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FINAL GUIDELINES FOR THE LONG-TERM IMPLEMENTATION OF **WOLF PREVENTION INTERVENTION UNITS** (WPIU) AND EFFECTIVENESS OF MITIGATION MEASURES TO REDUCE WOLF DAMAGES ON LIVESTOCK

Action C1

Wolf prevention emergency teams: damage inspections, preventive methods, moderation, wolf control, conflict mitigation in hot spot areas.

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TABLE OF CONTENTS

ABBREVIATIONS

APAM	Aree Protette Alpi Marittime
AREC	HBLFA Raumberg - Gumpenstein
LGD	livestock guarding dog
OFB	The French Biodiversity Agency
SFS	Slovenia Forest Service
WPIU	wolf prevention intervention units
APAC	Aree Protette Alpi Cozie
APOS	Aree Protette Ossola
APAP	Aree Protette Appennino Piemontese
METO	Città Metropolitana di Torino
ERSAF	Ente Regionale per i Servizi all'Agricoltura e alle Foreste
RELO	Regione Lombardia
RELI	Regione Liguria
RAVA	Regione Valle d’Aosta
PNDB	Parco Nazionale Dolomiti Bellunesi
CUFA	Carabinieri Forestali

1. INTRODUCTION

1.1. Context of the action: threats to wolf conservation and major issues related to livestock depredations and preventive measures at the alpine scale

The grey wolf (*Canis lupus*) was eradicated from the Alps in the 1920s [1]. Wolves from the Italian Apennine population began recolonising the south-western Alps of Italy and France in the early ’90s and then expanded across the mountain chain. In 2012, the first signs of wolves naturally dispersing from the Apennine and Dinaric populations to the eastern Alps of Italy and Slovenia were documented [3,4]. Today, wolves are regularly present in all Alpine countries except Monaco and their populations are increasing [5].

The return of the wolf to the Alps has repercussions for livestock breeding, in particular the traditional activity of summer pasturing in the mountains [6,7]. This is especially the case where husbandry systems no longer include measures to protect livestock from wolves due to the long absence of the predator, but it is also the case of hot-spot areas of wolf stable presence where breeders, despite the use of protection systems, experience chronic attacks. In addition, wolf presence is increasing in areas of the plains and hills where human density is greater than in higher altitudes and where livestock is managed differently when compared to methods used in the mountains. The resulting impacts, both in terms of economic losses and psychological and social effects on breeders, often elicit aversion and intolerance towards wolves, thus representing one of the most pressing threats to wolf conservation in the Alps [8]. Reducing the impact of wolf depredation to economically acceptable and socially tolerable levels, through appropriate adaptation of breeding systems and correct adoption of prevention measures, is therefore a strategic priority in order to maintain and develop traditional economic activities in tandem with long-term wolf conservation in the region.

1.2. The LIFE WOLFALPS EU axis of actions A2-C1: goals, activities and products

In the last century when wolves were absent and following the introduction of economic incentives to increase the size of flocks, Alpine breeders abandoned the use of preventive measures. Inevitably, the impact of the first recolonizing wolves on outdoor livestock husbandry was high. Today, in the Western Alps, where wolf packs settled about 30 years ago, some of these traditions have been recovered; however, even in these areas, preventive measures are not always completely effective, often because they are not completely adapted to every situation and because the necessary labour force is no longer available to the historic extent.

Moreover, wolf attacks have recently increased on cows and also occasionally horses, donkeys and *Camelidae* species. In order to increase breeder tolerance towards large predators, the first LIFE WolfAlps project operated in the Western Alps in Italy, where wolf packs settled from the early ‘90s, and in the Eastern Alps in Slovenia, where wolf

recolonization was more recent, testing new preventive strategies, in particular for cattle, and transferring best practices in preventive solutions from the West to the East. One of the main goals of the LIFE WolfAlps EU Project, an upscaled follow-up to the first project involving Italian, French, Slovenian and Austrian Alps, was to decrease the human-wolf conflict through the preliminary A2 Action and the concrete C1 Action leading to the establishment and implementation of novel first-aid Wolf Prevention Intervention Units (WPIU). The ambition of the project is to develop a long-term international strategy that will last for decades. The availability of targeted support to breeders by qualified experts has been shown on several occasions to be the key for a long-term success of coexistence between wolves and outdoor livestock breeding.

For better coordination and implementation of the Preventive Actions (Actions A2-C1), an international team, composed by an operator from each country, was created. The team organised several meetings during the project to discuss and solve problems. Furthermore, in Italy, due to the high administrative fragmentation, a national team, composed by an operator from each Region involved in the Project, and five Multidisciplinary Working Groups (one for each Region, involving Administrations with different professional roles operators), was also created.

To allow an exchange of experiences and knowledge about best practices in damage prevention among alpine countries, 4 field visits were organised during the project: two in Switzerland with Agridea on agricultural practices and on damage prevention measures; one in the Alpi Marittime National Park (Italy) to discuss mainly cattle prevention methods developed in the first LIFE WolfAlps Project; and finally one in the Alpi Cozie Natural Park to discuss the most common problems of LGD presence on the Alpine pastures and their correct management with cattle and sheep.

During the Project different products have been developed to describe, analyse and find solutions for implementing prevention strategies; they are briefly reported hereafter.

1.2.1. International Alpine Report on damages and prevention

An International Alpine Report describing damages caused by large carnivores and focusing on prevention practices adopted and currently evolving in each Alpine Country has been produced by the LIFE WolfAlps EU project in collaboration with the WISO platform of the Alpine Convention (Berce et al., 2022). The main objectives of the report were to present an overview of the systems and sources of funding available for livestock protection against damages by large carnivores, to highlight examples of good practices and to prepare general recommendations at the international scale. Best practices, tried and tested through the intensive effort of many experts throughout Europe, have proven that a variety of solutions are available to reduce the occurrence of damages caused by large carnivores on livestock. Throughout different countries, technical solutions were tested and adjusted to fit specific landscape features and other environmental factors in the Alpine region.

All the experts agreed that the following three methods are effective in reducing large carnivore damages to livestock:

(1) the use of **electrified fences** to surround a pasture and discourage large carnivores from reaching grazing animals;

(2) the use of **livestock guarding dogs** (LGDs) that are brought up within the herd of grazing animals to create a strong bond between them; and

(3) the presence of **shepherds** guarding the herd during the day and closing the animals into a night pen.

Within each method, a range of approaches has been developed by the various countries to be implemented depending on terrain configuration (e.g., considering slope, degree of openness of the landscape, etc.) and the specific needs of the grazing animals under protection (e.g., access to water, location of resting sites, etc.). As there are no uniform, one-size-fits-all solutions, it appears evident that solutions need to be adapted to suit specific circumstances. Nevertheless, each method has a set of obligatory steps and procedures that need to be considered and that are described in the report.

1.2.2. The engagement of Life projects in reducing the impact of wolves in livestock husbandry in the Alps

In September 2023, the LIFE WolfAlps EU project provided important feedback to the European Commission by drafting a document in response to the EU Commission's invitation to local communities, scientists and all interested parties to submit quick and up-to-date data on wolf population and their impacts on livestock breeding. The WPIU national coordinators of each country worked together and produced the document "The efficacy of prevention systems in the Alps in the framework of the LIFE projects". It provided data collected within the framework of LIFE projects dedicated to large carnivores in the Alps and useful for the decision-making process. In particular, support for livestock protection carried out in 3 different LIFE Projects (i.e., LIFE SloWolf, LIFE Dinalp Bear and LIFE WolfAlps) and in one local Project (i.e., the Italian Progetto Lupo Piemonte) was summarised, highlighting the main results obtained in decreasing wolf damages and providing advice on best practices to be followed for protecting grazing animals. A particular focus on the LIFE WolfAlps EU prevention activity has been also described at each country level. The experience gained from the above-mentioned projects, together with other scientific publications on this topic, is encouraging and shows that it is possible to reduce the impact of wolf depredation and approach economically acceptable and socially tolerable levels, through the appropriate adaptation of breeding systems and the correct adoption of preventive measures. The evidence available indicates that it is generally feasible to maintain traditional economic activities in tandem with long-term wolf conservation in the Alps. Following this fundamental recognition, the next step is to comprehensively finance the measures for practical application.

1.2.3. Common Agricultural Policy (CAP) and prevention of damages caused by large carnivores

The expansion of populations of large carnivores, especially wolves, represents a major challenge not only for livestock breeders and local communities, but also for decision makers. The need for the rapid introduction of new, sustainable and, most importantly, effective measures and support for breeders is being increasingly apparent in the field and among livestock herders' communities. The issue was recognized by the LIFE WolfAlps EU project team and also by the Large Carnivores, Wild Ungulates and Society Working Group of the Alpine Convention (WISO). In 2024, collaboration between these various experts led to the publication of an important document entitled "Common agricultural policy (CAP) and prevention of damages caused by large carnivores". The report involved experts from different countries who are driving the evolution of damage prevention practices within the framework of current EU agricultural policies. The focus of the report is on the European Union's Common Agricultural Policy (CAP). The CAP policy for the period 2023-2027 has a strong emphasis on economic results and performance. The policy focuses on ten specific objectives, linked to common EU goals for social, environmental, and economic sustainability in agriculture and rural areas. European countries implement CAP through national CAP Strategic Plans, combining funding for income support, rural development, and market measures.

The main objectives of the present report were to (1) present the preventive measures involved in different Alpine countries, (2) present the measures and practices implemented within CAP 2023-2027 and (3) compare the previous EU supporting scheme RDP 20214-2020 with CAP 2023-2027. Additionally, the report includes the complementary activities that each country (or region) has adopted to mitigate the conflicts between farming practices and large carnivore species. The report has shown differences in the approaches of dealing with large carnivores and their impact on agricultural practices, emphasizing the room for improvement both within the implementation of measures and monitoring of their effectiveness in the field.

1.2.4. Wolf prevention intervention units (WPIUs) international strategy

One of the fundamental goals of the LIFE WolfAlps EU Project was to develop a novel, first-aid prevention approach: the Wolf Prevention Intervention Units (WPIU). These teams were composed of multidisciplinary staff that were trained to help and support breeders whose livestock suffered damages from wolves or that grazed in an area of recent wolf recolonization. The aim of the WPIU was to give concrete answers and immediate support to breeders for improving prevention strategies using *ad-hoc* guidelines based on best practices, as well as providing administrative assistance and information on how to access damage compensation tools and funds dedicated to prevention (i.e., European Agricultural Fund for Rural Development - EAFRD). WPIU staff therefore acted as mediators. Furthermore, they also evaluated, when possible, the correct use and effectiveness of

prevention systems, thereby helping breeders identify the weaknesses in their system and improve its effectiveness.

The WPIU worked on the basis of a common operating strategy and activity protocol developed at the international, national and, for Italy, regional level. The strategy details the best practices to be followed over the Alps. To produce the document, several meetings were organised among Partners for better coordination and implementation of activities. The document is composed by a general, common international operative strategy, that is then detailed and adapted at country level and, for Italy, at regional level. It contains a set of directives that establish a routine procedure for field actions to optimise WPIU performance and to allow interventions to be the most suitable for each context. To ensure uniformity of approach and coordination, and also to solve problems, 4 WPIU national coordinators were identified (one per country).

The WPIU ultimate goal is to create an effective organisation, which will remain active over the long term even after the LIFE Project.

Globally, 43 WPIU were created compared to the 23 expected by the Project: 29 in Italy, 2 in France, 7 in Slovenia and 5 in Austria. The high number of WPIU in Italy reflects the high administrative fragmentation of the country, so that comparatively more WPIU are needed given the number of organisations locally involved. Instead, France is a more centralised country where 2 WPIUs worked over more extended territory, above all the OFB. Each WPIU is composed of operators with different roles in terms of qualifications, depending on the Administrations involved at each country level. To date, the number of WPIU operators is almost 400. The involvement of public Administrations is essential to ensure maintenance of the WPIU beyond the end of the Project. All the operators involved in the WPIU were trained through 13 specific training courses and 14 workshops and they are now ready to intervene in case of wolf depredation on livestock, to propose better prevention strategies and to inform breeders on damage compensation tools and specific funds dedicated to prevention.

2. GOALS OF THE PRESENT REPORT

The goals of the present document are to evaluate the effectiveness of mitigation measures implemented to reduce damages caused by wolves on livestock in the project area in Austria, France, Italy and Slovenia, where **wolf prevention intervention units (WPIU**s**)** were established. Within each country, national WPIU operating strategies have been developed and gathered in a common International WPIU operating strategy.

The operating strategy was developed at the beginning of the project within the action A2. The activities and experiences from each established WPIU are a valuable aggregate of best practice examples and knowledge which will be continued within the regular work of institutions involved in the development. In order to achieve this, our goal is to define long-term guidelines at each national level to transfer the lessons learned beyond the boundaries of the LIFE WOLFALPS EU project.

3. WPIU MITIGATION MEASURES IMPLEMENTED IN THE PROJECT AREA

3.1. MITIGATION MEASURES IMPLEMENTED BY WPIU IN AUSTRIA

3.1.1. Austrian WPIU strategy and data collection methods

The concept of WPIUs was adopted and implemented in Austria under the LIFE WolfAlpsEU project. In Austria, these teams provided rapid, unbureaucratic support to owners and shepherds after a wolf attack, offering expertise, equipment, and manpower, and facilitating claim settlements. Their tasks included erecting fences for herd protection, gathering dispersed animals, and assisting with a possible premature withdrawal of livestock from mountain pastures.

A WPIU is deployed when an expert determines that a recent kill (no more than 24 hours old) was likely caused by a large carnivore (i.e., intervention following a depredation event). The WPIU can also be deployed if there are current signs of wolf presence or predation near a pasture (i.e., intervention for preventive purposes). The long-term goal of the preventive deployments is to implement guided pasturing on the mountain pastures, where the herds are accompanied by shepherds.

Austria is divided into nine Bundesländer (Federal State or provinces) that have a certain level of independence. Livestock protection is not managed by the government but by the Federal States, causing huge differences in the process and refunds.

If there is the suspicion that a farm or domestic animal has been attacked or killed by a wolf, farmers can ask for compensation, which varies in each province:

Carinthia: In 2019, the Carinthian Wildlife Damage Fund was established under the Carinthian Wildlife Damage Fund Act -K-WSchFG.[1] Financial support is provided mainly for directly caused damage. Support services are also provided for missing farm animals if it can be proven that a killing occurred on or adjacent to the affected alpine pasture during the alpine pasture season in question.

Lower Austria compensates proven damage to livestock caused by bears, wolves and lynx through a project of the landscape fund, which also finances wildlife ecology accompanying research on large predators. Compensation rates are agreed with the representation of the interests of the injured parties (State Chamber of Agriculture or farmers' associations).

In **Upper Austria**, damages are compensated according to compensation rates calculated by the Upper Austrian Chamber of Agriculture. The funds come from the agricultural budget of the state.[2]

1 https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=LrK&Gesetzesnummer=20000327

2 https://www.land-oberoesterreich.gv.at/wolfsinfo.htm

Salzburg pays compensation based on market values through its hunting law. Not only dead animals are compensated, but also wounded animals and animals that subsequently die of their injuries. In most cases, missing animals are also compensated on the basis of goodwill if the connection to the killing can be clearly established.[3]

Styria has an insurance model with fixed indemnity rates established together with representatives of the Chamber of Agriculture. The cost of the insurance is paid by the state, half from the nature conservation budget and half from the agriculture budget.[4]

Since 2012, **Tyrol** has had a directive for the compensation of damage caused by large carnivores. Currently, direct and indirect damage caused by large carnivores is compensated by the State of Tyrol. Previously, direct damage caused by a carnivore was compensated by the insurance of the Tyrolean Hunters' Association.

As in Salzburg, there are also goodwill regulations in Tyrol: the State of Tyrol pays compensation in cases where no direct evidence can be provided, but the crack was most likely caused by a large predator. This probability is assessed on the basis of the assessment of the damage or the crack and all other available data. There is also support for necessary animal rescues and veterinary costs. Tyrol also applies standardised rates for compensation. They are based on auction and market prices updated annually. [5]

The federal state of **Vorarlberg** pays fixed compensations based on market values. These compensations are paid for animals found dead and injured, which are recorded in the crack inspector's official report. For farm animals, the amount of compensation is determined on the basis of the assessment of an expert of the Vorarlberg Chamber of Agriculture.[6]

In **Burgenland** contact should take place immediately after the breeding animal is found so that evidence can be collected in the best possible way. Afterwards there is an analysis by experts and veterinarians to see how to proceed.[7]

In **Vienna** has been exempt from wolves' attacks and a procedure still needs to be developed.

Regarding the collection of data, Austria is currently applying opportunistic monitoring of wolves on both wild and domestic animals that have been attacked. To develop other types of monitoring is a goal to reach in the future.

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[3] https://www.salzburg.gv.at/themen/aw/richtlinie-wolf

[4] https://www.agrar.steiermark.at/cms/beitrag/11944042/100807466/

[5]https://www.tirol.gv.at/fileadmin/themen/land-forstwirtschaft/agrar/LWSJF/Grosse_Baeutegreifer/Entschaedigungsrichtlinie_aktuell.pdf

[6] https://vorarlberg.at/-/wolfsmanagement

[7] https://www.burgenland.at/themen/natur/naturschutz/wolfbaerluchs/

3.1.2. Challenges faced by WPIU units in Austria

The creation of WPIU units was very controversial in the Austrian rural communities, with the main stakeholders having a negative attitude. Most of them have not yet accepted the return of wolves and its consequences on livestock protection. Farmers and breeders are not keen to implement prevention methods as they are mostly used to free grazing without fences. On the other side, hunters practise winter ungulates management and the presence of wolves is affecting the process.

Figure 1: Advertisement from Alm Ohne Wolf. Translation from German: Only one is possible: either livestock on mountain pastures or the wolf in the wild. [8]

In general, in rural areas the population has been less cooperative during the project, while in urban areas people tend to have a more positive opinion about large carnivores. This difference may depend on the lifestyle, as usually residents in cities are not directly affected by wolves and only have theoretical knowledge.

Thus, the biggest challenge for the WPIU units was acceptance by farmers. This was not the case for WPIU emergency operations in Austria, but a change in strategy has changed this situation. Outside the planned activities of Life Wolfalps EU, three large mountain pasture areas in Tyrol[9] (Spisser Schafberg, Lader Heuberg, Verwallalm) have decided to change their grazing strategy in favour of a higher protection status (controlled grazing with pens at night). In Styria, one mountain pasture area (Hauser Kaibling) has been using this

[8] almohnewolf.at

[9] Livestock Protection Projects of the State of Tyrol https://www.tirol.gv.at/landwirtschaft-forstwirtschaft/agrar/rechtliche-bestimmungen-in-der-landwirtschaft/beutegreifer/herdenschutz/

type of grazing since 2008[10], while a new area (Grabneralm) joined the EU during the Life Wolfalps project. All alpine pasture areas are co-managed by the WPIU of AREC Raumberg-Gumpenstein, but now as WPIU for preventive protection. In the areas in Tyrol, however, the main work is carried out by the province of Tyrol as part of its own herd protection project. In Styria, a private association and an agricultural school[11] are active. The successful change in strategy has led to a redefined effectiveness of the WPIU in Austria. Based on our experience, we recommend the following WPIU strategy for the future in Austria: By closely observing the activities of mountain pasture communities in regions affected by wolf predation, they should be picked up early in their discussion and planning phase and then supported in the longer term. Selective WPIU missions should be converted into permanent support for willing groups. This means that WPIU operations in the broader sense may also be useful in the future.

WPIU emergency operations: Wolves depredations numbers are smaller than in the other countries involved in Life WolfAlps EU. The main reasons are believed to be connected to (i) quantity, as the wolf population is not widely spread, and (ii) their behaviour, as most individuals are migratory and don't form packs with a territory. For these reasons, emergency operations are left to chance and cannot be planned. Nevertheless, twelve emergencies were supported by the various WPIU teams. It is possible that this type of operation will no longer be important in the future because a.) local vets and organisations have organised themselves better and b.) the hunting community has become more active.

WPIU prevention operations: To facilitate the transition from free-grazing animals (stationary grazing) to guided pasture management, the alpine farming communities were supported in preparing the herds (deworming, fitness of the animals, sheep mating and lambing schedules, treatment for foot rot) and in monitoring the development of the animals (weighing all animals during both ascent to and descent from the pastures). Each herd was equipped with a large number of GPS collars provided by the Life Wolfalps EU project to help learn more about effective herd management by the shepherds. There is still little knowledge available on this in high alpine pastures. A total of 15 WPIU activities were required across all the alpine pastures for this purpose.

In this way, AREC Raumberg-Gumpenstein has completed a total of **27 WPIU operations**.

[10] Practical Handbook for the Revitalization of Alpine Pastures with Sheep https://raumberg-gumpenstein.at/jdownloads/Forschungsberichte/33_2014_agram_handbuch.pdf

[11] LFS Grabnerhof https://www.fachschulen.steiermark.at/cms/ziel/105467289/DE/

3.1.3. WPIU overall activity in Austria in detail

In Austria, there are five WPIU-Teams for emergency operations from two operators: one at AREC in Styria, three at the machine syndicate in Tyrol and one in Upper-Austria.

The WPIU for emergency operations was involved twelve times: (i) five in Tyrol (no data available because the corporate structure of the Maschinenring was changed), (ii) four in Salzburg, (iii) two in Carinthia and (iv) one in Styria. In five cases, the units responded to an emergency caused by a wolf depredation, while preventive actions in cases of emergency were taken in the remaining seven. AREC was responsible for seven interventions, which will be analysed in this report. In all cases, the farmers were lent electric fences for two weeks. After that span, the material was given back to AREC. One breeder bought a set of fences afterwards, but he was given special subsidies by the Federal State of Salzburg. In one case, the units intervened twice on the same pasture. Only on one pasture the regular presence of a shepherd was recorded, in all other cases the animals were not under human supervision. In all instances the flock was not supervised by livestock guarding dogs.

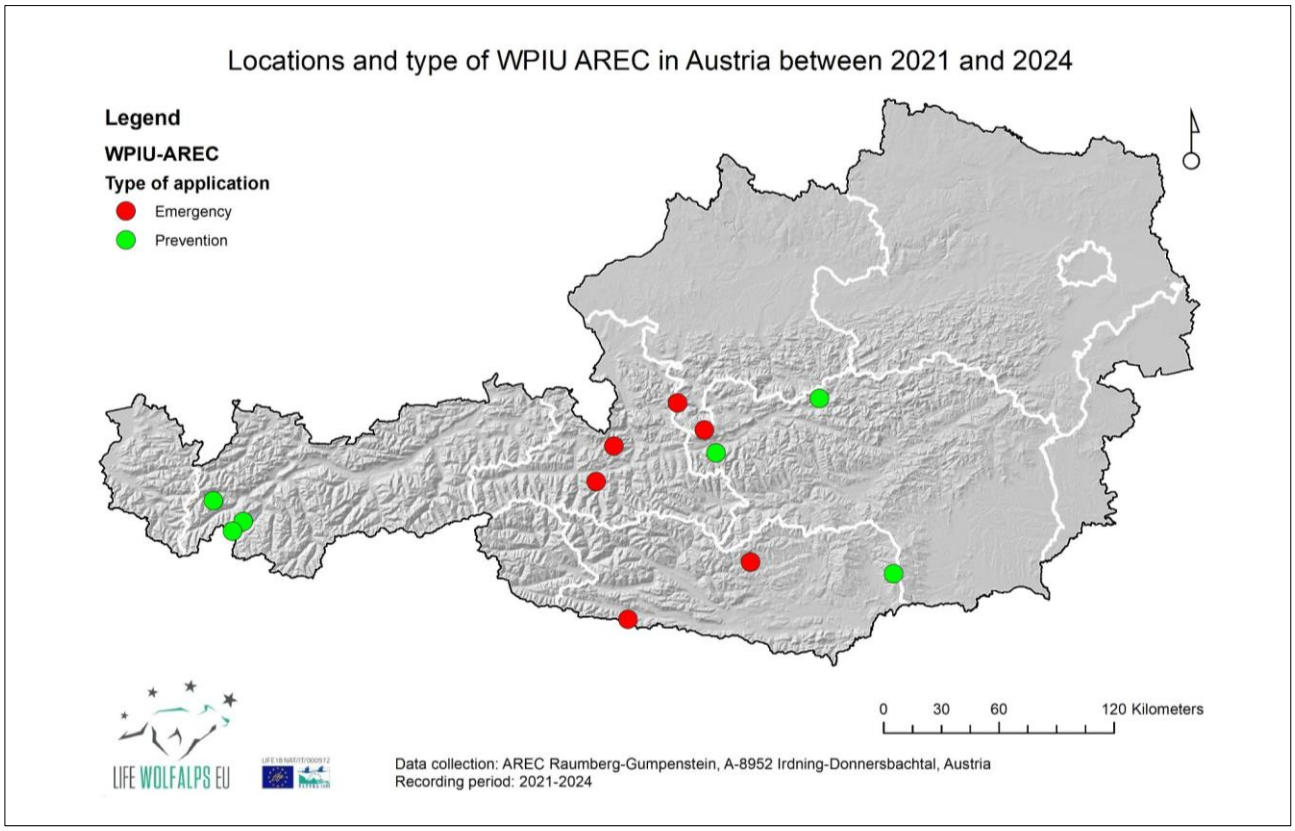


Figure 2: Map of the interventions by the WPIU unit from AREC.

