



DIFESATTIVA:
a farmers' association

**THE USE
OF LIVESTOCK
GUARDING DOGS**
in North-Eastern Portugal

**LIVESTOCK
GUARDING DOGS
IN GEORGIA:**
a tradition in need
of saving?

**THE EVOLVING
USE OF LGDs**
in Western Canada

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possible solutions
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Dear Readers,

Welcome to the first of two issues of CDPNews devoted to livestock guarding dogs (LGDs). This issue includes articles from Canada, Georgia, Italy and Portugal, as well as a special feature reviewing possible solutions to perceived limitations of LGD use.

Shepherds have kept dogs to protect livestock for millennia. Today, although the traditional application of LGDs in transhumant pastoralism has declined or been lost in many areas, they have been successfully introduced elsewhere and can now be found in a wider variety of settings and husbandry systems than ever before. The list of livestock species they are required to protect, as well as the number of predators involved, continues to grow. At the same time, the expectations of owners, and of society in general, are also changing, with greater attention paid to questions of liability and animal welfare.

Introducing LGDs to novel scenarios brings new challenges which need to be addressed. The article from Canada shows that modern circumstances may be very different from traditional practices, as can still be found, for example, in Georgia. LGDs are not suitable for every farmer, and not every dog will make a good LGD. It is therefore important to choose the right dog for the right job and to adapt its behaviour to existing conditions and farmer expectations. The exchange of experience between farmers, managers and researchers is crucial to increase expertise and address issues associated with the use of LGDs. The case from Italy demonstrates how an association of farmers can promote best practices while also adding value to their products.

Exchanging experience and finding solutions were among the goals of an international meeting of experts, Livestock Guarding Dogs – From Tradition to Modernity, held in Portugal in 2015 as part of the LIFE MEDWOLF Project, the main results of which are presented in this issue's special feature. While some of the points discussed are not new, they are worth emphasising. Selection of pups can be a critical factor and there is value in efforts to improve aptitude testing for LGDs, drawing on what has been learned with other working dogs. Assessment of working LGDs is also indispensable and advances in technology and animal behaviour science offer new opportunities. More data are needed to improve understanding of the potential effects of neutering/spaying on the behaviour of LGDs and their effectiveness against different predators and in different contexts.

Data included in the article from Portugal show that, in some cases, LGDs can impact wildlife in unintended ways, so potential negative as well as positive effects should be carefully considered before implementation. The case of Portugal also highlights the importance of promoting damage prevention measures in areas where wolf presence is currently low but is expected to increase, to ensure that knowledge and experience is not lost. Maintaining unbroken lines of good working dogs is an important factor. In places where their use was discontinued following the eradication of predators, it is a big challenge to reintroduce this ancient practice.

Despite the long history of LGDs, there is clearly still room for improvement and a need for adaptation of one of the oldest and most valuable damage prevention tools. We hope you find the articles in this issue of CDPNews informative and inspiring. As usual, we welcome your feedback, comments and suggestions.

The Editors

Short Communication

DIFESATTIVA: A FARMERS' ASSOCIATION

TO FOSTER NETWORKING AND SUPPORT FOR DAMAGE PREVENTION



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MEDWOLF - Best practice actions for wolf conservation in Mediterranean-type areas - www.medwolf.eu

1. Background

The wolf (*Canis lupus*) population in the Italian Apennines has been increasing noticeably in recent decades and wolf presence is now being recorded in submontane and lowland areas (Galaverni et al., 2015). In the central region of Tuscany, the landscape is mainly dominated by agricultural productivity and wolf presence has been reported with increased frequency during the last decade, often associated with claims for damage to livestock production.

According to the latest National Agricultural Census, 43.5% of the Province of Grosseto is used for agricultural practices and 14.7% for pastures (Pasqual, 2012). The area has a human population of about 225,000 inhabitants, but they are mainly concentrated in coastal areas. In rural areas, there are many more livestock than humans. The national census documents over 2,100 production holdings. Sheep raising represents an important activity with 86% of livestock heads being of sheep, and only 11% of cattle, with 2% horses and 1% goats. Considering only

sheep breeding, there are 1,142 active farms in the Province with a total of over 199,000 head of sheep: 89.29% are primarily dedicated to milk production, and 10.71% to meat production (BDN, 2016). Sheep production in Grosseto is mainly managed through



Fig. 1. A flock of Sarda sheep. Photo: Luisa Vielmi.

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semi-extensive grazing in areas not far from the property holdings (Fig. 1).

The south of Grosseto is characterized by high quality dairy production. Since 2010 the frequency of attacks on livestock, mainly dairy sheep of the Sarda breed, has caused concern (Fig. 2).

High quality dairy products are certified according to quality standards. No shepherding is used in the area, and farmers receive incentives for producing D.O.P. sheep cheese (Pecorino Toscano DOP), with milk from sheep that are free-ranging for at least 60% of the grazing time. Such production represents an important share of the local economy. Milk is either used by communal cheese factories or local single holding cheese factories, ensuring a high diversity of products (Fig. 3).

The area is also interesting for its rich agricultural tourism economy, often associated with wine and olive oil production. As a result of the return of predators, many livestock producers have had to modify their husbandry methods in order to prevent further losses, as they were not used to guard their animals. In some cases this increases their workload, for example if they are not used to looking after livestock guarding dogs (LGDs).

2. The MEDWOLF project

In 2012, the Province of Grosseto together with agricultural and environmental associations started to collaborate within the LIFE MEDWOLF project, with the aim of mitigating the impact of wolves on livestock production. Concrete actions included the donation of prevention measures to farmers, namely LGDs of the Maremano Abruzzese breed. In the beginning few farmers showed interest in receiving LGDs as they had neither knowledge nor experience of having such dogs, which they perceived as a burden and cost they did not want to bear. In order to overcome the initial reluctance, a process of awareness raising and information provision was initiated (Fig. 4). Alliances with the few farmers who already had LGDs were made and those farmers were asked to provide information to others. Additionally, two training workshops were organized in June 2014 and March 2016, each with the participation of around 30 livestock owners, during which



Fig. 2. Milk is referred to as “white gold” by local livestock producers. Photos: Luisa Vielmi.



Fig. 3. DifesAttiva counts four local holding cheese factories among its members. Photo: Luisa Vielmi.



Fig. 4. Awareness raising activities developed within the LIFE MEDWOLF project in DifesAttiva farm. Photo: Matteo Franchi.

constant contact was maintained between farmers and technicians, and during which the technicians monitored the dogs, interest in using LGDs increased significantly (Fig. 5).

The LIFE MEDWOLF project included the objective of providing 20 LGDs to selected farmers in the Province of Grosseto. Despite the initial reluctance, the project’s objective was achieved, with 20 LGDs delivered to 10 farms. Selection of recipients was based on a set of criteria, including: i) previous history of attacks; ii) flock size over 50 heads; and iii) grazing areas in regions where most attacks were registered in the previous three years. Once these criteria were passed, the farmer’s willingness to start a long-term engagement with the LGD was assessed during a direct visit to the farm.

With increasing confidence in the project, the number of farmers willing to have LGDs also in-

creased and the experience they gained was made available to all the others. They were thus linked to each other through an information network to which they could contribute (Fig. 6).

3. The farmers’ network

With the stimulus of LIFE MEDWOLF, the existing network was formalised in 2016 through the establishment of the DifesAttiva association (www.difesattiva.info). DifesAttiva is a formal institution, with corporate bodies and roles. A full-time technician runs activities, answers calls and requests for information and makes sure the information flows in the correct direction. Although the participation of the President and Vice-President is on a voluntary basis, the technician that runs the practical activities is



Fig. 5. Livestock guarding dogs in a mountain area of Roccalbegna, Grosseto. Photo: Luisa Vielmi.



Fig. 6. DifesAttiva LGDs at work in the field. Photo: Luisa Vielmi.

Fig. 7. Images sent by livestock breeders of their LGDs. Photos: Francesca Barzagli, Giacomo Tedeschi, Paola Famoso, Matteo Malaguti.



paid by the LIFE MEDWOLF project and from 2018 will receive a salary from the association's activities. Joining the association requires a subscription fee (10 euro per farmer to be used for puppies' veterinary care from 2018), but members must also accept and adopt the association's philosophy of commitment and sharing experience and technical guidance for correct management of LGDs. The latter is provided through direct visits by the association's technician and in some cases exchange visits among farmers.

To our knowledge, this is the first time in Europe that livestock breeders have joined directly in an association aiming at sharing information and experience as well as concrete damage prevention tools. Such a network permits the exchange of good practice and makes raising LGDs easier and more feasible if suggestions are provided directly by experienced farmers. Farmers have taken the initiative and created a chat group on WhatsApp® for sharing comments and images. Social events are regularly organised, such as participation at fairs, informal meetings and dinners.

3.1. Goals

The motto of the association is "Protezione È e DÀ qualità", which loosely translates as "Protection assures quality", stressing the positive role of the adoption of damage prevention measures. We suggest that protected stock is less stressed and owners are also less stressed, thus improving their quality of life.

The association has a statute and a general aim: to promote best practices for damage prevention as a means to enhance quality of life and products in predator ranges. Specifically, its goals are to:

1. Promote and facilitate the adoption of damage prevention measures and provide support for their correct use;
2. Provide guidelines for best practice in raising LGDs;
3. Promote the exchange of information and experience among farmers facing predation events;
4. Promote high quality standards of management approaches at associated farms through awareness raising, tourism and information activities.

3.2. Organization

Farmers usually trust information from their fellow farmers more than that from outside "experts" who do not live in the same conditions as they do. This is the main strength of DifesAttiva. The association's president, Mrs. Francesca Barzagli, is a livestock owner from Grosseto who decided to run the family business after concluding her studies in nearby Rimini (Fig. 8). She and 20 other farmers have joined the association and actively contribute to activities aimed at improving conditions of farmers operating in wolf areas. The farms that joined the association are mainly sheep milk production with sheep flock size ranging from 250 to 700. The number of LGDs present at the farms ranges from two to eight. Some farms are also open to the public for educational activities (Didactic Farms), cheese making and selling (in-house cheese factory) and agro-tourism activities. This increases the visibility of DifesAttiva, providing

Fig. 8. DifesAttiva president, Francesca Barzagli, and one of her LGDs. Photo: Francesca Barzagli.



Fig. 9. LGD checks in the stable and on the field. Photos: Luisa Vielmi, Veronica Mazzucato.



information to visitors directly from the farmers and through providing leaflets. All of them have chosen to adopt damage prevention measures, mainly (but not only) LGDs, and to share their experience, mostly through social media.

4. Actions developed

4.1. Promoting best practices and networking

Following delivery of a LGD, the DifesAttiva technician usually visits the beneficiary daily for the first five days in order to monitor the initial reaction of the dog when left with livestock. In the following days contacts by telephone are made daily to ask wheth-

er any problem has arisen. After the first two weeks, monitoring visits are made every three months and include direct observation of dog behaviour. LGDs are observed while they are in the pasture with flocks and in stables. If the livestock owner has any doubts or problems concerning the dog's behaviour, he/she is directed to the farmer who owns the dog's parents in order to gather information about their behaviour. The association technician provides suggestions on how to correct the behaviour and they work together to achieve the best results. DifesAttiva asks all farmers who receive LGDs to take photographs and film of the dogs while working in order to document their process of integration and education (Fig. 9).

The association fosters the provision of suggestions and solutions to problems that some farmers may have encountered to those who are new to the use of damage prevention measures. Communication is conducted through Facebook®, WhatsApp® or by telephone. Word of mouth is still one of the most effective ways of spreading information in rural areas, where people go to local cafes to relax and chat. Short TV spots have been produced, media articles have been published and public events organised. Meetings



Fig. 10. Delivery of LGDs to livestock breeders.
Photos: Luisa Vielmi, Veronica Mazzucato.

an agreement that includes monitoring of the dogs by DifesAttiva staff and respecting guidelines for the correct management of the dog (Fig. 10). DifesAttiva staff also assist farmers in managing breeding dogs, encouraging neutering in some cases and helping to find recipients for pups. Associated farmers must manage breeding in a way that ensures dog health, genetic variability and minimisation of occasions when a dog in heat represents a distraction for other LGDs.

4.3. Raising awareness

Besides promoting the use of damage prevention measures among farmers, DifesAttiva also works towards increasing the awareness of those who are not directly involved in the wolf-livestock dynamics. In this direction, DifesAttiva takes part in markets and festivals, educational activities with schoolchildren and technical seminars directed, for example, at farmers or environmental guides in order to inform them how to behave in the presence of a LGD.

Farmers are taken to schools to talk to pupils and students are taken to farms to experience the difficulties in managing productive activities with the risk



have been held with other farmers outside the association in order to discuss issues such as expenses for dog maintenance and suggestions to be put forward to the regional administration, as well as management of the most common problems encountered.

4.2. Donating pups

A total of 34 pups were produced from the LIFE MEDWOLF LGDs and they were given free of charge to other farmers in Grosseto or nearby. When receiving a dog, the beneficiary is required to sign

of losing part of the productive capital. A demonstration on how to make cheese is offered.

4.4. Promoting farm products

Products from associated farms (e.g. “Al lupo” sheep cheese; see Fig. 3 - bottom right) are promoted, particularly at festivals and markets, but also in other information actions. During awareness raising activities some of the products from DifesAttiva farms are offered to visitors. The promotion of such high quality products, together with accurate communication and information about the presence of the wolf and how prevention measures work, stimulates the visitor to appreciate the work done by the farmer and to recognise the added value of the products, often resulting in increased sales. Such events are thus important for farmers to make themselves known and acquire new clients so that their added workload due to protecting flocks is at least partially counterbalanced (Fig. 11).

4.5. Developing tourism

A collaboration with the local sport and tourism association Terramare (www.terramareitalia.it) has provided occasions to develop tourism activities in the associated farms, whereby groups of tourists have visited farms and learned about the difficulties they face and the solutions implemented in living with wolves. We have run 18 promotional initiatives, each with a minimum number of 10 participants.

There is also a collaboration with the regional Association of Environmental Guides. This is an extremely important activity aimed at sensitising those who use the landscape for tourism and hiking about the role of LGDs and appropriate behaviour in their presence. To this end, a warning sign was produced



Fig. 11. Promotion of products from DifesAttiva farms with cheeses from a communal cheese factory in the area. Photo: Paola Fazzi.



Fig. 12. “Wolf on the farm” excursion. Photos: Paola Fazzi.

that includes indications on what to do during an encounter with a LGD (Fig. 6).

New thematic excursions called “Wolf on the farm” are currently running. They are led by an experienced local tourist guide who takes a group of hikers on a trail to look for signs of wolf presence and

provides information about wolf ecology and behaviour. The guide also takes them to a DifesAttiva farm for their lunch, where they can taste a range of different products from the associated farms. A total of eight such tours have so far taken place and the targeted farms offer full availability for sharing their knowledge and experience. Information is given on the measures they take to protect their flocks from wolf attacks, their management approaches and social attitude. Products are also available for sale (Fig. 12).

5. Expanding the range

Activities are not limited to the province of Grosseto: partnerships are being signed with two National Parks, Foreste Casentinesi NP and Appennino Tosco Emiliano NP, where programmes for using LGDs are being implemented. The initial results of such partnerships are the transfer of LGDs to areas outside Grosseto. A total of 19 LGDs were provided to farmers in or nearby the territories of the Appennino tosco emiliano NP. The agreement will include a common strategy for management of dogs and continued communication for providing inputs through experience. A new programme for using volunteers to guard animals during summer camps is currently being evaluated in collaboration with the Pasturs project (pasturs.org).

6. The way forward

DifesAttiva will continue to work with farmers in central Italy to achieve the association's main aims. The livestock production industry is currently facing many difficulties due to other factors independent of wolf presence (e.g. climate change, market prices of milk and meat, etc.), and DifesAttiva is committed to safeguard the best practices for undertaking such an important activity, which has a fundamental role in preserving natural habitats. The main challenges faced so far are related to cultural resistance to accept the responsibility of taking action to protect against predator attacks because, as in many other areas, there is a strong belief that predators have been "reintroduced" and the state should be responsible for the management of their impact on livestock production. We have adopted an approach of transparent communication and persuaded farmers that this responsibility should be shared among all parties.

Further information

Website: www.difesattiva.info

Facebook: [difesattiva](https://www.facebook.com/difesattiva)

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Research Paper

THE USE OF LIVESTOCK GUARDING DOGS IN NORTH-EASTERN PORTUGAL:

THE IMPORTANCE OF KEEPING THE TRADITION

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1. Introduction

Livestock guarding dogs (LGDs) are regaining their important role as a non-lethal damage prevention tool, in the scope of efforts for the conservation of endangered large carnivores, due to their recognized adaptability and efficiency. In Europe, the return of grey wolves (*Canis lupus*) to parts of their former range has often been followed by the use of LGDs to mitigate human-wolf conflicts. Nevertheless, their implementation faces serious challenges, especially in regions where their use was discontinued following large carnivore extirpation, resulting in the loss of traditional habits and knowledge about their use, aggravated by the transformation of livestock husbandry to systems less suitable for coexisting with wolves and for working with LGDs. Promoting the use of LGDs in regions of low wolf densities or at the limits of current ranges is thus important to prevent further loss of knowledge and habits that would delay the effective implementation of LGDs. This is especially true if we consider the European trend in recent years, where most wolf populations have been increasing and ex-

panding their areas of occasional presence (Kaczensky et al., 2013; Galaverni et al., 2015).

According to a census in 2012-2014, the wolf population in Spain is expanding southwards, with 47 new packs identified since 2007, representing a 16% increase (MAPAMA, 2014). In Portugal, since the last national census of 2002-2003, new packs have been identified at the limits of the wolf range (Álvares et al., 2015). Wolves in Portugal are highly dependent on livestock, since wild prey is generally scarce (Álvares et al., 2015), and thus the potential for conflict is high. Wolves are currently limited to less than 20% of their original distribution area that included the entire country (Petrucci-Fonseca, 1990; Pimenta et al., 2005). Wolves are opportunistic predators and if they return to parts of their original range they may cause considerable damage to livestock that is left unprotected. The wolf has been a protected species since 1988 and damages to livestock are compensated by the government if minimal requirements are met, namely the presence of shepherds and LGDs (one dog per 50 head

of livestock up to a maximum of five dogs), or if the livestock is confined (Law Decree Nr. 139/90).

