dogs in Switzerland, which contains as well a chapter about how to integrate guard dogs.

Canada

Since the 1970's interest has shown up for a new non lethal-predation method named livestock guarding dogs in North America, (Green and Woodruff, 1988; Coppinger & Coppinger, 2001; Green, Woodruff & Andelt, 1994; Musaini & Paquet, 2004). North America has no historically tradition of livestock ,wolves and the use of guard dog as prevention method like Eurasia does (Coppinger & Coppinger, 2001). However, Misses Liebenberg gathered lot of experiences in using LGD as a predator friendly prevention method since 2008 in Alberta, Canada (Grazerie, 2013). She breed guard dogs, but has as well experiences with integrating adult guard dogs into a sheep herd.

Name and date	Method	Material	Time	Experience
Liebenberg, 2013	pen the LGD's in the new sheep flock; with shepherd, dog can be let off the leash; slowly build the time up that the sheep and dogs are together 24/7	pen, leash	2-3 weeks	pioneer of LGD's in Canada
Rudolf, 2003	1st day: walking with LGD's on leash through herd; in the night, dog in separate fence within the herd; 3rd night: LGD's without fence, but on leash	extra fence, leash	5 days	member of mobile herd protection team
Hildbrand, 2002	1st day: LGD only within sheep in extra fence which surrounded the sheep area; LGD's on the leash when sheep are feeding; LGD's free when sheep are resting	leash, extra fence	4 days	member of mobile herd protection team

Kley, 2003	LGD's walk on leash through herd; 1st night: dog in 16m² extra fence 2nd night: LGD's are free	leash, extra fence	3 days	member of mobile herd protection team
Lüthi, 2004	1st day: LGD's on the edge of fence on a leash; 1st night: LGD's free 2nd day: LGD's are walking through herd on the leash; bind LGD's close to resting place	leash	3 days	member of mobile herd protection team
SRVA, 2005	1st day: LGD's on a leash, next day already free	leash	3 days and 4 nights	member of mobile herd protection team
Lüthi, 2006	no specific information	extra fence	4-5 days	member of mobile herd protection team
Agridea, 2005	LGD's on leash; walking through herd for 3-4 days; LGD's got fasten to a solid object within sheep herd in the night; first one dog free, then all	leash, solid object to tighten to	3-5 days	Experiences from Switzerland
Lüthi, 2006	LGD's with group of 30 sheep in one fence; later all sheep together with LGD's	extra fence	1 week	member of mobile herd protection team

Table 4: Proposed methods from experienced shepherds from abroad

Almost in all cases experts make use of a leash during their integration method (Liebenberg, 2013; Rudolf, 2003; Hildbrand, 2002; Kley, 2003; Lüthi, 2004; SRVA, 2005). In two cases it is unsure if leashes were used or not (Lüthi, 2006 ;Lüthi,2006). Three times, an extra separated fence was build to separate guard dogs from the sheep. The reason behind was that only sight and smell contact was possible (Rudolf, 2003; Hildbrand, 2002; Kley, 2003). In all other situations the guard dogs were directly together in the same fence as the sheep (Lüthi, 2006). The size of the sheep herd was variable from 47 sheep till up to more than 1000 sheep. Time before LGD was free in the herd variables between different shepherds from two till several days. Because almost all (except interview Liebenberg, Canada) integration processes are conducted by the mobile herd protection centre, experience is no point of discussion. The suggested method of Liebenberg contains a pen to bind the LGD in the middle of the herd. This approach is quite similar as using an extra fence.

Integration of LGD with different kind of livestock then sheep

In this subchapter the results of how owners of fallow deer and alpaca would integrate an adult guarding dog into this kind of livestock are shown in table 5. One example is gained about integration of livestock guarding dogs and fenced game (fallow deer). Three owners of alpacas were interviewed about guarding dogs and alpacas and how to integrate them. All owners came from Germany.

Name and date	Kind of livestock	Method	Material	Time	Experience
Menzel, 2-5-2013	Fallow deer	LGD's outside fence of fallow deer in a separate place; then while feeding, LGD's on the leash within the fence	fence, leash	14 days	integrated 1,5 year old dog
Wehner, 17-5-2013	Alpaca	1st day: LGD's in metal fence; 2nd day: in same fence with opening only for dogs	fence	2-3 days	visit by Hildbrand
Müller, 23-5-2013	Alpaca	show LGD's the borders of enclosure; then leave the dog free with alpacas	leash	1 week	no experience
Hansemann, 2-6-2013	Alpaca	2-3 days LGD's in extra fence; just smell and sight contact; then LGD's on a short leash, later on a longer leash; after 5 days dog can be free	special fence, leash, short and long one	5 days	integrate 1 year old dog

Table 5: Proposed methods from owners of guard dogs and other kind of livestock.

Most owners would build a special fence for the guard dog , so only sight and smell contact is possible. For alpacas, the owners think it takes one week maximum before a dog is integrated into an alpaca herd (D. Müller, alpaca producer, pers. comm. 23-5-2013; Fam. Wehner, alpaca producer, pers.comm. 17-5-2013; A. Hansemann, alpaca producer, pers. comm. 2-6-2013). The only reference for fallow deer indicates it will takes two weeks (K. Menzel, fallow deer owner, pers. comm. 2-5-2013). All owners had no experience with guarding dogs before they got guard dogs pups. K. Menzel integrated an 1,5 year old dog, which is almost an adult guard dog and so approximately usable as a reference.

5.2.3 Experiment ''Groß Kreutz''

To gather practical information about integrating an adult and trained guarding dog into a new sheep herd, a practical experiment is set up together with Mister Körner and the LVAT. The goal from this experiment is to get some more detailed information about how sheep and guarding dogs reacts when an adult guarding dog is included into the pasture and herd. All participants have no experience with such an integration project.

Location and farm management

The pasture is located around 6km from ''Groß Kreutz'', outside the village Deetz in West Brandenburg. The pastures are close to the river Havel, which makes the fields relatively wet. This is a calm area with not a lot of activities. On the Southeast side there is a road accessible by cars. On the North side a dike is located, where only bike and hikers have access to. 150m from those fields, a sand depot of MEAB Potsdam is located. This cause a lot of traffic by trucks.