The summary of the AREC unit's activities and a more detailed description of the Alpine pastures are explained in Table 1 and Table 2.

Table 1: Summary of the overall WPIU in emergency activity from AREC from June 2021 to December 2023.

Location	**Number of operators**	**Date**	**Number of breeders involved**	**Number of interventions per type**		
				Following a depredation event	**For preventive purposes**	**Evaluation of preventive methods after the intervention**
Rauris	1	2 interventions on the same pasture: 07.06.2021 08.06.2021	2	Yes, 40 sheep killed	No	Electric fences were put up for two weeks. After that, the farmers bought their own set.
Kirchbach	1	23.06.2021	3	Yes, 8 sheep killed	No	Presence of a shepherd before and after the event. The flock was fenced for two weeks.
Sirnitz	1	21.07.2021	1	Yes, 9 sheep killed	No	The flock was fenced for two weeks.
Rußbach	1	10.06.2023	3	No	Yes	Fencing was not possible due to terrain conditions.
Mühlbach	1	17.06.2023	4	No	Yes	Fencing was not possible due to terrain conditions.
Dachstein	1	23.08.2023	7	No	Yes	Fencing was not possible due to terrain conditions.

Table 2: additional data on the pastures with emergency necessity. Referring to the Alpine pastures that received an intervention from the WPIU from AREC.

Location	**Flock's dimension**	**Pasture elevation**
Rauris	150	1500 - 2000 a.s.l
Kirchbach	200	1700 - 1800 a.s.l
Sirnitz	33	1500 a.s.l.
Rußbach	130	1400 - 1800 a.s.l.
Mühlbach	200	1800 a.s.l.
Dachstein	670	2000 a.s.l.

As previously introduced methodologically, the WPIU supports alpine farming communities interested in preventive measures during the transition to guided pasture management. Especially with sheep, a very free grazing management has developed in the high alpine regions since the absence of large predators. This approach involves allowing the animals to graze in topographically defined areas of free pastures. The owners regularly visit their animals for monitoring. The needs for food and water, as well as the sizes of the local herds, have aligned in a practical balance over generations. There are no specific preparatory measures in place, neither for animal health nor for livestock protection. At the end of the grazing season, the animals naturally return to lower altitudes, where they are gathered and brought back to the owners' farms.

In guided pasture management, this very simple process changes dramatically, requiring both specialized expertise and high management competence. In all cases where AREC-WPIU visited the selected pastures for preventive measures (Table 3), specific areas were implemented according to the "Handbook for the Revitalization of Alpine Pastures with Sheep," which was developed between 2008 and 2013.

Table 3: AREC- WPIU prevention operations.

Date	Location	N. sheep	N. cattle	Number of breeders involved
30-04-2022	Grabneralm	27	0	1
14-05-2022	Spisser Schafberg	496	0	27
17-05-2022	Haus im Ennstal	110	0	23
20-05-2022	Lader Heuberg	356	0	24
04-06-2022	Verwall Alm	254	0	22
08-06-2022	Hauser Kaibling	580	0	23
04-09-2022	Verwall Alm	254	0	22
23-09-2022	Lader Heuberg	356	0	24
24-09-2022	Spisser Schafberg	496	0	27
21-09-2022	Hauser Kaibling	690	0	23
23-09-2022	Grabneralm	27	0	1
19-05-2023	Spisser Schafberg	496	0	26
09-06-2023	Hauser Kaibling	110	0	23
02-06-2023	Lader Heuberg	356	0	23
04-06-2023	Verwall Alm	254	0	19
08-06-2023	Hauser Kaibling	580	0	23

23-09-2023	Verwall Alm	254	0	19
21-09-2023	Lader Heuberg	356	0	23
21-09-2023	Spisser Schafberg	496	0	27
15-09-2023	Hauser Kaibling	690	0	23
06-05-2024	Almgemeinschaft Speikkogel	0	405	40
28-05-2024	Hauser Kaibling	690	0	23
07-06-2024	Verwall Alm	210	0	19
08-06-2024	Spisser Schafberg	420	0	27

The cost of the implementation of the WPIU is variable, mostly depending on the quantity of days spent on the field. An average estimation is shown in Table 4.

Table 4: Costs of the implementation of the WPIU emergency operation in Austria from 2021 to 2023 – small intervention, one day. [12]

	Amount	**Unit of calculation**	**Cost/unit**	**Total**	
Personnel					
Team leader	14	Working hours	€ 60,00	€ 840,00	1.day
Team leader	4	Working hours	€ 60,00	€ 240,00	2.day, follow up
Team members (3 people)	40	Working hours	€ 45,00	€ 1 800,00	
Expenses (meals etc.)	4		€ 30,00	€ 120,00	
Machinery, additional equipment					
Kilometre allowance	240	km	€ 0,42	€ 100,80	
				€ 3 100,80	

[12] Based on Austrian strategy for WPIU and real costs including taxes following prices of the machinery syndicate providing personnel, modeled after real interventions:

Table 5: Costs of the implementation of the WPIU emergency operation in Austria from 2021 to 2023 – big intervention, three days.

	Amount	**Unit of calculation**	**Cost/unit**	**Total**	
Personal					
Team leader	8	Working hours	€ 60,00	€ 480,00	1.day
Team leader	15	Working hours	€ 60,00	€ 900,00	2.day
Team leader	2	Working hours	€ 60,00	€ 120,00	3.day
Team members (3 people)	21	Working hours	€ 45,00	€ 945,00	1.day
Team members (3 people)	45	Working hours	€ 45,00	€ 2 025,00	2.day
Rest period (4 people)	28	Working hours	€ 25,00	€ 700,00	
Accommodation	4	Nights	€ 80,00	€ 320,00	
Expenses (meals…)	4		€ 20,00	€ 80,00	
Machinery, additional equipment					
Kilometre allowance	300	km	€ 0,42	€ 126,00	
Quad	4	operating hours	€ 45,00	€ 180,00	
Trailer	300	km	€ 0,30	€ 90,00	
				€ 5 966,00	

Writing-off and allowance for depreciation of standard equipment (fences, foxlights, fladry, tools) and consumables were not calculated during the project period, as it was provided by AREC, but contributes to long-term costs.

Case study of a wolf attack in Hochwipfelalm, Carinthia.

Until 2018 in Hochwipfelalm sheep were kept in a free grazing system. When farmers experienced their first wolf attack, they decided to not use that Alpine pasture anymore. A second attempt was tried in 2022, but after only five days on the pasture some sheep

were found killed. The farmer decided to stay overnight with the sheep sleeping in a tent. According to his witness, when the moon was covered by clouds, the wolf attacked again, ignoring his presence.
Thus, the farmer found himself with a choice to make: either he took the sheep back home again or he needed to start livestock protection. A technician went to the pasture to check on the predation and stated it was a wolf. He suggested the farmer got in contact with the WPIU from AREC. After an exchange of ideas, he agreed to apply some preventive methods in his pasture.
A team composed of four WPIU members, the farmer, two helpers and a wolf expert built a paddock of about ten fences. The sheep were then collected and put safely into the paddock for a few days.
At the same time the farmer searched for a shepherd to have human supervision on the flock. He found a woman soon, who started as a shepherdess a few days later.
A new management was designed: during the day the sheep would graze freely, but at night they would be fenced. At the beginning the sheep had to get used to being herded and collected every day, but they haven't experienced any more attacks.
The shepherdess worked in the pasture until 2024. After that date, the pasture was not guarded anymore. Even though some rumours circulated about wolves going back in the area, nobody requested the aid of AREC.
We suppose that the reasoning behind this choice is related to the absence of attacks during the past years. Hence, in case of more losses, the response team might be called again.
Due to the lack of public advisory offices, the AREC WPIU team for preventive operations was often involved in various activities outside of practical livestock protection. These activities can be broadly divided into: a) discussion rounds or lecture events with local agricultural chambers or regional politicians, b) discussions arising from the formation of associations of wolf opponents, and c) appearances within the framework of public administration. 14 activities are shown in summary in Table 6.

Table 6: Additional non-field-related activities of the AREC WPIU for preventive operations.

Type	**Number of events**
Support Austrian Assoziation Bear, Wolf, Lynx	2
Common information to farmer	7
Field information to farmer	1
Common information to associations, chamber of agriculture, administration	4

3.1.4. Evaluation of the effectiveness of mitigation measures implemented to reduce wolf damages on livestock in Austria

3.1.4.1. Results

Due to several factors, to precisely evaluate the effectiveness of mitigation measures is not possible.

The reasons are both social and environmental. In Austria, the preventive method used most often is setting up electrified fences, but they are not always kept in optimal condition. Breeders are free to follow the WPIU guidelines or not, and often prefer free grazing rather than keeping animals in a fenced pasture. In almost totality of the cases, the electric fences are not stable and are implemented only when a wolf is in the area or when an attack nearby is reported.

There is also a natural factor to consider: in 2019, Austria had only 3 wolf packs. By 2023, this number had doubled to 6 wolf packs. In addition, most of the population is represented by single individuals wandering the country without a stable territory, which makes it challenging to predict where their predations on livestock will take place. Nevertheless, these aspects will be considered in future research, when more data becomes available.

Nonetheless, after the WPIU interventions on a pasture, no wolf attacks have been recorded. The motive is not clear, it could derive from the efficacy of the prevention methods or it could be caused by a low density of wolves in the area. The perceived positive trend is not supported by scientific data.

Details on the prevention methods available in Austria

Farmers don't employ **shepherds** often due to lack of funds. Hence, the average wage of a shepherd is too low to sustain a sustainable lifestyle. For these reasons, flocks are usually left unguarded on the Alpine pastures, with the owner checking on them two to three times a week during the summer grazing period.

AREC is currently holding shepherding courses to spread the knowledge and to raise awareness on the job conditions. The age of participants is very variable, but the majority of them identify themselves as women. This information is quite surprising, as the position was traditionally covered by men.

A future goal is to expand these courses, have more members and promote gender equality.

Livestock guarding dogs are not usually deployed on the pastures. Historically, the practice was not included in Austrian culture and is now being considered due to the return of large carnivores.

At the moment, Austria counts two guarding dogs (for details, see Table 7) with an official certificate provided by the Österreichzentrum Bär, Wolf, Luchs (Austrian Centre for Bear,

Wolf and Lynx). The number is supposed to grow in the next few years. On the other side, shepherd dogs are more commonly used to gather the flocks.

Table 7: Data on the LGD in Tyrol, Austria.[13]

Location	**ID**	**Breed**	**Sex**	**Age**
Pfunds	1	Maremmano	Female	3
Pfunds	2	Maremmano	Male	2
Pfunds	1	Maremmano	Female	3
Pfunds	2	Maremmano	Male	2

The main prevention method used in Austria is fencing. AREC is encouraging farmers to shift from barbed wire to **electric fences**, but at the moment the first one is more widespread.

When the WPIU were called to intervene, AREC was supporting the farmers by lending six fences of 50 metres each for two weeks (for details see Table 8). After that time, the fences were returned to AREC and the farmers had the chance to buy their own.

Table 8: Details of the electric fences, property of AREC.

Model	**Height**	**Volts**	**Batteries**	**Grounding**
Gallagher S - 400	1.08 metres	4.000 to 5.000 volts	4 joules, batteries powered by solar panels	Grounding of 3 metal poles, positioned every 3 metres.

[13] Regarding the Alpine pastures where the WPIU units from AREC intervened, none of them had LGD. Both the certified livestock guarding dogs are in two pastures in Pfunds, Tyrol. Further information is not currently available.

3.1.5. Other activities conducted in Austria

3.1.5.1. Remote monitoring of sheep herds using GPS collars

Triggered by the shortage of shepherds on Austrian mountain pastures, farms requested a technology for the remote monitoring of sheep. Right from the start, GPS collars from different suppliers and using different technologies were deployed by the LIFE WolfAlps EU project to test a) the practicality and precision of the devices, b) the reliability of signal transmission and c) their cost-effectiveness. The first two points were deemed appropriate after the project was completed, while the cost aspect became obsolete due to falling prices. Through close contact with suppliers, AREC has not only succeeded in securing the data of the GPS collars purchased in the Life WolfAlps EU project, but also almost all the data of the devices used in Austria. By the end of 2023, a total of 1275 GPS collars recorded around 2.5 million positions between 2021 and 2023 (Figure 3).

The original plan to develop an additional panic function for GPS collars was abandoned during the prototype phase. In their everyday behaviour, individual animals show significantly higher activity levels at incomprehensible intervals, the extent of which also corresponds to an artificially induced high stress level. Attacks by wolves cannot be distinguished from rank fights, enjoyment of life, playing, etc. However, the large number of positions recorded in the Life WolfAlps EU project has led to the description of reliable movement vectors in space. These represent both the course of the day and the course of the month in the alpine summer. Taking into account the scattering that occurs, we now know the natural movement radii of free-ranging and herded animals. These results are currently being refined with the integration of terrain and weather data. At the end, we will be able to send a warning signal to the farm for grazing animals with GPS collars if these limits are exceeded or if there is a lack of movement. In the case of free-ranging herds, both aspects indicate a possible damaging event caused by large predators. The response time is expected to be 6 hours.

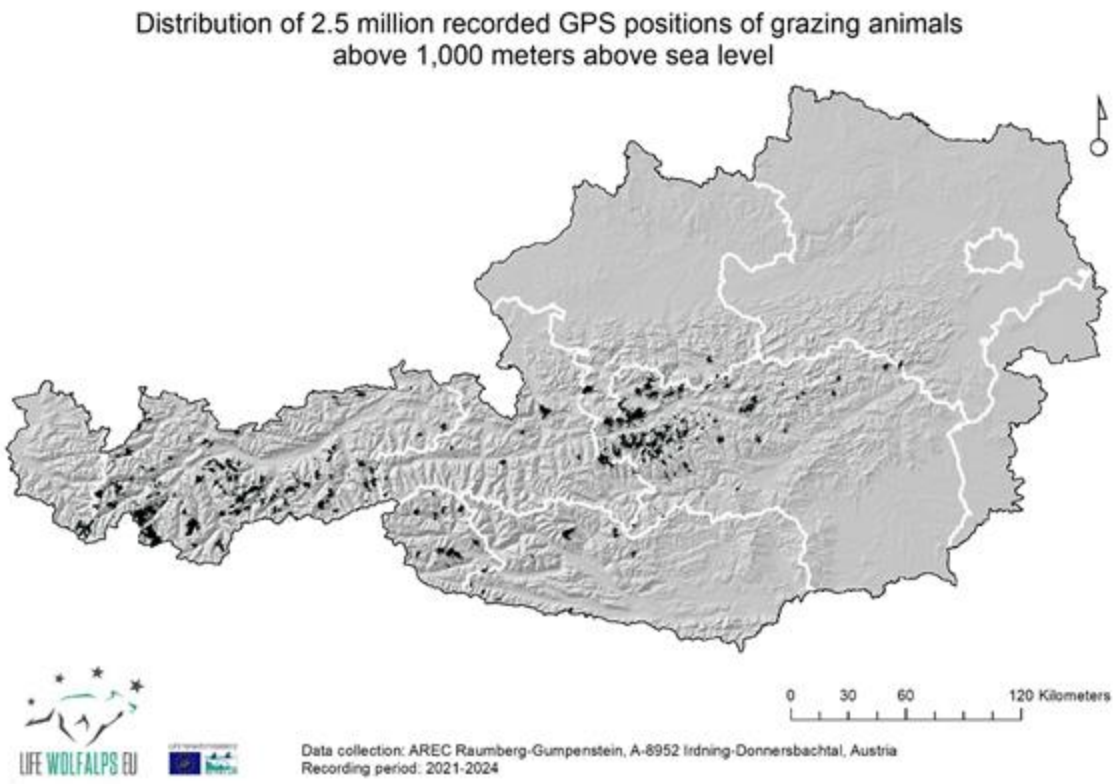


Figure 3: Distribution of GPS positions of grazing animals.

3.1.5.2. Drones

The use of drones is slowly gaining acceptance among tech-savvy people for the rough search of grazing animals. Since DJI has enabled flight distances of several kilometres, shepherds have been using cameras to search for their animals. This technology does not require any special agricultural knowledge, because the search itself is strongly influenced by experience of the practical use of an alpine pasture by the animals. Modern drones are easy to fly by anyone who can assess the risk of loss. The use of drones often meets with little approval from hikers or people with a cultural affinity. Under no circumstances can the search replace individual animal control. Injuries at an early stage, nutritional status or other aspects cannot be detected from a distance, even if the animal is very close. Sheep and cattle have a different approach to drones.

A DJI Mavic drone with a high-resolution thermal camera was used in several WPIU operations to search for scattered animals. This technique is successful when a) the pilot is able to fully scan a search area in free flight, b) the vegetation allows for the animals to be found (no obstruction), and c) the farmers are then able to capture the animals. In practice, the last point has proven to be the greatest challenge. After a wolf attack, sheep are so frightened that they cannot be caught even by their well-known owners in the steep terrain of the Alps. Humans are unable to move fast enough on steep slopes.

3.1.6. Discussion

Pastures and rangelands shape Austrian alpine regions. Their management is highly variable due to land ownership and its associated legal basis, type of livestock, altitude, terrain, flock size, history and tradition, etc. This diversity also requires diverse measures of livestock protection. The implementation of WPIU is one of them, which can be useful especially in areas where other livestock protection measurements were not put into practice yet. WPIU can thus be seen as a “first aid”-measure. WPIUs for emergency operations have not proven effective, which is why, as in other project countries, they were converted to WPIUs for prevention. In this way, the Life WolfAlps EU project was able to support 5 large alpine pastures as beacons for new grazing methods. The most important basis for sustained livestock protection in Austria is the increased implementation of targeted grazing, guided by shepherds. Currently, most alpine sheep and goat farms, which are affected most by wolf attacks, practise a free grazing system without the constant presence of shepherds. This management system makes it almost impossible to implement livestock protection methods, since it would entail an immense additional workload for breeders. Targeted grazing methods – in sectors or through active shepherding – allows not only for better use of pastures, but sheep flocks can also be guided more easily. Shepherds can thus react flexibly in case of wolf presence and implement appropriate livestock protection methods (e.g., LGD, fencing) when needed. In Austrian agriculture, however, there is still a strong resistance against the implementation of livestock protection and therefore also against a change in management. Moreover, Austrian agriculture experiences a lack of qualified staff. This also concerns the availability of trained shepherds. Firstly, this might be related to the low wages for shepherds and the associated insufficient social security. Adequate subsidies for this purpose are currently missing in Austria. Secondly, there is a lack of shepherd training. Together with project partners, AREC is currently setting up a prototype for shepherd training with a focus on goat and sheep farming on alpine pastures. The idea is to implement a modular training course (app. 100 hours), including important aspects of shepherding of goats and sheep: animal health, pasture management, working with LGD and shepherd dogs, livestock protection, safety at work, etc. After a first round in 2025, the prototype will be evaluated and adapted for its subsequent implementation. To ensure a high training quality, it should also find recognition in the National Qualifications Framework (NQF).

3.2. MITIGATION MEASURES IMPLEMENTED BY WPIU IN FRANCE

3.2.1. French WPIU strategy and data collection methods

In France, livestock breeders generally must have implemented at least 2 out of 3 preventive measures (i.e., livestock guarding dogs, electric fences and/or a shepherding) to access financial compensation for wolf damages and to be recipients of wolf lethal control to protect their flocks. Most breeders willing to use preventive measures against wolf attacks thus already do so in the country, and particularly in the French Alps where wolves have been present since the early 1990s. For this reason, the two French WPIUs – one from the French Office for Biodiversity (OFB), the other from Mercantour national park (PNM) – did not provide LGD or fences, although the PNM WPIU did occasionally provide acoustic and visual deterrents to breeders and shepherds. The strategy of the French WPIU focused mostly on providing advice, when appropriate, on how to improve the effectiveness of the preventive system in place (for more details, refer to the French WPIU operating strategy in Menzano *et al.* 2020).

Local public authorities (DDT – “Direction Départementale des Territoires”) of each French “département” (an administrative unit of the French state) were responsible for establishing the link between the OFB WPIU and breeders interested and willing to engage with the LWA EU project. Other public structures – regional parks and nature reserves – also worked as intermediaries, but the local DDT was always informed of any OFB WPIU intervention in the territory under their administration.

In the case of PNM, the park is in charge of wolf damage reports since the return of the predator to the area. Breeders exposed to wolf attacks are well known by park staff and those most affected were a priority for WPIU interventions. As for most breeders contacted by the OFB WPIU, all breeders in PNM already use preventive measures and cannot be coerced into cooperating and accepting the presence of WPIU or park agents in their pastures. Their participation was strictly voluntary. PNM has no authority to do otherwise and the park is not considered a legitimate structure to be providing advice to breeders on how to raise their livestock and protect it from wolf attacks. As a consequence, the first year of WPIU implementation in PNM mainly consisted in visiting breeders, and particularly those whose flocks were most attacked, to offer help in trying to understand why attacks persisted despite the use of preventive measures. The PNM WPIU decided to focus efforts on only a few pastures each year and all summer long in a bid to take the necessary time to understand what the situation really was in each site. Because of a lack of breeders willing to collaborate with the project, PNM WPIU intervened over shorter periods in unusual circumstances and at the breeder's request (for example, a herd attacked for the first time after years when nothing had happened, or at a higher rate than usual). The report of each intervention was then sent to the breeders after the document was revised by the local agricultural trade union and the local authority (DDT). As a consequence of this revision process, breeders only received the report several months after the PNM WPIU intervention.

In any case, because breeders in France often pool their flocks and work collectively to benefit from economies of scale – e.g., to hire shepherds –, several breeders were usually

involved in each WPIU intervention, although most discussions took place with only one lead breeder. French WPIU agents collected data on the effectiveness of mitigation measures by observing the preventive system in the field, usually over several days, and filling in the common Action C1 data form agreed at the international level (see Annex 1 in Menzano *et al.* 2020). WPIU agents in France also deployed GPS collars on LGD and used camera traps and thermal infrared cameras to document the interactions between the flock, dogs, wildlife and, occasionally, wolves. Breeders and shepherds were provided with immediate feedback at the end of interventions, before receiving a full report a few days later (or months later in the case of PNM). This document was also systematically sent to the local authorities and any other structure working with the WPIU. Apart from a detailed account of observations – including several maps, diagrams, pictures and links to video footage –, the reports always contained a section providing explicit advice on how to improve the preventive system in place (e.g. reduce the size of the fenced area and keep it as far as possible from wooded areas, add a LGD, etc.). There was however no obligation for breeders to act on the recommendations provided.

3.2.2. WPIU overall activity in France

From June 2021 to the end of August 2024, the two French WPIU performed a total of 395 interventions in France (

Table 9). Although the area of intervention of the OFB WPIU covered the entire French Alps - with the exception of the Mercantour National Park -, most of its interventions occurred in the central part of the region (Figure 4). Interventions by the PNM WPIU were also heterogeneous in space, albeit only at the scale of the national park (Figure 5). Most flocks under surveillance by the French WPIU were composed of mainly, but not necessarily exclusively, sheep (Table 10). This is hardly surprising given the sheep are by far the type of livestock most impacted by wolf depredation. Flocks under observation containing more than 1000 sheep were fairly common, and particularly so in the Mercantour NP (Figure 6).

Table 9: Summary of the overall WPIU activity in France from 2021 to 2024.

WPIU	Number of operators	Period of activity	Number of breeders involved	Number of interventions per type		
				Following a depredation event	For preventive purposes	Evaluation of the correct use of preventive systems
1. OFB	2	June 2021 to August 2024	101 [1]	33	243	276 [2]
2. PNM	2	June 2021 to August 2024	81	27	22	71
TOTAL	4	June 2021 to August 2024	182	60	264	347
					Grand total	**395**

[1] This number is the sum of unique combinations of breeders-pasture-flock, as interventions occurred along the same breeder but in a different pasture or after the composition of the flock was modified.