The LGD Programme, implemented by Grupo Lobo since 1996, has donated more than 550 dogs of autochthonous breeds throughout the wolf range, with very good results (Ribeiro and Petrucci-Fosenca, 2005). Since 2012 this Programme expanded to the northeast region of the country, north of the Douro river, in the south of Bragança District, in a low wolf density area (Álvares et al., 2015). This was possible due to a compensatory measure (Medida MC8 do Aproveitamento Hidroelétrico do Baixo-Sabor) from the impact of building a large dam in the Sabor river, that could overlap the territories of some packs, and increase habitat fragmentation. Wolves are present at low densities and damage levels are low and so, although the importance of having LGDs is still acknowledged, not all shepherds use sufficient numbers of LGDs. Providing farmers with LGDs would reinforce the use of these dogs in a preventive way, in advance of the expected wolf recovery in the region. Here, we present the first results of this measure, namely an evaluation of the LGDs placed and the advantages of using them, even when predation risk is low.

2. Material and Methods

2.1. Study area

The measure was implemented in nine counties surrounding the Sabor river basin (Fig. 1). Two mountain ranges (up to 1,310 m) cross regions that are characterized by plateau areas (200–400 m) and river valleys, with a typical Mediterranean climate (hot summers and mild winters). Human density is relatively low for the Iberian Peninsula (<25 habitants/km²), and the landscape is dominated by cereal fields and plantations, mainly of chestnut, olive and almond trees, with pine

tree patches, and bushy grazing areas in higher grounds.

Livestock production is a major economic activity, mainly of sheep for meat production. Larger flocks are frequent at higher grounds whenever communal grazing areas exist. In mountainous areas goats are more frequent, whereas in warmer areas sheep are in higher numbers. Livestock breeds are mainly autochthonous, sometimes crossed with exotic breeds to increase production. Husbandry is usually of the extensive type and flocks are usually shepherded, sometimes kept in fenced areas during the hottest hours of the day and in night corrals during summer.

The local LGD breed, the Transmontano Mastiff, was traditionally used to protect livestock from wolves. It is still mostly used as a working dog, mainly in the north of Bragança District, being less frequent in the south and rare in the rest of the country. It is the largest Portuguese dog breed, with males reaching 85 cm at the shoulder and weighting up to 75 kg. The breed's provisional standard was only defined in 2004 and recognized by the Portuguese Kennel Club

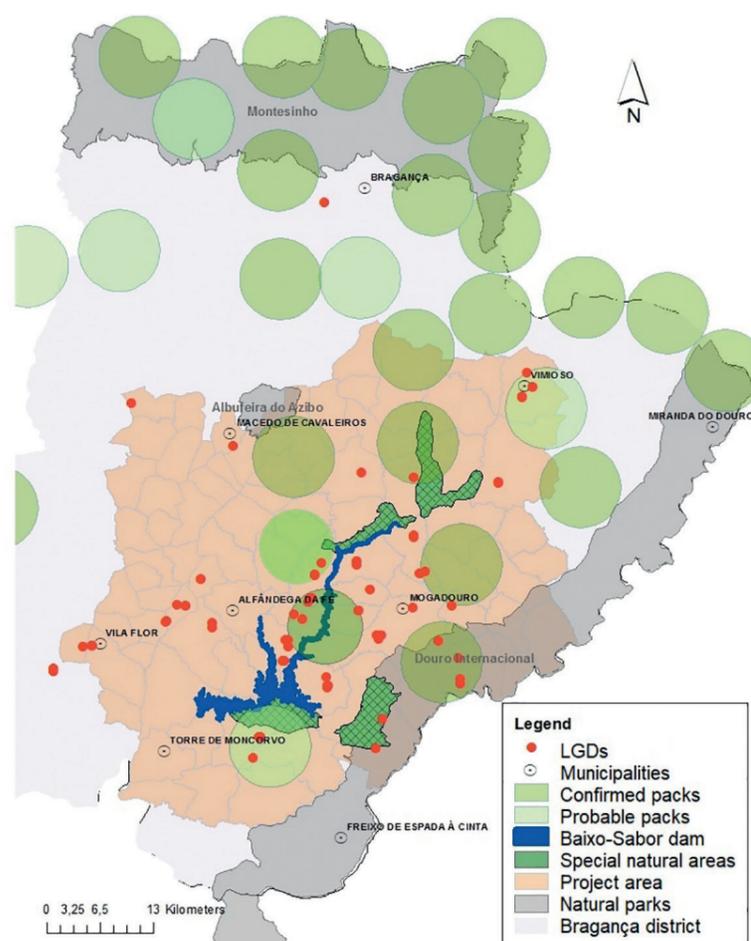
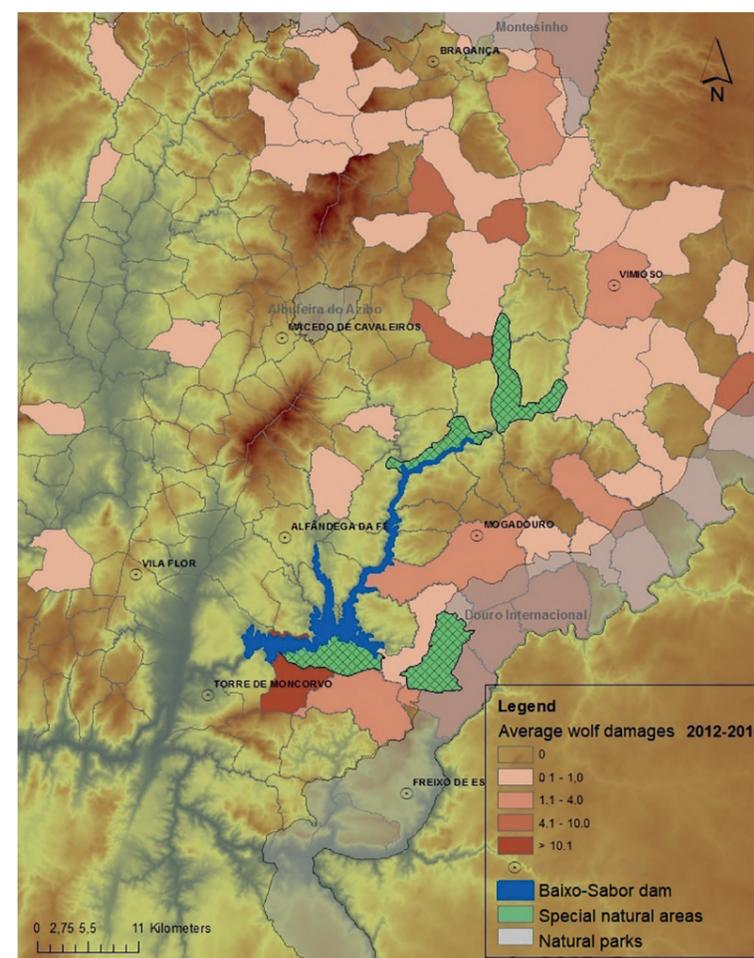


Fig. 1. Distribution of wolf packs identified in the last national census, 2002–2003, and in recent monitoring studies, in the NE of Portugal and the project intervention area (data from Álvares et al., 2015), showing the location of selected holdings where dogs were placed.

in 2012. According to data provided by this Club, the number of registries per year ranged from 154 to 411, between 2004 and 2015, being the 8th in rank among the 12 national breeds' registry in the last years.

Monitoring has identified seven confirmed and three probable wolf packs in the intervention area, indicating this to be a relatively low density area, with 3.3 packs per 1,000 km² (Pimenta et al., 2005; Álvares et al., 2015) (Fig. 1). Except for wild boar (*Sus scrofa*), which is common in the region, wild prey is scarce, although roe deer (*Capreolus capreolus*) is slowly increasing. According to official records provided by the Institute for Nature Conservation and Forests (ICNF), from 2012 to 2016 a total of 457 predation events were registered in the Bragança District, mainly of sheep and goats (89%), ranging from 0 to 20 annual events per parish, except in one particular parish of the intervention area (Felgar and Souto da Velha), where an average of 46.8 yearly events were registered during this period (Fig. 2).



of conditions to raise LGDs and interest to participate and follow guidelines. All holdings were located inside the study area except two: one sheep farm north of the study area (Bragança municipality) and one to the southwest (Candoso Parish, Vila Flor municipality).

2.3. Dog selection, placement and monitoring

Dogs were placed with livestock at 2–3 months of age to foster bonding. Pups were selected according to the behaviour and working abilities of the parents, breed standards and lack of abnormalities (e.g. light coloured nose, loose lids, malocclusion of teeth, hernias, dysplasia). Genealogy was also considered, especially when dogs were placed in the same or nearby flocks, to avoid inbreeding and promote variability. Dog breeds were selected according to the preference of the farmers, but the local breed, the Transmontano Mastiff, was preferred.

Fig. 2. Distribution of average yearly wolf damages recorded per parish from 2012 to 2016 in the NE of Portugal (data from ICNF).

An agreement was signed with farmers to clarify responsibilities, ensure the dogs' welfare and provide adequate raising procedures to allow dogs to become efficient guardians. Food and veterinary assistance were provided by the Programme, as well as support to the farmers regarding dog raising, training, breeding, registering and legal aspects. Regular visits were made to monitor dog development, health and welfare and correct any problems that occurred.

2.4. Dog evaluation

Since wolf presence was not uniform in the intervention area, and predation levels varied greatly among flocks, damage variation was not the best criterion to evaluate and compare dog efficacy as it may not reflect the real performance of the dogs. Thus, adult dogs (>18 months old) were evaluated according to other criteria based on behavioural analysis, owner satisfaction and perceived effectiveness.

2.4.1. Behavioural observations

Behavioural observations were made during regular monitoring and also after dogs reached adulthood, by observing them with livestock while grazing for an average of 30 minutes, complemented with inquiries to farmers about specific behaviours and situations. Behaviour was evaluated according to the three behavioural components defined by Coppinger and Coppinger (1980): attentiveness, trustworthiness and protectiveness. Attentive dogs accompany and stay in the proximity of their flocks, following their movements. Attentive behaviour is based on the dog's attachment to livestock, and implies the establishment of social bonds with the animals in the flock (Coppinger et al., 1983). Trustworthiness refers to the absence of disruptive or harmful behaviours towards the animals in the flock. Behaviours that disturb the flock's activity or lead to injury/death of livestock must be prevented. The most appropriate behaviours are those of submission and social investigation (Lorenz and Coppinger, 1986). Protective behaviour relates to the ability of the dog to react adequately to strange situations and interrupt a predator attack (Lorenz and Coppinger, 1986). Each of these components was rated as either excellent, good, satisfactory or bad using the following scale of criteria:

Attentiveness: A LGD was rated excellent if it was always near the flock and accompanied its movements, was not attracted by the shepherd and exhibited appropriate social behaviours towards the livestock (e.g. submission, allo-grooming and social investigating, attentive and curious about the livestock, excitement when reunited with and not afraid of the stock). It was considered inattentive if it did not stay with the flock and did not exhibit behaviours indicative of having established social bonds with the animals in their flock.

Trustworthiness: A LGD was rated excellent if it never injured or disturbed the livestock (even during the younger developmental phases). It was considered bad if it killed or seriously injured animals in the flocks and continued to do so after adulthood.

Protectiveness: A LGD was considered to be excellent if it was mostly vigilant and alert to what was happening around the flock, reacted to abnormal livestock behaviour and strange situations around the flock including the presence of outsiders or unfamiliar livestock, barking and alerting to their presence, approaching and chasing intruders, but returning



swiftly to the flock. A bad LGD was one which did not alert to the presence of strange elements and did not approach them to investigate.

2.4.2. Farmer satisfaction and perceived effectiveness

Assessing farmers' opinions is a good way to evaluate the success of the measure, since the implementation of damage prevention measures depends on their acceptance by farmers, which is ultimately based on their efficiency, but also on the effort and costs involved. Farmers were asked about the general performance of the dogs and about each behaviour component, and their degree of satisfaction with them. They were asked to assess this using a four-point scale, ranging from Excellent/Very Satisfied to Bad/Unsatisfied.

3. Results and Discussion

3.1. Holding characteristics and husbandry systems

LGDs were added to the 48 selected flocks of sheep (79%), goats (19%) or in one case of cattle (Table 1, Fig. 3). Flocks ranged in size from 50 to 600 head, averaging 160 head, while the cattle herd had 26 cows.

During winter, flocks were either confined to stables (52%) or kept in fences (48%) during the night. From March to October, 31% of the flocks were kept in fenced pastures during the night and the hottest



Fig. 3. Most dogs were placed with sheep, but some with goats.



Fig. 5. Some flocks were kept in fenced pastures during the hottest hours of the day.

hours of the day; 71% grazed also during the night (Fig. 4). The cattle herd was always kept in fenced pastures. An average of 2.6 adult LGDs, including the dogs donated by the LGD Programme, were present per flock (ranging from 1-5, with an average of 69 head/dog), accompanied by one herding dog on average (Fig. 5). Hunting dogs were also present in nine flocks which, according to the farmers, allowed them to get some exercise and, since they investigated a wide area around the flock, helped the work of the LGDs by providing early warning of the presence of strange animals, and as an additional benefit could even catch some small game.

3.2. Dogs donated

A total of 72 dogs, 88% of them Transmontano Mastiffs, were donated (Table 1, Fig. 1). One to three



Fig. 4. Flocks were usually accompanied by a herding dog.

Table 1. Dogs donated per type of livestock species.

Breeds	Litters	Males	Females	Total Dogs	Cows	Sheep	Goats	Total Farms
Transmontano Mastiff	32	32	31	63	0	37	7	44
Estrela Mountain Dog	8	3	5	8	0	1	2	3
Castro Laboreiro Dog	1	1	0	1	1	0	0	1
Total	41	36	36	72	1	38	9	48

dogs were placed per flock, and if both male and female were donated together they belonged to the same breed but were unrelated. Pups were selected from 41 litters descending mostly from working dogs (78%) (Fig. 6). Dogs were kept intact and breeding was controlled by confining the females in heat.

**Fig. 6.** Selected pups descended mostly from working stock.

3.3. Health and mortality

A total of 39 cases required veterinary assistance, mostly to treat light wounds and traumas including bites from other dogs (11 cases), which is normal in these working dogs, but a few cases of mange (9), tick-borne diseases (4), and gastrointestinal prob-

lems (3) were also treated. Some dogs were found to be infested with thelazias (8), or leishmania (2), and treated accordingly. Thelaziosis is caused by an eyeworm and can lead to blindness. It is spreading in Europe, having been identified for the first time six years ago in Portugal, and is currently very prevalent in the study area (Vieira et al., 2012). Leishmaniasis are endemic to the Mediterranean region and, if not treated, can result in multi-system failure and frequently death. Both parasites are transmitted by flies, and are increasing in prevalence and range as a consequence of global warming (WHO, 2010;Vieira et al., 2012), as are tick-borne diseases (Sainz et al., 2015).

So far 26% of dogs placed by the LGD Programme have died or disappeared, eight of them males and 11 females. The average age of mortality was 20 months. The main known causes of death were road accidents (26%) and disease (16%). One dog died due to injuries caused by a wild boar and there were two cases of suspected poisoning. The latter diagnosis was based on clinical symptoms exhibited by the dog, since it was not possible to confirm the presence of toxins through laboratory analysis. In two cases the cause of death could not be determined while a further 6 dogs simply disappeared.

3.4. Dog behaviour

A total of 46 LGDs in 32 flocks were evaluated: 26 males and 20 females, 40 of which were Transmontano Mastiffs. Almost all dogs scored good-excellent for attentiveness to livestock (98%), trustworthiness (98%) and protectiveness (93%) (Fig. 7).

3.4.1. Behaviour problems

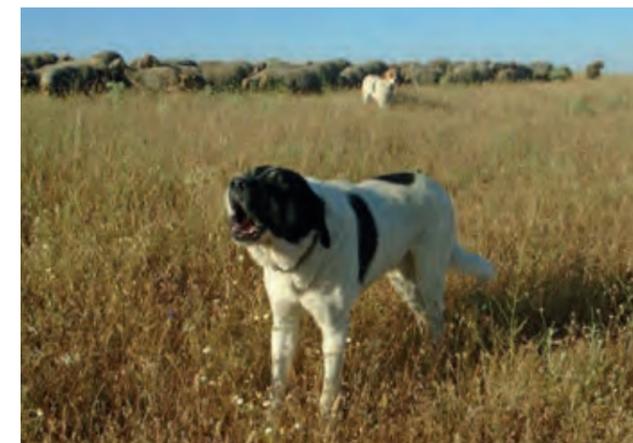
Wildlife chasing

Most LGDs (91%) were reported to chase wildlife, especially foxes (89%), wild boar or roe deer (72%) and rabbits/hares (42%). Chases were of shorter duration in the case of smaller species such as rabbits. Chasing bigger game could last longer and usually involved several dogs. In some cases, the presence of hunting dogs seemed to stimulate this behaviour and farmers may have encouraged them to catch wild boar.

Sixteen LGDs (35%) were observed killing wildlife, mainly wild boar or roe deer (17%), foxes (15%), and rabbits/hares (13%).

Aggressiveness to people and other dogs

Some farmers mentioned problems of aggressiveness towards other dogs with 11 LGDs (24%) chasing and attacking dogs that approached the flock, in three cases resulting in the death of the other dogs. LGDs usually barked at unfamiliar people, sometimes approaching but seldom showing any aggressiveness (Fig. 8). On one occasion a juvenile dog (7-8 months old) jumped onto a person that was passing through the flock, but without biting or causing injuries.

**Fig. 8.** LGDs usually responded to the presence of unfamiliar people by barking and approaching, but seldom with aggression.

3.5. Farmer satisfaction and perceived effectiveness

Farmers rated most dogs (96%) as having an excellent or good performance, and none was considered bad. Specifically, most dogs were rated excellent-good in attentiveness (98%), trustworthiness (96%), and protectiveness (96%).