The sheep herd which is used for the experiment contains 460 sheep with a mix of ''Schwarzkopf Schafen'' and ''Merino Landschaf'. Whereby the distribution is about 50% ''Schwarzkopf'' and 50% ''Merino Landschaf''(see figure 6). In addition, the herd consist out of mixture of different ages. There are mother sheep and yearlings. Lambs are not present in the herd.

The sheep herd is property of the LVAT. The shepherds always approach the sheep quietly and handle them calm. Due to the calm handling of the sheep, they react on the shepherds. The mating seasons occurs end of August. The herd is then divided in 5-6 groups and one ram is added per group. At the start of the experiment, the herd is already outside the barn for two weeks.

Figure 6: Mixed herd with ''Merino's'' and ''Schwarzkopf''

The herd has no experience with wolf attacks. Beside this, the herd has no other big problems which can influence the behaviour of those sheep. The only experience the sheep have with dogs are herding dogs of the breed ''Altdeutsche Hütehund''. But the herd is seldom driven by those dogs.

The sheep get every 3-4 days a new field with a size of 1,5/2 hectares and are fenced in with an electric fence. Within this pasture the sheep have access to water and minerals.

Guarding dog

Two Pyrenean mountain dogs from shepherd Körner are used for this experiment. In figure 7 the dogs ''Jerry''(left) and'' Maya'' (right) are shown. ''Jerry'' born in 2009 is one year younger then ''Maya'' which is born in 2008. Mister Körner specially selected those two dogs, because they are really calm. In addition, those dogs showed that they can cooperate in a team. This couple have no experience as well with protecting a complete new sheep herd. The dogs get 800 gram of food consists out of dog pellets once a day in the morning.

Figure 7: ''Jerry'' and ''Maya''

Diary of the Integration process

Tuesday 23-4-2013
The first meeting with the LVAT. This meeting took around one hour. Within this meeting a general explanation was given about the plan and goals of the project. All participants were positive about the project. Practical questions like insurance, availability of guarding dogs, integration method and time schedule were afterwards still unknown.

Tuesday 7-5-2013
In this meeting the proposed method and some practical information were discussed. There was an agreement to start with the project on the 24st of Mai. All participants were positive about the project. Only some materials like dog food, leashes and caution and information signs has to be organized. Again this meeting took around one hour.

Friday 24-5-2013
Before arrive Mister Körner:
Mister Uwe and mister Lutz give the sheep a new pasture with fresh grass.

10.15:
Mister Körner arrives with two dogs from 1,5 hour drive.
15 min talk with shepherd mister Lutz and mister Uwe about the plan for the day. Topics which were talked about:

- caution and information signs about LGD
- who is responsible/available for the weekend
- general information about LGD
- herding dogs

10.45:
Mister Körner and mister Lutz going into the trailer (see appendix 4). Lutz get to know and put a leash on the dogs. This takes around five minutes. Meanwhile mister Uwe places the signs about livestock guarding dogs in the surroundings (see appendix 4), so people take care of the presence of the new guarding dogs. The electricity is taken off the fence and the fence is made open (very important that dogs are not jumping over fence). Then the pasture is entered with two dogs on the leash (mister Lutz with ‘’Jerry ‘’and mister Körner with ‘’Maya’’) and they walk 50m in direction of the herd. The sheep react quit normal and curious.

11.00:
‘’Maya’’ is released of the leash but stays more close to ‘’Jerry’’ and mister Körner. Sheep are looking and approach ‘’Maya’’ till circa 15m. ‘’Maya’’ behave calm.

11.15:
Sheep show curiosity to them and surround mister Lutz with ''Jerry'' (see figure 8). Especially more adult sheep of the breed ''Schwarzkopf'' shows interest in the new dog. ''Maya'' checks the borders of the new area. The sheep walk as group after her, but keep distance. Mister Lutz walks along with Jerry while walking slowly and stops sometimes to give both animals time to get used of each other. Sheep stay around the dogs, but sometimes there is a shock moment and then sheep run away a bit.

Figure 8: Mister Lutz and ''Jerry'' surrounded by sheep

11.30:
Both dogs are now released of the leash. Dogs stay far away from the sheep herd and the sheep still run away when the dogs are approaching to close. All participants are out of pasture. Both dogs are focused to mister Körner. When mister Körner is out of sight, dogs return to herd.

11.50:
Dogs control the fence, but walk around the herd. Besides this, the dogs show protection behaviour and runs to the front of the pasture and barks to passers-by.

12.15:
''Jerry'' and ''Maya'' acquaintance the 14 year old herding dog. Mister Uwe and mister Körner are present during the acquaintance. In addition, the herding dog is outside the fence and the guarding dogs within. No problems occur with this acquaintance.

12.40:
Both dogs get food from mister Lutz. This is part of the accustom process of the dogs to mister Lutz. This goes without any problems.

13.15
Mister Körner, Uwe and Lutz leave the sheep herd. Observer take place on the trailer for observing the herd (see Appendix 4). There is distance between dogs and sheep, but everything is calm.

14.15:
Both dogs start running after sheep, which causes a lot of stress. Sheep run around within the pasture. Within ten minutes everything is again quiet. No intervention was needed. Two hikers passes the pasture. ''Jerry'' runs to the fence and bark to the passengers. Stress reaction within the herd.

14.30- next morning 6.00:
Everything is calm. Sheep get more calm by the time. When dogs shows protection behaviour (bark and run to the fence) , then sheep run away and are nervous. This shock reaction of the sheep get less as well. Important to notice is that at 20.15 a ''Schwarzkopf'' touches ''Jerry'' out of curiosity. Dogs stay free in the pasture during the night. During the night at 12.00, 2.00 and 4.00 observer check if everything is okay. Sheep are on other side of pasture which makes it hard for observing ,but everything looks calm. Note: In the afternoon it starts raining this didn't stop till Sunday midday.

Saturday 25-5-2013
6.00:
Everything is calm within herd. No sign of stress during night.


Figure 9: ''Jerry'' in between the sheep

8.30:
Mister Lutz comes to feed the dogs and check the sheep. Sheep come close to the food of ''Jerry'' and'' Maya''. They protect their food, which causes a shock reaction of the sheep. Because of presence of mister Lutz, sheep come closer to the dog as well. Sheep show a bit off, by tramping with feet on the ground.

9.00- till next morning following day:
Sheep herd is calm, but walks away when the dogs come too close. But both dogs can walk through herd. Herd become more calm by time.