[2] Every intervention provided information for the evaluation of the correct use of preventive systems. So this figure is the sum of the numbers appearing in the previous two columns.

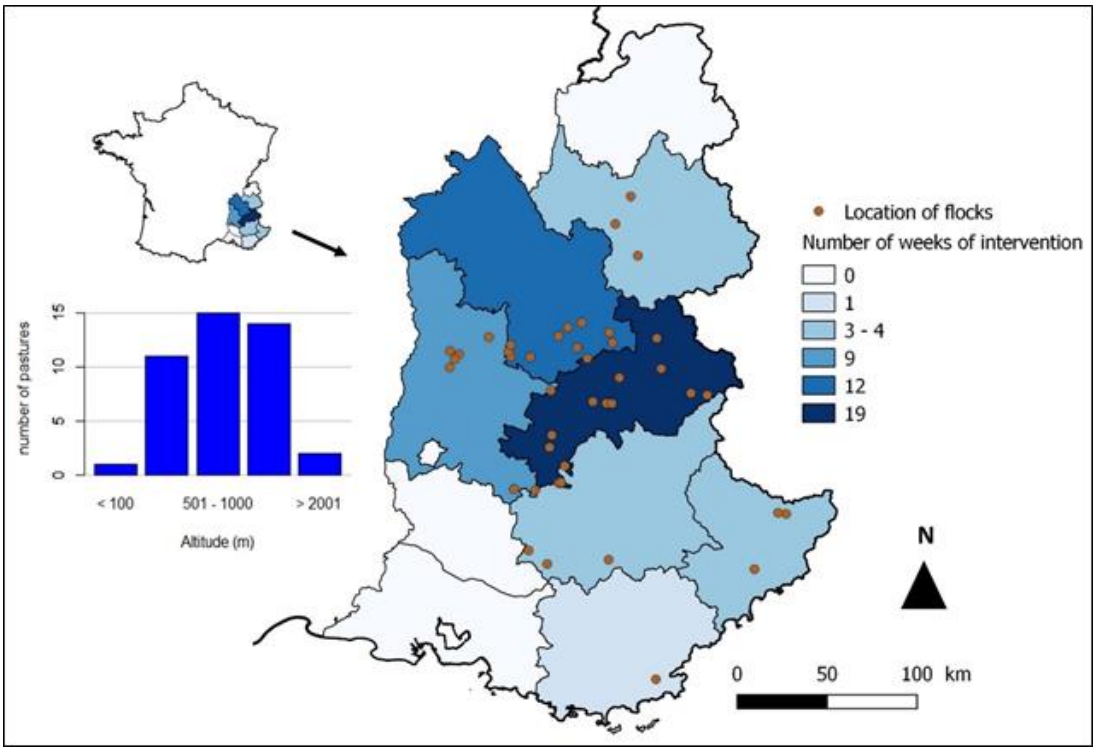


Figure 4: Pasture location, altitude above sea level and number of weeks of intervention per alpine department (an administrative unit of France) by the OFB WPIU from 2021 to 2023.

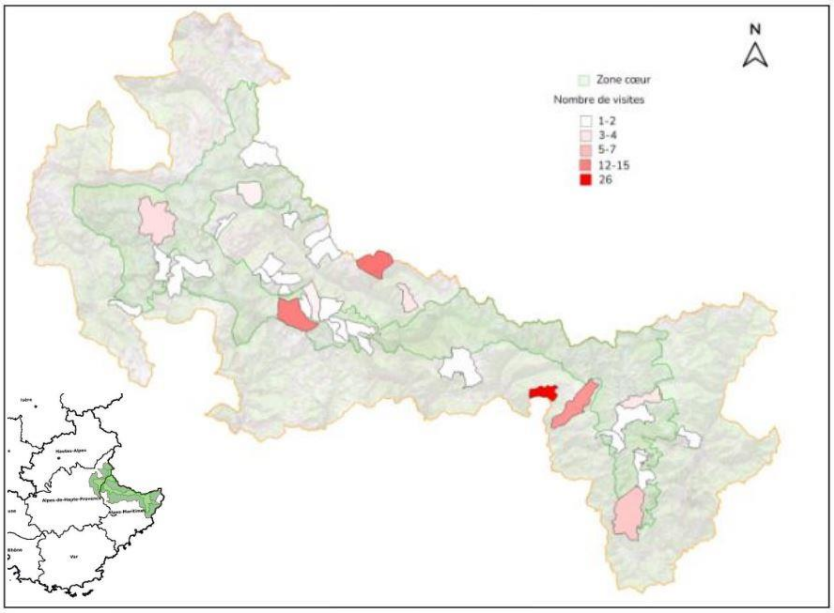


Figure 5: Pasture location and number of interventions per pasture in the Mercantour National Park by the PNM WPIU from 2021 to 2023.

Table 10: Livestock types and numbers observed by the French WPIU in the French Alps (2021-2023).

WPIU	Animal type	N flocks	Mean N	Median	Min N	Max N
OFB	Sheep	39	849	600	35	3000
	Goats	17	20	39	1	190
	Cattle	9	94	43	10	355
	Horses and donkeys	8	7	3	1	28
PNM	Sheep	44	1039	1063	150	2177
	Goats	17	26	10	1	106
	Cattle	3	19	1	1	56
	Horses and donkeys	5	3	2	1	4

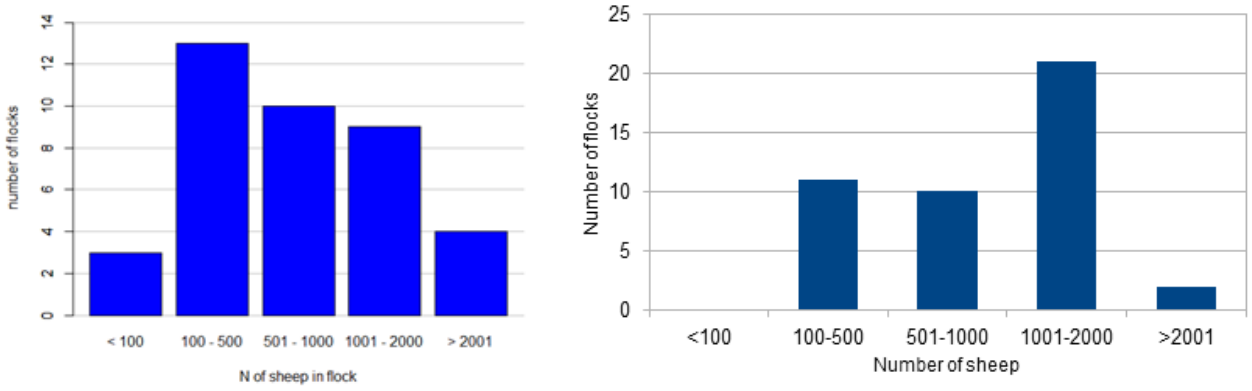


Figure 6: Number of sheep per number of flocks containing sheep observed by the OFB (left) and PNM (right) WPIU in the French Alps from 2021 to 2023.

Total costs for the implementation of the French WPIU varied between the OFB and PNM, with the former being almost twice as expensive as the latter (Table 11). There are two reasons for this difference: the first is that the OFB WPIU operated year-round, whereas the PNM WPIU were active only during the pasture season (4-5 months/year). The second is that OFB WPIU had greater operational costs due to accommodation expenses, which were absent for the PNM WPIU.

Table 11: Costs of the implementation of the WPIU in France from 2021 to 2023.

WPIU	Category	Cost
OFB	Personnel	135 000 €[1]
	Operational	20 500 € (vehicle[2]) + 2515 € (fuel[3]) + 7400 € (food[4]) + 16 650 € (accommodation[5]) = 47 065 €
	Material	4850 € (1 thermal infrared camera) + 2000 € (4 camera traps) + 2050 € (trekking and consumable material) + 1700 € (GPS collars for LGD and sheep) = **10 600 €**[6]
	Total	192 665 €
	Per intervention	192 665 € / 236 interventions (2021-2023) = **816 €/intervention**
PNM	Personnel	35 313 €[7]
	Operational	**7800 €** (vehicle rental + fuel)[8]
	Material	4850€ (1 thermal infrared camera) + 1752 € (4 light and acoustic deterrents) + 4500 € (16 camera traps) + 1951 € (GPS collars for LGD and sheep) + 2050 € (trekking and consumable material) = 15 103 €[9]
	Total	168 581 €
	Per intervention	168 581 € / 118 interventions (2021-2023) = **493 €/intervention**

[1] Based on a gross salary of 2500 €/agent/month, and 7 months of employment in 2021, 12 in 2022 and 8 in 2023.

[2] Acquired in 2021.

[3] Estimate based on 236 interventions in 2021-2023, an average consumption of 6 L of diesel per day and 10.66 €/day given 1.776 €/L, as observed at the petrol station nearest to the OFB WPIU base in Gap on 23/07/2024.

[4] Estimate based on 40 €/day and 185 out of 236 interventions in 2021-2023. The difference is because food costs were only covered when agents were out in the field, and hence usually do not include lunch on Monday and dinner on Friday.

[5] Estimate based on 90 €/night and 185 out of 236 interventions in 2021-2023. The difference is because accommodation usually only had to be paid for 4 nights in a week.

[6] The OFB WPIU did not provide fences, dogs or other preventive material to breeders as most were already equipped (see Berce et al. 2020 for a detailed explanation of the WPIU strategy in France).

[7] Total cost of the 2 WPIU salaries from 2021 to the end of 2023, corresponding to a total of 28 months divided between the 2 WPIU and funded 57% by the LWA EU project. Day cost of one WPIU = 237€ day/agent x 149 days = 35 313€). NB : days spent analysing data, writing reports, etc. are not included, only the cost of the time spent in the field by the 2 WPIU. Time allocated to this action by the technical coordinator is also not included.

[8] Not funded by the LWA EU project.

[9] Not funded by the LWA EU project. All other types of preventive material are paid by the French state (see Berce *et al.* 2020 for a detailed explanation of the WPIU strategy in France).

3.2.3. Evaluation of the effectiveness of mitigation measures implemented to reduce wolf damages on livestock

3.2.3.1. Results

Use of prevention systems

Most flocks under observation by the OFB WPIU (79%) were protected by at least two of three main preventive measures (electrified night pens, LGD and shepherd), as usually required in France for breeders to be able to access compensation in case of wolf damages (Table 12). The only flocks observed without any form of protection were cattle and horse flocks which, under current policy, do not qualify for national public funds dedicated to preventive measures. In the Mercantour NP, 81% of flocks under observation by the PNM WPIU deployed the three main preventive measures, while only 13% used only LGD and shepherd, and 6% only fence and shepherd. **Overall then, 89,5% of breeders collaborating with the French WPIU used prevention systems.**

Table 12: Prevention measures observed by the OFB WPIU in the French Alps (2021 -2023).

Prevention measure				
LGD	Electrified fence	Shepherd	Visual deterrent (Foxlight or collar)	N = 43 (100%)
x	x			17 (40%)
x	x	x		11 (26%)
	x	x		3 (7%)
x				3 (7%)
	x			1 (2%)
		x		1 (2%)
	x		x	1 (2%)
x	x	x	x	1 (2%)
x		x		1 (2%)
x	x		x	1 (2%)
			x	1 (2%)
none (cattle and horse flocks)				2 (5%)

Decrease in wolf depredation

Relatively few breeders in France acted on the advice provided by the WPIU. In the case of the OFB WPIU and from 2021 to 2023, out of 39 unique breeder-pasture-flock combinations (a given breeder could have his/her flock in different pastures, and have changed its composition over time), only 7 modified their preventive system as a result of recommendations from the OFB WPIU, 18 choosing not to do so, for various reasons. For 14 breeder-pasture-flock combinations, no information was available as it proved impossible to get hold of the breeder again.

In the Mercantour, among the 10 breeders who accepted to work in collaboration with the PNM WPIU team in 2022 and 2023, 4 followed our recommendations, 2 have partially applied our advice, 2 did not, and the last ones did not need to do it. There were a number of reasons to explain those heterogeneous results and each case is a particular case. As for all those who totally refused our interventions, for some the reason was that the only acceptable solution was to shoot the wolves in the core area of the park, others because of their refusal to collaborate with the PNM.

Given that most preventive systems were not modified on the basis of WPIU advice, it is perhaps unsurprising to find that attacks on livestock continued after interventions. Yet even for the 7 breeder-pasture-flock combinations in which the preventive system was modified in accordance with the recommendations of the OFB WPIU, this did not necessarily lead to a reduction in the number of attacks or the number of depredated livestock. In one case, for instance, the flock suffered 11 attacks over 24 months resulting in 55 compensated sheep prior to the OFB WPIU intervention, yet was still subject to 16 attacks leading to 78 compensated sheep over a similar period of 18 months after the intervention. The breeder in question added an LGD as advised by the OFB WPIU, but a young dog is not fully operational until its 2 or 3 years-old. A similar case occurred in the PNM, an experimented LGD killed by a wolf has been replaced next year by a young and inexperienced one. The attacks have increased the year it has been introduced in the LGD group, despite the application of our recommendations.

In the case above, the lack of effectiveness of the WPIU intervention is thus easily explained. Yet even when attacks or the number of depredated animals did decrease after a WPIU intervention, in the absence of data showing that wolves tried to attack the flock but failed, it is questionable whether we can assert that the cause of the reduction was the WPIU intervention and the fact that the breeder acted on the advice provided. Wolves are often shot in France to protect livestock, and this might explain the reduction in the number of attacks in a given area, regardless of modifications to the preventive system. Given the wide area used by wolves, even wolf removals outside of the Mercantour NP could have impacted the level of damages inside the park. It is very difficult to separate the effect of lethal and non-lethal preventive measures on wolf depredation if both are occurring at the same time in the same area.

Sometimes the recommendations cannot be implemented because they require financial support (for example hiring an additional shepherd in the areas most vulnerable to predation) or require the intervention of an external organisation. In Mercantour, the attacks are often concentrated in forest areas. In this case, the WPIU recommended maintaining open environments, which can only be done by a specialised organisation through controlled burning, but these interventions are planned a year in advance, and requests are not always honoured for reasons of priority or feasibility. Additional human resources also require the possibility of housing shepherds in conditions that comply with the French labour code, which is rarely possible in this profession. More and more shepherds are demanding decent working conditions that are difficult to respect without significant involvement of the municipalities that own the land.

Other factors might also impact the propensity of wolves to attack a flock that are independent of the preventive system in place. For instance, if wolves have succeeded in attacking a flock elsewhere, they may be inclined to continue attacking that flock, leading to a reduction in the number of attack attempts on other flocks in their territory. Again, this will have nothing to do with whether the breeder modified his/her preventive system in line with recommendations made by the WPIU.

For all these reasons, the French WPIU do not appear to have been successful in reducing the number of attacks or the number of depredated animals in the areas they intervened. We will return to this point after presenting the other activities conducted by the French WPIU.

3.2.4. Other activities conducted in France

3.2.4.1. Observations of wolf behaviour through thermal infrared cameras and camera traps

Observation conditions and effort

From June 2021 to July 2024 included, the OFB WPIU spent 202 nights and a total of 897 hours in the field making observations, for an average of about 4.5 hours of observation per night (897/202), usually starting right after sunset. The PNM WPIU, for its part, observed on average for 4 hours per night over 42 nights of observation, to a total of 168 hours of observation from June 2022 to September 2023. This figure was however highly variable: observation sessions could be cut short due to bad weather, for instance, or greatly extended if high levels of dog and wolf activity were observed (minimum number of hours of observation in a single night for the OFB WPIU = just over 2 hours; maximum = just under 7 hours). WPIU agents directly observed and recorded wolf behaviour through the use of thermal infrared cameras (Pulsar Accolade 2 or Helion 2 models). Once settled in a site or sites (if two cameras were available, agents would split up), they regularly scanned the environment and recorded the behaviour of any wolf that came in sight (Figure 7). The camera was mounted on a tripod to ensure the stability of the images.

Figure 7: A couple of wolves recorded by the OFB WPIU passing next to a flock of sheep in the French Alps.

The greatest effort by the OFB WPIU was made in 2022, when agents worked all year, clocking 440 hours of observation in the field over 85 nights. Effort was somewhat lower in 2021 (194 hours over 40 nights) and in 2023 (208 hours over 57 nights) because agents only started working in June in the first year and stopped in August in the second, after having moved on to jobs with better pay and more convenient working hours. New OFB WPIU agents then only came back to the field in 2024 at the end of May, which also explains the lower effort observed during this year (55 hours over 20 nights). Unsurprisingly, although observation effort was spread throughout the year, it was higher during the summer months of June, July and August (average of 36 nights of observation/month), while also being considerable in September and March (average of 22 nights of observation/month). Spatially, most observation effort was recorded in the Hautes-Alpes department of France (344 hours over 77 nights), followed by Isère (224 hours over 53 nights) and Drôme (139 hours over 31 nights). Efforts elsewhere were considerably less: Alpes-des-Haute-Provence (80 hours over 16 nights), Savoie (53 hours over 11 nights), Alpes-Maritimes (30 hours over 6 nights), Var (19 hours over 4 nights) and Bouches-du-Rhône (11 hours over 4 nights). At a finer spatial scale, most observations were made in different locations, even if on a few occasions, agents returned to sites already previously visited.

The PNM WPIU worked 6 months per year from May to October since most of the breeders in the park are transhumant who bring in their flocks into the area from the lowlands during summer. As explained above, 2021 was a trial year when breeders were first approached to find the ones interested in working with the project (32 visits). It was also in 2021 that data were obtained on the preventive system in place (Annex 1 in Berce et al. 2020). Field sessions then began in earnest only in 2022 and carried on in 2023 (43 day and/or night interventions each year). Activities in 2024 were drastically reduced because of lack of

breeder requests (only 3 goat breeders did so since January 2024). PNM WPIU worked exclusively inside the park. In total, WPIU PNM intervened in 13 sites (4 in 2022, 8 in 2023 and 3 in 2024), and worked intensively in one of the most attacked pastures in the Mercantour for 2 consecutive years, as well as in 3 other pastures belonging to the 2 other main attack hotspots in the Mercantour.

OFB WPIU agents made 24 independent, direct recorded observations of at least one wolf in the vicinity of flocks from 2021 to 2024, whereas the PNM WPIU made one from 2022 to 2023. One of the observations was recorded by the PNM WPIU. Overall, OFB WPIU agents made an average of about 0.03 wolf observations per hour of observation (24/897). In order to make 1 wolf observation, therefore, agents had to observe for an average of just over 33 hours. Given roughly 4.5 hours of observation effort per night, **1 wolf observation was made on average about every 7 days (33/4.5).** These figures, however, were also highly variable: even though the average number of hours of observation per night was similar in two neighbouring departments (about 4.5 hours, as the overall mean), 53 nights of observation resulted in 11 wolf observations in one department (i.e. 1 observation per about 21 hours of effort), whereas 31 nights led to only a single wolf observation in the other (i.e. 1 observation per 139 hours of effort, almost a seven-fold increase). These differences are due to the suitability of local sites for observation, which is undoubtedly a function of wolf density and the extent of openness of the landscape – better observational conditions arising when both are high –, as well as possibly other factors.

Agents were usually at 450 m or less from the flock under surveillance when a wolf or wolves were observed (N = 18), but were sometimes relatively far from livestock (800 m, 1200 m) to avoid having their line of sight completely blocked by trees or other landscape features. In some cases, however, this was unavoidable, even though agents knew where the flock was. Moreover, for 5 observations in particular, the flock was 2 km away and also not in their line of sight: agents were on these occasions monitoring the area around carcasses of sheep recently killed by wolves. At least one sheep carcass was lying in the area under surveillance on 13 occasions (plus 1 case in which agents were unsure).

Most wolf observations (N = 16) were made between 23:00 and 02:00, but because agents did not work all night (they usually left at 03:00 at the latest), this pattern is not representative of the activity rhythm of wolves. The camera trap data obtained by agents is more reliable in this respect (Figure 8). Duration of observation once a wolf or wolves were in sight was highly variable, with a minimum of less than a minute (N = 2 observations) to a maximum of two to almost four hours (N = 1 each, such situations arising when wolves decided to lie down and rest in a site within the observational range of agents). This irregular distribution of duration of observation resulted in a mean of just over 24 minutes yet a median of 8 minutes. Somewhat similarly, the minimum distance of the observed wolf or wolves to the flock under surveillance per observation varied from 0 m (in case of an attack, N = 2) to 2 km (N = 5), with a mean of 596 m and a median of 220 m. The minimum distance of observers to the wolf or wolves per observation ranged from 10 m (when one animal unknowingly approached an observer, N = 1) to 1.2 km (N = 1), with a mean of 283 m and a median of 200 m.

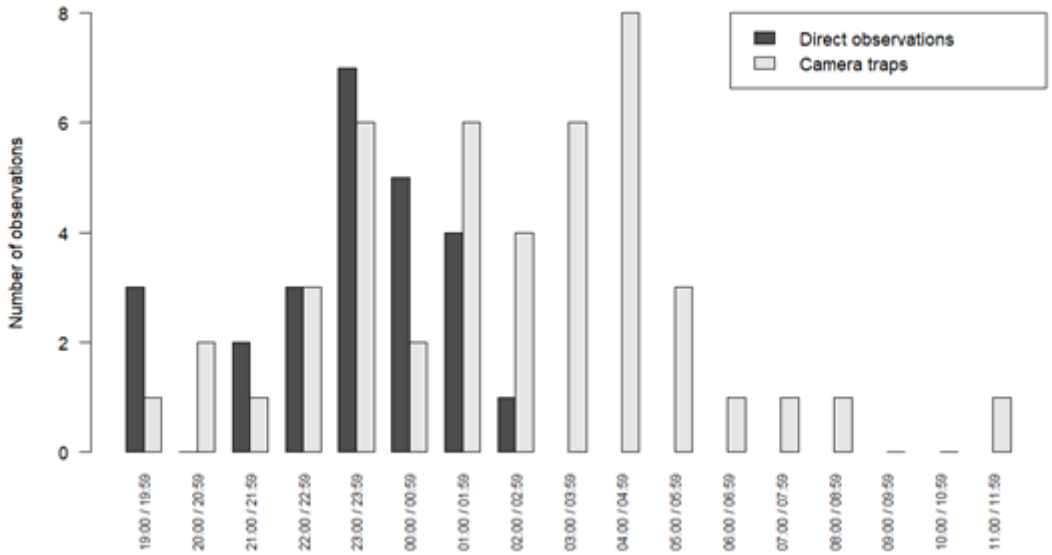


Figure 8: Time when OFB WPIU agents directly observed at least one wolf while monitoring flocks at night from 2021 to 2024, and when videos of wolves were recorded by camera traps during the same period.

The configuration of preventive measures in place when wolves were observed was highly variable. For most observations, livestock were contained inside a fenced area with the presence of LGD (N = 19), either only inside (N = 8) or only outside (N = 2) or both inside and outside of the fence (N = 9). Fences were usually 0.9 m high and electrified. At least 2 or 3 (N = 6) but up to 7 (N = 1), 8 (N = 1) or even 10 (N = 1) LGD were inside the fenced area when wolves were observed. However, 4 or 5 LGD inside the fence was the most frequent case (N = 8). Five or 6 dogs were outside of the fenced area in 4 observations, 3 dogs in 4 cases, and 1 dog in 5 occasions. For two observations, 5 dogs were inside the fence while 6 roamed outside, while in another two cases, 4 LGD were inside and 5 were outside of the fence.

In the case of 2 wolf observations, the preventive system in place was rather peculiar. On one occasion, a fence was installed but no LGD were present. Sheep in this case were however equipped with so-called “anti-wolf” collars which emit an ultrasound signal and flash lights when the equipped animal makes sustained sudden movements (e.g. when fleeing from a predator). In the second case, the fence did not entirely contain the flock and the four LGD (so-called “half-moon” fence). Finally, for 5 observations, no fence was present because these correspond to the observations mentioned above that were made around sheep carcasses lying 2 km away from the flock. In 3 of these 5 occasions, however, a LGD was roaming around the carcasses.

Composition of most flocks under surveillance when wolves were observed was usually mixed, although sheep were always present and by far the most common species of livestock. Minimum and maximum number of sheep present when wolves were observed was 50 and 2300 respectively, with a mean of 836 and a median of 630 animals. In 9 observations, the number of sheep present was over 1000. Goats were sometimes also

present (N = 6 observations), with a minimum of 2, a maximum of 190, a mean of 53 and a median of 17 animals. For 3 observations each, cattle (N = 34, 31 and 18 animals) and donkeys (N = 3, 2 and 1 animal) were also present. In one case, a horse was also in the flock.