Farmers were also satisfied-very satisfied (96%) with their dogs. Only two were less satisfied: one because the dog in question chased cars and in the other case the dog had difficulty in accompanying the flock due to a debilitating disease (leishmaniasis).

**Fig. 7.** Most dogs were attentive and trustworthy to livestock, not disturbing and accompanying the flocks' movements, as well as protective, being alert and chasing intruders away from the flock.

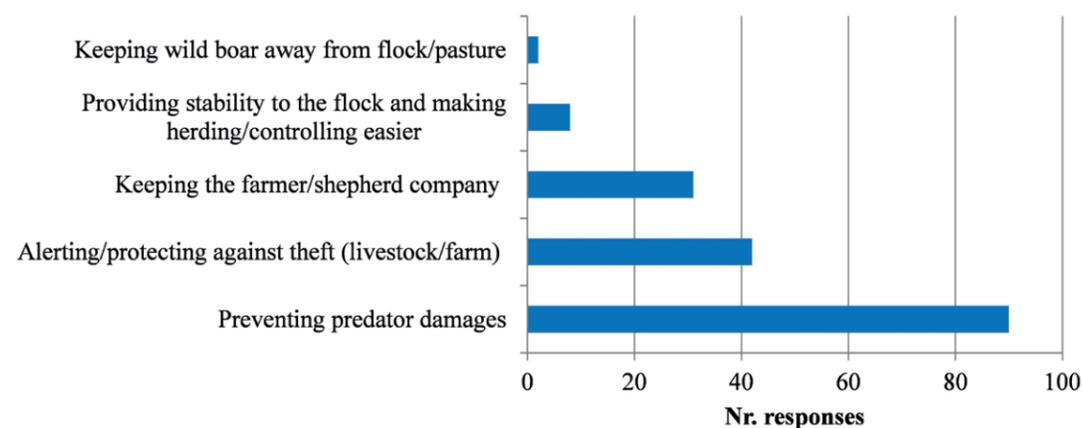


Fig. 9. Advantages mentioned by farmers regarding the use of LGDs.

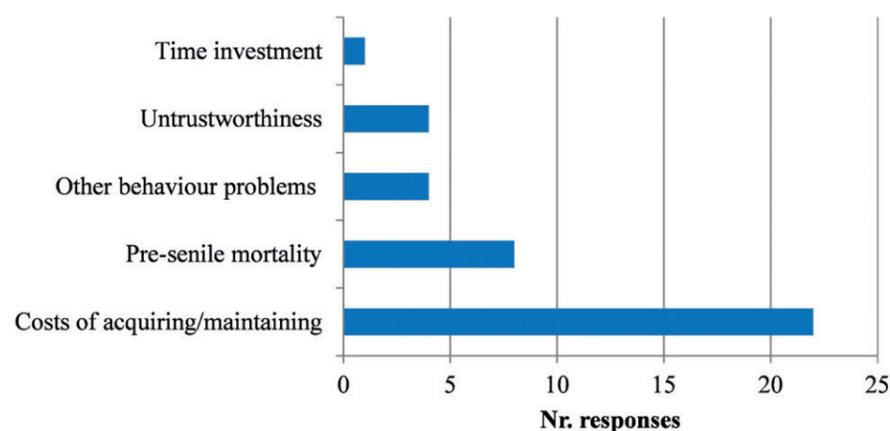


Fig.10. Disadvantages mentioned by farmers regarding the use of LGDs.

3.6. Advantages and disadvantages of using LGDs

Of the 169 farmers who were asked this question, 67% provided one or more answers regarding the advantages of using LGDs, and only 20% identified one or more disadvantages. Of those who identified advantages, 79% mentioned prevention of predator-caused damages (by wolves, but also foxes and stray dogs) as one of the main advantages of using LGDs (Fig. 9). Alerting and protecting against theft of livestock and guarding the farm was mentioned by 37% of farmers. Other advantages included keeping the farmer or shepherd company (27%), and providing stability to the flock and making herding/controlling easier (7%). Two farmers mentioned LGDs were also useful for keeping wild boar away from the flock.

Concerning disadvantages, the cost of acquiring and maintaining dogs (food and veterinary care) was mentioned by 56% of respondents, and pre-senile mortality by 21%, while untrustworthy behaviour (disturbing/injuring livestock) and other behaviour-

al problems (shyness or aggressiveness towards people, car chasing, damaging neighbours' vineyards/orchards) were each mentioned by 10%. Time investment was mentioned only once (Fig. 10).

4. Discussion and management implications

Farms in our study were at the edge of current wolf range, hence only a minority suffered predation. Nevertheless, the majority of farmers considered the advantages of having LGDs to outweigh the costs and they were interested in maintaining them in their flocks.

The behaviour analysis reveals that dogs performed well, which was also supported by the assessment and satisfaction of farmers. Our scores for dog behaviour are similar to those obtained in other regions of Portugal (Ribeiro and Petrucci-Fonseca, 2005), but higher than those obtained elsewhere (Coppinger et al., 1988; Marker et al., 2005). However, since this concerns

qualitative data from studies conducted in different conditions, comparisons should be considered with caution. We found a much higher degree of satisfaction with LGDs among farmers in NE Portugal than was reported in Namibia (Marker et al., 2005), though only slightly higher in comparison to other regions of Portugal (Ribeiro and Petrucci-Fonseca, 2005).

Chasing wildlife was more frequent than observed in Namibia (Marker et al., 2005), but similar to that found in Norway (Hansen and Smith, 1999) and in other regions of Portugal (Ribeiro and Petrucci-Fonseca, 2005). The killing of wildlife was much more frequent in our study compared to others (Ribeiro and Petrucci-Fonseca, 2005; Potgieter et al., 2016). These behaviours may be dependent on wildlife density and diversity, as well as the type of terrain and vegetation that may influence its onset and outcome. In areas with higher densities of game, chasing is expected to be more frequent and thus the probability of killing of game is also expected to be higher.

While deterring foxes and wild boar may be useful to farmers, chasing or even killing game species may result in conflicts with hunters and have an impact on their populations, especially when small. However, chasing wild ungulates away from the flock and the pastures can reduce potential damages they cause to pastures and agriculture fields, prevent harassment and even attacks or injuries to livestock and reduce the risk of disease transmission (VerCauteren et al. 2012). Nonetheless, this behaviour should be controlled by the shepherd to avoid wildlife mortality, injuries to the dogs and reduce the time that LGDs are away from or less attentive to livestock.

The proportion of LGDs lost to pre-senile mortality (<10 years of age) during the 3.5 years of our study (26%) was similar to that reported during longer periods in other regions of Portugal (Ribeiro and Petrucci-Fonseca, 2005: 26% in 7.5 years) as well as in South Africa (Rust et al., 2013: 22% in 6 years). However, mortality is usually higher in the first years of working dogs' lives (Lorenz et al., 1986), i.e. the period covered by our study.

Disease was a significant cause of mortality despite the provision of veterinary care and, together with road accidents, endemic diseases can limit dog survival and efficiency in this region. In regions where the prevalence of such diseases is high, financial aid should be higher to compensate the increase in prophylactic and treatment expenses, as well as the higher mortality rate.

The LGD Programme in Portugal has achieved good results thanks to the support it provides, but also due to the existing knowledge and high motivation of farmers to use LGDs. In areas where the practice of using LGDs was lost, reintroducing these dogs is harder, due to the lack of motivation, experience, knowledge and affinity towards these dogs by the farmers and the local community. It is thus important to promote their use in areas where wolves have disappeared and where its future expansion is expected, in order to ensure the use of LGDs is not disrupted. In such areas, since the maintenance cost of LGDs can be a constraint, financial aids should be in place to allow farmers to be prepared in advance of wolf recovery since LGDs may take some time to implement.



Photo: Joaquim Pedro Ferreira.

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Research paper

LIVESTOCK GUARDING DOGS IN GEORGIA: A TRADITION IN NEED OF SAVING?

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1. Introduction

Livestock guarding dogs (LGDs) are integral to the herding traditions of the Tushetian pastoralists of East Georgia (Fig. 1). Largely a sheep-breeding community, the Tush have practised transhumance for centuries, moving their flocks between the Greater Caucasus Mountains in summer and various lowland pastures in winter. Livestock breeding continues to be their main economic activity today.

The Georgian Mountain Dog, recognised by the Cynological Federation of Georgia (though not yet by the Fédération Cynologique Internationale, FCI), has been described as an ‘ancient’ natural breed, the ‘ancestor’ of many other Molossian-type dogs and the ‘real’ Caucasian Shepherd Dog, which was popularised and registered with the FCI by the Soviets (Beradze, 2003; Sicard, 2003). According to the breed standard¹, the Georgian Mountain Dog, also known as the Georgian Shepherd Dog or locally as Kartuli Nagazi, is large and robust, with a shoulder height of at least 65 cm in males and 60 cm in females. It

has strong bones and musculature, a large head, short neck and powerful body. The short, coarse coat has several colour varieties. Although there are regional variations within Georgia, the greatest value is placed on the Tushetian Nagazi.



Fig. 1. Livestock guarding dog with flock in Georgia. Photo: Robin Rigg/FFI.

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¹ www.fcg.ge/eng/index.php?option=com_content&view=article&id=25:georgian-mountain-dog&catid=2:static-page

Fig. 2. Shepherds, livestock and guarding dogs completing the annual migration from the Caucasus to winter pastures in Vashlovani, East Georgia. Photo: Robin Rigg/FFI.



Political changes and economic development have had major impacts on the Tushetians' transhumant lifestyle. During the Soviet period, many of them were coerced into resettling (Mühlfried, 2010). Whereas many livestock owners and shepherds once crossed from their homeland in Tusheti into neighbouring Dagestan, since the dissolution of the Soviet Union transboundary transhumance is no longer possible, reducing the availability of lowland winter pastures to the herders. The majority now take their flocks from the Greater Caucasus Mountains to the semi-arid grasslands of Vashlovani in East Georgia, bordering Azerbaijan (Fig. 2). Even this route is being encroached upon by settlers and cultivation of the surrounding land (Anthem, 2009).

As well as limiting access to traditional migration routes, Georgia's recent history is thought to have affected other aspects of Tusheti pastoralism. Current shepherding practises have been criticised, with poor livestock management thought to result in overgrazing of winter pastures (Gintzburger et al., 2012) and high livestock mortality, including substantial losses to predators. Moreover, some Georgian cynologists believe that the quality of the Georgian Caucasian Sheep Dog has decreased due to crossbreeding, inbreeding and export of the best dogs to the former Soviet Union, where they were used as military patrol dogs and show dogs (Sicard, 2003). Traditional knowledge, including how to raise attentive, trustworthy and protective LGDs, is said to have declined in recent years (Kikvidze and Te-

vzadze, 2015). According to the Bombora Caucasian Sheep Dog Club and the Caucasian and Georgian Sheep Dog Developing and Revival Union, the breed is 'close to disappearing in its natural environment' (G. Goldthorpe, unpublished data).

The Georgian Carnivore Conservation Project (GCCP), a joint initiative between Fauna & Flora International and NACRES Centre for Biodiversity Conservation & Research, began work in Tusheti and Vashlovani in early 2009 with the goal of improving the conservation status of large carnivores as key components of the region's unique and globally important biodiversity (Zazanashvili and Mallon, 2009). Unregulated hunting following the collapse of the Soviet Union in 1991 precipitated major reductions in wildlife populations (Bragina et al., 2015), whilst the large-scale abandonment of agricultural land in Georgia led to an expansion of available wolf habitat (Goldthorpe, 2016). In areas where natural prey has been depleted, wild carnivores tend to shift to livestock and come into conflict with people (Sillero-Zubiri et al., 2007). Human-carnivore conflict (HCC) typically has a negative impact on attitudes towards the implicated species and their management and may result in retaliatory killings, with consequences for wildlife conservation and the integrity of associated protected areas (Woodroffe et al., 2005). HCC was therefore identified as an important issue for the GCCP to address in partnership with the Tushetian community.



Fig. 3. Locations of Vashlovani (VNP) and Tusheti National Parks in the Kakheti Region of East Georgia.

As part of the GCCP, we undertook a baseline survey of livestock husbandry and HCC in East Georgia. We characterized contemporary livestock farming practices in the winter range, quantified depredation in comparison with other causes of livestock mortality and assessed the use of damage prevention measures. We also conducted a survey of attitudes to large carnivores and their management (Rigg and Sillero-Zubiri, 2010a). Here, we report our findings on the status and effectiveness of LGDs in East Georgia.

2. Materials and methods

2.1. Study area

We conducted our study in and around Vashlovani Protected Areas (VPA) in the Dedoplistskaro District of East Georgia (Fig. 3). In winter, when high-altitude pastures in the Caucasus are inaccessible due to deep snow, VPA and surrounding areas are used extensively by Tusheti pastoralists for grazing sheep, goats and cattle (Fig. 4). Wool and lambs, primarily for export, are the main sheep products in winter, whilst cows from a few permanent dairy farms are used to produce milk, cheese and meat.

The main vegetation types in VPA are: open arid forests dominated by pistacieta (*Pistacia mutica*) mixed with juniperita (*Juniperus foetidissima* and *J. polycarpos*); open scrub habitat typified by low

and dense, drought-resistant small trees and shrubs; semi-desert occurring on foothills and dominated by *Artemisieta phytocoenosis*; steppe vegetation dominated by Gramineae; and an area of mountain forest dominated by *Quercus iberica*, *Acer ibericum* and *A. campestre* (Kikodze, 2007; Gintzburger et al., 2012). Elevations range from 90 to 708 m a.s.l., and the area has a dry climate. Livestock grazing is forbidden in Vashlovani Strict Nature Reserve (110 km²), but widespread in the remainder of the National Park (240 km²) and surrounding Eldari Lowland, Patara Shiraki and Iori Steppe, where there are mostly open grasslands.

Vashlovani supports a rich array of wildlife, including 35 species listed in the Georgia Red Book (MENRPG, 2013). There is a diverse guild of carnivores, including the grey wolf (*Canis lupus*), brown bear (*Ursus arctos*), Eurasian lynx (*Lynx lynx*) and golden jackal (*Canis aureus*). Few data on wolves in Vashlovani were available at the time of our study, but packs seemed to be relatively small (2–5 adults). Since



Fig. 4. Livestock grazing in Vashlovani NP, Georgia. Photo: Robin Rigg/FFI.

the 1990s poaching has drastically reduced wild ungulate populations, with wild boar (*Sus scrofa*) being the only extant species. The goitered gazelle (*Gazella subgutturo*) was extirpated in the mid-20th century (APA, 2011; Anon., 2014).

2.2. Farm survey

Data on livestock, husbandry, damage prevention measures, predator attacks and losses were gathered using a semi-structured interview protocol based on a similar study in Slovakia (Rigg, 2004), revised and tailored to the specific objectives of the present study (Rigg and Sillero-Zubiri, 2010a). Potential questions for the survey were piloted with the aid of an interpreter during informal interviews with livestock owners (defined as owning ≥ 100 sheep/goats or ≥ 15 cattle/horses) as well as hired shepherds (tended livestock on a daily basis but owned $\leq 10\%$ of the herd/flock) at eight farms in and around VPA in December 2009.

For the full survey, we prepared a face-to-face interview protocol which was tested and finalised in February–March 2010. The final protocol contained a total of 74 items, including the following about LGDs: how many were at the farm (adults and juveniles < 1 year old); the breed or variety (Caucasian, Georgian, mixed or other); where they were obtained; how they were

trained; and the respondent's rating of their working ability (good, partially good or not good).

An interviewer was recruited on the basis of prior experience working with rural communities in Georgia. Training in the specifics of the current survey was provided. Emphasis was placed on best practice to minimise observer bias (e.g. Rubin and Rubin, 1995; Leech, 2002), the interviewer being instructed not to share personal experiences or views and to use neutral probes and prompts to maximize the information obtained. Phrasing of questions was kept short, straightforward and clear. Jargon and leading questions were avoided.

Using a database of livestock farms developed by VPA administration and augmented by the GCCP, in March 2010 the interviewer visited all active farms within VPA and up to 2 km from its periphery. The basic sampling unit was the farm (Fig. 5): if more than one livestock owner or shepherd contributed answers at the same farm their responses were pooled and treated as a single 'respondent'. After eliminating farms that were either permanently abandoned or unoccupied in the current season, a total of 69 GPS-referenced farms were included in the survey, which was conducted towards the end of the grazing season. In the winter pastures, livestock owners typically aggregate their



Fig. 5. Typical livestock farm in Vashlovani, East Georgia. Photo: Robin Rigg/FFI.



Fig. 6. Interviewing livestock owners in Vashlovani. Photo: Robin Rigg/FFI.

flocks and each farm had, on average, three owners with a total of 848 sheep, 23 goats, 77 cattle and 14 horses tended by three hired shepherds. The interviewer used individual datasheets to record responses to survey questions and make additional notes (Fig. 6). Statistical analyses were carried out using SAS/STAT[®] 9.3 (SAS Institute Inc., Cary, NC, USA) and PASW[®] Statistics 18 (SPSS Inc., Chicago, IL, USA). Null hypotheses (H0) were rejected at $\alpha=0.05$.

3. Results

LGDs were ubiquitous in the study area, with at least one at every farm (mean=7.8, SD=4.8). We documented a total of 525 dogs: 376 adults and 149 juveniles. Respondents most often described their dogs as being of 'mixed' descent (66%), with a minority claiming to have either Georgian (25%) or Caucasian (10%) Shepherd Dogs or a combination of pure and mixed breed (4%). Most dogs were reported to originate from on-farm breeding (82%), with some exchanged (9%) or given as gifts (9%).

Usually no special regime for training LGDs was described, with most respondents claiming that dogs learned what to do by themselves (40%), from being brought up with the flock (31%) or from older dogs (25%). Only two respondents mentioned specific actions to train dogs: promoting attentiveness by encouraging dogs to accompany the flock and feeding them near livestock. Spaying/neutering of dogs was not normal practice in the Tushetian community.