Sunday 26-5-2013
6.15- 21.30
In the morning ''Jerry'' lay in between the sheep herd (see figure 9). This characterize the whole day. Sheep are calm and accept that the dogs are walking through herd. Sheep also don't stamp with the feet on the ground anymore when dogs are to close. Field get more wet and less grass is available. Beside those circumstances, everything is quiet.

Monday 27-5-2013
7.15:
Mister Uwe and mister Lutz take a look for new field. Dogs are within the sheep herd. Everything calm.

9.45:
Herd got new pasture directly next to old pasture. Dogs walk in between the herd in direction of new field (see figure 10). Then both dogs run as first into new pasture and control the borders of the new area. This makes the sheep a bit nervous. The grass is high again, which decreases the visibility. Within 15 min everything is calm again. Dogs are more active for some hours again. But sheep behave calmly with new the circumstances (see appendix 4).


Figure 10: ''Jerry'' walking in between herd to new a pasture

Tuesday 28-5-2019 till Thursday 30-05-2013

Sheep get more calm with the presence of two dogs. Dogs are walking and lay in between the sheep. Everything is looking calm. On Wednesday morning, sheep got a new pasture. Field was located on the other side of the street, which means a crossover of 20m with no fence. This went well. Both dogs run again as first into the new pasture and checked the borders. Everything is calm. Sheep are less nervous as last time, when they got a new pasture.

Thursday 30-5-2013

10.30:

Integration of twelve new sheep within the herd and dogs. Dogs get first food, but are excited about the new trailer and don't eat a lot. Twelve sheep are in trailer. Both dogs are on the leash. ''Maya'' and mister Uwe stays next to the trailer and ''Jerry ''with mister Lutz are going into trailer with sheep (see figure 11).

Then the door is opened and sheep run away. Dogs are really active and run through herd.

Groups of the herd are not calm and run through pasture. After 15 min everything is calm again and new sheep are divided over the herd.

Figure 11: Mister Lutz and ''Jerry'' coming out of trailer

5.3 Provisional conclusion of methods for integrating adult guarding dogs

There is no literature available about integrating mature dogs into a sheep herd. Not even in North America, where a lot of research is done about this topic. Moreover there is information how to train and integrate pups into a livestock herd. The reports, which are given out by mobile herd protection team in Switzerland, give an idea how to integrate guarding dogs into sheep herds.

Shepherds with no experience of integrating an adult guarding dogs seem to think it takes more time and material than it actually takes. Also they would recommend similar approaches as they used to integrate their pups.

At the moment F. Neumann is the only one in Germany who has experiences with integrating trained guarding dogs. Even if the other interviewed owners of LGD's have no experience with integrating a grown up dog, they mostly recommended to use a special fence, so there is only sight and smell contact. This method is universal, because this method is also used in Switzerland. There can be distinguish two different kind of methods or a combination of those two: the LGD is placed for some time in a extra fence or the dog is only on the leash and is let through the herd with supervision of a shepherd.

Owners of alpacas and fallow deer have similar ideas as shepherds of how to integrate guarding dogs.

Conclusions drawn after the experiment ''Groß Kreutz'' are:

- Integration went remarkably fast
- Integration of LGD is a continuing process, sheep get slowly accustom to guard dog
- Bad weather may have a negative influence on integration process, but there are no direct clues
- Environment is important; different kind of pastures and activities
    - High grass, bad visibility
    - Wet pastures, faster chance on diseases
    - A lot of activities, causes a lot of startle responses of sheep
    - To less activities, sheep cannot get accustom to defence reaction of guard dog.
- Background of sheep is important
    - Experiences from sheep with dogs
    - Experiences with wolf attack
- Meat sheep (Schwarzkopf) are more calm then landscape sheep (Merino)
- Proper training of dogs is really important
    - Dogs anticipate on sheep and are calm
    - Dogs easily accept new people
- Fresh grass is of great importance, too high grass decreases visibility
- Traverse to new pasture, which not directly border on previous pasture, dog most be on the leash; dog must stay within proper fence
- Communication about presence of guarding dogs is important

6. Protocol for integrating livestock guarding dogs into a new sheep herd

1. Introduction

Guarding dogs can be an effective method to protect livestock against predation by carnivores. Normally a guarding dog is grown up with sheep and stay there year round with this herd. There can be situations where a guarding dog is needed to prevent predation by carnivores, for example when wolves are approaching. This protocol is to support shepherds with integrating a trained livestock guarding dog into a sheep herd, which has no experience with guarding dogs at all.
Guidelines are given for introducing guard dogs outside barns in farming systems comparable as those in East Germany (e.g fenced pastures, landscape maintenance). Favourable is to integrate two dogs at the same time during the integration process. This protocol should be applied under conditions without wolf attacks.

Before starting with an integration of livestock guarding dogs, it is important to realize and think about some topics described later in this protocol. Those topics can strongly influence the time, quality and safety within the integration process. Beside the topics which will be discussed below, not in all cases guarding dogs will be the best prevention method. In some occasions extra measurements should be taken.

At last, integrating a guard dog into a sheep herd to protect against predators is not only about the sheep herd itself. The guard dog will be part of the farm management system and must get used of other parts of the management as well. The dog should get used of the new owner, the herding dog, but also the equipment which is used by the sheep producer.

Kind of Dog

What kind of breed will be used for the integration? How is the dog educated? What kind of character has the dog?

The guard dog can influence the reaction of the herd and the time it needs for sheep to accept the dog into their herd. The more calm the dog is, the more easier it is for sheep to realize that the dog is no threat. To have a good dog for integrating into a sheep herd, three main themes are important: dog breed, education and individual character.
Every guard dog is different, but there are some characteristics for different guard dog breeds. Some guard dog breeds are divided in calmness in table 3. There are no hard borders in between the breeds, this is a generalized schedule.

''calm''	**''Less calm''**
Pyrenean mountain dog	Akbash
Mastin Espeanol	Tornjak
Maremma-Abruzesse	Komondor

Table 6: Guarding dog breeds divided in 'calm' and 'less calm' behaviour

However, education of the dog is key opponent in the behaviour of the dog. Guarding dogs can be trained to listen to the owner, but should show attentive behaviour towards sheep and other livestock. Important commands a guard dog should listen to are: stop, come here, stay with herd. A dog should be able to be for a longer period on a leash, be able to be connected to a pin and be used

of transport by car to other locations. Every dog is different in the behaviour, although the kind of breed and education.