In most cases, only 1 or 2 wolves were observed (N = 23), although in 5 of these occasions, observers were not entirely sure of the count. It can be challenging to ascertain the number of wolves under observation when the animal or animals are moving through forested areas and possibly going back and forth. In one additional observation, agents counted 3 wolves but were again unsure of the estimate. Yet they were certain to have observed 6 wolves in the one remaining occasion.

Recorded wolf, dog and flock behaviour

When a wolf or wolves were observed, often there was no visible reaction from livestock (Table 13), possibly because the presence of the predator went undetected. Unsurprisingly, when the predator actually launched an attack, the animals nearest to the wolf flocked and collectively moved away from it, but movement in both cases was over a short distance and quickly subsided.

Table 13: Sheep behaviour recorded when wolves were observed by the OFB WPIU from 2021 to 2024.

Sheep behaviour	N
No visible reaction	14
Flocking and moving away from wolf	2
Not visible	9

For wolves and dogs, several different behaviours could be identified in a single video. In the case of dogs, a common behaviour was to be barking (Table 14), either during or well after they perceived the presence of a wolf. LGD were interpreted as being vigilant if they had their heads up, scanning the surroundings or turned in the direction of wolves or some other stimulus (e.g. observers). No visible reaction by dogs was sometimes observed, again possibly because the presence of wolves went undetected. On other occasions, dog reaction, if any, was not visible due to trees or other elements blocking the view. In two cases, LGD were seen in pursuit of a wolf, while in another three, they appeared to be tracking the scent of the predator (i.e. sniffing the ground while moving along the path used by the wolf, even if in the opposite direction of wolf movement). In one case, one LGD was seen briefly fleeing from a pursuing wolf. It then retreated when faced with its pursuer around a sheep carcass, but with no visible signs of distress or urgency.

Table 14: LGD behaviour recorded when wolves were observed by the OFB WPIU from 2021 to 2024.

LGD behaviour	N
Barking	12
Vigilance	4
No visible reaction	8
Not visible	5
Pursuing wolves	2
Fleeing from wolf	1
Tracking wolf scent	5
Retreat (when facing wolf in close proximity)	1

Wolves, for their part, were most often observed travelling at their usual trotting pace and with little change in the direction of movement (Table 15). Other behaviours observed were resting (lying or sitting down for extended periods), scent marking (with urine), group play, scratching oneself and scent rolling (i.e. when the animal rolls on the ground, presumably over a pungent source of odour). On two occasions, wolves were heard spontaneously howling. We sometimes interpreted wolves to be prowling (i.e. moving about slowly and without any clear direction while pausing every once and a while to sniff the ground or the air). When moving slowly but clearly in the direction of the flock, we considered wolves to be in the approach phase of their predatory sequence. While performing this behaviour or otherwise, we interpreted a wolf to be vigilant when it was static, with its head raised and turned toward a visual or auditory stimulus, as if looking and listening intently. On five occasions, the stimulus at the origin of this behaviour was clearly identifiable (Table 15). Other behaviours still were carcass inspection (certain or probable) and fleeing/quick retreat if the wolf was seen running away for whatever reason. On some occasions, however, after apparently noticing a stimulus, wolves simply retreated by turning on their heels and moving, without running, in the opposite direction of initial movement. On one occasion, this behaviour was triggered by WPIU agents flashing lights towards two wolves that were resting near the flock under surveillance. It was time to end the intervention yet agents felt compelled to haze away the wolves before leaving. Finally, on another occasion, when close to a carcass, a wolf was observed to pursue and then remain still when faced with a LGD at short range. It was the dog that eventually retreated, as mentioned above.

OFB WPIU agents recorded, during a single observation, two failed attacks by two wolves on roe deer and a female red deer. The prey fled and quickly outran the wolves. Two additional observations pertained to attacks on livestock, one successful, the other failed. Given the paucity of information about such cases and the fact that one of the main

objectives of the French WPIU was precisely to obtain it, we provide in the next section a detailed description of these two observations.

Table 15: Wolf behaviour recorded by the OFB WPIU from 2021 to 2024.

Wolf behaviour		N
Travelling		22
Lying down (resting)		4
Scent marking (urine)		4
Group play		1
Scratching itself		2
Scent rolling		1
Prowling		8
Spontaneous howling		2
Approaching flock		6
No visible reaction to LGD in close proximity		1
Pursuing LGD		1
Vigilance	Towards observers	3
	Towards parked vehicle	1
	Towards barking LGD	1
	Towards unidentified stimulus	4
	Towards LGD and observer	2
Carcass inspection	Certain	2
	Probable	2
Flight / quick retreat	After an apparent electric discharge	1
	Pursuit by LGD	2
	Unexpected proximity to a human	1
	After a successful attack	1
	After noticing a fence and observers	1
Retreat	After hearing dog barks	1
	After observers flashed lights	1
	For unknown reason	1
Failed attack on wild prey (deer)		3
Failed attack on livestock		1

Detailed description of two wolf attacks on livestock

In the first case, a mixed flock of 450 sheep, 12 goats and 2 donkeys were being kept in an electrified fence of 0.9 cm in height built on steep terrain and partly enclosing a patch of trees. Two LGD were also present inside the fenced area. At 23:15, a single wolf was recorded slowly approaching the flock from above and through the trees. It came to within a few metres of the fence without being noticed. Then in a sudden burst of speed, the animal easily jumped over the fence and entered the flock, causing some of the sheep to move down the slope. At that point, the wolf was no longer visible because the terrain, trees and the flock blocked the view. The two LGD, which were at the bottom of the fenced area, were however quick to react and run up the slope in the direction of the wolf. In apparent confusing circumstances, they then appeared to be pursuing a sheep. The wolf, now visible again, is seen fleeing briefly in another direction, away from the dogs and the flock. It slows down its pace for a few seconds but then resumes fleeing when the LGD come in pursuit. The wolf then stumbles over the fence on its way out. Once the wolf is outside the fenced area, the dogs abandon the pursuit to return excitedly to the flock, barking all the way. The wolf carries on fleeing up the slope but quickly reduces its pace once it seems to notice that it is no longer being chased. The animal eventually disappears behind the terrain and is no longer seen during the night. From the moment the wolf entered the flock to the moment it stumbled out of the fenced area; the whole incident lasted for only about 30 seconds. And clearly, it was the swift reaction of the dogs that prevented the attack.

The shepherd was somewhat nevertheless distraught in seeing the footage the next day, as he believed wolves did not jump over fences. WPIU agents recommended he move the fenced area elsewhere, away from the patch of trees that clearly favoured the undetected approach of the wolf, and to an area of less steep terrain, to reduce the ease with which a wolf could jump over the fence. For undisclosed reasons, the shepherd however was unable to do so straight away. But to encourage the dogs to stay close to the top and most vulnerable part of the fenced area, he decided to place the food for the LGD there, instead of at the bottom of the fenced area as he had done up until then. The dogs would then presumably be able to react even more quickly to an attack attempt by wolves.

In the second case, filmed by the PNM WPIU, a flock of 630 sheep was being kept for the night in a so-called half-moon fence, which is not entirely closed. Four LGD were with the livestock. When agents started recording at 00:46, the successful attack by the wolf had already taken place and the animal was seen moving away from the flock. It stops for a few seconds to apparently improve its jaw grip on what appears to be a lamb, given its small size, and then retreats swiftly up the slope. The sheep nearest to the wolf run away from the predator and into the herd, leading several individuals to stand up, but the commotion lasts for only a few seconds. One LGD that was lying down raises its head and looks around as the flock moves, but does not stand up and apparently fails to notice the retreating wolf. The other dogs are not identifiable in the footage.

Surprisingly to PNM WPIU staff, reporting this event to the breeder did not cause any emotional reaction. He only asked whether the footage could be used as evidence to claim compensation for the loss of an unmarked lamb. The following year, the same breeder was

helped by the PNM WPIU staff to entirely redo the night pen where his livestock were kept. The material was provided by the local public authority. But the night pen has not been properly maintained since then. The general consensus is that he is overwhelmed and may need professional psychological support, which is obviously beyond the expertise of the PNM WPIU.

In another case, the PNM WPIU filmed a lamb falling from a cliff. A playful LGD caused the flock to move, and a female goat ended up headbutting the lamb off the cliff. If the cause of the fall had not been filmed, it could have been attributed to panic caused by wolves that had attacked the flock a few days earlier… This event and the associated footage undoubtedly prompted the breeders to install a night pen on their August quarters the next year. Finally, in another case, a shepherd showed great interest in the footage and was willing to let the PNM WPIU film a wolf attack while not intervening to better understand the interactions between wolf, LGDs and flock.

It can be challenging to convince breeders and shepherds that non-lethal preventive measures work. Often there is an issue of lack of trust, as government, NGOs and academics might be perceived as outsiders with little to no knowledge of livestock rearing, and as people ideologically motivated to protect wolves at any costs, with no sincere or only a secondary concern about the economic viability of livestock rearing under the risk of wolf depredation or the well-being of breeders and shepherds. The availability of footage showing how non-lethal preventive measures actually work (or occasionally do not) immediately circumvents these issues. Such hard and indisputable evidence cannot easily be dismissed, and often serves as a catalyst to allow the discussion to pragmatically focus on the problem at hand: how to improve, if necessary and possible, the effectiveness of the preventive system in place. The downside of the approach, however, is that obtaining such footage today requires a massive observation effort (see estimates above) under conditions that are not easily compatible with labour regulations (i.e. night shifts and long hours). Automatizing the observational and recording process could hence be a solution to be explored. The judicious placement of automatic cameras around flocks contained in fences during the night should be possible in at least some circumstances.

Observations made through camera traps

In 2022 and 2023, OFB WPIU agents also installed camera traps in areas around the flock under surveillance to verify wolf presence and use of access trails. If agents knew they would be returning to the same or a neighbouring site, camera traps were left in the field over several weeks. Camera traps were all Reconyx HyperFire 2 and most often installed at varying heights and angles in trails and roads suspected or known to be used by wolves. On one occasion, a camera trap was set next to the intact carcass of a sheep killed the previous night by wolves. Cameras were set with maximum trigger sensitivity and to record only videos. In areas of frequent human presence, cameras were set to record only during the night. On average, the devices were placed about 1.5 km from the flock under surveillance (minimum distance = 50 m, maximum distance = 5 km).

Forty-six video sequences of wolves were recorded. Most were recorded from 23:00 to 05:00, while none were obtained from noon to 19:00, confirming the nocturnal habits of European wolves and particularly a peak in activity in the early hours just before sunrise (Fig. x). However, because cameras were programmed not to work during the day in areas of frequent human presence, wolf diurnal activity might be somewhat underestimated by these data. In terms of duration, 40 video sequences lasted less than 1 minute, 5 went on for 1 minute, and only one lasted for 5 minutes. In the latter case, it was unclear whether 3, 4 or 5 wolves were involved given the back-and-forth movement of individuals separated by a minute or so. In most cases, however, only one or two wolves were recorded (N = 27 and N = 12, respectively, plus 1 observation in which it was unclear if 1 or 2 wolves were involved; remaining observations were N = 4 for 3 wolves and N = 1 for 5 wolves). Unsurprisingly, given that camera traps were set up to monitor trails and roads, most videos simply showed wolves travelling, usually at a trotting pace (N = 40). On two of the latter occasions, both involving two wolves, one individual was observed scent marking (urinating via posterior leg raise). In another two, implicating just one wolf each, the individual was observed transporting food in its mouth. In one additional travelling video, a wolf was seen drinking water from a temporary pond before resuming movement. Wolves were observed moving about slowly and stopping to sniff the ground or the air, as if prowling, in three separate videos. One additional footage showed a wolf clearly bothered by the camera as it hesitated to continue moving forward. The animal probably took an alternative path to avoid the device. Finally, the remaining two sequences showed a wolf inspecting a sheep carcass but leaving without consuming it, and a wolf fleeing with food in its mouth followed by a livestock guarding dog in pursuit about a minute later.

The PNM WPIU also installed camera traps to monitor wolf presence in pastures or in their vicinity, as well as the minimal number of individuals in the pack, the impact of lethal control on wolf presence in pastures and the efficiency of deterrent devices (Table 16). Camera traps were programmed to take videos or photos without interruption. Contrary to the approach used by the OFB WPIU, which did not leave the materiel out in the field for more than 2 or 3 weeks, PNM WPIU camera traps remained in the field during the entire pasture season, until the departure of the breeder or even later. In 2022, for 15% of the attacks wolves have been observed by camera traps 48h before or after the event, and 26% in 2023. On the contrary, this continuous monitoring also showed that the presence of wolves near flocks did not necessarily always lead to an attack since 72% of wolves caught on camera in 2022 and 80% in 2023 at a given time and date were not associated with an attack 48h before or after. One can only guess at what the intentions of a wolf are, but most of the time, the animal seems to be only passing through the pasture (see above and below).

Table 16: Devices used by PNM WPIU from 2022 to 2024 to help breeders understand wolf activity in their pasture and the effectiveness of deterrent devices.

	Pastures	**Nb of camera trap**	**Nb of wol pics**	**Max number if wolf on pic**	**Nb of night with IR camera**	**Nb of deterrent**	**Nb of "anti-wolf" collar**
2022	1	4	0	/	2	4	/
	2	11	18	2	13	/	/
	3	10	0	/	8	/	/
	4	3	0	/	3	/	/
2023	1	9	24	3	0	/	/
	2	6	10	3	1	/	/
	5	0	/	/	4	/	/
	6	0	/	/	3	/	/
	7	4	10	4	6	/	/
	8	0	/	/	0	/	/
	9	2	/	2	2	/	/
	10	6	32	7	0	/	/
2024	11	4	10	3	0	/	/
	12	2	0	/	0	/	3
	13	1	2	1	0	1	/
TOTAL	15	56	106		42	5	3

A total of 56 camera traps were installed by the PNM WPIU in 10 pastures from 2022 to 2024, for a total of 104 pictures or videos of wolves (0 – 32 footages/per pasture). The maximum number of individuals was 7, 1.4 on average. Most of the time, only one or two wolves were recorded (N = 77 and N = 17, respectively, the seven remaining observations were N = 3 to 7 wolves). As with the OFB camera trap footage, most if not all pictures obtained by the PNM simply showed wolves travelling, usually at a trotting pace, although some individuals seemed surprised or hesitant before passing in front of the camera. On the night when the PNM WPIU filmed a successful wolf attack at 00:46, as described above, a single wolf was also camera-trapped at 11:58 pm at 1800 m away from the flock and moving in its direction.

The wolf activity, as revealed by the camera traps, was mainly nocturnal, i.e., between 9 pm and 5 am (Figure 9). Only one wolf was observed at 1 pm. The fact that results show that wolves were almost exclusively nocturnal, at least as inferred by camera traps, fits with patterns of wolf activity reported in other anthropogenic landscapes of Europe. Yet it is somewhat surprising given that most of the attacks in the Mercantour are reported to occur during the day. Could this be explained by the fact that wolves use trails and human paths to travel from one area to another at night - as revealed by camera traps in the Mercantour and elsewhere, but adopt sit-and-wait hunting tactics away from trails during the day, waiting for sheep to pass by.

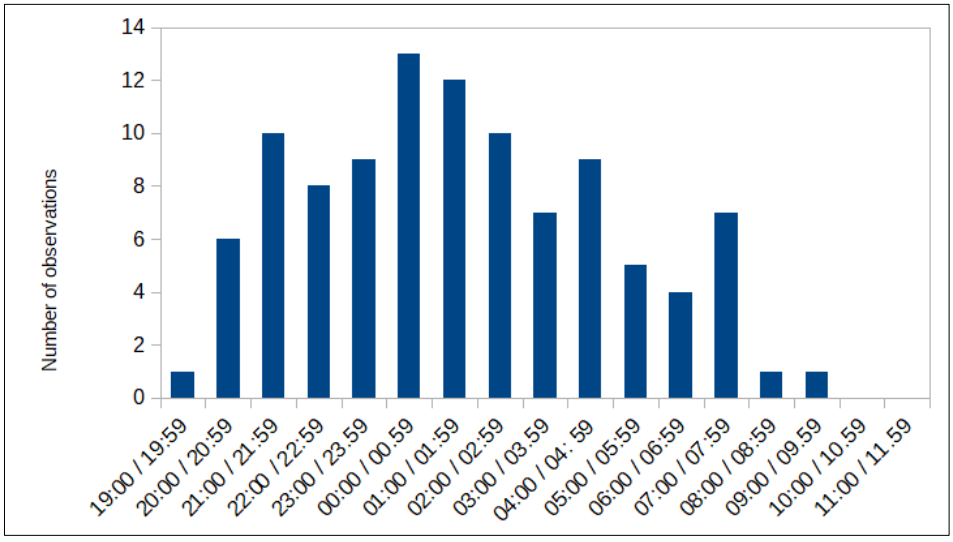


Figure 9: Period of activity of wolves as revealed by camera traps installed by the PNM WPIU on pastures and their vicinity.

PNM WPIU also tested light and acoustic deterrent devices to assess their efficacy (the devices were monitored with camera traps to document any wolf reaction), but the trial was inconclusive as there were no wolf passages in front of the devices during the duration of the test (from 19/08/2022 to 10/10/2022). In the last and most recent case, a deterrent was installed by a goat breeder, even if only in light mode, as he was afraid that the powerful sound emitted might scare his goats and lambs. A camera trap filmed the reaction of a wolf twice. In both cases, the wolf did not flee, it just looked at the device and pursued its way but changed direction (90°). The breeder was advised to add the sound for better efficiency.

In 2024, for the first time, the PNM WPIU also tested the so-called “anti-wolf” collars, which emit ultrasound and flash lights when sheep or other livestock equipped with it accelerate their movement. Given the workable size of the flock, a breeder raising 35 goats for milk yet without LGD was identified as someone who could benefit from the trial, given that, in any case, using the material was the only immediate solution that could be tried in his context. Such “anti-wolf” collars are currently under experimentation by several local authorities in France. At the time, the device was proposed on an experimental basis, but also in a bid to reassure breeders. Since implementing the collars, the goat breeder has indeed felt reassured that his flock is protected.

3.2.4.2. Monitoring LGD behaviour with GPS collars

When possible, OFB WPIU agents also equipped LGD and sometimes one sheep with GPS collars from 2021 to 2023 to provide breeders and shepherds with information about dog behaviour, particularly during the night. In 2024, collars were no longer operational. Total number of weeks when at least one LGD was equipped with a GPS collar was 17. Up to 7 or 8 dogs were equipped during a week of interventions in the same site (N = 2), although the usual figure was only 2 or 3 dogs (N = 12). In total, 55 different LGD were monitored through the use of GPS collars. Although the data are yet to be formally analysed, they show that most dogs stayed with the flock most of the time, with some instances of exploratory behaviour and/or possibly of interaction with wild fauna (Fig. x). Breeders and shepherds are not necessarily always aware that their dogs can behave in this way, but invariably appreciate learning it.

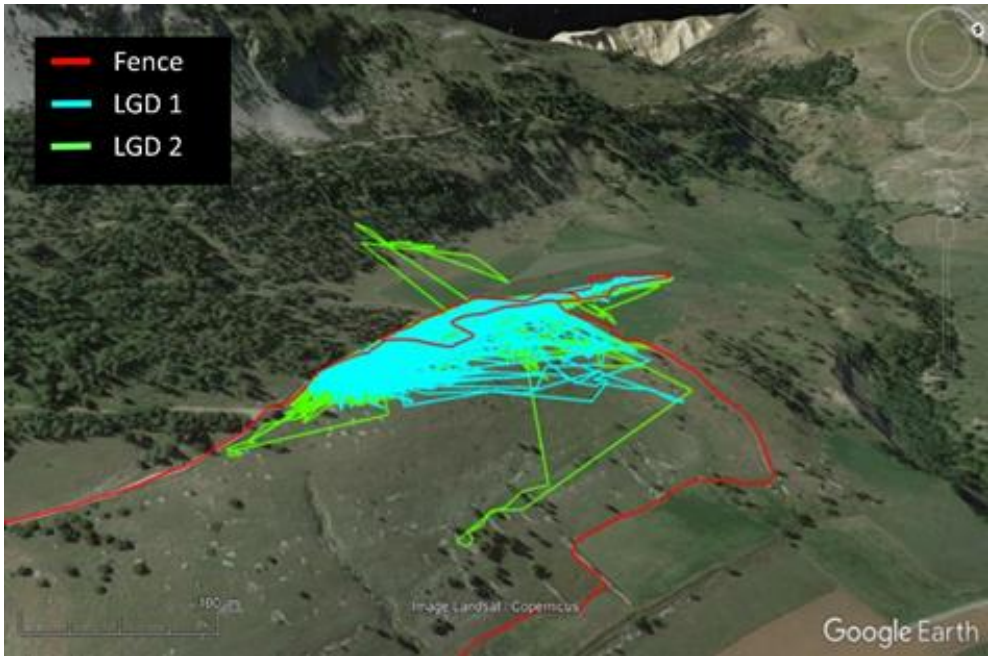


Figure 10: Activity of two LGD equipped with GPS collars by the OFB WPIU.

Tracks obtained for one dog (in green) show that the animal exited the fenced area and left the flock to enter the forest (for unknown reasons but possibly because of interaction with wild fauna). The same dog also seems to explore the lower part of the fenced area. Tracks for the second dog (in cyan), however, suggest a more constant and stable presence near the flock.

The PNM WPIU also offered to breeders and shepherds the possibility of fitting GPS collars on LGD and sheep to determine the behaviour of the LGD/flock pair, specifically to: (i) better understand the use of the territory by the LGD and the herd, (ii) verify our impression regarding the proximity of the LGD to the herd, both day and night, (iii) observe any instances of dogs straying away from the flock, particularly during wolf attack dates, and (iv) analyse the situation before, during, and after attacks.

In total, breeders and shepherds in three mountain pastures agreed to the placement of collars, including one that participated for two consecutive years (pasture A2 – Table 17). Therefore, two pastures were equipped in 2022 and two in 2023. On average, the size of the equipped flocks was 1577 ewes protected by 10 LGD (Table 17). During the study, 16 LGD and 16 ewes were equipped over periods ranging from June to October.

Figure 11: Installation of GPS collars on LGD and flock by PNM WPIU staff.

Table 17: Presentation of herd/LGD equipped by PNM WPIU staff.

Year	Pasture	Flock	LGD
2022	A1	Flock size : 1200 Equipped: 3	Nb total : 5 Equipped: 2
	A2	Flock size : 1677 Equipped : 3	Nb total : 14 Equipped: 3
2023		Flock size : 1800 Equipped: 5	Nb total : 10 Equipped: 6
	A3	Flock size : 1630 Equipped: 5	Nb total : 10 Equipped: 5

Between 2022 and 2023, the settings of the GPS collars (CatLog Gen2) were modified. In 2022, the setting was one location every 5 minutes for the LGD and one location every 20 minutes for the ewes, with an increase in frequency during acceleration. If the animals exceeded 4 km/h, the GPS tracking increased to every 10 seconds. In 2023, the GPS collar settings for both the LGD and the flock were identical, with a location point every 5 minutes and the same acceleration-triggered schedule.