A large majority of respondents rated their dogs as good (61%) or partially good (22%). They considered good dogs to be attentive to livestock (51%),

aggressive to predators (12%) and unafraid of wolves (7%). Partially good dogs were regarded as not being attentive enough (38%), insufficiently protective (33%) or attentive but afraid of predators (19%). At five farms, respondents stated that their dogs (some or all of which were described as 'mixed breeds' that had bred at the farm) were not good, citing lack of attentiveness (2), the dogs' fear of wolves (1), poor breeding (1) or a failure to train them as pups (1).

Respondents provided details of 105 attacks by predators on livestock that occurred during the current grazing season. Most of them were reported to have occurred in the afternoon or at dusk, typically when flocks were in the pasture (69%). Dogs were said to have been present during 62% of attacks, to which they were alleged to have responded by chasing and barking ($\geq 90\%$). In two cases respondents stated that their dogs had killed an attacking wolf; one of these assertions was corroborated by the remains of a dead wolf and an injured dog with major facial injuries seen at the farm (Fig. 7).

Although only four cases were reported in which dogs and shepherds were said to have successfully repelled wolves without loss of livestock, higher dog/sheep ratios were associated with lower levels of damage (Fig. 8).



Fig. 7. Remains of a grey wolf (top) apparently killed by livestock guarding dogs, one of which was seriously injured (bottom), at a farm in Vashlovani, East Georgia, in 2010. Photos: Aleco Baghdadze/FFI.

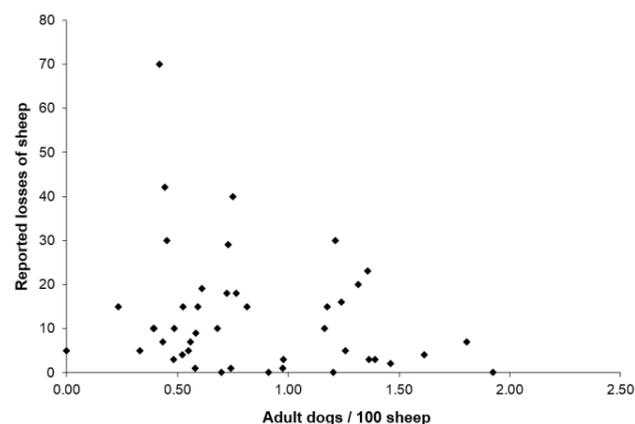


Fig. 8. Number of adult dogs per 100 sheep and reported losses to predation during the winter 2009–2010 season at 69 farms in and around Vashlovani Protected Areas, East Georgia.

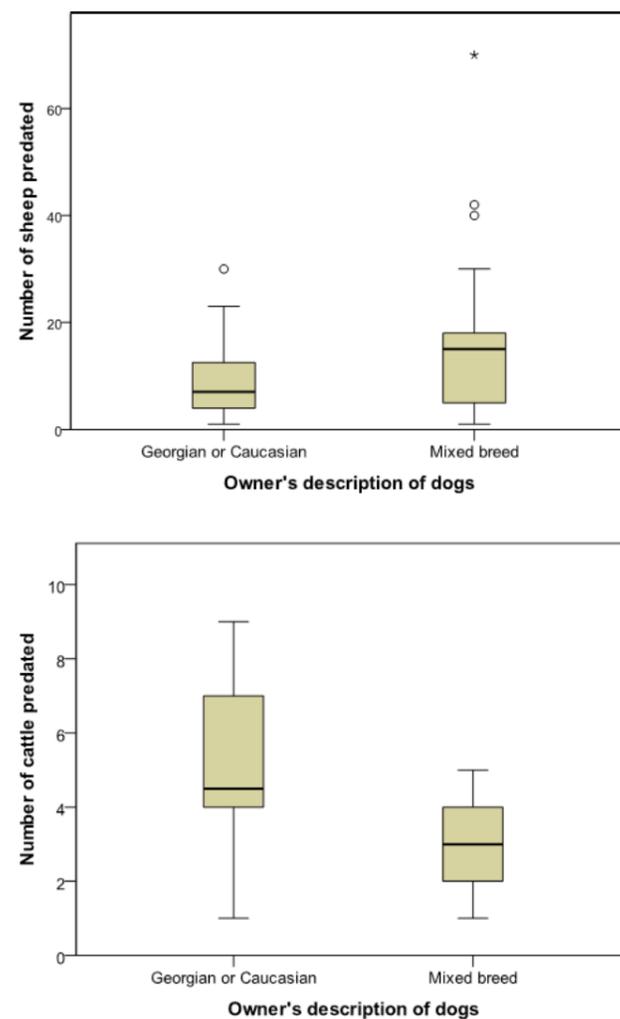


Fig. 9. Reported losses to predators (mainly wolves) of cattle and sheep during the winter 2009–2010 season at farms with 'pure-bred' versus 'mixed' dogs in and around Vashlovani Protected Areas, East Georgia.

There was a tendency for owners of 'pure-bred' dogs to be more satisfied with their performance (Mann-Whitney U test, $U=247.500$, $P=0.001$), even though such dogs were not associated with fewer reported losses (all livestock combined, Mann-Whitney U test, $U=388.000$, $P=0.294$). Neither were owners' ratings of dogs correlated with reported losses (Kruskal-Wallis test, $\chi^2=1.613$, $df=2$, $p=0.446$). However, there was some evidence, though not statistically significant, that mixed breed dogs were better at defending cattle while pure-bred dogs were possibly slightly more effective with sheep (Fig. 9).

4. Discussion

The ability of livestock guarding dogs to protect livestock from predators has been documented in a range of settings (reviewed in Rigg, 2001; Gehring et al., 2010). Although we found that their use in East Georgia did not prevent losses, the percentage of livestock depredated at farms in our study area (1.3% killed, 0.2% injured) was only slightly higher than generally found in Europe (Kaczensky, 1999), despite the presence of a diverse predator guild and a paucity of wild prey. Damage was spread across a high proportion of farms (Rigg et al., in prep.), similar to the pattern found in central Greece, where stocking densities of sheep and cattle were comparable to Vashlovani in winter and represented the only abundant food for wolves due to human-caused depletion of wild prey populations (Iliopoulos et al., 2009). We suspect that in such circumstances losses would be much higher if prevention measures such as LGDs were not used.

During our fieldwork, we frequently encountered dogs away from flocks. Livestock owners and shepherds stated that LGDs were often absent during attacks by predators, most of which occurred during daylight hours (Rigg et al., in prep.). Wolves may have been observing flocks and waiting for opportunities, such as when LGDs left to seek food at farm buildings. Watchful behaviour by wolves has also been reported by shepherds in Slovakia (Rigg, 2004) and Portugal (S. Ribeiro, personal communication). Insufficient attentiveness (cf. Mertens and Schneider, 2005) may explain why the majority of attacks in Vashlovani were reported to occur when flocks were in pastures (not necessarily always accompanied by dogs), rather than under cover of darkness, when livestock was gathered in corrals close to farm buildings, presumably where LGDs were most likely to spend the night.

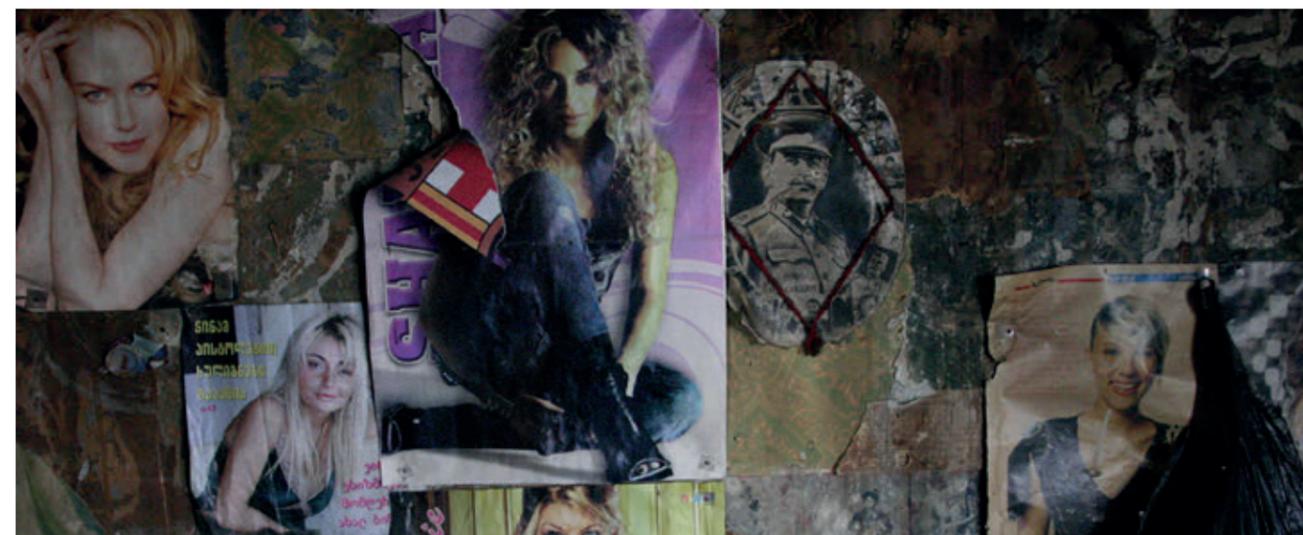


Fig. 10. A portrait of Joseph Stalin at a livestock farm in East Georgia in 2010. Photo: Robin Rigg/FFI.

In our study, higher dog/sheep ratios were associated with fewer losses of sheep. Iliopoulos et al. (2009) postulated that if the number of LGDs with a flock exceeds a certain threshold their effectiveness declines, as large numbers of dogs may result in poor nutrition, lack of appropriate training and undesirable behavioural traits. Farms in our study had up to 17 adult dogs. Instead of keeping a large, uncontrolled number of dogs, maintaining an 'optimal' number of well-trained LGDs from proven working parents, adapted to flock size and attentive to livestock, may result in more effective protection of livestock while also reducing costs. In Greece, the optimal number was shown to be 3–4 LGDs in flocks of 100 animals rising to 7–9 in flocks of 500–1,000 (Iliopoulos et al., 2009). This suggests that the average number of dogs we found at farms in Vashlovani was appropriate, although it was not clear if there were sufficient LGDs to adequately cover all livestock when flocks were subdivided for management purposes.

Issues of breed identity and origin have been somewhat politicized. The standard accepted by the Cynological Federation of Georgia in 2000 describes the Georgian Mountain Dog as originating in the northeast mountains of Georgia, which include Tusheti. On the other hand, the FCI standard for the Caucasian Shepherd Dog (*Kavkazskaia Ovtcharka*), first published in 1985, gathered several types, including Georgian dogs, within a single 'breed' that was claimed to originate in Russia i.e. the Soviet Union, of which Georgia was then a part. Interestingly, Joseph Stalin (born Dzhugashvili), leader of the Soviet Union until 1953, was an ethnic Georgian and is still revered by some Tushetian pastoralists (Fig. 10), des-

pite his part in the Red Army invasion of Georgia in 1921 and the impact of subsequent Soviet policies on their cultural heritage.

At the time of our study there were breeding programmes in Georgia aiming to 'save' the 'pure' Georgian Shepherd Dog and 'return it to nature', i.e. to work on farms. The standardised, selective breeding of kennel and breed clubs emphasises size, coat colour and other phenotypic traits considered desirable for show, pet or guard dogs but which are of less relevance to farm dogs. Regional varieties (*landraces*) of LGD, many of which are nowadays termed breeds, probably arose by processes closer to natural selection than artificial selection, as transhumant shepherds lack the means to conduct planned breeding programmes (Coppinger and Coppinger, 2001). Notwithstanding the pessimistic prognosis of Georgian cynologists, we found the use of LGDs to be ongoing and widespread in East Georgia: all 69 farms we surveyed in 2010 had at least one, with an average of eight per farm.

According to our survey results, livestock owners with pure-bred dogs were more satisfied with their performance than those who said they had mixed dogs. However, we found no significant relation between reported losses and either how owners rated their dogs or if they described them as 'pure' versus 'mixed breed'. Moreover, during informal pilot interviews prior to the survey, several livestock owners and shepherds had rated non-pure dogs as superior on the basis that they were 'faster'.

Coppinger and Coppinger (1995) and others have emphasised the deterrent effect of LGD presence and their supposedly ritualised, non-violent interactions



Fig. 11. A livestock guarding dog in East Georgia wearing a spiked metal collar as protection from wolves. Photo: Robin Rigg/FFI.

with wolves, dismissing the use of protective collars fitted by owners to LGDs in many regions, including East Georgia (Fig. 11), as status symbols and machismo. However, we found evidence of LGDs occasionally fighting with, being injured by and even killing wolves. Since our baseline survey was conducted, the GCCP has documented two cases in which wolves fitted with telemetry collars were probably killed by dogs (Fig. 12). LGDs have also killed wolves and other predators in Bulgaria (Sedefchev, 2005), Turkey (R. Rigg, unpublished data) and elsewhere. It therefore seems that LGDs are not necessarily always a non-lethal measure, which has clear implications for conservation management, especially where rare and protected species are involved.

5. Follow-up work

Based on the survey results, we developed a strategy to mitigate human–carnivore conflict in East Georgia, drawing on approaches that have been successful in comparable situations elsewhere (Rigg and Sillero-Zubiri, 2010b). In 2011 the GCCP established a HCC response team to investigate instances of predation, assist with damage prevention and improve access to veterinary care. The response team also initiated annual surveys of livestock husbandry and losses to predators and other causes in Vashlovani.



Fig. 12. Carcass of a telemetry-collared male wolf probably killed by livestock guarding dogs in East Georgia, November 2010. Photo: Gareth Goldthorpe/FFI.

Improving the attentiveness of adult dogs can be problematic and requires a patient and consistent approach. Success is more likely to be achieved if starting with young pups. As part of a suite of initiatives to address HCC in Vashlovani, the GCCP initiated a pilot study in 2011–2012 aimed at improving methods used within the Tusheti community for rearing LGDs. A manual of best practices was prepared for the long-term use of Georgian sheep breeders (Rigg, 2011a). Training in socialisation and husbandry techniques was provided to members of the HCC response team as well as participating livestock owners and shepherds in Vashlovani (Rigg, 2011b).

Although all farms included in our survey had LGDs, these were not always present during predatory attacks. In order to determine whether insufficient daytime attentiveness of LGDs is a key factor leading to losses in East Georgia, more systematic and intensive study of dogs and flocks would be necessary. Data could be gathered either by direct observations (e.g. from a vehicle or horseback) using a focal observation protocol (e.g. Rigg, 2012) or by fitting a sample of dogs and livestock with tracking devices to record their relative positions (Ribeiro et al., in this issue). It could also be revealing to investigate relationships between dogs and what influence these might have on the effectiveness of LGDs at repelling predators.

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THE EVOLVING USE OF LGDs IN WESTERN CANADA

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1. Introduction

Livestock guarding dogs (LGDs) arose within ancient shepherding systems. Whether in the mountains of Macedonia, the plains of central Asia or the steppes of Turkey, the traditional way such dogs were worked was a simple system based on shepherding (Fig. 1). The

dogs would accompany a shepherd and his flock to the grazing areas. This could be in the form of a seasonal transhumance, with the shepherds spending the entire summer away from home to ensure the sheep had enough food, or the trek would be a daily occur-



Fig. 1. Shepherd, flock, and dog head out to graze in a traditional shepherding system in Macedonia. Photo: Louise Liebenberg.

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Fig. 2. LGD being bonded to cattle in Canada. Photo: Louise Liebenberg.

rence to a close mountain or communal pasture. Winters were spent in villages. The shepherds ran multiple dogs, often in cohesive family packs. These dogs were free-roaming in the pasture but always close to the flock and shepherd as an integral part of pastoral life.

Less than 50 years ago, barely anyone in North America knew about LGDs and even fewer used them within their livestock operations. The wolf (*Canis lupus*) had for the most part been extirpated in the United States, with a few scattered populations surviving in the northern states bordering Canada. Ranchers had become accustomed to not having to deal with wolves and problems that arose with other predators were devolved to various government agencies to deal with. This led to a situation where looking after livestock became the government's responsibility rather than that of the rancher.

In Western Canada, too, predators were dealt with by killing them, which was encouraged through payment of bounties. In 1824, an interview was conducted with Mr. Alexander Brown who noted that, "wolves, though unknown in Britain, are very destructive to flocks in most places in this province, I conceive the bounty offered for their destruction to be a measure of general utility." (Colonial Advocate, 1824). The exter-

mination of the predator was simply the only solution offered to prevent predation and it would take another 150 years for the use of LGDs to become established as a preventative measure against predators.

2. An Old World solution for the New World

Domesticated sheep were first brought to eastern Canada in the 1600s. In Western Canada, the sheep industry only took hold in the mid-19th century, when wool production was the primary business. Although Great Pyrenees dogs were mentioned as being present in Canada in the 17th century, there is barely any documentation of their early use as working dogs. From anecdotal reports and conversations with sheep keepers it is clear that in the late 1970s there were sheep ranchers using Komondor and Great Pyrenees dogs in Alberta. Research investigating the potential of using LGDs for livestock operations in the United States (Coppinger and Coppinger, 1978; Coppinger et al., 1988; Green and Woodruff, 1988) stimulated interest in Canada. Awareness of the "new" method spread rapidly among livestock farmers and has been promoted by the sheep industry. For example, a manual published by Alberta Agriculture and Rural De-

Fig. 3. Guardian dogs working on a migratory western range system. Photo: Cat Urbigit.



velopment concludes that, “Guard dogs are the most useful tool for reducing livestock losses to predators.” (AARD, 2010, p. 77).

By 1993, it was estimated that about half the flocks in Alberta were protected with LGDs (Acorn and Dorrance, 1998). Today, a large majority of sheep ranchers in Western Canada understand the need for LGDs, which are now commonly found on sheep ranches and in growing numbers on cattle ranches (Fig. 2). However, despite their widespread use, many producers still struggle to raise these dogs in an effective manner. History highlights how relatively new the whole concept of using guardian dogs is in Canada. There has been no generational transfer of knowledge, nor cultural history of using these dogs, so the only readily accessible ways for people to learn about LGDs has been from reading the literature and edu-

cation programmes offered by the sheep industry or various government and non-government agencies. Part of the problem can also be attributed to changes in how LGDs are expected to work under varying grazing management systems.