Kind of sheep
What kind of breed? How are the sheep handled in daily management? Size and structure of the sheep herd? What kind experiences do the sheep have with dogs and wolves?

The sheep have to accept the continued presence of the guard dog in their herd. For this several factors can influence the acceptance of the sheep. The more calm the sheep are, the faster they accept the guarding dog. Different breeds of sheep react and behave different. In general, sheep used for landscape maintenance have a more nervous behaviour then sheep used for meat production. This will lengthen the integrating process.
How the sheep are handled in daily management can influence how nervous the sheep are. Another factor in the sheep management is the size and structure of the sheep herd. The bigger the sheep herd is, the harder it will be to habituate the sheep to the dog. In addition, when a sheep herd is accustom to guarding dogs, smaller groups of sheep can be easily integrated into this herd.
The different behaviour sheep show in different ages can fasten the integration of guard dogs. Lambs, as well as yearlings are curious and have the tendency to accept dogs faster. Adult sheep with young lambs are more protective and are suspicious towards dogs in general.
At last, experiences which the sheep had with dogs and wolves are really important. When there are negative experiences with dogs or wolves, for example attacks, the sheep will be faster stressed and have a lot of fear towards canids.

Kind of environment
What are the conditions of the pasture, visibility? What kind of activities are in the environment?

The actual conditions of the pasture where the sheep are located during the first days of the integration process can have an impact on the integration process.
Visibility is for sheep an important sense. Sheep can be more stressed, when there is high grass or other plants as sight obstruction and the dogs are inside the pasture. On the contrary, sheep are more satisfied and calm when plenty of food is available.
Guarding dogs react with barking and running to the fence on every possible threat for the herd. This causes startles within the sheep herd. When there are a lot of disturbing activities, sheep continue startles responses. This is not advantageous for the integrating and will lengthen the process. However, it is necessary that the guarding dogs show sometimes protective behaviour, so the sheep can get accustom on this behaviour.

2. Materials
Beside the considerations which should be made, some materials are required to integrate a guard dog. Necessary materials are shown on the upper part of table 7. Underneath some optional materials are shown. Those materials can be necessary as well in special situations, which are explained in the next chapter.

Necessary Material	Explanation
Dog food	An integration process can take up to 10 days. One dog eats around 800 gram a day.
Transport for dog	This can be a closed trailer or a big dog cage in a car.
Sign about guard dogs	Gives information for public about the task of the guard dog and how to behave towards it.
Herding dog	In emergencies, herd dog can gather the sheep. Guard and herd dog have to be able accept together as well.
Leash	In the beginning, guard dog should be on the leash to have total control. Also when moving to new pasture, dog should be on the leash.
Optional materials	
Electric fence	Electric fence is sufficient to separate guard dog from sheep. Can be a solution in some situations.
Metal pin	A metal pin, well set in the ground can be used to bind the dog on a leash.
Chain	When the dog will be connected a strong object (metal pin), a chain is necessary instead of leash.
Camera	Filming the integration can give valuable information about integration of guarding dogs.

Table 7: Necessary materials for integration

3. Steps for integrating guarding dogs into sheep herd.

In this part, the most important steps for integrating a guard dogs are shown. Important to realise is that not everything can directly be copied. Variables, as said in the introduction, can change to procession. Key moments and important topics are enumerated below.

Meeting

Some meetings between the participants should be organized, before starting at the integration projects. In general two meetings are enough to ensure that all topics are well discussed. Topics, which should be discussed during the meetings are: general information about guarding dogs, insurances, time schedule and integration plan.

In the second meeting, more detailed information about the project can be discussed; for example: which dog is used, exact location, available shepherds, payment of integration process and possible involvement of research projects.

Shepherds who delivers the dogs must make a trade off which dogs they take. Favourable are calm dogs, but important is that the dogs can work together and now each other. Beside this, it is possible to integrate older dogs together with younger dogs.

Both meetings take in average one till two hours. Reasonable is, to let the meeting take place either at the farm where the process will take place or at the livestock guard dog experts place. Therefore practical information can be explained better.

Integration process

At arrival, first some things have to be organized:

- Give sheep new pasture or enough food in the morning
- Last talk about process and emergencies
- Placement of the warning and education signs on good visible place nearby the pasture.

- Acquaintance of shepherd and new LGD
- Controlling the fence

The steps shown below, must be followed to integrate guarding dogs into a sheep herd on a responsible way. This method cannot guarantee 100% of success.

1. Take two dogs on the leash to the new pasture, open and close the fence. Never let the LGD's jump over the fence.
2. Wait for the reaction of the herd. Estimate, if there is chaos or more curiosity.
3. Walk slowly with one dog on the leash along the borders (Never force the sheep to come to the dog!). Let the other LGD with a supervisor stand on the beginning of the pasture. Look for the behaviour of the sheep.

Do the sheep come closer?

→ yes: If there is curiosity (sheep come closer on a calm way): LGD can get of the leash (Keep in mind, not to hasten it. Never let the dog off the leash, when not sure about the reaction of the herd.).

→ no: Continue with walking and stop regularly to let the sheep come to you.

If the first dog is off the leash, there can be start with walking on the leash with the second guard dog. When the second guard dog is not of the leash yet, the situation must be evaluated. An estimation must be done about the mood of the sheep. If the owner of the sheep, thinks the second dog can be introduced without major problems. The second dog can be introduced by walking on the leash through the pasture.

4. Is there confidence that the dog can be left off the leash for the night?

→ yes: Leave it off the leash. Make sure there is a frequently a check by somebody of the situation in the night.

→ no: Connect the guard dog to a metal pin/strong object on a chain for the night. Still, check several times during the night.
The metal pin/strong object must be placed within the pasture or nearby. So there is contact between sheep and guard dog.

5. Was the dog on a chain during the night?

→yes: Continue with walking with the dog through the herd.
Sheep probably get slowly used of dogs and will show less fear.

→ no: Keep holding supervision, even when the dog is off the leash the following days.

6. Sheep must be get slowly accustomed of the guard dogs during this days. Sheep accept them walking through herd, but still sometimes are a bit scared and walk away. This is normal, but should not be seen as a sign of bad integration. It will get better over time.
After three days, the amount of supervision can be decreased, when it can be suspected no problematic happenings will occur. Normal management (change of pasture, checking sheep) activities can be continued.