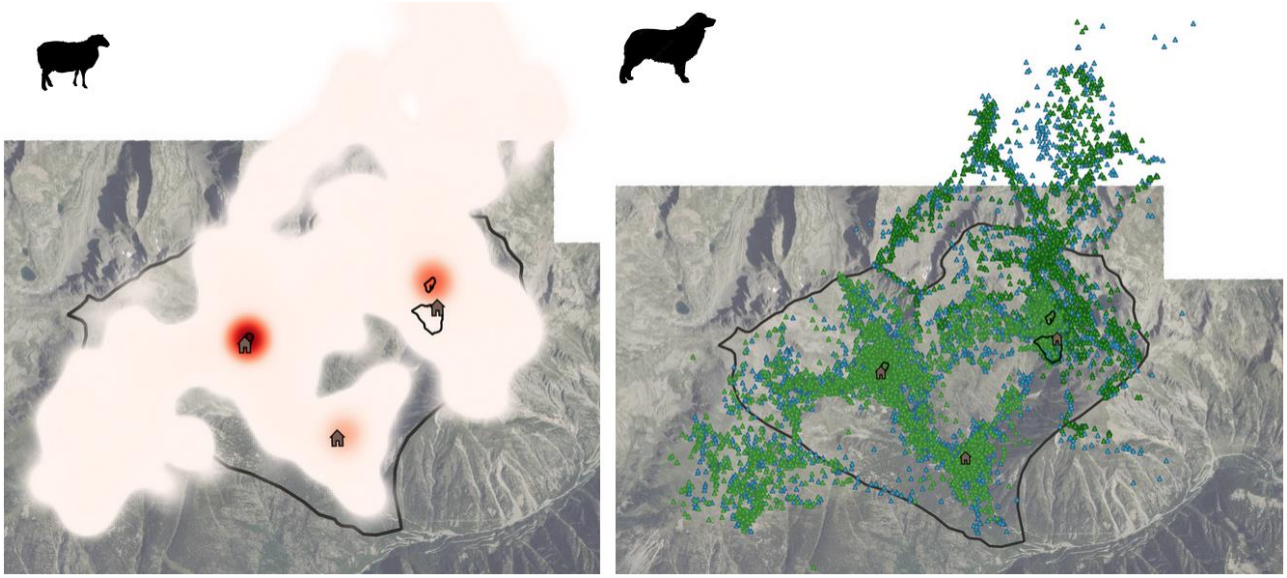


Figure 12: Example of sheep and LGD locations obtained by GPS collars deployed by the PNM WPIU. On the left is the heatmap of the sheep, where the intensity of red indicates the concentration of points. On the right, LGD are represented with a different colour for each individual.

Data retrieved from the GPS collars were cleaned, and erroneous GPS locations were removed. Interpolation was used to create additional locations and maintain the 5-minute interval between locations unless the gap of missing data was over 1 hour. The location of the flock was calculated by estimating its barycentre from the equipped ewes and the distances between them (Figure 13: Illustration of the barycentre location and distances between equipped animals.). Once the data was processed, a dataset for each dog and

each flock was obtained. This resulted in over 56 600 location correspondences between the LGD and the estimated barycentre of the flock.

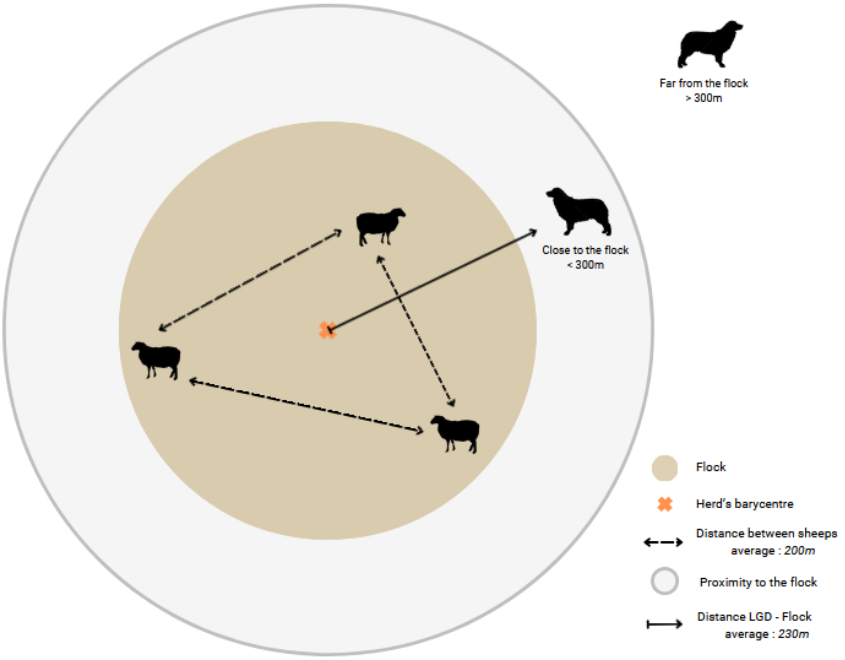


Figure 13: Illustration of the barycentre location and distances between equipped animals.

Results of the analysis showed that LGD maintained an average distance of about 230 m (95% CI: 134 - 597) from the flock's barycentre, while the sheep were on average 200 m apart from each other. The data revealed that the LGD stayed close to the flock (< 300m of the barycentre) 79% of the time, and were farther away the remaining 21% (> 300m from the barycentre).

The study of movement speeds detected by the GPS collars revealed that the LGD were at rest 66% of the time, walking/trotting 32% of the time (less than 10 km/h), and running the remaining 2% (over 10 km/h). When attacks were frequent, analyses showed a slight increase of 2% in walking/trotting time. Therefore, the movement speed does not reflect the influence of attacks on the LGD.

The time of day influenced this distance, with greater separation during the day than at night. This increased proximity during the night was likely related to the fencing of the flock. For example, in pastures A1 and A2, where the flocks were corralled at night, 25% of the locations between LGD and the flock were more than 300 m during the day compared to only 13% at night. In contrast, in pasture A3, where the flocks are left to roam freely at night, the LGD were almost equally distant both day and night, with 25% and 22% of the locations between flock and LGD superior to 300m, respectively.

Next, the PNM WPIU studied the evolution of the distance between the LGD and the flock by month, distinguishing between day and night. Because variable monitoring periods and

durations among different dogs, combined with their respective distances from the herd, could bias results, only data from LGD that were continuously tracked were analysed in this case. As a result, the number of LGD that were studied was reduced to one or two per pasture and year, which does not provide a comprehensive view of the behaviour of the total group of dogs. In some cases, an increase in dog-flock distance was observed as the season progressed, while in others, there was a sudden peak or drop in the distance for about a month in otherwise stable periods of similar dog-flock distances. It is difficult to attribute a change in proximity to a specific factor, whether it be a change in practice, location, or the attacks on the flock. The PNM WPIU then examined changes in LGD behaviour that could have been caused by the 26 recorded wolf attacks that occurred while the domestic animals were equipped with GPS collars. These sequences were shared with the breeders, although interpreting the spatial discrepancies of the LGD is challenging, as for a third of the attacks, there are inconsistencies between the flock's movements, those of the LGD, and the reported time and location of the attacks. These inconsistencies could stem from the low number of sheep equipped with GPS collars, leading to a misestimation of the flock's location, the presence of stray flocks on the pasture, or incorrect information gathered during the damage report.

In the remaining two-thirds of the cases, there was always at least one LGD near the herd. In pasture A2, where five LGD were monitored in 2023, different behaviours were observed among the dogs: some strayed away from the herd, sometimes for several hours, while others stayed close by, with the dog group thus providing apparently complementary functions during 5 of the 10 recorded attacks (1/10 times all the LGD stayed close to the herd, and 4/10 the timing of the attack and GPS locations did not coincide). Additionally, it appears that these individual variations remained consistent throughout the season. When the dogs strayed during attacks, the lack of additional information prevented us from drawing conclusions about their activities, highlighting the limitations of the tool in interpreting straying without being present on the pasture. On the other pastures, 1 to 3 LGD were equipped at the time of the events, which is insufficient to detect the complementary roles of the LGD, as the monitored dogs all stayed close to the flock.

In a second analysis, the attack factor was studied (i) by comparing the proximity of the LGD to the flock between “low attack” and “high attack” periods, with at least 3 times more attacks in “high attack” (4-9 attacks) period than in “low attack” (1-2 attacks), and then more precisely (ii) by comparing the “3 days before,” “3 days after,” and “non-attack” periods. Depending on the pasture, year, and equipped LGD, observations varied greatly (Table X). In half of the cases, the LGD were farther from the flock during periods of heavy attacks: “before attacks” for pasture A2 in 2022, and “after attack” for A3. In one case, the LGD were closer during heavy attacks (pasture A2 in 2023), and in the last case, the change in proximity was minimal. Therefore, the evolution of the LGD proximity to the flock varies case by case depending on the context, which does not allow for a general trend to be concluded given our sample size. However, results suggest that GPS equipment should ideally be installed on as many LGD as possible from the start to the end of the season, comparing each dog's behaviour individually, and carrying out this monitoring over several years. Apart from producing scientific knowledge, replicating this protocol on multiple pastures would lead to

more robust results that could then be used to assist in the selection and breeding of most suitable breeds or lineages of LGD adapted for different environments and attack contexts, thereby improving flock protection.

The use of GPS collars allowed the PNM WPIU to learn more about how LGD and flocks used space and proved to be a very useful tool in understanding their proximity and its variability over the season and in the event of an attack. It is preferable to interpret the results on a case-by-case basis for the different pastures, years, and monitored LGD, favouring the collection of data from a few dogs for the entire season rather than from many dogs over fragmented periods, allowing for a more reliable interpretation of dog behaviour, based on the knowledge of shepherds and breeders as well as fieldwork. For more precise information on the location and extent of the flock, the PNM WPIU recommends increasing the ratio of equipped sheep to 1 in every 100. It would also be interesting to compare results between different breeds of dogs. Furthermore, GPS monitoring could be combined with the placement of collars detecting the LGD' barking (date/time, duration, frequency, intensity) to study whether these barks could serve as a signal from the impending occurrence of an attack. All these results will be sent shortly to each breeder/shepherd who contributed to the monitoring.

Table 18: Evolution of the LGD - flock proximity according to pastures and attack contexts.

			Before	After	Non-attack
					
Year	**Pasture**	**Contexte**			
2022	**A1**	2 attacks 2 LGD equipped	The LGD were slightly closer to the flock in the context of an attack, particularly 3 days before.		
	A2	9 attacks 3 LGD equipped	The LGD were farther away when there were many attacks: nearly twice as far from the flock before the attack and half as far afterward.		
2023		10 attacks 5 LGD equipped	The LGD were closer when there were many attacks.		
	A3	5 attacks 1 LGD equipped	The LGD were farther away when there were many attacks: almost twice as far from the flock after the attack.		

3.2.5. Discussion

Livestock depredation numbers in France are particularly high. In 2022, for instance, the French government compensated for the loss of 11 616 head of livestock (all species), of which the overwhelming majority were sheep (DREAL AuRA). This figure has been increasing nationally as wolves continue to expand their distribution in the country. In the Alps, where wolf presence is densifying, the number of animals compensated for wolf depredation has varied from one year to the other, sometimes increasing slightly, other times decreasing somewhat. Different stakeholders come to different conclusions when looking at these data: proponents of wolf conservation argue that numbers are more or less stable, whereas proponents of wolf control claim that numbers are increasing, despite some variability, and that in any case, the number of depredated animals in the Alps is too high, even if they were stable.

A national action plan defined by the government in collaboration with members of different stakeholders (breeder trade unions, hunter federations, environmental organisations, etc.) determines wolf management in France. The plan is renewed every 5 years, and under its current dispositions, the French ministry in charge of agriculture and the EAFRD, as well as the ministry in charge of the environment, fund five non-lethal prevention measures: shepherding, livestock guardian dogs (LGD), electric fencing, vulnerability analysis and technical support. Prevention requirements and the percentage of funding that is available for breeders depends on a zoning system based on the frequency and intensity of local depredation on sheep and goats: the greater the depredation pressure, the more funds are available but the more the breeder needs to ensure the use of prevention measures. For a flock to be considered protected, usually at least 2 out of 3 measures (shepherding, LGD, electric fencing) need to be in place.

Removal of wolves is authorised in France under derogation to the species' protected status, except in protected areas like the core area of the Mercantour national park. A strict protocol is observed under which authorisation for wolf removal and the number of shooters allowed to intervene both depend on the intensity and reoccurrence of wolf damage to the flock. The objective of wolf removal in France is to prevent attacks on livestock, and not to regulate wolf numbers. But there is strong disagreement over the efficiency of the approach. Proponents of wolf conservation claim that it does not work, and might actually make matters worse by favouring pack disruption that leads to increased depredation. Proponents of the approach, however, argue that it does work and that removal restrictions actually need to be relaxed so that its efficiency is improved.

Most breeders in the French Alps today use some form of preventive system. Yet a major challenge is to control and evaluate the effectiveness of the system, and both for lethal and non-lethal measures. Assessment of the correct use of non-lethal prevention measures in the field – e.g., if fences are installed and electrified correctly, if sufficient numbers of LGD that behave appropriately are present, etc. – is rarely done. The reasons are many. The general perception is that breeders perform a difficult job in difficult conditions, and that adding yet another layer of public control of their activities is abusive and unnecessary. Use of preventive measures is sometimes perceived by breeders as a severe constraint imposed

by outsiders to the profession for illegitimate reasons, i.e. wolf conservation. In addition, breeders sometimes appeared to lack the desire to change habits and practices used for many years, and were often reluctant to use preventive measures given the substantial amount of additional work that they require (maintaining fences, caring for dogs, etc.). Public funds that are available for such work are often considered insufficient or poorly adapted. The need to advance funds prior to being reimbursed by the state, for instance, is a major constraint for some breeders, who simply cannot afford it. Finding and retaining competent shepherds is also a difficult task for breeders. Shepherd accommodation and wages are usually far from optimal, which exacerbate the challenge of retaining these professionals.

Yet perhaps the greatest challenge is lack of trust towards government agents, particularly if the latter are not based locally. Breeders and shepherds often question the legitimacy and expertise of government agents that have no professional experience in livestock breeding, regardless of the agents' knowledge and experience with wolves. They also doubt the information provided by the government on wolf numbers and other aspects of wolf biology. Non-local government agents are often perceived as belonging to a militant, pro-wolf lobby whose concern for the viability of outdoor livestock breeding is not sincere. There is often a fear that behind wolf conservation lies a hidden agenda that aims to remove livestock breeding from landscapes so as to give greater room for nature, particularly in protected areas.

OFB and Mercantour WPIU, as government agents funded by an European project aiming to further wolf conservation, faced these challenges on a regular basis. The OFB WPIU relied on local authorities to identify breeders that would be willing to collaborate with the project, while the Mercantour WPIU also only worked with breeders open to engage with the project. This meant that in both cases, WPIU interventions did not always take place where they might have been most useful, i.e. where depredation pressure was highest. For example, the PNM WPIU was particularly interested to work in the 2 pastures where most wolf attacks were recorded for the last 3 years. These pastures were located in the core area of the park, where wolf lethal control to protect livestock, as practised elsewhere in France outside protected areas, is not allowed. Therefore, only non-lethal protective measures (electrified pen, shepherding and LGD) were available to the breeders keeping their flocks in these pastures. We thought that these breeders would be more inclined to accept our help, but unfortunately, they were not interested in collaborating with the park to learn more about why the protective measures appeared to be failing on a regular basis. The PNM WPIU thus ended up intervening more outside the core area of the park, where the recurrent removal of wolves has not prevented wolf attacks from reoccurring over the long term.

Willingness of local authorities to support the French WPIU varied: some made the most of it and requested interventions regularly, other rarely if ever did so. As most WPIU interventions occurred during the night, some local authorities felt the action was poorly adapted to their context, in which most attacks are recorded during the day. In any case, PNM WPIU agents often resorted to directly meeting breeders in the field, particularly in the depredation hotspots, to offer them interventions. OFB WPIU agents had to spend

considerable time contacting local authorities and other structures to incite or remind them to identify breeders willing to accept a WPIU intervention. The nature of the relationship and the degree of interaction between local authorities, other institutions working in livestock protection, and the WPIU were key factors in the perceived success of the intervention. Yet in general, the number of requests for WPIU interventions was rather low. Breeders often preferred to benefit from lethal interventions, if possible, and in at least one case were disappointed to learn that WPIU agents were not carrying rifles.

An additional difficulty was that little to no funds were available to incite breeders to act on the advice provided by the WPIU. Some funds were available through local authorities, but the administrative flow was not necessarily optimal and again relied on local authorities to follow through. Moreover, in some cases, when shepherding was ensured by at least one shepherd (as far as the flock size allowed it), when the number and behaviour of LGD seemed appropriate, and when electrified night enclosures were correctly in place, the French WPIU were at a loss to recommend improvements to the preventive system. Sometimes proposed solutions were difficult or hard to implement for diverse reasons (logistical/technical factors, lack of human and financial resources). In some situations, it was apparent that breeders were doing all that was possible to protect their flocks given the inherent difficulties of doing so in the environmental context of their pasture (e.g. heavily forested areas, food for sheep dispersed over a wide area). It hence appears simplistic to claim that wolf attacks will completely stop as soon as non-lethal protective measures are correctly in place. Even when preventive measures appear to be properly installed, local context can favour wolf depredation.

Information on depredation events before and after each intervention were not readily available to WPIU agents. Generally, information on wolf depredation and removal is laborious to access in France, even for staff of protected areas that sometimes might not be entirely informed of what is happening in the area under their management. PNM WPIU agents were aware of depredation cases only because the damage inspectors are paid by the park and because park agents in charge of wolf issues were close to the field and hence regularly updated about the occurrence of wolf attacks. Yet detailed information about wolf removals was far from easy to obtain. The information was only communicated to the PNM WPIU later, because of explicit requests to that effect or thanks to fieldwork with informed breeders.

Breeders were in any case contacted by WPIU agents a few months after each intervention for an update on their situation: most had not acted on the advice provided, for reasons specific to each breeder and already mentioned above, and for the few that did follow the advice provided, wolf depredation did not necessarily stop. For the OFB WPIU in particular, with only two agents to cover the entire French Alps (apart from the Mercantour national park), it was challenging to establish a long-term relationship with breeders and shepherds, an absolute necessity not only to fully understand how and why local circumstances might be favouring wolf depredation, but also crucially to establish and maintain trust. Again, the role of local authorities here was key in presenting (or not) the WPIU as a useful initiative that could bring benefits to breeders.

This challenging context in France, however, did not prevent the WPIU from establishing trust and providing useful advice and information to the breeders that accepted to collaborate with the project. This was particularly true in the case of breeders that benefited from more than just one WPIU intervention. Participating breeders and shepherds often expressed gratitude and relief to be able to talk about the challenges of living and working alongside wolves without feeling that they were being judged. In one case, a breeder claimed that the WPIU initiative partially restored his trust in the OFB. Particularly appreciated were information obtained from deploying GPS collars on LGD: without exception, all breeders and shepherds demonstrated interest in learning more about how their dogs operate, especially at night. The use of camera traps was also requested and appreciated by breeders because it provided direct evidence of wolf presence in the pasture. Obtaining footage of wolf behaviour in the proximity of flocks was also appreciated, even though it sometimes elicited breeder or shepherd anxiety that a wolf attack on their flock might be imminent. The main benefit of such footage is that it provides hard evidence that cannot be dismissed of where the limitations of the prevention system are, as exemplified above in the case of a failed wolf attack. If a picture is worth a thousand words, then clearly a video is worth a million. The drawback, however, is that it is very time-consuming and challenging to obtain such footage, as quantified above. And tricky negotiations with breeders and shepherds are necessary to decide how WPIU agents should act when witnessing an attack attempt: intervening might stop the attack but doing so will reduce or even prevent agents from fully assessing what might or might not be working.

In any case, it is apparent that for WPIU to be more effective in France, they should be placed directly under the responsibility of local authorities or other local structures specialised in outdoor livestock breeding. This could render the administrative flow more fluid and probably lower the misgivings of breeders and shepherds in accepting WPIU interventions. The OFB and the Mercantour national park are often perceived, fairly or not, as institutions that favour wolf conservation over livestock breeding. Much resistance could be avoided by placing the WPIU under the responsibility of institutions or structures that are perceived as being more neutral or favourable to livestock breeding. Dedicated funds and human resources should also be readily available to encourage and support breeders to act on the advice provided.

The reduced cost of thermal infrared cameras and their growing use by a variety of people offers an opportunity to document wolf behaviour in the proximity of flocks in different contexts. Such footage can be used to improve assessment of the effectiveness of the preventive system and the quality of the advice provided to breeders and shepherds. Enormous benefit could be accrued by automatizing the recording process so that people do not need to be constantly present, in similarity to closed-circuit television monitoring. The technical challenges of implementing such an approach in mountainous terrain are many and obvious. Yet with a flock that is kept inside a well-defined area, they should not be insurmountable.

One future challenge that is already a reality in southern France in general and in the Mercantour in particular is that wolves might react to preventive measures used during the

night by attacking flocks during the day, when livestock cannot be kept in fences. The protective role of the shepherd(s) and particularly of the LGD becomes even greater in these circumstances, and solutions, as always, will certainly be case-specific and prone to change over time. Another challenge that is increasing rapidly is wolf depredation on cattle, which might be the result of wolves switching their predation from relatively well-protected sheep and goat flocks to relatively unprotected cattle (and horse) flocks. Prevention measures that are used for sheep and goats can also be used for cattle and horses, but are more challenging to put in place, particularly LGD. As of yet, at least in France, no specific national funds are allocated to protect flocks other than those containing sheep and goats.

3.3. MITIGATION MEASURES IMPLEMENTED BY WPIU IN ITALY

3.3.1. Italian WPIU strategy and data collection methods

Since the return of wolves in the Alps, depredation on livestock represents the main reason of human-carnivore conflict in the Italian Alpine Regions especially where preventive measures aren't used or aren't correctly implemented (Marino et al., 2016).

In the last years, wolves are recolonizing the entire Italian Alps and, recently, they are also expanding in some areas of the plains and hills of north-western Italy, where human density is greater and the type of livestock management is different from that in the mountains; here the operators are often amateur breeders that do not have the skills and equipment to face the depredation events and can't accede to the public contributions reserved to professional breeders, leading to an increase in conflict.

To reduce the human-predator conflict and give specific support to breeders, wolf prevention intervention units (WPIU) have been created, trained and locally activated. They operate on the base of a common Italian strategy, which defines how and when the teams can intervene. All the Italian partners participated in the activity and improvement of the teams: APAM, APAC, METO, APAP, APOS in Piemonte Region, RELO and ERSAF in Lombardia Region, RELI in Liguria Region, RAVA in Valle d'Aosta Region and PNDB in Veneto Region. CUFA supported all the teams with their own agents.

In particular, the teams act:

a) **after a depredation event**, acting rapidly, helping breeders to define the best livestock protection strategy and limiting further damages;

b) **at a preventive level** to train breeders and spread the knowledge of the risk of depredation and the good measures to manage the livestock in areas of wolf presence;

c) **to evaluate the prevention systems** already in use by the breeder, to understand their correct use and effectiveness. The protocol includes remote and close observation of LGD and on-site observation of electric fences, presence and activity of the shepherd (Annex 1).

Furthermore, the teams have the task of communicating data relating to depredation events and the effectiveness of protection measures, the successful intervention realized and can be involved in educational activities also reporting virtuous breeders that tell their stories in public events.

Due to the strong administrative and legislative fragmentation among the Italian Regions and, indeed, the absence of approach homogeneity and solutions regarding the "damage assessment and compensation" and "prevention systems" topics, in Italy the WPIU operating strategy has been detailed also at **regional level**, taking into account the regional peculiarities and identifying a National WPIU coordinator and 5 Regional WPIU Coordinators. This was necessary to guarantee uniformity in training approach and WPIU intervention and to ensure coordination at country level.

The internal coordination of the several operators of the Italian WPIU is ensured by the presence of an **intervention protocol** containing a set of directives that establish a routine procedure for field actions and by the use of the app “WhatsApp” within the team operators.

Each WPIU team has a responsible, that collects and archives in a database all the information about interventions (collected by the operators on a specific schedule) and checks the correctness of the activities.

A WPIU intervention is activated by a **trained damage inspector** (veterinarians of the sanitary authority in Piedmont Region, Regional Wildlife and Environmental Surveillance Unit -NRVFA- in Liguria Region, CUFA agents in Valle d’Aosta Region and Dolomiti Bellunesi National Park, CUFA agents and Provincial police in the Stelvio National Park and in Lombardia Region) who evaluates the depredation events and, when needed, put in contact the WPIU responsible with the farmer. The WPIU team operates on the field and compiles an **intervention form** to analyse the context and the management of the livestock and then defining, in accordance with the breeder, the most correct *ad hoc* livestock protection strategy. It also informs the breeder about the availability of funds dedicated to prevention and damage compensation. If necessary, the team can also lend *pro tempore* protection measures to breeders for a maximum period of 1 year, waiting for RDP funds for prevention (i.e. CAP funds or Regional funds). An intervention is considered **closed** at the end of the mountain pasture season or when the livestock is moved to a different grazing area, or at the end of the calendar year.

In Italy, a “**WPIU intervention**” is defined as each field intervention during which an operator of the team hands out protection measures (fences, LGD) or provides advice on their correct use to a breeder/shepherd or help the breeder/shepherd in improving the protection systems.