3. Changing grazing systems

The original role of LGDs was primarily to protect small hoofed livestock from predators, particularly wolves. This usually formed part of a shepherding management system in which a shepherd tended to and guided sheep or goats to grazing areas on a daily, or seasonal, rotation. Livestock guardian dogs were initially introduced into the USA and Canada primarily for the protection of livestock in range operations (Fig. 3). These typically involved large flocks grazing



Fig. 4. LGD with goats and turkeys. Photo: Linda Sutterfield.

vast tracts of land, some privately owned, some public land including forestry leases and communal pastures. Public lands are often in wilderness areas, where livestock is under constant predation pressure. Shepherds live in camps, often shepherd on horseback and move flocks to follow the growth of the grass. In winter the flocks, dogs and shepherds return to the homestead for lambing, before heading back to the summer grazing the following spring, a system much like the transhumance in Europe.

However, the grazing management systems in which LGDs are expected to function and the expectations of livestock owners are changing. There is a trend from shepherded flocks to more commercial, intensive or stationary based systems without full-time shepherds and, increasingly, small-scale micro-farms (very small subsistence-type farms primarily providing the immediate family with food). The demand for LGDs to protect a broader range of livestock against a greater variety of predators is increasing (Fig. 4).

A disconnect has arisen between the traditional use described in older literature on LGDs and the expectations and problems people are experiencing when raising and utilizing these dogs today. Most of the literature on how to work with these dogs is geared more to the range/shepherding system rather than the smaller stationary operations, resulting in many misconceptions or lack of understanding of how LGDs work. Guidelines for raising LGDs have

tended to promote minimising human interaction, based on the belief that LGDs needed to bond with livestock and not with humans. Additional problems such as inappropriate cross breeding, poor raising techniques, lack of selection in breeding dogs and the misconception that any breed can be trained to do the job of a LGD add to the issues with LGDs in North America.

Public opinion also now has a greater influence on how people can utilise working dogs, with concerns such as liability, sustainability and welfare becoming increasingly important. There is an informational and educational lag in meeting these new demands. Breeding and selecting LGDs which can fulfil roles, educating users with no previous farming or ranching background and incorporating the demands that today's society is placing on the care and use of working dogs all need to be addressed.

4. Predators, livestock and dogs in Canada

Predators are regarded as a major threat to livestock in Western Canada. The wolf was never extirpated and the population is robust, with estimates of 4,000 wolves in Alberta (AWA, 2017). Many ranchers must deal not only with wolves but also coyotes (*Canis latrans*), black and brown bears (*Ursus americanus*, *U. arctos*), cougars (*Puma concolor*), lynx and bobcats (*Lynx canadensis*, *L. rufus*) as well as wolverines (*Gulo gulo*).



Fig. 5. Guardian dog working in fenced pasture in Canada. Photo: Louise Liebenberg.



Fig. 6. LGD working on a large open pasture system in Canada. Photo: Louise Liebenberg.

Sheep numbers in Canada reached an all-time high in the 1930s, when there were over 3.6 million (Castonguay, 2017). Following the Second World Wars the demand for wool decreased and production focused on meat. Sheep numbers declined and grazing management became more stationary, with intensive grazing rotations on smaller fenced pastures. Sheep breeds changed to reflect the emphasis on meat production: higher growth rates, meatier carcasses and higher lamb production. Daily checks replaced full-time shepherds.

Even in a stationary, intensive system, sheep are still vulnerable to predators. Good fences, in many cases, may be sufficient to keep predators at bay, but LGDs are still the best solution to keeping flocks safe and are increasingly utilised. However, the dogs are now often expected to live alone in fenced pastures, with little interaction with people other than during routine flock checks and feeding (Fig. 5).

The requirement for LGDs to perform their job under very different circumstances than the traditional shepherding system (Fig. 6) may perhaps explain the multitude of problems that many ranchers have when raising their dogs: issues such as compulsive escaping/roaming, excessive barking, longer and rougher play periods, boredom and lack of bonding to the stock. On a

mountain top or on the steppes, there are no fences. Instead, the flock, shepherd, pack and food “tie” the dog to its area. A cohesive pack of LGDs provides support, back up, guidance and companionship. Undesirable behaviour such as rough play with the stock can be promptly corrected as the young dogs are under constant supervision of the shepherd. This is not the case in many large, fenced operations.

A new trend in LGD use is to be the protector of the micro-farm. Increasingly, people are looking to livestock guardian dog breeds to protect a handful of chickens, rabbits, a goat or mini horse on a few acres (Fig. 7). These dogs are perhaps not strictly speaking “livestock guardian dogs” anymore, but instead are expected to take on a more generalised “farm dog” role, where they co-exist with the animals on the farm and provide some general guard dog duties. Over the last decade there has been a dramatic increase in people wanting LGDs for such micro-farms, but the transition has not always been smooth.

It was never the primary job of LGDs to guard chickens and it is perhaps premature to have expectations that most LGDs will work out as poultry or rabbit guardians. Too often, advice is given to new owners that stems from the range or pasture system, that may simply be inappropriate under these micro-

-farm conditions. While larger sheep operations are advised to utilise two or more LGDs, on a micro-farm it might be a better option to build a good chicken coop. Some dogs certainly do excel at this job, and it is these dogs who should form the basis for a new generation of poultry guardians. However, demand is currently outgrowing the ability to select and breed dogs with the requisite traits. For now, in order to be successful in this situation, most dogs will require an owner to have an abundance of stock sense, practical understanding and the experience to raise them correctly.

There has also been a rise in popularity of exotic animals for niche and hobby markets. LGDs are now expected to guard alpacas, llamas, quail, reindeer and other species. In most cases the animals are barely domesticated and often their owners have little experience either in raising them or working with LGDs. In addition to protecting animals from familiar predators (e.g. wolves, bears, coyotes, foxes *Vulpes vulpes*), there is now an expectation that LGDs will also protect against a variety of other predators including raptors, ravens (*Corvus corax*), raccoons (*Procyon lotor*), mink (*Neovison vison*), weasels (*Mustela* sp.), fishers and martens (*Martes pennant*, *M. americana*) as well as stray dogs.

5. Predator-friendly farming, animal welfare and public involvement

The historical, and current, approach to reducing depredation on livestock in Western Canada is to hunt, poison, snare and trap predators close to livestock operations. Bounties are still utilised, primarily targeting wolves. There is little evidence that shows that these bounties significantly reduce depredation, but they cause animal suffering and may compromise wildlife conservation efforts (Proulx and Rodtka, 2015). Alternative, effective approaches to livestock protection are therefore greatly needed.

LGDs are being used in areas where wolves were reintroduced, returned or are protected. The idea is to provide farmers with tools to better protect their livestock, thus reducing the need for lethal control of predators. LGDs have thus become the means to promote conservation and co-existence. This reflects a significant change of mentality towards predation and livestock. Many ranchers now understand that predators are part of the landscape and, instead of trying to eradicate them, they are trying to manage their livestock better (Fig. 8). According to Susan Hosford (pers. comm.), an early user of LGDs in Alberta, predation should be viewed “like our Canadian winter: not as



Fig. 7. Maremmas guarding poultry in Australia. Photo: Jacqueline Zakharia.



Fig. 8. These seven wolf pups were born and raised in the middle of our ranch, about 300 m from our sheep and cows. It is a challenge to live with them, requiring management changes and the implementation of protective as well as aversive measures. Photo: Louise Liebenberg.

a problem to be solved, but to be managed as best as possible.” Ranchers are implementing multiple strategies to decrease the risk of predation, for example: cleaning up dead stock to avoid attracting predators; utilising better fencing strategies; monitoring weak, sick and young animals; timing lambing to avoid times when predators have their young; and shifting lambing to more intensive indoor systems.

The public are also becoming a major factor: they are more vocal on how public lands are used for grazing, demand more sustainability from producers, more co-existence with wildlife and higher welfare standards for dogs and livestock. On the other hand, there is less tolerance for barking and roaming and members of the public are generally not informed about how to deal with large dogs such as LGDs when recreating in the backcountry, forcing policy makers and owners to consider liability issues.

The public simply does not comprehend the work LGDs do, so for many, seeing a dog out in the snow, doing its job, appears to them to be neglectful as they do not understand the distinction between pet and working dogs. New laws are being put in place to ensure that all dogs (including LGDs) must be housed indoors in poor weather (e.g. Alberta Animal Protection Act¹). Welfare standards for pet dogs are thus being imposed on working dogs. Laws on the number of dogs that owners can have, compulsory spaying and neutering in certain counties, and even legislation on dangerous dogs² (Shaw, 2009) can have an impact on how and where people can utilise LGDs and this in turn, impacts the effectiveness of LGDs in protecting livestock from predators.

There is a lag between understanding how to utilise guardian dogs in this rapidly changing landscape and educating the various users of LGDs in how to

work and raise such dogs effectively. Older literature, still widely cited as “best practice”, is not relevant to most of the new roles LGDs are expected to fulfil. It does not provide enough information on how to raise and train LGDs in a world that is demanding more welfare and socialization of dogs.

6. Conclusions and recommendations

The working environment of many LGDs in North America has changed, along with various management systems. In a relatively short time period, one can see how dogs have gone from working in an extensive, pastoral system to stationary, mid-size, pasture-based farms, and now onto the homesteading micro-farm. There is a need to breed and select for dogs with the right temperament and the ability to adapt to these various management styles. Socialization of LGDs is becoming increasingly important and should be balanced with the need for dogs to bond with livestock, protect against predators and be sociable to the family.

Multifaceted education is the key. Dog breeders should focus on breeding and selecting dogs with the

correct temperaments to fulfil the needs of today’s users. The idea of semi-feral dogs is simply unacceptable to most new owners, who do not want a liability on their farm or the possibility their dog will cause injury to others. Instead, they want a more rounded dog who can fulfil the role of protector while being sociable to family and friends. Buyers must be made aware that they should find good working dogs from a reputable source and they need mentors to help raise them successfully. Ranchers need guidance in raising techniques that are applicable to the specifics of their husbandry system. The public should be taught how to behave around LGDs.

Whatever system one uses, if predators are present, there will always be a need for good dogs. The selection for dogs with the right traits to meet new challenges cannot happen overnight. Education is ongoing and better management systems are being put in place. New electronic and digital technologies are opening new possibilities for livestock protection. Guardian dogs will remain one of the best deterrents for predator management, but we need to rethink their role in our changing society so they can continue to perform effectively for many years to come.

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² www.qp.alberta.ca/documents/Acts/D03.pdf

LIVESTOCK GUARDING DOGS TODAY:

POSSIBLE SOLUTIONS TO PERCEIVED LIMITATIONS

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Exchanging experience and finding solutions to problems facing the use of livestock guarding dogs (LGDs) in modern societies were among the goals of a meeting organized in Portugal from 20th to 21st October 2015 within the scope of the LIFE MedWolf Project (www.medwolf.eu). The meeting was attended by 16 specialists from around Europe (Portugal, Spain, France, Switzerland, Italy, Croatia, Slovakia and Bulgaria), as well as from Australia and the USA.

In this article we outline constraints on the use of LGDs identified during the meeting and summarize the main solutions proposed. We have grouped the issues into 10 main topics ranging from a lack of quality dogs to personal, social, cultural, economic, time, management, technical, legal and political constraints. Guidelines on the proper raising and caring of LGDs

are not the focus of this article, since a great deal of information is already available, including on specific solutions to common problems.

1. Personal constraints

1.1. Lack of affinity with LGDs, motivation or willingness to accept responsibility for livestock protection

One major concern about the implementation of LGDs is farmers' resistance to accept responsibility to protect livestock, and their lack of motivation to use LGDs, sometimes based on a low affinity with dogs (Fig. 1). Hired shepherds who do not own the livestock under their care may be particularly reluctant to take on additional tasks required to raise LGDs.

Although the lack of motivation/affinity to dogs can be overcome with education, networking and experience, and may not be a widespread problem (dogs are common on farms, and many people in rural communities keep dogs as pets), resistance to accept responsibility to protect livestock from predators is definitely more challenging. This is frequently grounded in other motives, like the lack of experience or the additional work and costs of using LGDs and potential problems associated with their use (see below), but is mostly due to lack of acceptance of predators' presence. Further studies are needed to identify ways to improve acceptance rates of predator presence.

To increase acceptance, a participatory approach should be developed and a strategy should be drafted together with farmers. Furthermore, it is possible



Fig. 1. Affinity and motivation to use LGDs can be limited in regions where their use was not part of the traditional husbandry, contrary to what happens in Croatia, where shepherds still value the work and company of their Tornjak Dogs (Bosnian and Herzegovinian – Croatian Shepherd Dog) (top), or in Portugal, where in some regions farmers are happy to get an Estrela Mountain Dog pup (bottom).

to work to change this attitude by sharing information and raising the awareness of the community, and of farmers in particular, about the benefits of using LGDs. Economic, ethical, and welfare issues concerning wildlife and livestock can be used to convince farmers to use long-term non-lethal tools to mitigate conflicts.

Farmers' responsibilities regarding the welfare of their livestock and the need to protect them from predation should be made clear. In this case, it is also important to highlight that other measures, such as lethal predator control, despite its immediate results, may in fact be more costly, have a fleeting impact, or lead to increased damages, not guaranteeing the desired long-term damage reduction (Allen and Gonzalez, 1998; Krofel et al., 2011; McManus et al., 2015).

Good examples could be disseminated and advocated by expert farmers and, when necessary, demonstration projects implemented. Promoting engagement with farmers experienced with the use of LGDs, providing financial incentives for implementing LGDs, and providing technical support – not only about the use of LGDs but extending this to other aspects of farm management – may help increase LGD use and acceptance.

Linking monetary compensation to the use of damage prevention measures, namely LGDs, will probably facilitate this process, which should always be monitored by experienced advisors. To obtain the best possible results in LGD management, certain obligations and criteria for farmers should be prescribed.

Farmers who remain reluctant to implement mitigation measures should not be encouraged to use LGDs, since that could have negative effects on the dogs' welfare and efficiency, and consequently be detrimental to the successful implementation of this damage prevention tool. In extreme situations where a dog's welfare or upbringing is compromised, facilitating transfer of the LGD to another farmer might be the best option.

2. Social constraints

2.1. Conflicts with the community

The deployment of LGDs has the potential to create conflict with other interest groups, which may constrain the use of LGDs. This constraint, which could be grounded in the lack of knowledge and experience with LGDs, could lead to inappropriate behaviours, and which could be aided by societies' intolerance and prejudices towards dogs, may surface



Fig. 2. Educational materials produced in France and Bulgaria to inform children and adults on the function and behaviour of LGDs and how to behave in their presence.

in some situations and regions. This is evident in areas with high human presence, particularly in areas with high tourism. Even in less populated areas, conflicts may also occur with neighbours, other farmers, or hunters. Each conflict should be assessed in order to help devise best practices and reach coexistence between all activities, both traditional and more contemporary.

Solutions involve education and communication actions, as well as the selection and training of dogs. Ideally, education and outreach could be conducted in advance of dogs being placed. Communication campaigns directed to the community could provide information about the function and behaviour of LGDs, and on how to behave in their presence. Specific initiatives already exist in some countries. For example, in France a comic was produced by Direction Départementale des Territoires des Alpes de Haute-Provence (DDT 04) to inform children and adults on the function of LGDs and how to behave in their presence, which was later adapted in other countries, like Switzerland (Fig. 2).

In Portugal, Grupo Lobo and dog breed clubs organize talks and visits of LGDs to schools to interact with children and to teach them about how they work (Fig. 3), and in Bulgaria, Semperviva and



Fig. 3. LGDs visit schools to teach children about their important work and how they should relate with these dogs. Such actions are frequently developed in Portugal, either by Grupo Lobo, in collaboration with local farmers and dog breeders, but also by dog breeders.



Fig. 4. Examples of signs used in different countries to warn about the presence of LGDs in the pastures with livestock, and inform on how to behave in their presence to avoid interfering with their work and prevent potential conflicts (left to right: Switzerland, Italy and Australia).

the Balkani Wildlife Society, developed an exhibit and an activities' book for children focusing on large carnivores and the role of LGDs (Fig. 2). Similar initiatives and programmes could be made mandatory in other regions where LGDs are used. Such campaigns could be complemented with warning signs about the presence of LGDs in pastures, and also schematic information on how to behave and handle other dogs where LGDs are present. For example, in the USA, France, and Switzerland, signs are available for farmers using LGDs on either public or private lands to post warnings and provide information. Such signs have been produced and made available to farmers in other European countries under specific projects, and can easily be provided by Farmer Associations (Fig. 4).

A participatory approach should be used to promote dialogue between farmers and the hunting community, focusing on the importance of controlling hunting dogs, and the legal liabilities associated with shooting LGDs, clarifying rights and responsibilities, devising solutions to accommodate all activities, address concerns, and enhance policies. Examples to minimize the risk of encounters between LGDs and hunters can include not using the same areas at the same time, changing grazing areas during the hunting season, or restraining LGDs when hunting is taking place, when feasible. In areas with high predation risk this may not be possible if it will increase exposure of livestock to

predation. Specific education campaigns could be directed to tourists and tourism operators, including posters or leaflets made available in tourist information offices, videos and websites, and explanatory panels at the start of trails. Tourism activities and grazing could be coordinated to prevent conflict. Promotional activities could include bringing people to farms or taking LGDs to the community to familiarize people with them (Fig. 5).

Educating farmers to improve LGD control is also important. Promoting networking and experience ex-



Fig. 5. Visits to farms promote socialization between LGDs and tourists decreasing dog aggressiveness towards strangers, and raise people awareness about their important role and on how they work.

change among farmers, as well as providing them with proper technical support on raising and training LGDs to avoid undesirable behaviour, may help to solve or prevent conflicts. Buying insurance for any legal liability can also help.