7. When there is no trust that the guard dog can be left in the herd without a leash, the following options can be tried:
- Build a special fence of circa 10x10m (electric fence is sufficient) within the pasture.
- Place the metal pin close to a place where sheep can get water and connect the guard dog to this pin.

When after six days no promising results are shown, it can be concluded that the combination of this guard dog and sheep will not work. However, this means not that no guard dog can be integrated in this sheep herd. There is no case known, that it did not work.

4. Costs of integration project

Costs are calculated for 2 dogs, whereby the purchase costs of guard dogs starts at 1000 euro per dog .This costs calculation is based on 3-5 days of integration. For the integration there has been chosen to calculate 1 LGD expert for the supervision of the project. The sheep producer must be present to learn about guard dogs and get to know the dog. Time which he cannot spend on other tasks. However the LGD expert also needs some support while integrating an LGD. A leash is necessary in every occasion, but an extra chain and fence to make a separated part for the dog, is optional.

Material	**Amount**	**Total costs**
Food for 5 days	10 kg	€ 10,-
Hours LGD expert	3 -5 full time days	€ 750 - 1250,-
Hours of sheep producer	3 full time days. Rest of the week, 2 hours a day	€ 480,-
Leash	2	€ 30,-
Chain	2	€ 50,-
Electric fence	Depends on size, 1 electric fence is 50m	€ 100,-
Guard dog	2	From €2000,-
	Total costs	**From € 3420,-**

Table 8: costs of integration project

Costs of the project has to be relativized to the advantages which the project bring with it. Sheep are sometimes attacked by foxes and dogs. This will occur less often with the presence of guard dogs, which brings direct less economic losses with it. There is no scientific research how many sheep will be killed with the presence of guard dogs, but it is reasonable to assume that seldom till no sheep kill will take place after the placement of a guard dog within the sheep flock.

7. Sheep management in the Netherlands

With the knowledge about guarding dogs from Germany and other countries, an estimation can be made about the possible use of guarding dogs in the Netherlands.
First, the sheep farming system of the Netherlands must be reviewed regarding present problems. Next, an estimation of problems and oppurtunities which will occur with the presence of guarding dogs in this system can be made.
In the following chapter, a short overview is given of how sheep farming is organized and the problems which exist within this system. After that, a short conclusion/estimation about the practicability of the use of guarding dogs will be discussed.

Sheep farming

Sheep farming have five different functions: meat production, maintenance of landscape, breeding, tourism and health care and milk production (LTO Noord, 2007). Whereby landscape and nature maintenance with sheep is the major task of most professional sheep farmers (W. Schellekens, shepherd, pers. comm. 11-06-2013). There are professional producers who have more than 500 ewes for grazing nature areas or for meat production. Hence, owners of sheep who keep sheep for hobby, have between one and five sheep. In total there around 1,3 million sheep in the Netherlands (LTO noord, 2007).

Out of the interview with W.Schellekens (11-06-2013), independent shepherd for more than eleven years, the following information is gathered. In almost every situation a shepherd is in the surroundings of the sheep herd during the day. In the Netherlands, most often electric fences are used to keep sheep together. It depends on the situation how long sheep stay within this fence. On heath pastures, bigger areas are fenced in and sheep stay there for a longer time. Whereby on dikes sheep are moved to new fences every day. In the night, sheep are fenced in smaller areas like a night enclosure with electric fences as well. Sheep are moved to different places and driven together by herding dogs. The sheep are outside the whole summer. In winter, they will go to relatively wet pastures, which are too wet to mow. Shepherds try to keep them as long as possible outside, before they stall sheep inside a barn. Most shepherds in the Netherlands are not common with the use of guard dogs as protection method.

Wolf development in the surroundings of the Netherlands

Wolves are dispersing in Germany; one wolf pack and one wolf pair is settled down on the ''Lüneburger Heide'', south of Hamburg. It shows that the wolf is settling down more closer to the Netherlands. There was a wolf sighting close to the border of the Netherlands in April, 2013. On the 4th of July 2013, a dead wolf was found in the ''Noordoostpolder'' (wolveninNederland 2, 2013). A spatial analysis done by Lelieveld (2012) conclude that there is place for at least 14 wolf packs in the Netherlands. Lelieveld (2012) assumed that wolves will be able to live in a populated country as the Netherlands. In contradiction, Groot Bruinderink said in an interview with Resource that he expected that if there are wolf packs will be living in the Netherlands, they will be most likely live in the border region with Germany (Resource, 2013).

Problems within sheep farming

The production of sheep meat is getting harder in the Netherlands, because of the development of a more free world economy (LTO noord, 2007). There is less money from the government available for landscape maintenance by sheep (Elbersen et al. 2003). A good example is that nature organisation Natuurmonumenten had less money for grazing by sheep on their areas, whereby a contract was stopped with a shepherd (omroepgelderland, 2013).

Sometimes power clocks for electric fences are stolen or/and fences made open or destroyed. This problem is often for a short duration of time, because people get used of the presence of sheep (W.Schellekens, shepherd, pers. comm. 11-06-2013).

Another problem is the attack on sheep by foxes and dogs. In average, 92 sheep got attacked by dog or fox in the province Limburg every year in the last ten years (Van den Hove & Penning, 2012). With the predicted comeback of the wolf to the Netherlands, unprotected livestock will be vulnerable for predation by wolves (Kluth & Reinhardt, 2011).

Provisional conclusions

Most sheep are kept in areas with a lot of human activities. Guarding dogs react with roaming towards everything which is a possible threat for the sheep herd which they are guarding. This can appear on an aggressive way and can cause a lot of problems with people. For example, dogs can be a threat for sheep, so they can be aggressively eliminated by LGD's with deadly ending when the dogs are within the fence. In situations on heath pastures, sheep cover a bigger area, where tourist can cross the fields. Especially problems can occur, when those people have dogs or ignore the signals, which are given by guard dogs.Professional sheep farmers and keepers have less money to spend by lowering prices of meat and subsidies. Besides that, a big part of the sheep owners keep sheep for hobby. Guard dog cost in between 350-1000 euro a year, on top of the purchase price of a guard dog. This can be high expenses for a shepherd. Most shepherds have experiences with herding dogs, but no experiences with guarding dogs. To be able the use guarding dog in a sufficient and good way, knowledge of the use of guard dogs must be available. This can cause a problem when there is no management and accompaniment.