Each team is composed by technicians or wildlife trained and qualified agents from public administrations, as:

- CUFA agents

- metropolitan or provincial police officers in Piedmont and Lombardia Regions

- park rangers in Piemonte and Lombardia Regions

- Nucleo Regionale di Vigilanza Faunistica e Ambientale (NRVFA) of Liguria Region

- ERSAF/PNS technician in the Stelvio National Park and in Lombardia Region

- PNDB technicians in the Dolomiti Bellunesi National Park

- technicians of the Piemonte Region protected areas

All the operators are trained on the use of the different prevention measures, on the prevention and compensation funds locally available, on the WPIU strategy protocol, on wolf biology, behaviour, and presence. They are also supported by a mediator, whose task is to reduce conflicts.

3.3.2. WPIU overall activity in Italy

In some Italian Regions Action C1 started before planned, in 2020, due to the increase of wolf packs in some areas and the consequent need for farmers to protect their livestock. This was the case of APOS, APAM, PNDB and RELO/ERSAF.

The Italian partners formed and created 29 WPIU compared to the 12 planned by the Project (Table 19: Number of WPIU foreseen and created by each Italian partner of the LWA_EU Project. and Table 25): 16 in Piedmont Region, 4 in Liguria Region, 5 in Lombardia Region, 3 in Aosta Valley Region and 1 in Dolomiti Bellunesi National Park (Veneto Region). The high number of WPIU in Italy reflects the high administrative fragmentation of the country, so that comparatively more WPIU are needed to cover the number of organizations locally involved. From January 2020 to August 2024, **744 farmers have been assisted by WPIU** (Table 20 and Figure 14) and **371 received prevention materials** (248 funded by LIFE and 123 by other funds; Table 19: Number of WPIU foreseen and created by each Italian partner of the LWA_EU Project. and Table 25).

Table 19: Number of WPIU foreseen and created by each Italian partner of the LWA_EU Project.

	RAVA	Piemonte Region								RELO ERSAF	RELI				Veneto Region
		APAM	APOS				APAC METO	APAP							
		CN	BI	NO	VB	VC	TO	AL	AT		GE	SV	IM	SP	PNDB
Foreseen by project	1	2			1		2	1		3	1				1
Created by project	3	5	1	1	1	2	3	2	1	5	1	1	1	1	1

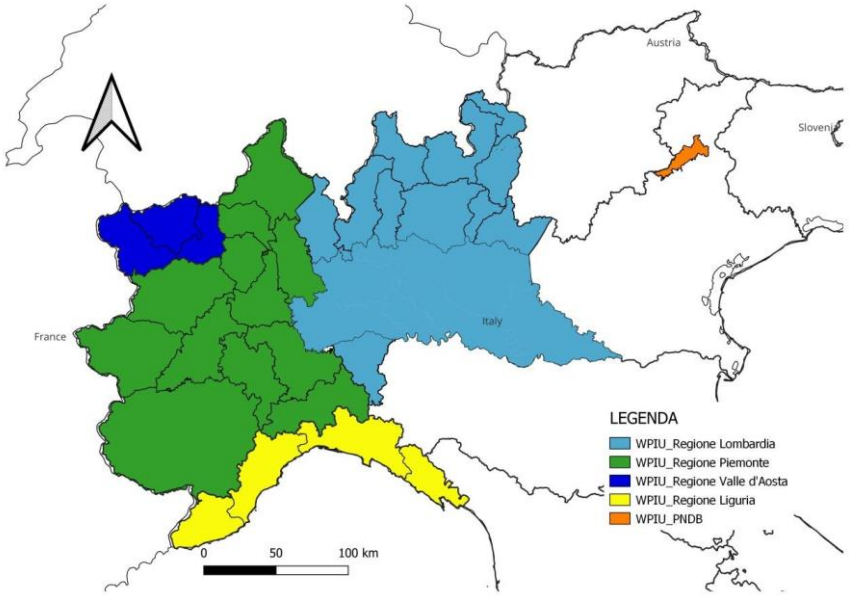


Figure 14: Map of the Italian WPIUs.

Table 20: Number of farmers assisted by WPIU and number of farmers who received damage prevention material by WPIU at each Partner level (both by LIFE funds and by other funds).

	RAVA	Piemonte Region				RELO ERSAF	RELI	PNDB	TOTAL
		APAM	APOS	METO APAC	APAP				
Farmers assisted by WPIU	77	80	111	147	29	150	116	34	744
Farmers provided with damage prevention material by WPIU	38	68	79	63	25	63	5	30	371

According to the WPIU Italian strategy, several training courses have been organised by each partner, both dedicated to WPIU operators and to Veterinarians of the public administrations or to other damage inspectors to ensure a common basic knowledge and so that they can all act according to a common protocol. The number of WPIU operators trained by each LIFE partner are reported in Table 21 and Table 25.

Table 21: Number of WPIU operators trained by each Italian LIFE partner.

RAVA	Piemonte Region APAM, APAC, APAP, METO, APOS	RELO, ERSAF	RELI	PNDB
8	214	13	25	5

In Italy, up to the 31st of August 2024, WPIU interventions were 1.112 compared to the 366 expected by the project (Table 22 and Table 23; Figure 15 and Figure 16).

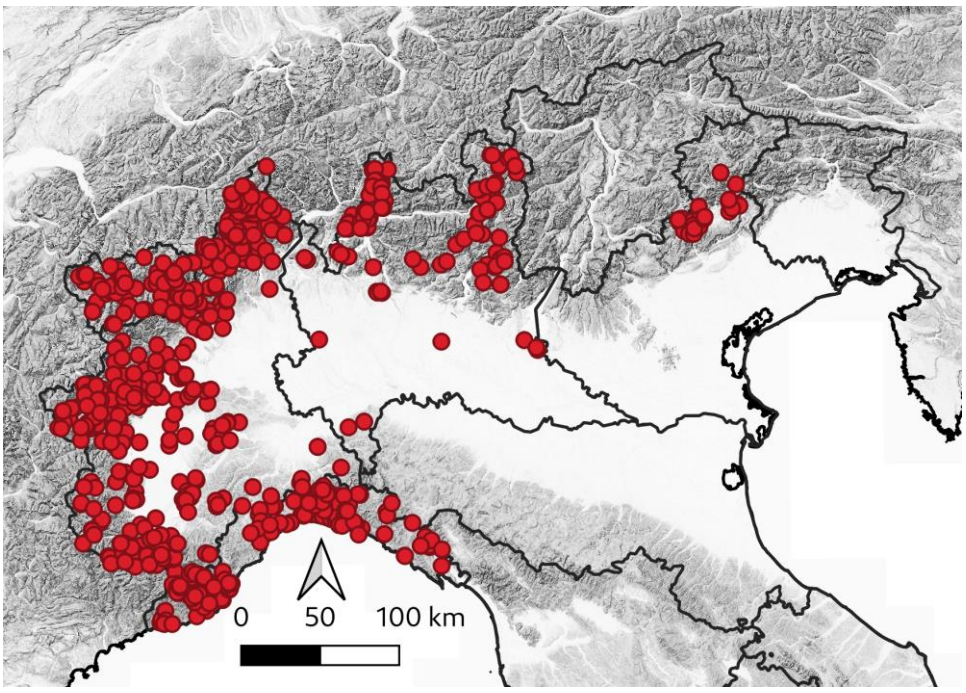


Figure 15: WPIU interventions occurred by the Italian LIFE partners.

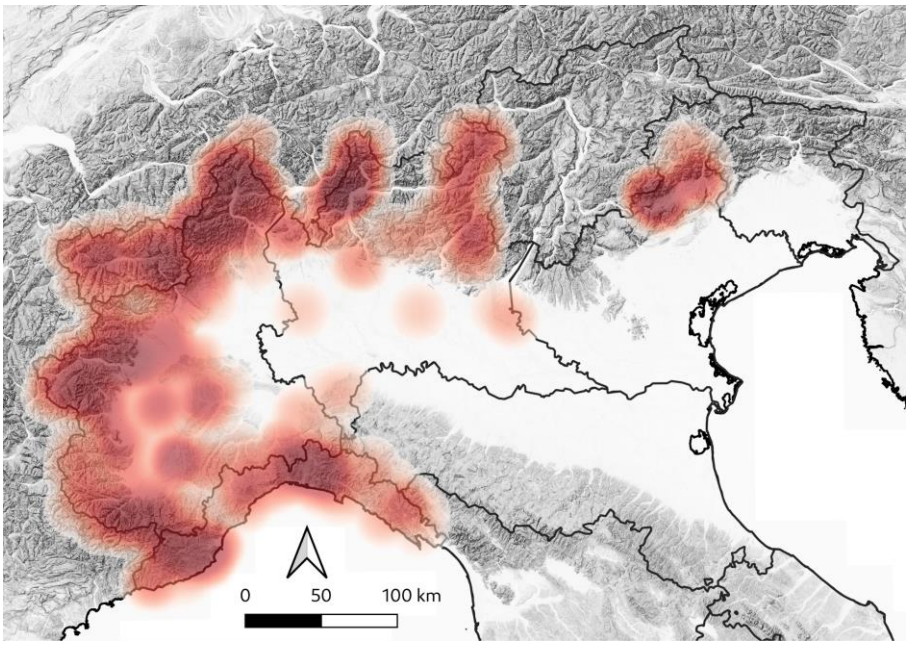


Figure 16: Kernel density of the WPIU interventions occurred by the Italian LIFE partners.

Table 22: Number of WPIU interventions foreseen and performed in the field by each partner.

	RAVA	Piemonte Region APAM APOS APAP APAC METO	RELO ERSAF	RELI	PNDB	TOTAL
Foreseen	100	106	100	50	10	366
Performed	103	546	238	175	50	1112

Table 23: Number of WPIU interventions performed in the field by each partner per year.

	2020	2021	2022	2023	08/2024	TOTAL
Piemonte Region APAM APOS APAC APAP METO	25	149	180	136	54	546
RELI	0	22	23	78	52	175
RAVA	0	34	25	18	26	103
RELO ERSAF	20	35	72	67	43	238
PNDB	10	4	17	17	2	50
TOT	55	243	279	316	96	1112

As foreseen by the WPIU strategy, interventions could be of 3 types (Table 24 and Table 25). Greater efforts were made by WPIU operators to intervene “following a depredation event” or “to prevent a depredation event” (respectively 38% and 37%), fewer interventions have been dedicated to “evaluation of the correct use of prevention systems” (25%).

Table 24: Type of WPIU intervention performed by each partner.

Type of intervention	RELI	RELO ERSAF	Piemonte Region APAM APOS APAP APAC METO	RAVA	PNDB	TOTAL
Evaluation of the correct use of prevention systems	8	131	93	38	9	279
Following a depredation event	167	43	162	29	21	422
For preventive purposes	0	64	291	36	20	411
TOTAL	175	238	546	103	50	1112

Table 25: Summary of the overall WPIU activity in Italy from 2020 to 2024.

WPIU	N. of WPIU	N. of operators	Period of activity	N. of WPIU interventions	N. of breeders involved	N. of breeders provided with prevention material	Number of interventions per type		
							Following a depredation event	For preventive purposes	Evaluation of the correct use of preventive systems
RELI	4	25	06/2021 to 08/2024	175	116	5	167	0	8
Regione Piemonte APOS APAM APAC METO APAP	16	214	05/2020 to 08/2024	546	367	235	162	291	93
RAVA	3	8	04/2021 to 08/2024	103	77	38	29	36	38
RELO ERSAF	5	13	02/2020 to 08/2024	175	150	63	43	64	131
PNDB	1	5	03/2020 to 08/2024	50	34	30	21	20	9
TOTAL	**29**	**265**	**02/2020 to 08/2024**	**1112**	**744**	**371**	**422**	**411**	**279**

In Italy, WPIU are composed of operators belonging to public administrations, so the cost of their activity is low compared to an operator with a specific activity contract. Furthermore, operators in performing a WPIU activity can simultaneously perform other tasks from their usual work, thus containing total costs (both travel and work). The cost of a WPIU intervention varies greatly depending on where it occurred (i.e., close to a road or reachable after a long walk) and on the type of intervention (i.e. just giving information and delivering prevention material, or helping farmers to set up an electrified fence and checking the proper functioning of a fence). We will therefore only provide, as indication, an **average cost** per hour calculated on the basis of WPIU operators from public institutions (and not considering for example travel costs, meals, …), that is **23,03 €/h**. We also provide the average cost of the main prevention materials given in Italy (tab. 8), sometimes paid within the Project funds and sometimes with other funds.

Table 26: Mean cost (€) of the main materials used in Italy for wolf damage prevention.

	Electrified net h. 120 cm (50 m)	Electrified net h. 145 cm (50 m)	Energizer	Electrified wire (100 m)	Battery	Solar Panel	Fladry (100 m)	Acoustic device
Mean cost (€)	60,07	124,87	185,58	5,65	64,64	107,7	706,5	410,45

3.3.3. Evaluation of the effectiveness of mitigation measures implemented to reduce wolf damages on livestock

3.3.3.1. Results

The greatest number of WPIU interventions involved flocks of **sheep and goats** (50,3%), which are also **the most depredated species**, but a minor part regarded also cattle (15,5%), horses and donkeys (3,7%), and mixed species breeding (30,5%; tab. 9). The most representative breeding farms conducted by the WPIU in Italy were composed of less than 100 heads (63,3%), whereas herds with more than 1.000 animals were occasional (3,7%; Table 28).

In general, contacted breeders were willing to collaborate with the project.

Table 27: Number of farms assisted by WPIU and classified per species bred.

Species	ERSAF RELO	APAM	RELI	PNDB	METO APAC	RAVA	APAP	APOS	TOTAL
Sheep goat	128	84	85	31	77	38	17	80	540
Mixed*	82	9	40	6	96	20	20	55	328
Cattle	20	24	30	5	26	43	3	15	166
Equidae	3	2	20	4	5	2	3	1	40
TOTAL	233	119	175	46	204	103	43	151	1074

** Mixed farms are composed of different species bred together (sheep, goats, cattle, equidae, camelidae, game animals).*

Table 28: Consistency of the farms involved by WPIU interventions (2020-2024).

Number of heads	APAM	APAP	APOS	METO APAC	PNDB	RAVA	RELI	RELO	TOTAL
< 100	54	28	88	93	33	78	121	130	625
101-1000	52	10	48	74	3	24	25	89	325
> 1001	1	0	4	15	3	0	9	5	37

Use of prevention systems

Most of the contacted farmers (62,9%) already had some kind of prevention systems in place before WPIU intervention, the rate of use of prevention methods for different species is reported in Figure 17. As assumed, sheep and goats are the most protected species, in fact the 74,8% of the flock explored uses at least one prevention method (LGD and/or electrified fence). Overall, the **49,9% received prevention materials** funded by LIFE or by other programs (

Table 29).

A mean value of **99,3% farmers** used damage prevention methods that have been implemented by WPIU **following a depredation event** or **for preventive purposes** (Table 30).

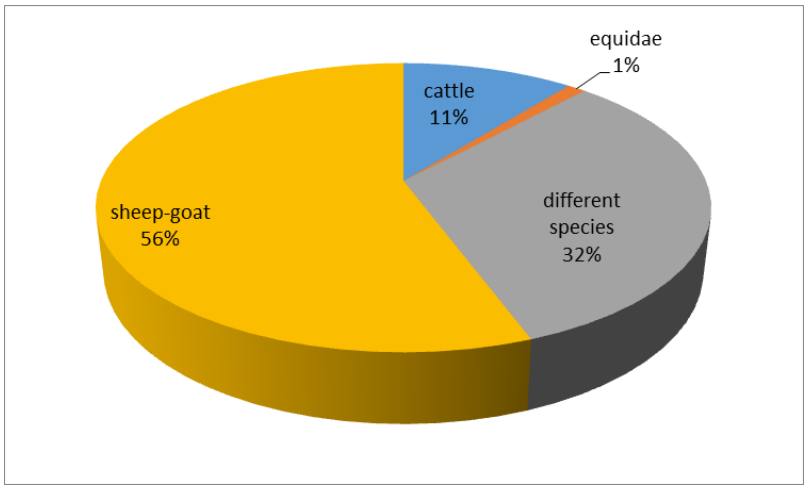


Figure 17: Use of prevention methods for species (different species: sheep, goats, cattle, equidae, camelidae, game animals bred together).

Table 29: Prevention systems furnished by WPIU.

	N. fences kit provided	**n. LGD**	**n. Fladry**	**n. acoustic devices**	**watering points**
RELO/ERSAF	89	0	0	1	0
RELI	10	0	0	0	0
RAVA	27	0	0	8	0
PNDB	41	0	0	0	0
Regione Piemonte (APOS APAM APAP APAC METO)	188	1	12	17	30
TOT	355	1	12	26	30

Effectiveness of mitigation measures

We evaluated the effectiveness of mitigation measures implemented to reduce wolf damages on livestock with 2 different approaches:

1. **following a depredation event** - the WPIU intervenes in the field where the depredation occurred, by analysing what was happened and seeking, in agreement with the farmer, how to improve the farm's protection strategy (possibly also providing *pro-tempore* material), so as to avoid further depredations. Then, we recorded how many farmers experienced attacks after the WPIU intervention in the period of flock permanence on the same pasture. Results obtained by the different Italian partners were all very satisfying, with rates greater than 70% (**mean value = 81%**; Table 30). If, otherwise, we consider both interventions “following a depredation event” and “for preventive purposes” the mean value of the attack reduction increases to 82,1%.

Table 30: Evaluation of attack reduction after WPIU intervention and use of prevention systems given by WPIU.

Region	Attack reduction (%)	Use of prevention systems given by WPIU (%)
Piemonte APAM APAC METO APAP APOS	76,5	96,5
RELI	80,8	100
RAVA	96,5	100
RELO ERSAF	90,7	100
PNDB	76,2	100
TOT	81,0	99,3

2. **evaluating the correct use of prevention systems** - the WPIU intervenes in the field to evaluate the correct use and effectiveness of the prevention methods put in place by the farmers, according to the protocol described in Annex 1. The protocol includes: 1. observations on LGD, 2. evaluation of the correct set-up of electric fences and 3. evaluation of presence of the breeder/shepherd.

A descriptive analysis of the collected data has been conducted.

A. Protection measures in place

Table 31 reports the different prevention strategies adopted according to the species. Also in this case, it is evident that the most protected species are sheep and goats and that, indeed, breeders are aware of their higher risk of depredation. In particular, the shepherd, the LGD and the electrified fences were present above all for sheep and goats flocks (

Table 32).

Considering the 254 farms observed by WPIU operators (Table 33), the 37,7% of them used the 3 methods simultaneously.

Table 31: Main prevention strategies adopted for protecting the different species.

	prevention strategies adopted		
	shepherd presence	LGD presence	electrified fence use
sheep/goats	151	68	144
cattle	37	4	34
equids	5	2	6
mixed*	92	27	75
TOT	285	101	259

* Mixed farms are composed of different species bred together (sheep, goats, cattle, equidae, camelidae, game animals).

Table 32: Shepherd presence with different species of livestock.

	Shepherd presence with livestock		
	always	during the day	2-3 times for week
sheep/goats	78	73	24
cattle	14	23	14
equids	2	3	1
mixed	50	42	22
TOT	144	141	61

Table 33: Prevention measures observed by the Italian WPIU (in 58 occasions the datum was not available).

Prevention measures			N=196 (100%)
LGD	**Electric fence**	**Shepherd**	
x			3 (1,5%)
	x		24 (12,2%)
		x	15 (7,6%)
	x	x	66 (33,7%)
x	x		4 (2,1%)
x		x	8 (4,1%)
x	x	x	74 (37,7%)
None			2 (1,1)

B. Correct use of the prevention measures

A more detailed analysis has been conducted for the prevention measures used for protecting sheep/goats (N=183).

- **Shepherd presence**: in 86,3% of the evaluated situations, the shepherd always accompanied the livestock during the grazing period and in 44,6% of the cases he/she slept in housing facilities located nearby the animals (
- Table 32). But it is important to remember that not always an adequate recovery for the shepherd is present on the Alps and, sometimes, they are forced to stay overnight in emergency facilities with precarious living conditions in order to be near livestock. Only in 13,7% of the situations the livestock was occasionally controlled by the breeder/shepherd (2-3 times a week) and this happened mainly in Valle d'Aosta region (10 cases) and in Lombardia region (provinces of Sondrio, Como and Brescia; 13 cases).

In the 25% of the cases the farmer actively managed the new-borns, otherwise they were managed together with the rest of the livestock.

The shepherd presence is essential not only to drive flock in the grazing areas, but also to control what happens in the pasture and to allow the use of other prevention systems such as LGD and electrified fences.

- **Use of LGD**: at least a livestock guarding dog (range 1-10) was present in 54,4% of the farms and in 50,8% of the cases the dog was combined to the use of the electrified fence. Analysing the position of the dog with respect to the shepherd and to the livestock most often they were, respectively, within 500 m. (85,4%) and within 100 m (74%), indicating a good degree of association with livestock; rare cases of displacement from livestock have been described (8,3%). If several dogs were present, they were in most cases (61,7%) distributed in different parts of the flock, allowing a better control of the grazing area from possible wolf attacks. The existence of a relationship between LGD and shepherd was also evaluated, for example considering if the dogs respond to the shepherds' calls effectively and this was the case for the 90,7% of LGD.

In Italy, LGD are considered a very effective protection method, but their success depends on a number of factors. Most important are the performance and experience of the dog, topography and forest cover, number of sheep to protect and size of the grazing area. Not least the ability of the breeder to correctly select and socialise the dogs to be included in the pack.

- **Use of electrified fences**: in 91,7% of the observed situations, livestock was recovered in an electrified fence during the night (sometimes also in a stable) and, in some occasions, also during the day. The fences were mainly composed of nets (88,6%) and rarely of wires (11,4%), and in 74,3% of the net-fences they were higher than 120 cm. Fences lower than 120 cm. are considered easily to jump by the wolf and indeed not effective (Wam et al., 2004).

The 14,2% of the farmers used not-electrified nets, sometimes over 170 cm in height, but they were not able to prevent wolves from climbing and depredating livestock. In 3 particular depredation events occurred on game animals' facilities, the fence was composed of a 220 cm high not-electrified fence. The cases showed that wolves can learn to climb over fences, acquiring a new mode of depredation, which they then extend over time. The solution was to add to the top of the net, 2 electrified wires with a 45° angle inclination and a further electrified wire at 30-40 cm of height. This new approach was efficacious and stopped the depredation events.

During their activities of **evaluating the correct use of prevention systems,** WPIU focused their attention on the correct placement of the electric fences considering 6 different parameters (tab. 16). Although most sheep-goat farmers used electrified fences (91,7%), these were rarely properly placed and, therefore, in the event of a wolf attack they may prove ineffective (table 16). Protection capability of a fence depends on many variables and is therefore hard to measure. The main flaws we encountered were: **1. the incorrect electric charge**: it is important to periodically check both the voltage and the joule of the fence-system that, in our opinion, should respectively be at least of 4.000 V and 3 J (AGRIDEA suggests a pulse energy of at least 5 J and 3000 V; AGRIDEA, 2016), but the electric discharge is rarely tested by shepherds. Tall grass, insufficient grounding, weathered material or battery problems can lower the discharge energy to a level hardly perceptible for the wolf. Moreover, inefficient grounding and dry ground can lower the energy discharge massively. **2. the incorrect cleaning of the vegetation**, since tall plants can lead the voltage off and small faults can have a massive destructive effect on the whole fence, it is important to periodically clean from new vegetation the perimeter of the electrified fence. **3. the incorrect fence placement**: elevated surroundings, which help the predator to jump in, uneven grounds, little water streams, nets not perfectly stuck to the ground, or not electrified gates can make high and strong fences useless favouring wolves to dig below fences. **4. the incorrect fence perimeter**: a round perimeter, without corners, should be preferred because if frightened, the animals move along the fence, piling up in corners and tearing down the fence. In this way they become easier prey for the wolf. Otherwise, with a round perimeter they tend to run along the nets. **5. the incorrect stakes placements***:* if the stakes are not straight, the net is not stable and it remains low, so it is easier to jump for the wolf.

A very frequent situation WPIU observed in the field was inadequate grounding. It resulted in a common malpractice to use broken fence stakes as a ground rod. When the soil is very dry (as happened during the summer 2023) neither 2 ground rods (50 cm length) were enough and energy of many fences was below 10 J, which empirically means that it is possible to touch the fence with the hand without suffering pain. In such situations usually the voltage value is still normal and economic testers measuring only the voltage fail to detect the fault of the fence effectiveness. We can say that without proper grounding also the best energizer cannot do the job. Another problem of conductivity when voltage is normal but energy is very low is when many conductors of the net are damaged. It is possible that the herder fails to detect such damage.