Selecting and training dogs to reduce aggressiveness and conflicts with other dogs and humans is also important. This means selecting dogs (by breed and behaviour) that are best adapted to local conditions and are more dog/human friendly, but without compromising their efficiency against predators. Other useful steps include adequately socializing LGDs with humans and other dogs, providing extra human socialization for LGDs exhibiting human-aggressiveness/shyness, and controlling and training LGDs to reduce the possibility of them leaving pastures and wandering away from livestock (Figs. 6, 11). This monitoring and training can be aided or even done by advisors, with the support of the government or local associations. Some examples already exist in France (e.g. La Pastoral Pyrénéenne). If necessary, and where possible, LGDs can be on a leash or muzzled while passing through villages, and when livestock are stabled at night LGDs can be enclosed to avoid wandering and other problems. If LGDs continue to exhibit undesirable behaviours they should be transferred to pastures less used by tourists/hunters or removed altogether. In this case, the use of alternative non-lethal methods should be considered.

Spaying or neutering working LGDs can reduce wandering (e.g. Green and Woodruff, 1988, 1990; Lorenz and Coppinger, 1986), and it can facilitate multiple LGDs working together in a group without conflict (van Bommel, 2010). Neutered LGDs were found to be equally effective as sexually intact LGDs



Fig. 6. If done properly LGDs can learn not to cross electric fences, like this Estrela Mountain Dog in Portugal. This can be used to control their movements and prevent them from leaving pastures.



Fig. 7. LGDs work best in a group, but it is important to have a balanced dog team to optimize each dog abilities and joint performance, like in this group of Karakachan Dogs in Bulgaria.



Fig. 8. Kangals are used to protect open-ranging sheep in the USA from large predators like wolves, coyotes and bears. Photo: NWRC.

in protecting livestock from coyotes (*Canis latrans*) in the USA (Green and Woodruff, 1988, 1990; Lorenz and Coppinger, 1986) and carnivores in Africa, including cheetahs (*Acinonyx jubatus*) and leopards (*Panthera pardus*) (Marker et al., 2005a,b). Concerns have been raised that neutered LGDs might not be as effective as sexually intact ones when protecting livestock from wolves (*Canis lupus*), but we are not aware of any scientific data supporting this assertion and it should therefore be further investigated. Neutering makes LGDs less distracted by breeding urges or caring for pups, and therefore more attentive to livestock, but also prevents the farmer from breeding them and producing replacement pups. However a select pair can be kept intact for breeding purposes, under closer supervision by the farmer. In some countries, like Australia and the USA, farmers are actively encouraged to neuter/spay their guardian dogs to prevent behavioural problems, and, in Australia, to prevent the risk of breeding with dingoes (*Canis dingo*). In other countries neutering/spaying is not common. For instance, in Bulgaria traditionally only problem dogs are neutered/spayed. Intact dogs should always be kept under close supervision of the farmer to avoid unwanted breeding.

It should be borne in mind that dogs work in a group, and thus it is important to have a balanced working dog team, i.e., having an appropriate number, sex, and age ratio of LGDs, and individuals with adaptive/complementary behaviours in each context (e.g.

Iliopoulos et al., 2009) (Fig. 7). Some of these solutions are already being implemented with good results (e.g. Gehring et al., 2011; Ribeiro and Petrucci-Fonseca, 2004), but additional research should be developed, mainly regarding dog selection and training.

3. Cultural constraints

3.1. Lack of traditional knowledge

The lack of traditional knowledge in regions where LGDs have never been used or where their use was discontinued following the eradication of large carnivores can be an obstacle to their implementation. However, LGDs have been successfully introduced where there was no known tradition, such as in the USA, Australia, parts of Africa and more recently in the Nordic countries and Germany (e.g. Coppinger et al., 1987; Hansen, 2005; Levin, 2005; Marker et al., 2005a; Otstavel et al., 2009; Reinhardt et al., 2012; van Bommel and Johnson, 2012) (Figs. 8, 9).

Measures to aid the establishment or recovery of LGD use can include working across political and cultural boundaries to share information and raise awareness of their advantages, promoting contacts with farmers experienced with LGDs in similar husbandry conditions, and providing training and technical support to farmers who want to start working with them. Subsidies for using prevention measures is a good option and could be especially helpful to promote LGDs



Fig. 9. The Maremma Sheepdog is used in farms across Australia to protect sheep, goats or cattle from wild dogs, but also less typical livestock, like domestic fowl.

in areas anticipating the return of large carnivores, considering the implementation of LGDs may take some time to reach optimal levels of dissemination and efficiency. Such measures have been implemented in several countries, for example Bulgaria, where in the scope of the agro-environmental measures, farmers using autochthonous LGD breeds to protect livestock grazed in high mountain pastures inside National Parks receive higher subsidy values per hectare.

Along with technical advisory programmes, information could be provided to farmers via printed materials, websites, documentaries, or even in a series of television programs. Information, including detailed manuals, is already accessible online and could be disseminated in other forms to farmers without internet access. Demonstration projects could be implemented to illustrate and propagate the use of LGDs.

4. Economic constraints

4.1. Cost-benefit decisions

The use of LGDs has inherent costs associated with maintaining dogs throughout their lives (e.g. initial purchase, food, veterinary care, insurance), as well as costs associated with time spent in caring for and training them.

Although the amount of time spent taking care of LGDs by experienced farmers is not very large, on farms with limited resources this can be an issue that limits their use. On farms where the total livestock head count is small, but the number of dogs needed is high (e.g. when livestock is divided into small flocks in small, scattered pastures), the relative cost of dogs as well as the management effort needed to handle them is higher, which may compromise the viability of such farms. This cost and effort is readily accepted by farmers in places where LGDs are traditionally used since they value their dogs, even when they may not strictly be needed, but not so much in places where LGDs are being introduced or reintroduced (Linnell and Les-cureux, 2015).

Dog mortality and illness, or inefficiency, are additional constraints that can reduce the success of working dogs (e.g. Lorenz et al., 1986; Rust et al., 2013). Furthermore, in most situations, the use of LGDs may reduce but not eliminate predation, so in areas with very low or extremely high predation risk – where LGD mortality by wolves may be high (Bangs et al., 2005) –, it may not be cost-effective.

It is thus fundamental to increase benefits and reduce costs. This can be done by increasing efficiency

of LGDs through better selection, training, and management, adding more LGDs, or replacing lesser performing LGDs. If several dogs are used together, the age structure should be considered, with more mature and experienced dogs in the group. Technical support should be provided to farmers to reduce costs and increase efficiency in the use of LGDs. Economic incentives from government agencies (e.g. by dedicating resources from rural development or wildlife conservation programmes) or NGOs could also be implemented to compensate for economic costs. If LGDs are not spayed/neutered and breeding is possible, selling LGDs to other farmers or as companion animals to people who are familiar with the breeds' needs may provide an additional source of income.

In all cases, a cost-benefit analysis should be undertaken beforehand. The result will often be favourable in the long-run, since LGDs tend to pay for themselves with the stock saved from predation (e.g. Coppinger et al., 1987; Green et al., 1984; Marker et al., 2005a; van Bommel and Johnson, 2012). Additionally, predator-friendly farming labels have been used to add value to livestock produced by farmers using LGDs which can help offset costs (Marker and Boast, 2015). Even so, it is important to monitor and promote their indirect

and direct benefits (e.g. facilitate herd management, reduce disease transmission from wildlife, and exclude mesopredators or livestock competitors; see Gehring et al., 2010a,b; van Bommel and Johnson, 2016) (Fig. 10).

If the use of LGDs is considered economically unviable, other non-lethal prevention methods should be implemented or used in conjunction with dogs. Implementing LGDs may take some time to achieve efficiency, so farmers should be encouraged to be proactive and be prepared in advance, especially in areas where increases in predator population size is expected.

5. Time constraints

5.1. Effort and time investment in raising and care of LGDs

Some farmers may consider the time invested to raise and maintain LGDs a constraint. Every method requires some time investment and maintenance, and when considering the time involved in other farm activities, taking care of LGDs (e.g. feeding) is not very time-consuming. Nevertheless, in some cases adding extra effort to an already hard working routine can be tough (e.g. typically when shepherds need to bring food to LGDs on a daily basis, especially when



Fig. 10. The Rafeiro de Alentejo is used in farms in the south of Portugal, outside the wolf range, to protect domestic pigs from mesopredators, and keep wild boar (*Sus scrofa*) away from the pastures. These dogs reduce the transmission of diseases to the domestic pigs, prevent wild boar from breeding with and injuring them, and exclude the wild species from the pastures avoiding competition with the domestic one. Photo: Joaquim Pedro Ferreira.

the herd grazes and beds far from the shepherd hut).

Livestock breeders must be familiar with the requirements of raising LGDs before making the decision to use them. Educating farmers to be more efficient in raising and training LGDs or providing them with already experienced adult dogs are solutions to be considered. If LGDs are acquired at a later age, already properly socialized with livestock, the farmer will not need to invest as much time as when raising a puppy, and the dogs can start working almost immediately, after a period of habituation. Good examples exist regarding the transfer of adult dogs to new flocks or herds (e.g. Coppinger et al., 1987; Mettler and Lüthi, 2009; van Bommel, 2010; van Bommel and Johnson, 2012). This could be optimized with a follow-up by experienced advisors, who could also be available to help solve any problems that may arise. However, in some cases, farmers may be less concerned with their LGDs if acquired at a later age compared to LGDs



Fig. 11. LGDs are only fully effective after reaching adulthood, and thus a proactive strategy should be in place to attain optimal protection when predation risk increases, and pups, like these Estrela Mountain Dog (top) or Castro Laboreiro Dog (down) from Portugal, should be bonded in advance with the livestock. When using pups is not viable due to the urgent need of protection, older dogs, already bonded to the livestock may be obtained. Right photo: Joaquim Pedro Ferreira.

received as puppies. In the latter case, owners spend more time with the LGDs and experience their puppyhood and juvenile periods, which could result in a stronger bond between them.

When compared with the time invested in other farm tasks and considering the value of the livestock saved by the LGDs, the outcome is likely to be very positive. Thus, investing in dogs should be rewarding in the long run. Nevertheless, subsidies to compensate for the extra effort involved could help overcome concerns from farmers new to LGDs.

5.2. Mismatch of intervention urgency with operational activity of LGDs

LGDs need time to reach adulthood and become efficient guard dogs. It takes around 18–24 months, for LGDs to reach full physical and mental development, and gain the experience needed to deal with predators. Therefore obtaining young LGDs is not appropriate when the need for protection is urgent.

Farmers should be aware of potential predation risks and encouraged to be proactive. They should get LGDs in advance or when damages are still low (Fig. 11). The delay in attaining optimal protection with LGDs can be reduced by using older pups already bonded to livestock or even experienced adults to work with the stock instead of (or in addition to) pups, as discussed previously. However, care should be taken during the bonding process of livestock to new pups or adult dogs to prevent inappropriate behaviour (see section 6.3). Creating a network of LGD breeders can facilitate access to pups and adult dogs as well as sharing of experience.

Other measures can also be implemented to provide temporary protection to livestock before LGDs reach adulthood (e.g. night confinement, shepherding, fladry and turbo fladry, scary sounds or flashing lights). Technical support can be important to provide the best advice to farmers.

6. Dog constraints

6.1. Restricted dog breeds

The classification of LGD breeds as dangerous in some countries (e.g. Spanish Mastiff in certain cantons of Switzerland), although not common, can greatly limit the use of LGDs. If it is not possible to use breeds that are not listed as dangerous, work can be focused on educating policy-makers and lobbying for delisting, or creating exceptions for working LGD breeds. The mandatory use of damage preven-

tion measures, including LGDs, in areas where large carnivores are present can probably facilitate the delisting process and should be considered. If the problem persists, alternative solutions include importing other dog breeds and creating a network of breeders working with non-restricted breeds to facilitate access to them.

6.2. Lack of access to good working LGDs

Difficulties of access to good working LGDs can be a problem, especially in areas where they have never been used traditionally or where their numbers were reduced following the eradication of large carnivores. Furthermore, due to different selection pressures, some breeds/lineages may have lost their working abilities (Sedefchev, 2003). A good solution is the creation of a network of breeders/farmers for the exchange of pups, knowledge, and information about good working dogs. A breeding programme, based on good working dog lineages and controlled mating and breeding, can be initiated to improve LGD quality. Creating nuclei of good working dogs is an efficient way to disseminate pups among farmers.

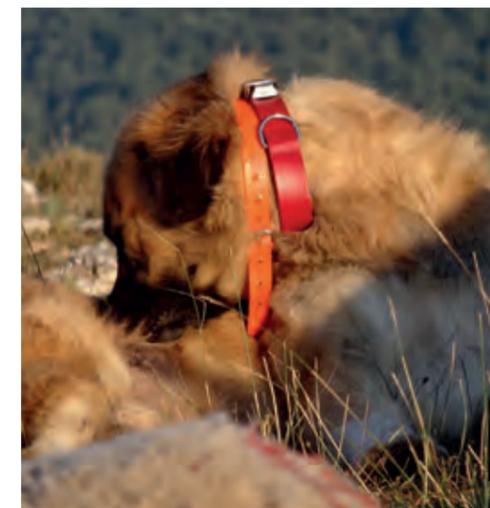
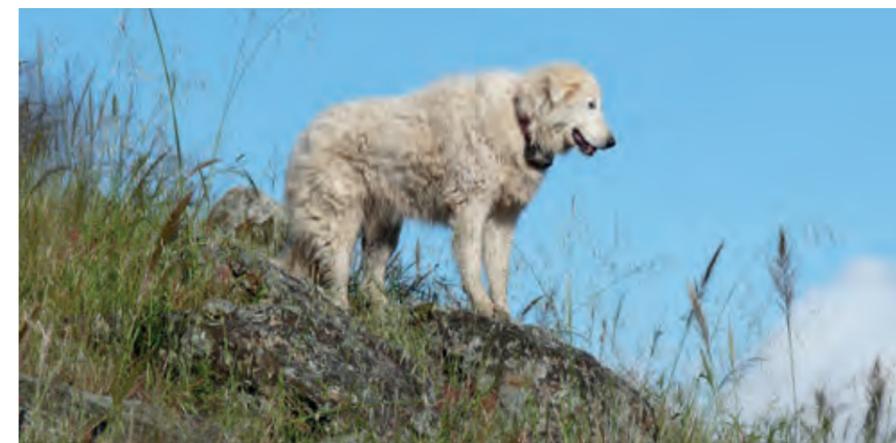


Fig. 12. The use of GPS collars can help with specific training needs or control inappropriate behaviours, making monitoring LGD activities easier, like with this Maremma Sheepdog in Australia (top), and even increase the farmers' interest and care for their LGDs, as observed in Italy (left). GPS and bright collars, like the one used by this LGD in France (right), can also help locate dogs that are missing, identify them as working dogs and reduce the risk of being shot by hunters.

Suitable breeds and dogs can be imported, and establishing partnerships with LGD programmes abroad may make it easier to access good working dogs from other countries at lower costs. Farmers should have access to information to learn about the breeds or lineages that best suit their husbandry and environmental conditions. Some effort should be made to find good working dogs; the internet and knowledgeable advisors can be sources of information.

Further research should be done on this subject to find the best dog breeds/lines for each region and livestock management practices, and proper selection criteria.

6.3. Mistakes in raising and training LGDs

To achieve an effective adult LGD requires not only selection of a suitable pup but also raising it in a correct manner. Failure to do so can result in a dog with a tendency to wander, or which is insufficiently protective, harms livestock, or is overly aggressive to people. For example, although 86% of LGDs raised during trials in Slovakia showed good or acceptable patterns of behaviour, only 50% of them were successfully integrated into flocks (Rigg, 2004).

Farmers and shepherds should be encouraged and supported to follow guidelines for raising and training LGDs. In some cases, it may be possible to provide them with older and previously trained LGDs, reducing the onus on the farmer whilst facilitating the integration process and lessening the risk of it failing.

GPS collars for LGDs and livestock can be a helpful tool for less experienced farmers or in case of young or less trustful/attentive dogs, since they enable continuous monitoring of the location of the dogs and of the livestock, and help with dog training, by allowing prompt correction of inappropriate roaming behaviour, significantly saving time and effort. This new tool may even increase the farmers' interest and care for their LGDs (Fig. 12).

6.4. Not all LGDs make the grade

Even when LGD pups are selected from suitable stock and raised appropriately, not all of them will become effective working dogs. Around 14% of dogs assessed in Slovakia were found to lack sufficient behavioural traits (Rigg et al., 2011). If such deficiencies are identified at an early age, the dog can be replaced quickly, saving time and money. Tests have been developed to help select pups and monitor their progress, but further validation is needed (e.g. Rigg, 2012). Behaviour can change during early development stages so it may be easier to identify and select against undesirable behaviour.

More information is needed to help in dog selection, and breeders' and shepherds' contributions should be considered when defining criteria, since specific preferences may vary, whilst taking into consideration that a good working dog team requires dogs with complementary behaviours. For example, if a standardized protocol were to be developed and validated scientifically, dog breeders could test young pups and direct them to different functions (e.g. guard, pet).

7. Farm management constraints

7.1. Unsuitable management systems

Changes of husbandry practices during the absence of predators may create additional difficulties to the implementation of LGDs. Adapting and optimizing grazing systems to the use of LGDs, may not be easily undertaken by farmers. A management system might not have the right environment to allow proper bonding between dog and livestock, but it is usually possible to create a suitable setup. For example, livestock can be temporarily confined during the day or for a period of the day (night or hottest period) with the LGDs. Pups can also be placed with confined animals (e.g. young/replacement animals) or during a particular period of the year when the livestock is confined (Fig. 13). Networking in and between communities could help, as sometimes other

farmers may have a better setup, and can bond the pups to stock, which can then be placed at a later age. Of course during the process of bonding a new dog to livestock and when moving LGDs to a new flock, it is important to manage the dogs correctly and provide the right circumstances for them to bond with their livestock, in order to prevent problems such as roaming or aggressiveness to livestock they are not (yet) familiar with.