Next to the protection against possible future attacks by wolves, guard dogs can help to decline problems with dogs and foxes which kill sheep. In addition, destruction of fences can be prevented when guard dogs are present year round.

8. Conclusions and recommendations

A final conclusion out of all provisional conclusions will be shown in the first part. In the second part, recommendations are given for the situation in Brandenburg, whereby the last part will contain recommendations about the possible use of guarding dogs in the Netherlands.

8.1 Conclusions

Many questions are unknown about integrating an adult and proper guard dog into a new sheep herd to protect it against predators (chapter 1). How to integrate an young dog into a sheep herd is known and written down in literature (chapter 5.1), but there is no available research conducted specific on introducing an adult guarding dog into a livestock herd (chapter 5.4). In North America, the management of guarding dogs is based on scientific research. There is a lack of scientific research which can support the use of livestock guarding dogs in Europe.

Different methods are available in reports and are proposed by shepherds about integration of adult guard dogs into livestock herds (chapter 5.2). After conducting an experiment, reading literature and interviewing guard dog owners, a method is designed to integrate adult dogs into a sheep herd which has no experience with guard dogs (5.3). Understanding the different situations, which can occur is key opponent when starting with integrating adult guarding dogs. Knowledge of both sheep and guard dogs is required. For a good integration, it can be concluded out of this research that proper training and breeding of guarding dog is an essential part of the success the integration process.

With the manual protocol (chapter 6), which is designed in this thesis, tools are provided for integrating guard dogs into a sheep herd with no experiences with guard dogs.
Guarding dogs are not a substantially part of the wolf management plan of Brandenburg. Moreover, positive implications for the management of wolves are available.

Using guarding dogs is an effective, non-lethal method against predation on sheep (chapter 4.1). Not only sheep producers use guard dogs to protect their sheep, also alpaca and fallow deer keepers use guard dogs as a guardian of their animals. There is no big difference with keeping guard dogs together with sheep then with alpaca or fallow deer. More often guarding dogs are used as prevention methods and owners of guard dogs are getting more organized into working groups (chapter 4.3). Guarding dogs are not only effective in protecting sheep. Owners of alpacas and fallow deer also see the value of getting their herd protected by guard dogs (chapter 5.2).
Less damage is done as well to fences and pastures by other wildlife because of the attendance of guard dogs.

The wolf will come back to the Netherlands, but it is unsure how the wolf population will develop. There will be some challenges to let guard dogs perform without problems in the Netherlands. Most conflicts will probably be with owners of dogs. Whereby guard dogs notice other dogs as threats for sheep herds and approach aggressively to dogs, especially when the dogs are within the fence. In addition, guarding dogs require an financial investment. Next to the challenges the use of guarding dogs can generate, guarding dogs can be promising prevention method to protect sheep in the Netherlands. Whereby in East Germany the combination of electric fences and guarding dogs seems to be most optimal. However, public awareness of guarding dogs is essential to make this prevention method successful.

8.2 Recommendations

8.2.1 Recommendations for guarding dogs in Brandenburg

Professional breeders of guarding dogs should be controlled, so correct trained guard dogs can be guaranteed (Blanché and Jaeger, date unknown). The MUGV (2012) is working on a ''Herdenschutzstelle''. This is an information point where support is available about protection methods against wolf predation. The ''Herdenschutzstelle'' should coordinate the proper breed and training of guard dogs. The '' AG Herdenschutzhunde'' should be involved into this information point, due to the available expertise within the working group. This should be accepted and approved by the ''Ministerium für Umwelt, Gesundheit und Verbraucherschutz'' of Brandenburg.
A mobile group of trained guarding dogs, which can be used in cases where there has been recently a wolf attack, would be a good solution to prevent further predation by wolves (Blanché and Jaeger, date unknown). In Saxony and Switzerland such teams are already existing and those teams can be good examples of how Brandenburg could organize a mobile herd protection team.
Out of the interviews, shepherds indicate that expenses for dog food influence their farm management and makes it harder to be profitable. When there would be a financial support for the use of guard dogs as prevention method, it would be easier and appropriate to compete with shepherds all over Europe. The Government of Brandenburg and the European union must only give subsidies for the use of guard dogs, when the dogs are proven to have a proper pedigree and training. This can be arranged by the ''Herdenschutzstelle''.

The experiment with integrating mature guard dogs in cooperation with the LVAT, ''AG Herdenschutzhunde'' and the LUGV, is a good example which shows how more research can be conducted for a more scientific based management of guard dogs. A solution can be that there will be cooperation with universities to conduct organized research to support management of the use of guarding dogs

8.2.2 Recommendation for guarding dogs in the Netherlands

To be able to use guarding dogs, some considerations must be made. Normally prevention methods should be taken in advance of the wolves presence.

It would be favourable to start a project to educate shepherds about prevention methods and specific about the use of guarding dogs in combination with electric fences. Therefore, education of the public is equally important. This project should be running on a small basis, because it is not known yet how the wolf population will develop and where it will be located. Shepherds should only participate on voluntary basis. If results out of this project are positive and there is more understanding of how the wolf population will develop, scaling up the size of this project would be a logical continuation.

Cooperation with Switzerland and Germany would be an important step in the development of guarding dogs in the Netherlands. Proper pedigree and training seems to be an important feature in the success factor of guarding. It would take years before such a system will work sufficient and so can be self-reliance in the Netherlands. It is important not to force shepherds in first sense to use guarding dogs.

9. Discussion

9.1 Data collection

Data is collected in this review on three different ways. There has been tried to gather knowledge by doing a literature review, interviewing guard dog owners and realize an experiment. This combination of different methods makes it possible to cover a wide range of experiences, gained in many countries.

9.1.1 Literature review

Reviewing of literature did not yield a lot of information specific about integrating adult guard dogs. However, usable information was collected out of reports, published by the SRVA (Service romand de vulgarisation agricole) and a report of a collaboration of SRVA and a sheep producer from north Brandenburg. In those reports often the steps, including pictures, were described to let the process run in a good way. Those processes were achieved in Switzerland, where sheep are brought up into mountainous areas and left there for the summer season. This is a totally different kind of sheep management system then which is used in Brandenburg. Still, the pictures and descriptions give good indications of how a sheep herd reacts on guarding dogs. Nevertheless, the method cannot directly applied into the protocol, without adapting it to the situation in Brandenburg.