When the soil is very dry the commonly used all hot systems (the electrons flow from the hot wire to the soil) can fail and hot/ground systems, where part of wires are connected to hot (+) and part to the ground (-), so the electrons flow directly from wire to wire through the body of the predator.

Electric fences work as psychological barriers, not as physical barriers, so repeatedly exposing the wolves to fences which are not associated with painful stimuli can enhance the risk that specific individuals learn how to violate the fence. For such reasons WPIU measured electrical parameters to drive the attention of the farmers to electric fence functionality.

Table 34: Parameters considered to evaluate the correct placement of the fence.

	fence perimeter	fence cleaning	stakes placement	fence placement	voltage	joule
correct	76	29	19	59	42	27
not correct	93	142	150	99	43	16

Correct fence perimeter: a circular perimeter, without corners; Correct fence cleaning: regular cleaning of the vegetation under the fence to avoid electricity dispersion; Correct pegs placements: the stakes must be straight to keep the fence stable; Correct fence placement: nets stuck to the ground, avoiding sags and openings; Correct voltage: minimum voltage of 4000 V. Correct joule: at least 3 joules of energy output.

3.3.3.2. Discussion

Different methods have been proposed by the Italian WPIU to breeders/farmers for reducing wolf impact on livestock. In general, both traditional protection measures, such as herding and use of guarding dogs and electrified corrals, both more particular protection systems, such as fladry (Reinhardt et al., 2012; Musiani et al., 2003; Iliopoulos et al., 2019) and acoustic deterrents (Menzano et al., 2018) have been proposed. Depredations by wolves have also been managed by proposing calving/lambing control, so as to reduce the availability of preferentially taken young livestock (Breck et al., 2011). Indeed, a range of different prevention methods have been proposed to minimize the risk of livestock depredations, but certainly the best results have been achieved by combining together more methods.

Sheep and goat farmers, the species most at risk of depredation, were found to be the most likely to use damage prevention systems. Despite the widespread use of such systems, checks carried out by WPIU operators showed that they were rarely used correctly and therefore may not be fully effective in protecting livestock from a depredation event. These observations show the importance of an ongoing dialogue between experienced operators

and breeders to make them aware of the importance of routinely checking that the electrified fences, in particular, are correctly put in place and monitored.

In some occasions depredations occurred after a WPIU intervention but it was evident that the shepherd didn't follow the operators' suggestions (i.e., nets not correctly placed, lack of electrification, …); in other, most often, they were due to the forgetfulness of some animals outside night shelters or to the difficulties of controlling grazing animals during bad-weather, which means that action can hardly be taken to reduce the risk of depredation on these animals.

The Italian Alps are characterised by a wide variability of conditions, be it in terms of wolf presence (which varies from stables, with numerous packs, to sporadic), livestock presence (species, number and categories grazed, management systems) and use or non-use of prevention systems. It is not easy to describe such a situation, but it is possible to highlight local criticalities and suggest recommendations and best practices as applied to different contexts.

Considering the different approaches and experiences of the Italian WPIU, Italian partners agreed on producing a SWOT analysis based on the 4 years of WPIU's activity to assess what this new approach has improved so far and to outline a successful strategy for the future. Some of the factors we are going to describe are controllable and thus an effective improvement of WPIU activities will be possible, others are not strictly under the control of the WPIU and thus solutions must be sought elsewhere (i.e. collaborations with institutions at higher levels, …).

SWOT Analysis

Strength

The positive evaluations of the WPIU are described in terms of activities appreciated by farmers and that, if continued, can reduce farmers' intolerance towards the predator. The main strength of WPIU is related to assisting farmers and taking prompt actions in case of wolf attacks or to prevent them, this is an essential activity to reduce conflicts and economic impact on livestock husbandry.

- WPIU represents a direct and immediate contact for breeders in areas of wolf presence. They improve a first aid approach for farmers in case of attacks, but they also assist them in using prevention systems and in having information on funds dedicated to prevention and damage compensation, otherwise difficult to find. During the summer, when farmers are busy with their livestock on the alpine pastures and cannot get away, the WPIU's activity of providing prevention material by going directly on the field is much appreciated.
- WPIU assist not only professional but also to not-professional breeders (hobbyists), who currently haven't access to prevention and damages public funds but who are an important reality to be maintained especially in lowland and hillside areas for their role of cleaning and maintaining ecotonal areas.

- WPIU interventions and data collected and analysed showed how the protection strategies they proposed, if properly installed and maintained, significantly reduce livestock losses and attacks.
- WPIU operators in Italy are numerous and belong to different public Institutions. So, there is always at least one operator ready for a prompt intervention and their cost is relatively low (during a WPIU intervention an operator may also perform other institutional activities). This will guarantee their maintenance after the LIFE WolfAlps Eu project. Moreover, the involvement of different institutions has led to the creation of a multidisciplinary networking group that can be also used for other purposes.
- WPIU operators have the important role of permitting an exchange of experiences from one breeder to another; they rarely experiment new methods. In this way, a particular and effective solution adopted by a farmer can be switched in other contexts. Breeders tend to be more inclined to adopt solutions already adopted by their colleagues rather than proposed by institutions.
- WPIU can spread correct information to breeders, debunking the wrong perceptions and avoiding political indoctrination. To do this, it is very important to build a relationship of trust with breeders by disseminating scientific data and findings and creating a space of active listening for the stakeholders.
- WPIU are composed of a well-trained multidisciplinary staff who provide information on prevention systems and their management and support for field assessment of wolf damages.

Weakness:

Some WPIU activities still remain to be improved to make interventions more effective, because they are underperforming or because they are not directly dependent on the action of the WPIU.

- Difficulty in interlocuting between the various components of the system (veterinary service, regional facilities, stakeholders, …). which can lead to mistakes in communicating correctly what the right processes are and how WPIU should intervene.
- No WPIU decisional power at Institutional level: WPIU can only give suggestions but are not able to change the system. WPIU doesn't have the possibility of controlling the proper functioning of prevention systems with surprise checks and of taking decisive action to eventually intervene to correct/improve LGD behaviour. So, it is not always easy to evaluate the real efficacy of a system and improve it.
- In some Italian regions the WPIU have difficulty in involving veterinarians during inspections and so the assessment of a damage is carried out by operators from different and not always qualified institutions.
- Lack of knowledge of the real data on predatory events: if the damage compensation system does not work correctly or is too complex, farmers are not motivated to report events (data underestimated). This is also the case of depredations reported by hobbyist breeders due to lack of compensation for their category. The coordination and the process of information sharing between WPIU and the institution in charge

for damage assessment should be improved, otherwise WPIU are not able to contact all the breeders who suffered a depredation.

Opportunity:

The creation of WPIU represented and will continue to offer an opportunity of improvement of the use of prevention systems and their efficacy thanks to the collaboration of formed operators with shepherds/breeders both after a wolf attack and/or to prevent them.

- Opportunity of exploring new methods for protecting new depredated species, currently difficult to protect due to breeders' low experience (i.e. cattle, equidae, camelidae): the WPIU represent a net of operators from different countries and with different backgrounds, able to exchange information and provide breeders new solutions.
- WPIU assists administrators in facing the problem of "urban wolves", helping them to communicate correct behaviour to the population and assisting them in finding the better solution.
- WPIU can put farmers' requests in touch with institutions (above all at regional level) to raise awareness of major problems and issues, too often ignored at high levels.
- WPIU helps breeders informing them about the availability of funds dedicated to damage compensation and to prevention, giving indications on the application forms. Each Italian region has different damage compensation tools and not all of them access RDP measures dedicated to "Specific commitments to coexistence with large carnivores". WPIU offers to breeders a continue update on the 2 themes.
- The relationship of mutual respect established between WPIU and breeders, can favour a process of trust and encourage the reporting of cases of depredation (reducing the number of unreported cases and of underestimation of depredations).

Threats:

Some impediments have been evaluated. If not solved, they could hinder the proper functioning of WPIU due to a breeder's lack of interest in contacting the teams or for other reasons.

- Difficulty in obtaining funds to equip WPIU with prevention systems for "emergency response": the lack of prevention systems to immediately help farmers could prevent them from staying in contact with operators.
- Non-retention of WPIU staff following turnover and training/upgrading of the same.
- If a WPIU external coordinator is not yet present, it may be difficult to coordinate the activities of all the teams.
- Negative campaign on the effectiveness of prevention systems and delegitimization of WPIU by some stakeholders.

3.3.4. Other activities conducted in Italy

3.3.4.1. PNDB - Activities with hobbyist breeders

In the first phase of the LIFE WolfAlps EU project, PNDB provided electric fences to all professional breeders operating within the protected area. Later, it appeared evident the strategic importance to learn how to protect livestock from predators also to non-professional breeders (hobbyists), for many reasons:

- they cannot access to public funds available for professional breeders;

- they are people who have another job, for whom breeding is a hobby, and therefore cannot dedicate themselves full time to the care and protection of livestock;

- despite their low economic value, animals bred by hobbyists have a very high emotional value, any predation against them has a strong emotional impact and, very often, also a great media outcry;

- animals bred by hobbyists are often used for land maintenance activities through grazing, as a replacement for mowing (now abandoned in many marginal areas);

- keeping this grazing active is essential to conserve the open habitats of the valley floor, otherwise prey to the advance of the forest;

- often these are farms located inside or near residential areas, any predation in situations close to homes has a great emotional impact and strong media coverage, often with alarmist tones.

Starting from these considerations, it was decided to purchase and provide free loan electric fences also to hobbyist breeders.

Figure 18: Electric fencing.

Through two public tenders, in 2022 and 2023, expressions of interest from breeders were collected, the fences were purchased and delivered on free loan. The breeders were adequately trained to ensure the correct installation of the fences and, upon request or through random visits, interventions by the WPIU were carried out to verify the correct installation and use of the prevention devices.

Twenty-nine fences were delivered in 2022 and 30 in 2023, to as many breeders who operate mainly in the surrounding areas outside the National Park. The distributed fences allowed to protect more than 400 animals, all belonging to hobbyist breeders. Five electrified fences were delivered to professional breeders by the PNDB, to protect a mean of 2000 grazing animals for each summer.

3.3.4.2. RELO/ERSAF activity with “prevention specialists”

For the implementation of experimental prevention activities in the regional territory, ERSAF has envisaged an external assignment to a Temporary Group of Professionals (TGP) with specific field experience on the implementation of prevention to train and assist the work carried out by the WPIU teams starting from November 2022.

Specifically, the TGP was entrusted with the following tasks:

- theoretical and field training activities for WPIU operators;
- field support to breeders for the implementation of prevention;
- veterinary assistance to farmers with LGD;
- local meetings with stakeholders;
- specialist checks in case of particular wolf attacks.

The TGP was composed by the following professionals:

- wildlife technician, expert in prevention strategies;
- zootechnical;
- Veterinary.

With the expert support service, 45 interventions were carried out by 31 August 2024. Further interventions are expected by 30 September 2024.

3.3.4.3. APAM - Livestock and livestock guardian dogs: spatial association

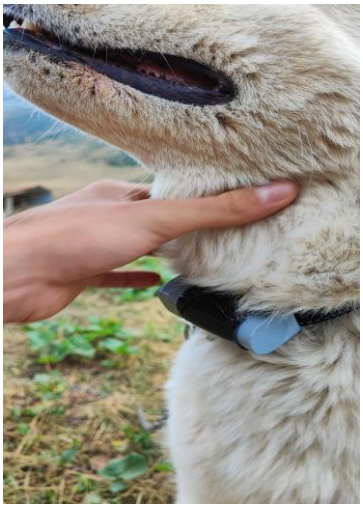
In different parts of the world, livestock guardian dogs (LGDs) have been used for centuries as a non-lethal strategy to mitigate conflict between predators and human activities. They are considered one of the most effective preventive tools to protect domestic livestock, mainly sheep and goats, from depredation by large carnivores. Some studies have shown and evaluated their effectiveness, but the mechanism by which LGDs protect livestock is still partly unknown. Their effectiveness is often assessed in terms of their proximity to the animals they are supposed to protect, and, for this reason, it is crucial to study their movement and degree of association with livestock.

During the 2022 summer grazing season, APAM conducted a specific study, not foreseen by the project, in which LGDs were monitored with GPS datalogger devices in order to investigate their movement and their degree of association with livestock. The study took place in the mountain pastures of three valleys in the Maritime Alps (Cuneo Province, Piedmont): Pesio, Vermenagna, and Ellero valleys.

Data collection focused specifically on night-time hours, when the dogs were unaccompanied and unsupervised by the shepherds, allowing them complete freedom of movement. During this period, the livestock should ideally be kept inside a night enclosure and therefore the LGDs should remain in close proximity to it.

A GPS datalogger collar was applied to a dog and a head of livestock for each pasture, contacting 25 breeders spread across 26 pastures. In half of these pastures, LGDs were present, for a total of 41 dogs, with 14 working in 5 cattle-grazed pastures and 27 working in 8 sheep and goats-grazed pastures. For the purpose of this analysis, 10 LGDs were selected, 6 of which were used for cattle protection and 4 for sheep and goat defence. The selection of dogs to be fitted with GPS devices depended primarily on the willingness of the breeders to collaborate, and secondly on their grazing practices. In particular, LGDs permanently kept within electrified fences were excluded. The selection of the livestock head to be monitored was based on the indication of the "leader" animal by the breeder, i.e., the

one most frequently followed by others during movements, according to a procedure previously adopted by Aslam et al. (2022). This approach was used to achieve a higher representativeness of the entire flock or herd, even though movement data for only one animal were available.



Spatial proximity, measured as the distance between the dog's position and that of the livestock, was calculated, and dog movement quantified; a Generalised Linear Mixed Model (GLMM) was used in order to investigate whether these two measures were influenced by certain environmental or herd-related factors. In particular, it was tested whether the type of livestock reared, the number of guarding dogs in the herd, the time of day, the distance to the forest and the moonlight influenced the proximity and movement of LGDs.

The data collected indicated an average distance between LGDs and cattle of 255.5 ± 333m. A clear difference in the proximity of the dogs was noted, depending on the type of livestock to be protected. In particular, LGDs associated with sheep and goats maintained a shorter distance from livestock than those associated with cattle, probably due to a more difficult socialisation of LGDs with cattle. Furthermore, an effect of certain environmental variables, e.g. moonlight, on both the proximity and movement of LGDs was found. The dogs, in fact, move further away from the cattle and move more during the most moonlight nights, probably as a behavioural response to an increase in depredation attempts, which seem to be more frequent on brighter nights. Proximity to livestock is also influenced by the number of dogs working in the same pack. In fact, the greater the number of LGDs, the greater the distance they maintain from the livestock. This could be due to the reduced risk of depredation in alpine pastures guarded by numerous dogs, which can therefore afford to maintain a greater distance from the livestock.

It can be concluded that quantifying the proximity of LGDs to livestock and their movement is useful in assessing the dog's effectiveness and understanding by which factors it is influenced. This is crucial for making informed management decisions that maximise the dog's performance and are therefore valid in mitigating the conflict between livestock and predators.

3.3.4.4. RAVA - Activities related to the use and presence of LGD in the territory of Aosta Valley

During 2022/2024, various activities were carried out to make grazing animal protection dogs known both to tourists and to all those who frequent the Aosta Valley mountains. The events were aimed at raising awareness of respect and knowledge; specific instructions were given on how to behave and, above all, what not to do.

The activities were divided into two different types:

1. publicity evenings (7 in total);
2. field trips (2 in total).

A PowerPoint presentation full of photos and videos was prepared for the evenings to better understand how to behave when encountering these wonderful grazing dogs. At the same time, there has been a lot of focus on the issue of wolves and predators in the broader sense; the discussions in some cases have been very heated, on the one hand those who do not wish to change their habits when going into the mountains, and on the other hand those who understand the importance of these dogs and are aware that turning back can be a form of respect for the farmers who have to defend their animals.

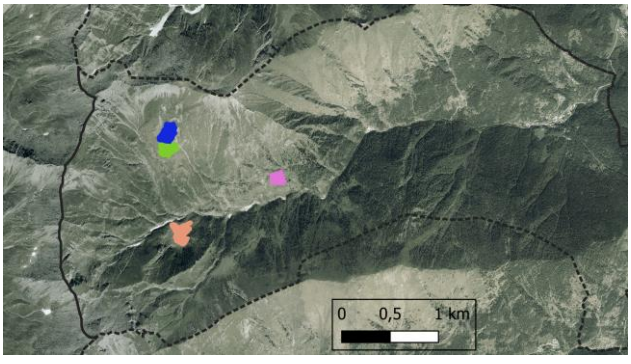
The excursions were carried out in the Mont Avic Natural Park at the Praz Oursie alpine pasture managed by Michael Nuzzi's La Vallée Blanche farm. In synergy with the park, the excursions were carried out with the help of a park ranger who explained the management of animals in a protected area. Volunteers from the Pastours project were involved, enthusiastically explaining their experience. Anna Crimella, the project leader, was present both times to best describe what has been done over the years.

The aim of these activities has been to inform as many people as possible who frequent the mountains in Valle d'Aosta. The more people are informed, the more the risk of accidents that would put the management of these dogs in a bad light is reduced.

For the dissemination evenings, the municipalities involved were: La Salle, Fénis, La Magdeleine, Champorcher, Champdepraz, Avise and Châtillon. For the excursions, the municipality concerned was Champdepraz.

3.3.4.5. APAC - Use of electric fences for diurnal grazing with bad weather

Context - A summer pasture grazed by a 1000 head sheep and goat flock. The mountain pasture is around 400ha, no road reaches it and the buildings are owned by the shepherd. Wolf attacks have occurred since 1997 (declared, since 2001 accerted). From 2000 electric fences are used during the night and guarded grazing during the day, from 2004 LGDs are employed, gradually improving their use. Nevertheless, multiple attacks are carried out each year, with big losses and big stress for the shepherd. In particular, a large number of victims in single attacks (i.e. 42 in a single attack in 2021) were recorded during fog and low visibility weather.



The intervention - We were inspired by the use of electric fences for fog days shown in the Agridea (Switzerland) field visit carried out in March 2022 in the context of the Project. We provided a kit composed of 16 electric nets (length 50 m each, height 120 cm) and a 5J fence energizer. During the first year (2022) the nets were mounted 4 times in

4 different places with the help of at least 4 operators of the project (figure X). The fenced surfaces were between 2,2 and 3,2 ha according to ground morphology and were grazed in 2-4 days according to surface and grass quality. In the second year (2023) the same procedures were applied but only 2 operators were provided. In third year (2024) the shepherd managed to carry out the task with his own resources.

Results - Number of dead animals dropped from 80 heads in 2021 to 39 heads both in 2022 and 2023. No official data is still available for 2024. All events occurred because of sick animals forgotten out of the night fence. The shepherd declared his satisfaction because of less stress during bad weather days.

Issues - Unmounting, moving and unmounting such a big fence without motor vehicles requires the manual work of 6 people for half a day. It is not easy for the shepherd to have such help available. Animals are used to going out every day, so there is the risk that they escape at the usual hour. Moreover, only in 2 out of 4 places there is a water source inside, so in two places it is needed to open the fence to allow them to drink daily. The electrification of the fence is an issue with dry weather like in 2022, when neither reinforcing and watering the ground pole we reached more than a 0,6 mJ power.

3.3.5. References

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3.4. MITIGATION MEASURES IMPLEMENTED BY WPIU IN SLOVENIA

3.4.1. Slovenian WPIU strategy and data collection methods

In Slovenia, there are two geographical areas that differ from each other in several features, especially in topography, which is connected with animal husbandry practices, and also in the historical presence of wolves. The first one is the Dinaric-Karst area from where wolves and other large carnivores have never disappeared. Here also the pastures are located near to villages and are more accessible. Here the farmers have always used different means of protection for their grazing animals. On the contrary, in the Alps, the large carnivores, especially wolves, have been absent for many decades before reappearing again in 2019. This is when three wolf packs formed in the wider alpine area in Slovenia and the conflicts with the species occurred after a long period of absence. The farmers in the Alpine region have abandoned practices of protecting the animals from large predators. They were used to leave the animals grazing freely on the mountains from May to September and then gather them again in Autumn and bring them into the valley. The mountains are usually poorly accessible by vehicles and also the methods for prevention are not needed and difficult to implement and maintain.

In the last decade, many focused activities were made to improve the damage prevention system in Slovenia. The majority of these activities were performed in the Dinaric-Karst area, where traditionally the bulk of the conflicts and damage cases with large carnivores occurred. With these activities it was proven that damage prevention is one of the key steps to maintain the acceptance of wolves in populated areas, especially in rural environments (Simčič et al. 2020).

In Slovenia, damage inspectors from Slovenia Forest Service (SFS) are the ones who visit the farmers when damages occur, therefore it is crucial for inspectors to have knowledge and experiences to handle this kind of emergencies in the field. Slovenia Forest Service damage officials are the most suitable expert personnel for performing controls in the field as they have a large spectrum of knowledge regarding the large carnivore presence in the local/regional environment. They regularly take part in the wolf monitoring activities and other activities aimed at preventing conflicts with large carnivores.

To further intensify and improve the quality of SFS activities in the field, **seven wolf prevention intervention units** (WPIUs) **have been created and trained in Slovenia**. The WPIUs are active regionally and the majority of members consisted of damage officials, whose main job, in terms of conflicts with large carnivores, is to assess damage after depredation events.

The WPIU members are activated:

a) **after a depredation event**, acting rapidly, helping breeders to define the best livestock protection strategy and limiting further damages with the implementation of intervention kits of electric fences (if needed);

b) **at a preventive level** - when breeders ask for help or assistance to improve their current preventions systems;

c) **to evaluate the prevention systems** that have already been in use by the breeder, to check if the implemented system is correctly used and effective. The protocol includes a close field control of the implemented electric fencing system. When performing controls – evaluations of the correct use of implemented measures, WPIU members fill-in a control form with controlled elements, such as the voltage value, the assessment of the correct setup of the fence and the grounding systems, etc.

Within the project, also project personnel took care of the controls in the field and advised the farmers in terms of damage prevention and reactions after depredation events. The role of the project members was to provide information, knowledge and share experience to regional WPIUs.

In Slovenia, a "**WPIU intervention**" is defined as each field intervention during which an operator of the team hands out protection measures (distribution of electric fences or an intervention kit), provides advice on or controls the correct use of implemented measures to a breeder or helps the breeder in improving the protection systems (after a depredation event or as preventive measure).

3.4.2. WPIU overall activity in Slovenia

SFS formed and trained seven WPIUs (five were planned in the project) to react quickly and efficiently after wolf attacks and to act proactively to prevent the occurrence of damages in areas where wolves are regularly present. WPIUs engaged with breeders in finding suitable solutions for their challenges and specific needs. Due to the demands from the field and the increasing damage events in the Alps, the activities started before planned, in spring 2020. From **April 2020 to August 2024** WPIU members performed a total of **335 interventions in Slovenia,** compared to 20 foreseen in the project**, involving 131 different breeders** (Table 35). The interventions covered almost the entire territory of Slovenia, except for the extreme north-eastern part of the country, where wolves are not present. Most interventions occurred in the south-western part of the country, where the wolf packs are regularly present and the most damage prevention activities have been implemented in the last 15 years. Most of the interventions happened on sheep herds, which is the type of livestock that is most impacted by wolves and other large carnivores in Slovenia. Involved farms were mainly small (hobby, part-time) farms, which is in line with the general sheep breeding situation in Slovenia, where 95 % of sheep breeding farms own less than 50 animals and only 0,6 % more than 150 animals (Simčič et al. 2020).