Fig. 13. LGDs can establish strong bonds with cattle, but extensive management systems may require some initial adaptations to promote the bonding between them. Dogs can be confined with replacement heifers or during the stabling season, as these Great Pyrenees, in Switzerland and France (above), after which they can accompany the herd to the pastures, like these Spanish Mastiffs, in Spain (below; photo: Juan Carlos Blanco). The use of LGDs in less suited husbandry systems can be overcome with proper technical support and networking between farmers.

Livestock protecting their young can be a threat to young LGDs, so pups should not be raised with particularly aggressive mothers. Especially in the case of sheep/goat flocks, extra care should be taken if placing pups during the lambing season to prevent damages that may occur due to playful behaviour from the dogs. When first releasing young dogs into pastures it is important to make sure they are old enough (both physically and mentally) to accompany livestock and defend themselves or escape from predators. Temporary shelters for pups should be provided near areas frequently used by livestock (hay dispensers, water, night-time bedding sites). Livestock can be encouraged to approach dog shelters using treats (e.g. salt blocks).

Other problems relate to the absence of shepherds in some grazing systems. The lack of supervision, mainly during the juvenile period when playing behaviour arise, may result in LGDs chasing and otherwise disturbing the flock, possibly injuring or even killing some animals. It may also allow dogs to start wandering. Such behaviour must be immediately corrected to avoid becoming reinforced. Thus, during this phase of the dogs' development, farmers need to be more vigilant. Selecting pups from attentive and trustworthy progenitors is a good way to reduce the risks and make them easier to manage. In grazing systems where shepherds are absent, special care is needed to guarantee LGD health and wellbeing: shelter, food, and water should always be available and LGDs' condition should be checked daily. Concern for the welfare of LGDs is increasing and specific guidelines have already been established for them (AWA, 2013).

It is important to educate owners about proper management, training, and bonding of LGDs, so they are in good condition and stay with livestock (Fig. 14).



A lot of information is available on the internet, and in many countries complete manuals have been produced by responsible authorities, as well as agriculture organizations and environmental NGOs (e.g. Hahn et al., 2016, Tsingarska et al., 1998). The proper use of GPS collars, as mentioned before, can be very helpful to control the wandering of the LGDs in real time, and understand the causes for this behaviour to help correct it.

In dense vegetation or when livestock tends to scatter, it may be difficult for dogs to protect the animals. In such cases the presence of a shepherd and herding dog(s) could be helpful to control the flock, as would fences to contain them. The selection of livestock less prone to dispersing during grazing could also be beneficial. If unfamiliar with herding dogs, some LGDs will try to protect livestock from them while others may join in with their chasing behaviour (Rigg, 2004). A patient approach is required to teach LGDs to allow herding dogs to do their work without interfering.

When the stock is divided in small flocks it may not be economically or logistically viable to have dogs with each flock or, in large properties, to have dogs throughout the whole area. Placing dogs with those flocks or in parts of the property where the risk of predation is highest (e.g. young livestock or birthing females, pastures located closer to forested areas) while using less expensive methods to protect other flocks or areas, could be a viable solution. Integrating LGDs with other methods (e.g. night confinement, fladry, e-fences, aversive lights and/or sounds) could be a good way to complement the work of the dogs. Other guardian animals (e.g. donkeys or llamas) can also be used in addition to guardian dogs, but some



Fig. 14. When properly raised and maintained LGDs can establish strong bonds with livestock and naturally protect it from predators reducing losses, like these Estrela Mountain Dogs in Portugal (left) and Karakachan Dogs in Bulgaria (right). It is important to give less experienced owners detailed information and technical support about proper management and training of LGDs.

time and effort will be required to get them used to each other, as donkeys and llamas generally do not like dogs. Even in cases where they never accept each other, they can still work near each other in different areas with different groups of livestock.

Feasibility studies should be done beforehand to assess the possibility of using LGDs, and which breed and number of dogs are likely to work best for a particular operation. The assistance of a well-trained advisory team can help to devise solutions applicable to each situation, and financial aid for farmers which can help them implement such solutions could be beneficial.

7.2. Management of dogs in winter

In some regions, during winter, when livestock are confined to barns or kept in areas where predators are absent, management of LGDs could be problematic for several reasons. Farmers may not have enough space to keep them, they may frequently bark, and conflicts with neighbours may increase leading some farmers to give up on LGDs.

Proposed solutions include asking someone else (a friend or other farmer with adequate conditions) to look after LGDs if the owner has no space to keep them. LGDs can be kennelled during this period, as long as kennels meet the animal's welfare needs. Kennelling LGDs may not be possible in every country – for example in Switzerland it is not allowed. If they are kept in a kennel or other small area (e.g. a barn with livestock), maintaining access to livestock would be important, as well as taking them for a run or long walk each day to keep them fit and burn some energy, which will make them quieter. Their diet should be adapted by feeding them with low energy food while they are not working.

Better sound insulation of barns could also be implemented. Furthermore, if trained early, LGDs can learn to stop barking on command. Finally, educating neighbours can help them understand and hopefully be more tolerant of working dogs.

8. Wildlife management constraints

8.1. Conservation of endangered species

In particular regions, using LGDs can conflict with conservation efforts and priorities, by disturbing or killing certain species, or through hybridizing with wild canids (e.g. Lescureux and Linnell, 2014; Potgieter et al., 2016). Disease transmission, which may also be a serious problem to endangered species, is discussed below.

Proper dog containment and management is crucial to keep LGDs out of areas where endangered species management takes precedence. Cooperation between wildlife management authorities and LGD owners is important to devise adequate solutions.

Dogs can also be trained to avoid certain areas or species. Working LGDs could be trained so they are desensitised to the endangered species in their area, and only dogs that have successfully been trained allowed in areas containing the species. The desensitisation could be achieved using the scent of the endangered species (for example rags or bedding from the endangered species, supplied to the LGDs from an early age) combined with (where possible) controlled introductions between the LGDs and ambassador individuals of the endangered species, or a closely related non-endangered species.

LGDs can bond with non-predatory endangered species as easily as they can with livestock. For example, in Warrnambool, Australia, Maremma Sheepdogs are successfully used to protect a colony of little penguins (*Eudyptula minor*) from predation by foxes (*Vulpes vulpes*). The dogs live on the island with the penguins mainly during the moulting and breeding season, and keep foxes away (van Bommel, 2010).

If hybridization with wild canids is a concern, such as with wolves or dingoes (Claridge et al., 2014; Kopaliani et al., 2014), LGDs can be spayed or neutered. As explained previously, existing scientific data show that neutered dogs work equally well as intact ones (but see section 2.1). When no solution is viable in making dogs compatible with policies for endangered species, alternative prevention measures should be used.

8.2. Spread of disease risks

Apart from human-caused mortality, LGDs are subject to many diseases that may cause their premature death, permanently incapacitate them, or negatively influence their physical condition and decrease their working capacity. Furthermore, if not properly vaccinated or dewormed, dogs can spread diseases to other dogs, endangered wildlife, livestock, and humans (e.g. Deplazes et al., 2011; Hughes and MacDonald, 2013). On the other hand, LGDs have the potential to deter disease transmission from wild ungulates to livestock, by chasing them away from pastures (Gehring et al., 2010b).

Prevention is key, and with proper and regular veterinary care most problems are easily solved. Owners should have access to experienced veterinarians, specialized in dog care, to regularly monitor and



Fig. 15. The use of illegal methods to lethally control predators can have a big impact on the population of LGDs. Poisoning can be responsible for over 30% of the deaths in some countries, like Portugal, where this Estrela Mountain Dog died after eating a bait poisoned with strychnine.

treat their LGD health, while a hotline for veterinary emergencies should also be available. Education campaigns (leaflets, workshops) could be implemented to raise awareness of basic dog health care and disease prevention. Compulsory vaccinations should be implemented when applicable. Although basic veterinary care is accessible to most farmers, in some cases this can be an issue, therefore financial aid could be a beneficial, especially when LGDs require more expensive treatments. Buying dog health insurance is also a possibility.

8.3. Risks of lethal predator control

Dog mortality is one of the major limits to the use of LGDs and thus any risk should be avoided. Some methods used for predator control, such as the use of poison or traps, constitute a major problem for LGDs and can be a significant cause of mortality. These methods are still used for legal predator control in some countries including the USA and Australia, and are also illegally used worldwide (Glen et al., 2007; Guittart et al., 2010). For example, poisoning can exceed 30% of the known mortality of LGDs in Portugal and Bulgaria (Silvia Ribeiro and Elena Tsingarska, unpubl. data) (Fig. 15).

Risks arising from legal predator control can be more easily solved than in the case of illegal control actions. This can be done by coordinating the timing of interventions, limiting the use of baiting or traps near areas where LGDs are working, moving LGDs and livestock to distant grazing areas during periods of predator control, training LGDs to avoid poisons or traps, or integrating additional dog management methods during hunting seasons (e.g. temporary lockdown of LGDs, enclosed overnight, shepherd presence). Regular communication with authorities and neighbours should be maintained in order to better coordinate activities and avoid risks for LGDs. Responsible entities are typically required to make public announcements and identify areas with traps/poison or hunting days and these actions are strongly encouraged in areas where LGDs are also used.

Communication and information actions could also be developed to address limits on the use of LGDs in areas where legal methods of control are also used. These include educating farmers to enhance vigilance and reduce risks faced by LGDs, training farmers on how to act if a LGD is trapped or poisoned, distributing anti-poison kits if applicable, educating hunters on how to behave in the presence of LGDs and to be

careful not to mistake them for stray dogs, informing hunters and the general public about the consequences and legal liabilities of killing LGDs, putting up signs in areas where LGDs are used to warn hunters and others of their presence, or even having television and radio announcements to inform the public.

Illegal predator control is much more difficult to detect and tackle, and although considered more common in regions where predators are fully protected, it is also frequent in some areas where legal control is used (Chapron and Treves, 2016).

It may be useful to increase anti-poaching control actions, make sanctions more severe, and raise social awareness of the problem. Dogs can be equipped with GPS collars or bells to help locate them in case they fall into traps. The use of e-collars with wireless fence systems may help keep them away from sites where traps/poison are being used. Conditioning dogs to avoid poisoned baits/traps and train them not to pull when caught in snares/traps should also be investigated. This training is already being done in some regions with good results, for example dogs in the USA are trained not to pull M-44 (a spring-loaded mechanism that delivers sodium cyanide to canids that pull it) using capsules filled with hot pepper instead of sodium cyanide (Young, personal communication).

Finally, emphasizing the advantages of non-lethal practices through scientific reasoning may also promote their use and help reduce the risks to LGDs. Recent studies confirm that culling predators may not always be a solution, and in some instances may even increase damage (Allen and Gonzalez, 1998; Krofel et al., 2011; McManus et al., 2015).

9. Advisory constraints

9.1. Advisors lacking adequate knowledge

Although owners/managers can acquire information from a variety of sources and do not always have to rely on consultants, knowledgeable and experienced advisors are important to guarantee the success of this method, especially in the case of farmers not familiar with or less motivated to use LGDs. Sometimes there may be a mismatch between what dog breeders or researchers consider to be desirable traits and what farmers and shepherds value in a working LGD (Rigg et al., 2017: this issue).

Specific training programmes, including technical issues (focusing on problems related to the use of LGDs, their behaviour, education/training and

maintenance) and social skills, and experience transfers can be promoted. Several successful programmes exist and plenty of information is available. Furthermore, control systems can be put in place to guarantee all advisors are sufficiently knowledgeable and skilled.

10. Legal and policy constraints

10.1. Agro-environmental policies and legal context

Incompatibilities may exist between agricultural and environmental policies regarding wildlife conservation. For example, as mentioned above, dogs can disturb or occasionally kill wildlife, thus interfering with local environmental policies. Furthermore, inadequate or negative legal context exists in some countries regarding the presence of LGDs. In some countries LGDs may be considered stray dogs from a legal point of view, while in others the obligation for dogs to be on a leash or confined may hinder their legal status because it is not feasible for working LGDs. These issues may put payment of compensation and insurance at risk.

While trying to implement adequate dog containment and control to avoid the problems previously discussed (e.g. proper training in combination with adequate nutrition can eliminate harassment, chasing, and killing of wildlife), work should be done to adapt legislation, and harmonize different legal instruments. The legal status of LGDs could be clarified and improved or exceptions made for working LGDs, while land management plans should be adapted to their presence.

Setting up an interest group to lobby for change legislation to make it more favourable to the use of LGDs might be a solution. Authorities should be informed about why LGDs are useful, and how they can be incorporated into broader management actions. Communication actions should also be directed at farmers so they are aware of local regulations and of possible solutions to reduce risks and avoid legal problems.

At a pan-European level, a standardised legal frame could be produced concerning the use of LGDs. This could benefit from the production of a pan-European document compiling national legislation, to identify best practices and provide recommendations for new or additional EU policies regarding LGDs in the frame of biodiversity conservation policies.

10.2. Legal liability

LGDs, like many other working or even pet dogs, are subject to risk and may be involved in situations that result in legal liabilities for the owner. The most common problems regard: i) collisions with cars, which can cause major damage to vehicles and injury to the occupants (and may result in the death or serious injury of the dog); ii) chasing and biting people, especially hikers, cyclists and horse riders, which can result in traumatic incidents and serious injury; iii) attacks on other dogs (e.g. hunting, herding or pet dogs, or other LGDs), which can cause injury or death of the other dogs involved; iv) damage to property (e.g. injuring neighbour's livestock, damaging agricultural fields, tearing clothes/equipment) (Fig. 16).

Possible solutions include educating farmers to adequately raise and manage LGDs, increasing LGD supervision and control to reduce risks, and selecting and training LGDs to reduce aggressiveness towards people and dogs. Nevertheless, this should be done carefully so as not to hinder the protection ability of the LGDs. As mentioned above, informing people about the presence of LGDs and how to behave is essential, and the use of warning signs should be encouraged around pastures, tourist trails, or along roads. Road signs to reduce speed complemented with speed bumps and the use of reflective collars or vests on dogs can help prevent accidents, especially at night. Correctly identifying the dog, with microchip and collar tags (containing the name and contacts of the owner), may also help to clarify any situation. Finally, if it is available, obtaining adequate insurance should be encouraged.

11. Conclusions

Most of the limitations to the use of LGDs identified were common throughout the countries and regions represented, but some were specific and require particular solutions. In most cases, viable solutions already exist although they may need to be adapted or improved. Some involve traditional and modern knowledge but others require additional research. Future studies should consider multidisciplinary approaches to address ethological, ecological, anthropological, social, economic and ethical issues.

The discussion surrounding the issues addressed above highlights the need to gather more information about the efficiency of LGDs and their use in different ecological, social and cultural contexts. Empirical



Fig. 16. LGDs chasing or biting hikers can result in legal liabilities for farmers, and adequate supervision of the dogs is essential if pastures are close to hiking trails, complemented with proper information of the public and, if available, with a specific insurance.

knowledge can be very helpful for decision-makers and for farmers considering using LGDs. One example is mortality and risk assessment studies, since early mortality and morbidity can compromise the overall cost-effectiveness of LGDs. Despite the widespread use of LGDs, only a few studies have reported such data, which is fundamental for assessing their efficiency, defining dog care procedures to minimize risks and designing adequate financial aids.

Applying new tools and technologies to monitor and evaluate LGDs is also needed to gather more definitive data and improve their success. Another aspect to consider is the importance of gathering data that could be comparable among studies and regions. Quality research is essential, and we stress the importance of knowing where, when, and why LGDs did not work to deepen our understanding and optimize their use. Education of farmers, decision-makers and the public about the use of LGDs is fundamental, and should draw on new techniques and information to prevent inappropriate use and unnecessary waste of time and money. Efforts should also be made to ensure an adequate legal framework, considering that the legal status of LGDs is highly variable and often blurry, since they are generally free-ranging, and often under little supervision.

This article is a brief contribution to the topic which could certainly gain from additional inputs of specialists from different regions. We hope it will start a wider discussion on how to improve and expand the use of livestock guarding dogs.

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IN MEMORIAM: RAYMOND COPPINGER (1937-2017)

**Renowned canid researcher
Raymond Coppinger
died of cancer on 14th August
at the age of 80.**

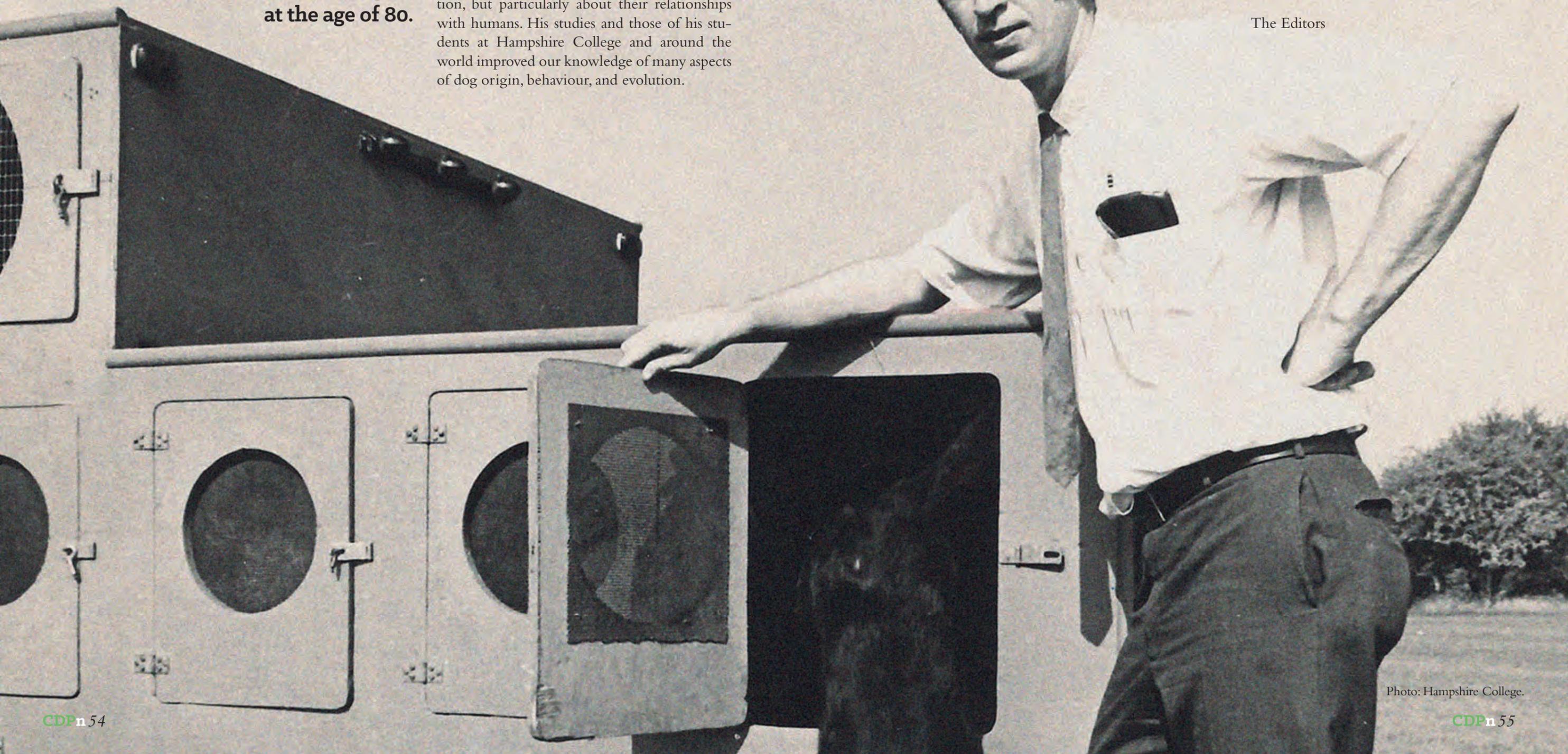
Almost everyone involved with working dogs, livestock protection and carnivore conservation comes across the name professor Raymond Coppinger sooner or later. Besides being a scholar and scientist of tremendous scope and ingenuity, Ray led by example, through his endless curiosity, willingness to share knowledge and generosity to help anyone who approached him in search of insights.