9.1.2 Interview with livestock producers

Kind of interviews

To collect information about integrating guard dogs, semi-structured questionnaires were used by mail and phone for three livestock producers. The other eight producers were visited and interviewed directly on their farm. In this way, extra questions were directly asked to clarify their answers. For this reason, the answers are not standardized.

Because of this way of collecting data, it is not possible to do some statistical analysis. Nevertheless, for this research, statistical analysis are not necessary, because the aim is to collect methods, set up a protocol and apply it practically.

Amount of interviews

In total seven shepherds, three alpaca producers and one fallow deer keeper were interviewed. Four out of seven shepherds were part of the ''AG Herderschutzhunde''. Within this organisation, members have on regularly base contact with each other. Due to this organisation, knowledge is shared and relative similar answers were given by several interviewed shepherds. More interviews with shepherds would probably not have given more results. Using guarding dog is relatively new in Germany, although animals which are most often protected by guarding dogs are sheep. Not a lot of owners of other kind of livestock then sheep use guarding dogs at the moment. This caused the low number of interviews of other livestock owners. However, the most important livestock sector for prevention methods for wolf predation are sheep. So the main focus was on shepherds and livestock guarding dogs owners.

Kind of livestock producers

All livestock owners have livestock guarding dogs, but did not have experience with integrating an guard dog which can work totally independent. An owner of fallow deer integrated a 1,5 year old dog into a group of fenced fallow deer. The dog suffice almost the requirements of an adult guard dog, but fallow deer behave different then sheep. So is not used for outlining the protocol. Because of the lack of experiences of integrating adult guard dog, results out of those interviews are seen as proposed and not as used methods.

9.1.3 Experiment ''Groß Kreutz''

To gather practical experiences and information, an experiment about integrating two adult dogs into a sheep herd, which has no experiences with guard is conducted. A fast integration of two Pyrenean mountain dogs was the result of this experiment.
Below some important components of this experiment are discussed and explained.

Method used for experiment

The owner of the guard dogs led the process. The different possibilities, which were collected out of the interviews and reports, were discussed with the participants. It has been decided to put the dogs on the leash and anticipate on the sheep. During the first day, both dogs were off the leash. During the following days, the dogs were left alone with the sheep with an exception while feeding the dogs and checking the sheep. The time when and what kind of action is taken were recorded.

Timeframe

Two guard dogs were six days in total within the herd. Reports from Switzerland (see chapter 5.2.1) show that guard dogs were integrated in maximum five days. The guard dog experts from the mobile team stayed there around 7-10 days and left the dogs, shepherd and sheep alone afterwards.
In the experiment ''Groß Kreutz'', both dogs were off the leash within two hours. The dogs were remarkably fast able to be let off the leash. Releasing the dogs from the leash went faster than described in methods from Switzerland (Lüthi, 2004; Kley, 2003).
No problems occurred the first day, due to correct training and behaviour of both guard dogs. In addition the dogs were able to move freely within the whole herd without problems after 2 or 3 days. In the following days, jobs like feeding dogs or put sheep in new pasture, were conducted without problems. The sheep herd seems to accept the guard dogs in their herd. Hence, the experiment was successful and there was no reason to extent the stay of the experts.

Kind of dog and sheep

Two "Pyrenean mountain" dogs were used to integrate into mixed herd with ''Schwarzkopf'' and ''Merino'' sheep. There were no other available sheep and dogs for this experiment. Both the sheep and the dogs were calm during the process. When using other breeds of animals, the experiment could take longer and the result could have been different. However, it is hard to give a statement about this, because comparable research with other kind of guard dogs and sheep is missing.

9.2 Usability of the protocol for integrating guard dogs

The result of this research is a protocol which owners of livestock can be used for integrating an adult guard dog into a livestock herd. In addition, it gives an extra tool for the implementation of guard dogs into the wolf management of Brandenburg.

9.2.1 Considerations of the protocol

In this protocol, three main considerations which should be made before starting with an integrating process are explained: kind of sheep, kind of dog and environment. Most factors which can influence the process are gathered in those three main topics. There are no grades added to those factors, which can have more effect on the process, due to lack of research.

Kind of dog

The kind of dog breed seems to be important, due to the high satisfaction of Pyrenean mountain dogs in Brandenburg (chapter 4.5). This kind of dog is adapted in management systems practiced in Eastern Germany. Interaction with human is an important part of this system. In table 6, some dog breeds are divided, which are more or less aggressive towards human.
There has been done some research on the aggressiveness of guard dogs (Andelt, 1999). Concluded was that Akbash were the most aggressive, followed by Komonder. The less aggressive guard dog was Pyrenean mountain. However, this aggressiveness is relative and measured by interviews of guard dog owners. In addition the aggressiveness was measured against predators and not towards humans. This table only give some indications. Out of experiences of guard dog owners, table 6 is created. This distribution of guard dog breeds is relative and cannot be used in every situation, whereby character and training of the dog is important.
Only the owner of the dog can give indications of how ''calm'' the dog is and what kind of character it has.

Lüthi (2004) assumed that the colour and size of the herd dog influence the reaction of the sheep to new introduced guard dogs. The sheep associate the presence of the guarding dog with the herd dog, which threaten them. Out of this research no indications could be gathered.

Kind of sheep

As well by sheep as by dogs, the different kind of breeds seems to influence the integrating process. There is no research been done about the influence of sheep breeds on the behaviour towards guard dogs. Out of the experiment, indications occur that breed influence a main part of the process. ''Schwarzkopf'' sheep were more interested in the new guard dogs then the ''Merino Landschaf''. It is reasonable to assume, that the more ”panic-like” a sheep breed is in its behaviour, the longer the accustom time and so the integration process takes. “Panic-like” behaviour can be stimulated by how the sheep are handled by shepherds and by size and structure of the sheep herd. Hansen et al. (2001) concluded that heavier sheep breeds display a shorter anti-predatory behaviour and flight distances, than lighter sheep breeds. Romeyer & Bouissou (1991) suggest as well that fear reaction of sheep are influenced by breed and sometimes rearing conditions before weaning, whereby dam-reared animals were more fearful than artificial reared sheep.

Kind of environment

Visibility is an important sense for sheep to detect predators (Simmons & Ekarius, 2001; Weaver, 2005). When sheep are fenced in pastures with bad visibility (high grass), it can be assumed, that sheep are more fearful to possible threats as when the visibility is good.

There are probably more factors which can influence the timeframe and the quality of the accustomed period, but those are yet unknown or from minor importance.

9.2.2 Different steps

In total two main steps are taking, to organize and achieve an integration of adult guard dogs.
The first step is, to organize the process in meetings. The next step, the process itself, contains some few steps due to variable situations.
Every situation is unique and integrating is a continuing process. For this reason an exact time schedule cannot be given and the sheep herd should be watched. After an estimation of the reaction, it should be decided if it is responsible to release a guard dog. The owner of the sheep can estimate best how the sheep behave different than normal.

9.2.3 Costs

Costs are calculated for two dogs, because at least two dogs should be present to be an effective prevention method. The costs for food, LGD expert and the new owner will increase, if the process takes unexpectedly longer. It is necessary, that there is at least one expert about guard dogs around for the first three days, perhaps with an elongation to five days. The expert should be present during the night, because “panic-like” situations can take place. The guard dog expert takes care about the integration process.
However, the owner of the livestock must be present to be able to learn about guarding dogs and help the LGD expert. This takes time as well, which cannot be spent in the own company. The protocol recommends to conduct the integration during a calm period, when there are no important activities like lambing. After those five days, the sheep herd must be calm enough that there is no need for professional supervision anymore. For the integration, a fence and chain can be necessary and should be present. This is not necessary anymore, when the integration was successful. However the leashes are still necessary after the process. Those costs are specific for this process, whereby if the chains and fences can be used more often by the LGD-expert, the tender will be less expensive.

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Appendices

Appendix 1: Example interview shepherds Germany
Appendix 2: Example interview Shepherds the Netherlands
Appendix 3: Integration method F. Neumann
Appendix 4: Pictures of integration process

Appendix 1| Example interview shepherds Germany

Farming system:

- How many sheep do you have?
- What kind of sheep do you have and bring this a special management?
- How many and what kind guard dogs do you use in total?
- How much costs a LGD in average on annual basis for food and veterinarian per year?

Training of guard dog:

- How did you train them (from puppy on, adult, method)?
- How much time does this approximately take in total before there were effective?
- What did you need to train your dogs (materials, persons, experience, time)?

Integration of guard dog:

- What do you think of integrating of trained guard dogs into a new sheep herd?
- How would you approach integrating trained guard dogs into a new sheep herd?
- How long do you think it will take before an trained LGD is integrated in a new sheep herd?
- Do you think is there a big differences of way in approach of different kind of dogs, sheep breed and sheep herd size? And what would that be?
- When is the best moment for integrating trained LGD in a new sheep herd?
- How often should a Shepherd be present together with a trained LGD to make the integration successful?

Guarding dogs in management:

- What kind of improvement would you like to see in supporting, management or other in the traineeship and deployment of guarding dogs?

Any suggestions or comments?

Appendix 2 | Example interview Shepherds the Netherlands

Own farming management:
How many sheep do you have?
What kind of sheep?
What kind of sheep management, Landscape maintenance or meat production?
Are the sheep within a fence, when yes, what kind of fence?
How do you use the sheep year round? Where are the sheep in summer and winter?
Where does the sheep stay during the night?
How do you move the sheep?

Problems:
Do you have problems with activities of people, cars, bikes, hikers?
Do you have other problems like demolishing of fence or abstraction of sheep?
Are you common with the use of guarding dogs to protect sheep?

General about the Netherlands:
What kind of sheep do you think is most used in the Netherlands?
What kind of sheep management is most used in the Netherlands?
What do you think of using guarding dogs in the Netherlands?

Any suggestions or comments?

Appendix 3 | Integration method F. Neumann

Sheep get food before dogs are arrived. This makes sheep more comfortable. A normal fenced area of around 1 hectare must be present with 100-250 sheep when possible without lambs. A strong object which are sheep are bounded with (e.g water canister) must be present.

2.1 First day

30 min till 1 hour. 1 LGD on a strong leash is guided by its owner through the fenced area. Sheep must be observed carefully and the sheep should not be forced. Herding dog of the new shepherd must be around but far outside the fenced area.

Then LGD is bounded to the water canister with a chain. Owner is outside the fenced area but present. This continue all day. In the evening LGD is taken out the fenced area for the night. When sheep get food, dog can be released from the leash in the fenced area.

Dogs get's food once or twice a day, depending per owner. Morning and evening. 700-800 gram per dog. Normal big dog food. Owner of LGD takes food for the dogs with him/her.

Note: there are no exact schedules available. It is depending on the sheep and the conditions. Can take longer and shorter then described. Sheep must be observed and handlings adapted to observations.

2.2 Second day

In the morning the second dog can be introduced on the same way as above described. This is together with the already accepted LGD of the day before. The LGD of the previous day is walking free around. In the evening 1 dog can be, bounded to the water canister, left in the fenced area. Owner must be present whole night in case of emergencies.

2.3 Third day

Both dogs can be walk free around in the fenced area. Both dogs are integrated in the sheep herd. Leave the LGD's and sheep together to let them make more bounding.

2.4 Fourth day

Depending on the size of the sheep herd. The LGD and the used sheep herd can be integrated into the bigger sheep herd. When sheep are divided into smaller flocks or fenced areas. Exchange of sheep is necessary.

All sheep are now used of the LGD's. Goal is succeeded.

3. Integrating and training of own LGD for sheep herd.

Start can be make with the training of the any purchased LGD. This dog must be at least 5 months old to be able to work together with the trained LGD's. The LGd day must be there for around 5 more days to guide the new dogs.

Appendix 4 |Pictures of integration process

Figure 1: trailer from mister Körner, to transport LGD to experiment location

Figure 2: warning and education sign to warn the public about LGD's. Placed close to location

Figure 3: day 1: mister Lutz and ‘’Jerry’’ are walking through herd; ‘’Schwarzkopf’’ sheep show interest

Figure 4: view from observing point. Good visibility on the process

Figure 5: ''Jerry'' and ''Maya'' waiting in between the sheep herd to move to new pasture

Figure 6: sheep and guard dogs calm in the new pasture