Dogs were Ray's favourite subject and he devoted most of his life to studying them. He travelled the world observing and researching dogs as a modern-day naturalist, craving to learn more about their biology, ecology and evolution, but particularly about their relationships with humans. His studies and those of his students at Hampshire College and around the world improved our knowledge of many aspects of dog origin, behaviour, and evolution.

Perhaps his most famous achievement, together with his wife Lorna, was their fundamental contribution to the introduction of livestock guarding dogs to the USA in the 1970s as a non-lethal tool to reduce coyote and wolf damage to livestock. Amusingly enough, as he put it, he was then invited to assist several projects on LGD recovery in the Old World, from where he had obtained LGDs and much of his knowledge about them in the first place.

Although some of his concepts for raising and training LGDs are being questioned, he remains a pioneer who changed the way we look at dogs and "how they work".

The Editors



ABSTRACTS OF SCIENTIFIC ARTICLES

PREVENTION METHODS

CATTLE RESPONSES TO A TYPE OF VIRTUAL FENCE

Christina Umstatter,
Justin Morgan-Davies,
Tony Waterhouse
Rangeland Ecology & Management
68, 100-107 / 2015

Interest in developing more flexible fencing technology to improve pasture and rangeland management is increasing. The objective of this study was to test the efficacy of a new virtual fencing product and measure impact on behavior, thus potentially allowing positive development of virtual fence systems. The Boviguard (Agrifence, Henderson Products Ltd., Gloucester, UK) invisible fence is now commercially available, consisting of cow collars, a battery-based transformer, and an induction cable laid on the ground or buried in the ground. As the Boviguard collar comes close to the induction cable, a warning sound is triggered and if the animal continues to move closer, an electrical stimulus is triggered. We tested this novel system on 10 cows wearing global positioning system (GPS) collars to pinpoint location and activity sensors to gather behavioral data. Two separate exclusion zones were created consecutively in different areas of a test field, with alternate periods of control, with no fence activity, and virtual fence activation. The system successfully prevented the animals from crossing the virtual fence line. No changes in general activity or lying behavior were found. There were significant changes in the pattern of use of the rest of the field area when the fencing system was activated. When only the unactivated cable was left on the ground in a final control period, the visual cue alone deterred animals from entering the exclusion area. The trial showed the effectiveness of a collar-based electrical stimuli system. This approach to virtual fencing could provide solutions for management systems where moving fences frequently is required, such as for strip grazing, nature conservation management of specific areas and habitats, and grazers of land where physical fences are not preferred or feasible.

MORE BARK THAN BITE? THE ROLE OF LIVESTOCK GUARDING DOGS IN PREDATOR CONTROL ON NAMIBIAN FARMLANDS

Gail C. Potgieter,
Graham I. H. Kerley,
Laurie L. Marker
Oryx 50, 514-522 / 2015

The conflict between predators and livestock farmers is a threat to carnivore conservation. Livestock guarding dogs are promoted as a non-lethal, environmentally friendly method to mitigate this conflict. As part of a farmer-carnivore conflict mitigation programme, the Cheetah Conservation Fund breeds Anatolian shepherd (also known as Kangal) dogs to protect livestock from predators. During 2009–2010 we interviewed 53 commercial and 20 subsistence Namibian farmers that are using 83 such dogs. Fewer commercial and subsistence farmers reported livestock losses to predators during the most recent year of guarding-dog use compared to the year before dogs were introduced. All subsistence farmers, but not all commercial farmers, ceased killing predators during the most recent year of guarding-dog use. All farmers ceased killing cheetah *Acinonyx jubatus* and leopard *Panthera pardus* during this year, and one dog killed a single cheetah. Conversely, dogs and farmers killed more black-backed jackals *Canis mesomelas* between them in the survey year than the farmers reported killing in the year before acquiring dogs. Two of the dogs reportedly killed non-target carnivore species, and 15 killed prey species. Thus our results challenge the categorization of livestock guarding dogs as a non-lethal conflict mitigation method. We suggest that the conservation status and

body size of wild carnivores relative to the size of the guarding dogs be considered before introducing dogs to protect livestock. Additionally, corrective training for dogs that chase or kill non-target species should be implemented, especially where farmers value these species or where non-target species are threatened.

REDUCTION IN LIVESTOCK LOSSES FOLLOWING PLACEMENT OF LIVESTOCK GUARDING DOGS AND THE IMPACT OF HERD SPECIES AND DOG SEX

Stacey-Lee Leijenaar,
Deon Cilliers,
Katherine Whitehouse-Tedd
*Journal of Agriculture
and Biodiversity Research* 4,
9-15 / 2015

Livestock guarding dogs have been placed on South African farms by the not-for-profit organisation, Cheetah Outreach Trust, since 2005, and have been proven to be an efficient form of non-lethal predator control against jackal, caracal, leopards, cheetahs and other predators found in South Africa. However, the impact that herd species (sheep, goat, cattle or mixed) or the sex of the dog may have on the observed reduction in livestock losses following placement of a livestock guarding dogs has not been investigated. To address this, the reduction in livestock losses following placement of an Anatolian livestock guarding dogs was measured in two South African provinces over a nine year period and data simultaneously collected on herd type and dog sex. Dogs comprised of 78 males and 49 females. Farms consisted of 68 sheep, 37 goats, 23 cattle, and two exotic game farms. Effectiveness was measured as the difference between farmer-reported livestock losses before and after the placement of a dog and was calculated as percentage change in stock loss after introduction of a livestock guarding dog according herd species and dog sex. This study determined the impact of herd type or dog sex on the difference between livestock loss before versus after livestock guarding dogs placement. This study indicates that the use of this breed of livestock guarding dog is an effective means of reducing perceived livestock losses due to predation, regardless of dog sex, and may be used with equal effectiveness with a range of herd species.

THE USE OF SHEEPDOGS IN SHEEP PRODUCTION IN SOUTHEASTERN BRAZIL

Rafael A. Moral,
Fernando C. C. Azevedo,
Luciano M. Verdade
*Pastoralism: Research,
Policy and Practice* 6: 18 / 2016

This study assessed the economic value of using sheepdogs as livestock guardians in southeastern Brazil by implementing a semi-structured interview format divided into four main categories: maintenance costs of sheep production, selling prices of carcasses, annual rate of depredation, and sheepdog acquisition and maintenance costs. According to our results, producers perceive the “unproductive” costs of sheepdogs similarly to the way they view taxes. However, management using sheepdogs as herd guardians tends to be most profitable for herds above 483 head from the fourth year on, being possibly more stable and predictable over time. In contrast, management without sheepdogs shows stochastic dynamics with occasional, though unpredictable, episodes of sheep depredation. This means that sheep farmers follow a cyclical decision strategy, which basically depends on the purchase price of the sheepdog.

FEAR OF LARGE CARNIVORES CAUSES A TROPHIC CASCADE

Justin P. Suraci, Michael Clinchy,
Lawrence M. Dill, Devin Roberts,
Liana Y. Zanette

Nature Communications 7: 10698
/ 2016

The fear large carnivores inspire, independent of their direct killing of prey, may itself cause cascading effects down food webs potentially critical for conserving ecosystem function, particularly by affecting large herbivores and mesocarnivores. However, the evidence of this has been repeatedly challenged because it remains experimentally untested. Here we show that experimentally manipulating fear itself in free-living mesocarnivore (raccoon) populations using month-long playbacks of large carnivore vocalizations caused just such cascading effects, reducing mesocarnivore foraging to the benefit of the mesocarnivore's prey, which in turn affected a competitor and prey of the mesocarnivore's prey. We further report that by experimentally restoring the fear of large carnivores in our study system, where most large carnivores have been extirpated, we succeeded in reversing this mesocarnivore's impacts. We suggest that our results reinforce the need to conserve large carnivores given the significant "ecosystem service" the fear of them provides.

NO SINGLE SOLUTION: APPLICATION OF BEHAVIOURAL PRINCIPLES IN MITIGATING HUMAN–WILDLIFE CONFLICT

Bradley F. Blackwell,
Travis L. DeVault,
Esteban Fernández-Juricic,
Eric M. Gese,
Lynne Gilbert-Norton,
Stewart W. Breck

Animal Behaviour 120,
245–254 / 2016

There is no proverbial silver bullet for mitigating human–wildlife conflict, but the study of animal behaviour is foundational to solving issues of coexistence between people and wild animals. Our purpose is to examine the theoretical and applied role that behavioural principles play in understanding and mitigating human–wildlife conflict, and delineate gaps in behavioural theory relative to mitigating these conflicts. Specifically, we consider two different, yet contemporary, examples of human–wildlife conflict: animal–vehicle collisions and carnivore depredation of livestock. Although ostensibly unrelated, both conflict areas share common themes relative to animal behavioural responses to disturbance and perception of risk. We first place the effects on wildlife due to these conflicts in the scope of population sustainability, and then examine current research relative to the following three questions. How is behavioural ecology relevant to these particular areas of conflict? Are advances toward understanding the mechanisms by which animals process information and make decisions being translated into management methods? How might management efforts be affected over time by individual behaviours, method integration and habituation/sensitization? Regarding animal–vehicle collisions, only in the last decade have researchers applied an antipredator theoretical framework with sensory ecology to understand aspects of marine mammal, terrestrial mammal and bird responses to vehicle approach, speed and associated stimuli. However, the size and speeds of modern vehicles demand that we improve economic models and possibly develop novel theoretical frameworks to better predict animal responses to vehicle approach. Within the context of carnivore–livestock depredation, our understanding of individual predator behaviour relative to perceived risk and factors contributing to the development of problem individuals will influence the efficacy of the most promising, nonlethal management approaches (e.g. distractive techniques, reproductive inhibition and olfactory barriers). In both cases, successful management is contingent upon a mechanistic understanding of how animals respond to disturbance and the information utilized to assess risk.

BOOKS

Shepherds of Coyote Rocks: Public Lands, Private Herds and the Natural World

By Cat Urbigit / 2012 / Countryman Press / 312 pp

Cat Urbigit journeys alone to spend a season on Wyoming's open range tending to a herd of domestic sheep as they give birth amid the challenges of nature – from severe weather to a wealth of predators. Her only companions are the livestock guardian animals (BIG dogs and a pair of burros named Bill and Hillary!) that repeatedly prove their worth in devotion to protecting the herd.

Urbigit offers interesting reflections on the role of pastoralists around the globe and on the controversial issue in the Western US of private livestock herds being run on public lands. The intimate ways in which abstract public policy plays out on the open range is eye-opening. More than a tale of herding sheep, *Shepherds of Coyote Rocks* is an action-packed true story that reveals the broad spectrum of the human relationship with nature, from harmony to rugged adventure.

The Sheep Dogs of Anatolia: Yörük Koyçısı

By Guvener Isik / 2014 / CreateSpace Independent Publishing Platform / 456 pp

The Sheep Dogs of Anatolia, Yörük Koyçısı, is not intended to be a guide or instruction manual, and the material in the book is presented by integration into stories and the author's personal observations. The author has worked on this book since 1997. Although the focus is on breeds native to Anatolia, the information provided here is applicable to all livestock guardian dogs, such as Great Pyrenees, Kuvasz, Alabai, and Ovtcharka. Readers are not forced to accept rules and laws dictated by the author or any club. On the contrary, they are encouraged to mould their own methods based on practices in rural Anatolia. Rights and wrongs in sheep dog raising are not confined to rules; rather they reside in understanding the mindset of the shepherds, the nature of the flocks and the dogs, which are summarized in principals. The main source of information for this book is working shepherds. No 'ready-to-swallow pills' are provided in order to successfully work with sheep dogs and to benefit from them. Once the reader understands the aboriginal conditions of the sheep dogs, only then can she or he start seeing where they are coming from and why these dogs act in certain ways. The book helps the reader to understand the source, which allows a smoother journey to the destination. The first half provides general information on sheep dogs in Anatolia in terms of historical background, descriptions, various strains of dogs, traditional selection, conditioning, feeding, numerous practices, fundamental characteristics, and determining standards of Anatolian sheep dogs in relation to the requirements set by the shepherds. The second part of the book is mostly discussion about common misunderstandings, such as breed descriptions, training problems and the concept of primitive breeding. The approach to tackle these issues is radically

*Texts from the books' publishers.

unconventional, challenging the show dog mentality which consists of pedigree-based breeding and artificial selection criteria, as well as other practices related to conformation showing. The author also looks at the dog–wolf interaction in terms of flock guarding.

Domestic Dog Cognition and Behavior: The Scientific Study of *Canis familiaris*

Edited by Alexandra Horowitz / 2014 / Springer / 274 pp

This book highlights the state of the field in the new, provocative line of research into the cognition and behavior of the domestic dog. Eleven chapters from leading researchers describe innovative methods from comparative psychology, ethology and behavioral biology, which are combined to create a more comprehensive picture of the behavior of *Canis familiaris* than ever before. Each of the book's three parts highlights one of the perspectives relevant to providing a full understanding of the dog. Part I covers the perceptual abilities of dogs and the effect of interbreeding. Part II includes observational and experimental results from studies of social cognition – such as learning and social referencing – and physical cognition in canids, while Part III summarizes the work in the field to date, reviewing various conceptual and methodological approaches and testing anthropomorphisms with regard to dogs. The final chapter discusses the practical application of behavioral and cognitive results to promote animal welfare. This volume reflects a modern shift in science toward considering and studying domestic dogs for their own sake, not only insofar as they reflect back on human beings.

Life with Livestock Guardian Dogs

By Barb Dickinson / 2016 / Blurb / 28 pp

Livestock guardian dogs are becoming more popular on farms, ranches and homesteads around the world. The purpose of this book is to make more easily understood information available about these amazing dogs through the author's personal experience.

Le Montagne des Pyrénées: Chien de protection de troupeaux (The Great Pyrenees: Livestock protection dog)

By Mathieu Mauriès / 2016 / L'édition à façon / 360 pp

This 360-page book, the first dedicated specifically to the working Great Pyrenees, includes more than 400 photographs. It is intended for shepherds, breeders and owners of Great Pyrenees. It brings together the author's more than 15 years of experience and research on livestock guardian dogs and testimonials from users around the world. It presents a way of life and instruction for livestock guardian dogs. It is also a tribute to these incredible dogs which have been protecting herds and shepherds since ancient times. The author advocates for safeguarding this unique genetic heritage and preserving the qualities of working Great Pyrenees.

MEETINGS OF INTEREST

25th International Conference on Bear Research & Management

12-17 November 2017 / Quito, Ecuador
quitolandofbears.com

International Symposium on Environment and Sustainable Agriculture Development

28-30 November 2017 / Sanya, China
www.clocate.com/conference/The-International-Symposium-on-Environment-and-Sustainable-Agriculture-Development-ESAD-2017/67861

20th International Conference on Agricultural Economics and Environmental Research

25-28 January 2018 / Innsbruck, Austria
www.clocate.com/conference/20th-International-Conference-on-Agricultural-Economics-and-Environmental-Research-ICAEER-2018/62051

World Food and Agriculture Conference 2018

14-16 March 2018 / London, United Kingdom
www.clocate.com/conference/World-Food-and-Agriculture-Conference-2018/69111

LINKS

Clever Dog Lab
www.cleverdoglab.at

Family Dog Project
familydogproject.elte.hu

SPARCS - Society for the Promotion
of Applied Research in Canine Science
www.sparcsinitiative.org

COMING TOPICS

We will continue with the theme of livestock guarding dogs in the next issue of CDPNews, which will be followed by an issue looking into socio-economic aspects of damage prevention. If you are working on a project or study dealing with any aspect of predation by carnivores on livestock and damage prevention measures please contact us to discuss ideas for an article in a future issue. Thank you for your collaboration!

The Editors

To be added to the mailing list or for further information, contacts us at: lifemedwolf@fc.ul.pt

You can download the Carnivore Damage Prevention News on the MedWolf website:

www.medwolf.eu

We welcome the translation, reprint and further distribution of articles published in the CDPNews under citation of the source. The responsibility of all data presented and opinions expressed is with the respective authors, and it does not necessarily reflect the official views of the European Commission.