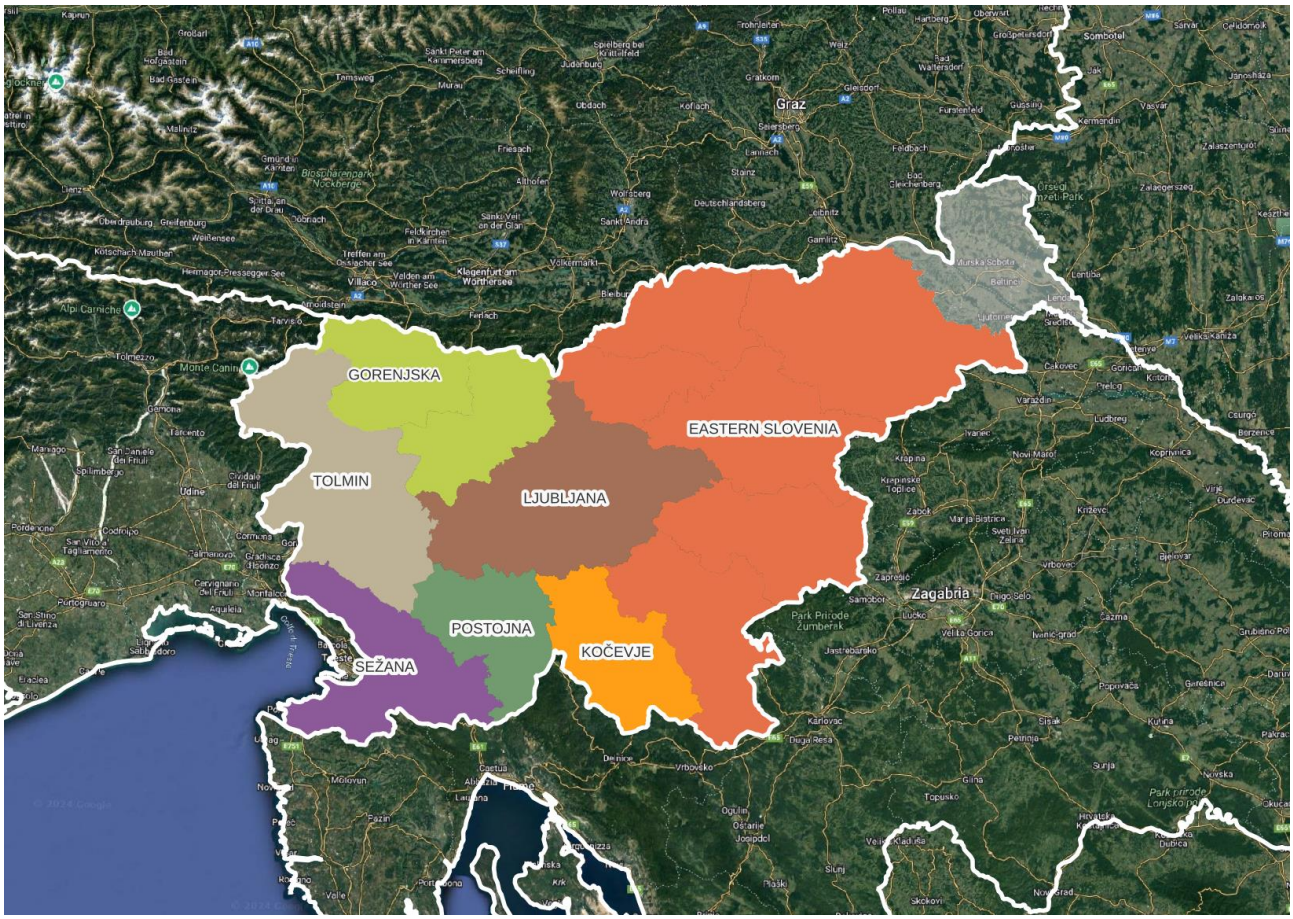

Figure 19: Distribution of WPIUs in Slovenia.

The main goals of WPIU activities in Slovenia were:

- **to distribute kits of electric fences** (kits consisted of 400m of electric nettings, an energizer, a battery, three grounding rods, a voltmeter and a protective box). All the distributed fences were checked by WPIU members in order to assist breeders and control the regular maintenance of the fence perimeter and the presence of electricity. Altogether, **14 sets of electric fences were distributed** to breeders (9 kits for protecting sheep herds, 5 for cattle and horses)
- **To quickly assist breeders who requested help** after a depredation event or when they were concerned about the presence of wolves in the vicinity of their pastures. In these cases, an intervention kit (consisting of 300-500m of electric nettings, an energizer, a battery, three grounding rods, a voltmeter and a protective box) was deployed as soon as possible to the breeder, giving the farmers the needed assistance in setting up the proper protection.
- To make controls of the implemented measures (distributed within the project and from other sources, e.g. co-financed by the Ministry of Environment and Spatial Planning).
- To advise livestock breeders on how to improve their protection (prevention of damages and after depredation events) and how to find a suitable and rational way of protecting their property.

- To monitor the situation using automatic cameras on pastures where attacks or attempted attacks happened regularly or repeatedly.

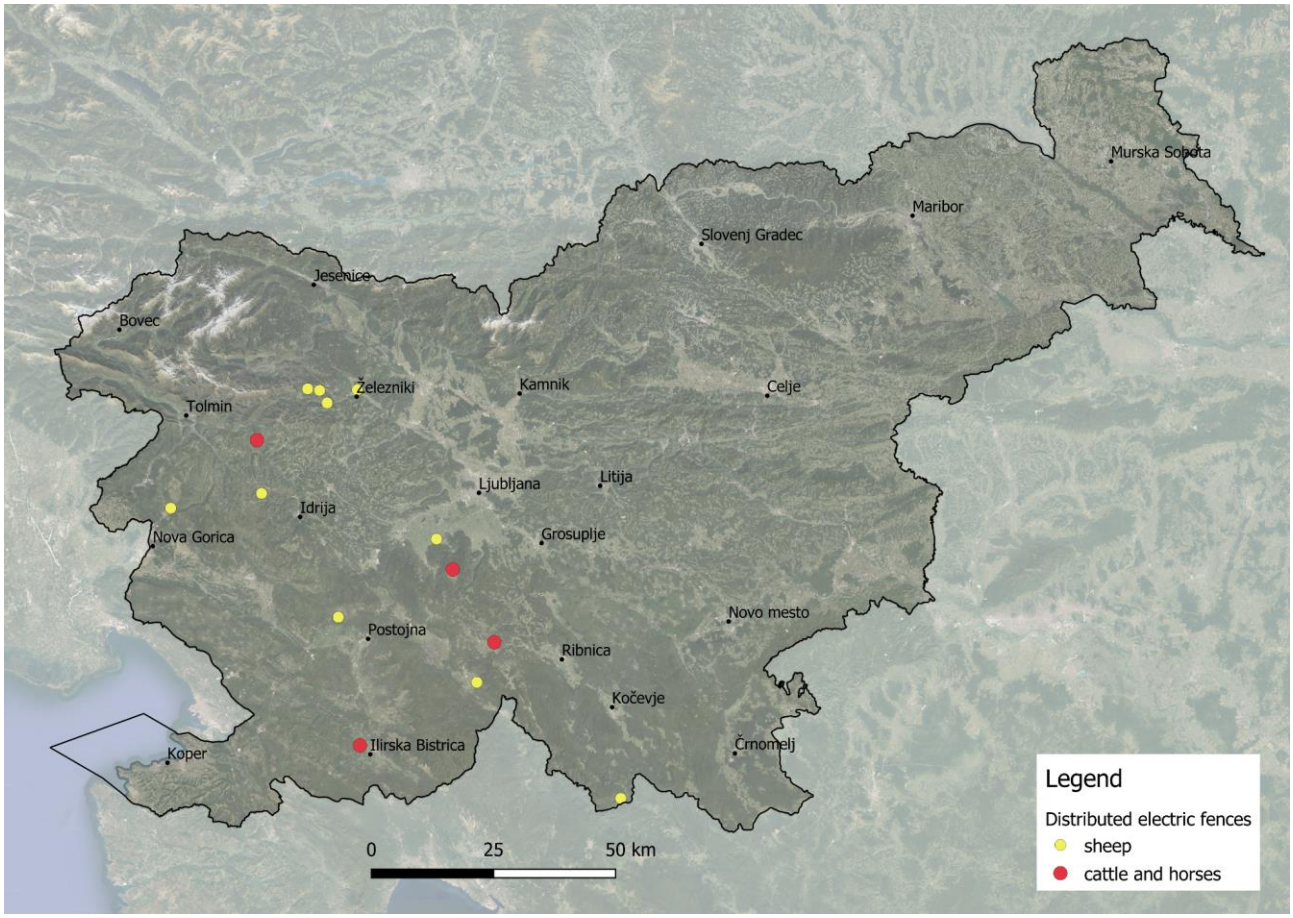

Figure 20: Locations of distributed kits of electric fences to livestock breeders (sheep, cattle and horses).

Table 35: Summary of the overall WPIU activity in Slovenia from 2020 to 2024.

WPIU	**Number of operators***	**Period of activity**	**Number of interventions**	**Number of interventions per type**		
				Following a depredation event	**For preventive purposes**	**Evaluation of the correct use of preventive systems**
OE TOLMIN	6 (8)	2020-2024	38	/	8	30
GORENJSKA (OE BLED, OE KRANJ)	9 (14)	2020-2024	49	5	13	31
OE LJUBLJANA	9 (10)	2020-2024	10	/	5	5
OE POSTOJNA	13 (12)	2020-2024	56	4	4	48
OE SEŽANA	8 (12)	2020-2024	142	3	2	137
OE KOČEVJE	10 (12)	2020-2024	23	1	2	20
VZHODNA SLO (EAST SLO)	16 (24)	2020-2024	17	1	/	16
TOTAL INTERVENTIONS	71 (92)	2020-2024	335 (131 different breeders)	14	34	287

* in brackets the numbers of WPIU members in 2024

Following the WPIU strategy, there were three types of interventions:

- following a depredation event,
- for preventive purposes and
- the evaluation of the correct use of preventive systems.

The majority of the Slovenian WPIU interventions were dedicated to the evaluation of the use of implemented preventive measures in the field (86 %) (Table 35). These interventions included all the controls made by WPIU members (mainly SFS damage officials) to assess if the equipment distributed by past LIFE projects, the LIFE WOLFALPS EU project or co-financed by the Ministry of Natural Resources and Spatial Planning is correctly used. These interventions are the most important type of interaction with livestock breeders as the purpose of the visits is to check if the equipment is properly set-up and maintained, which is crucial for their effectiveness in terms of preventing wolves and other predators from entering the pastures.

Interventions for preventive purposes (10 % of the interventions) include the visits when the equipment for electric fences was distributed or interventions made by WPIU to advise farmers on how to improve their prevention systems.

The intervention following a depredation event (4 % of interventions) represents an extra visit of the breeder that suffered a damage case and the advising did not happen during the damage assessment made by the damage official.

In Slovenia, WPIU are composed mainly by SFS damage officials belonging to the public service, so the costs of their activities are paid by the Ministry of Natural Resources and Spatial Planning. WPIU operators work also on other regular SFS activities, so the cost of their operations is very difficult to assess. The costs of WPIU interventions vary depending on different situations and on the type of intervention (advising, controlling the implemented measures, setting up an intervention kit, etc.), but in general most of the field activities were represented by control of implemented measures. The control itself usually does not take more than 2 hours, but it depends on the location (remote or close to accessible roads). The indication for the cost of an **average intervention** is based on the calculation of the time spent for the intervention (travel time and field work) and other costs related, such as fuel costs and if there is any equipment involved.

One of the most important factors is that WPIUs are positioned regionally at SFS regional units, which enables the units to act rapidly after the call. Local communities know the damage officials as they are present in the field and farmers trust them. They often collaborate also with other experts such as agricultural advisors to define the extent of the damage.

Table 36: Costs of the implementation of the WPIU in Slovenia from 2020 to 2024.

CATEGORY	INDICATION OF COSTS
Personnel	12.746 €
Operational	Vehicle: 4.271 € (fuel costs)
Material	Distributed electric fences: 14 sets (sheep and cattle, horses): 32.961 € Intervention kits: 16.184 €
Total	66.162
Per intervention	197,50 €

* Cost of interventions (salary and fuel) were only partially covered by the project (only for project personnel who are part of WPIUs). SFS damage officials, who represent the majority of WPIU members, are regular employees of SFS and WPIU activities represent part of their assignments. The calculations of cost are therefore included for the purpose of comparing and evaluating the WPIU work.

3.4.3. Evaluation of the effectiveness of mitigation measures implemented to reduce wolf damages on livestock

3.4.3.1. Results

The majority of interventions made by WPIUs was made on small livestock (sheep and goats) (more than 90%) (Figure 21) and on small herds up to 50 animals. 131 different livestock breeders were involved in interventions and from them, **120 (92%) applied and regularly used the damage prevention method suggested by WPIU members.**

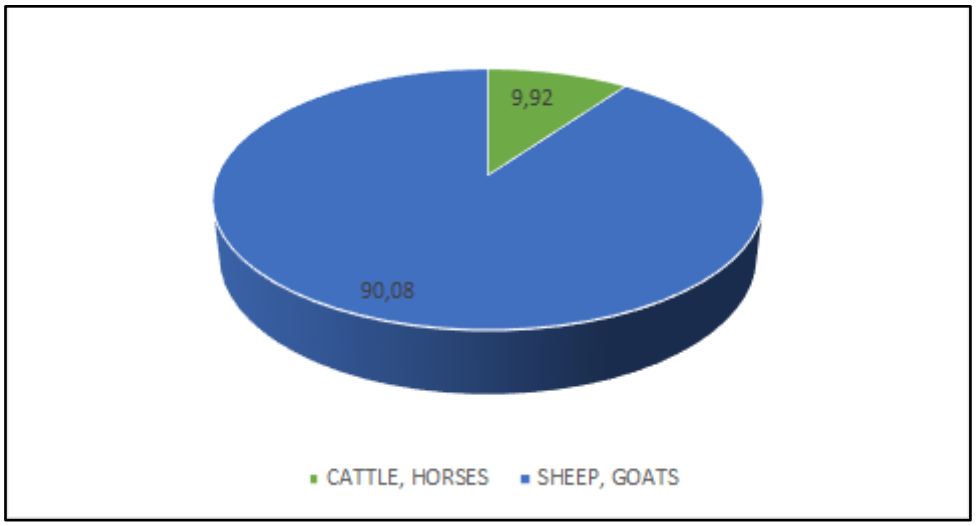

Figure 21: Types of grazing animals protected by livestock breeders involved in WPIU activities.

The before-after analysis of farmers involved in the interventions shows that **84,73 %** breeders have not experienced damage events after the interventions. All the breeders were using recommended equipment (145-160 cm high electric fences) to prevent damages, however, some of the breeders have multiple herds grazing on different pastures and therefore some herds were not protected properly. More than half of breeders that suffered damage attacks (the remaining 15,27 %) on their herds after WPIU interventions experienced damages on herds that were not protected with the recommended measures (e.g. they were using wired electric fences with 2-4 wires or even mesh-wire fences).

Breeders who used high electric fences regularly **reduced the number of damage events by 90,27 %** and the **number of affected animals (dead or injured) dropped by 95,87 %**, emphasising the importance of proper and effective protection. The majority of farmers, who experienced damage cases after the implementation of high electric fences, have suffered one attack. In these cases, WPIU members applied a closer monitoring of the perimeter of the pasture with automatic cameras to try to find out what was happening around the pasture.

In the interventions of evaluation of the correct use of prevention systems, members of WPIU were monitoring the technical aspect of the fence (presence of electricity, amount of voltage, etc.) and its maintenance (height of vegetation under the nettings, fence stability, correct implementation of the grounding system). During the field controls, the main anomalies identified were:

- low voltage level, which has to be of at least 5 kV to provide a sufficiently sharp shock to predators
- poor grounding installation, which must include at least three galvanised rods,
- irregular, insufficient cleaning of vegetation below the fence in order to maintain the needed voltage level and
- inadequate fence length, which has to be of at least 300 m to provide enough space for the herd to move within the fenced area in case of an attack.

3.4.4. Other activities conducted in Slovenia

3.4.4.1. Protection of cattle and other large animals

Due to an increase in depredation events on cattle in recent years in Slovenia, special attention was given to the establishment of best-practice examples for protecting cattle. As the majority of attacks by wolves are focused on animals in vulnerable stages, especially calves, we started a collaboration with 4 livestock breeders who breed cattle and horses. We provided the materials for setting up 3 permanent fences for calves and suckler cows, and one movable pen with electric nettings which is used as a temporary enclosure for the herd in calving areas. In all 4 cases the main element for protection was the use of constant electricity with at least 5 kV of voltage.

One of the most important things outside the technical implementation of the prevention measures was the collaboration between project and WPIU members with agricultural advisors from Agricultural institutes from Nova Gorica and Ljubljana. The collaboration was needed in order to provide measures, which were not only effective against wolf attacks, but also suitable as a fencing method for larger pastures where cattle are grazing. This includes also the knowledge that only experts in cattle management can provide.

Figure 22: Field collaborators from Agricultural institute Ljubljana.

3.4.4.2. Protection of livestock with livestock guarding dogs (LGDs)

In Slovenia, there is a long tradition of using LGDs to prevent large carnivore attacks. During the project, we wanted to continue the practice of collaborating with experienced dog breeders and co-finance young pups. As in Slovenia there is no implemented system of financing livestock guarding dogs, LIFE and other projects are the only mechanism to provide dogs to interested breeders.

Within the project, five experienced dog breeders were involved. From their litters, 14 LGDs were distributed to new owners. 11 of them reached new owners as pups, 3 of them were raised by two breeders to 1,5 years of age (pre-adult phase) and then they were transferred to the new farm (Table 37).

Table 37: Livestock guarding dogs distributed within LIFE WOLFALPS EU in Slovenia.

BREED	PUPS	ADULT
Karst shepherd	3	
Tornjak	2	2
Sarplaninec	6	1
TOTAL	11	3

All the provided LGDs were purebred, with an official pedigree and originated from a working line, which means that also the parents of each dog were working dogs used to protect grazing animals from large carnivores.

Each LGD was followed by the LGD breeder (its previous owner), especially in the first two years after the dog joined the new herd. The LGD breeders acted as advisors for new owners and they were always ready to provide advice and perform a visit in case of specific questions. The main goal was to provide good dogs from working lines and help the new owners to raise an effective working LGD. Half of the dogs were given as first LGDs on the farm and half of them joined the new environment as second or third dogs. All the dogs have successfully adapted to their new environment and serve as effective damage prevention companions on their farms.

3.4.4.3. Testing fladry as an alternative damage prevention method

The fladry system is a damage prevention tool made of a rope with suspended strips of fabric. The rope is mounted on poles so the flags wave above the ground in a breeze. Traditionally the system was used for hunting wolves in Eastern Europe and also in Slovenia as they prevent wolves from crossing the line of flags. As a novelty, the fladry system deters wolves for a limited time.

The system was tested during the project in some areas in Slovenia where a hot-spot of damage cases was detected on low electric fences (up to 110 cm high). It was installed on different pastures for a limited period of time and the area was monitored with automatic cameras. On each location, the fladry stayed on the pasture for at least two weeks, before moving to the next one, which depended on the livestock breeders who coordinated the grazing management. The fladry system was put in front of the electric nettings to provide additional protection as the sole nettings were crossed by wolves several times in the period before testing.

The addition of fladry provided a good solution for the first several weeks on each location (up to three weeks), but on one testing location, the 19th day of testing a wolf was detected by the camera inside the pasture proving that the wolf managed to cross both the fladry and the low electric nettings. Due to limited interest from farmers to use fladry as an additional

protection, it is difficult to assess its strengths and limitations. As a secondary tool, it may be a good addition to decrease the predation pressure on a pasture for a limited time-frame.

Figure 23: Testing fladry on a pasture in Slovenia.

3.4.5. Discussion

The damage compensation system in Slovenia implies the use of at least two electric wires in order to be compensated in case of attacks by large carnivores. Most of the farmers, however, use more electric wires, but mainly in order to keep their livestock within the grazing area. Breeders who have already experienced damage cases from large carnivores have the possibility to obtain a 80 % co-financing of the equipment to implement a protection with high electric fences by the Ministry of Natural Resources and Spatial Planning. Farmers who have not experienced damage events in the past have limited options of finding help through other mechanisms, this is why Slovenia Forest Service is trying to help farmers with the distribution of equipment through different projects.

The effectiveness of high electric fences shows that with a proper damage prevention approach livestock breeders can improve the safety of their animals and minimise the effects

of predations. This is especially important for small livestock (sheep and goats) as species most at risk of depredation.

High electric fences are an effective tool if used correctly. Field controls of the use and maintenance of the equipment is crucial to provide good results. Despite the farmers regularly use different types of electric fences and nettings, a lot can be improved with advice given from WPIU members.

In Slovenia, there are two main approaches to damage prevention. The use of electric fences, especially high electric netting (145-160 cm high), shows excellent results in the field. The amount of damage and the number of damage events was reduced by more than 90 % when farmers used these tools regularly. In some rare occasions when the attacks of wolves were still successful, it was quite evident that the breeders did not use the prevention methods appropriately or they used a different less effective method.

The second most applied method is the use of livestock guarding dogs to protect the herd. This practice is used mostly by experienced breeders, while other livestock breeders are still a little sceptical due to different reasons. In Slovenia, the majority of farms are small ones with up to 50 animals in the herds, so these farms usually do not consider LGDs as a rational and cost-effective solution for them. Such farms usually add one dog to their primary prevention tool (electric fence) in order to improve their safety. Farms with larger herds (more than 100) are more interested in the LGDs as the dogs can provide protection over large grazing areas, which are used for a larger number of animals. Despite important steps have been made to promote LGDs in Slovenia, the lack of a systematic approach is still the most limiting factor for the expansion of this traditional damage prevention measure.

3.4.6. References

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4. GENERAL COMPARISON OF RESULTS IN EACH COUNTRY

A striking result from action C1 of the LIFE WolfAlps EU project is the staggering variety of situations that characterise not only different breeders, pastures and flocks in each country - a situation that is usually well-known by experts in each country - but also, and perhaps more acutely, between countries. For instance, in France, flocks containing over 1000 sheep were quite common, whereas in Slovenia, flocks that large are absent as the large majority of flocks have up to 50 animals. Flocks that are smaller are inherently less challenging to protect, as animals are less likely to disperse over wide areas while feeding or moving, particularly in landscapes of rough terrain and containing large patches of wooded areas. However, simply advising breeders to reduce the size of their flocks generally fails to lead to any changes on the ground, because the size of the flocks is usually the consequence of economic incentives and the need to pool animals to afford paying shepherds. Breeders therefore often cannot afford to reduce their flocks.

Another clear difference between countries is related to how long wolves have been back on the landscape and the current abundance of the animal. In the French and Italian Alps, where at least in certain areas, wolves have been back for some 30 years, most breeders have adopted the use of preventive measures such as electrified fences and LGD, often because compensation payments are conditional on the use of these tools. Yet in Austria, where only a few wolf packs are present and most wolves are wanderers, the majority of breeders do not use preventive measures. Several appear to be at the early stage, previously and currently observed in other countries, of refusing to protect their livestock because doing so would imply acceptance of the presence of wolves. However, given the geographically central position of Austria, the country is likely to be colonised by wolves coming not only from the Alps, but also from the central European wolf population. As it has occurred in other countries, it is thus at least possible that as wolf abundance and attacks on livestock in the country increase, many breeders will eventually adopt preventive measures, even if reluctantly. A key advantage here is that preventive measures can be adopted in Austria by capitalising on the lessons learned in other countries about what does and does not work, even though the specificity of cultural and other aspects of the country obviously need to be accounted for.

Significant differences were also observed between countries on the willingness of breeders to work with the project team. In Slovenia, breeders appear to generally trust the SFS, the public authority responsible for damage inspection and livestock protection. Breeders in the country generally asked for advice from the SFS, usually implemented preventive measures as recommended, and accepted regular visits to evaluate the correct use of preventive measures (usually fences). This relatively “ideal” situation is likely to have increased the effectiveness of the preventive measures in Slovenia, and explains why WPIU interventions in the country were by and large successful. In stark contrast, many breeders in Austria and France appeared reluctant or unwilling to work with the WPIU, and even if they did, rarely followed the advice and recommendations provided. In France, both the OFB and the PNM are generally not seen as legitimate public authorities to be dispensing advice on livestock breeding. The strategy was therefore to try to include local authorities (DDT) as much as

possible in action C1, as these are the public authorities that deal with breeders on a regular basis. However, the level of involvement of these local authorities varied, with some trying to make the most of the WPIU offer, while others less so. Participation of technical structures that specialise in livestock rearing in France was also very limited, although interesting exchanges did occasionally occur between them and the French WPIU staff. In any case, to improve the effectiveness of WPIU, it is clear that personnel should belong to technical structures that ideally specialise in livestock breeding, or that at least are not responsible for wolf monitoring and estimating wolf numbers, as this topic in particular can often be a source of controversy.

In Italy the collaboration with breeders was quite good, above all with “amatorial breeders” who cannot apply for any type of public funds both for damage compensation and for preventive system support. In most cases, farmers positively accepted the advice given by WPIUs and used the entrusted protection systems, and this resulted in a reduction of the suffered damages. However, it is evident that having prevention material available to provide immediately to breeders is an important factor that encourages communication and the creation of a relationship of trust between WPIU operators and breeders.

As a final major difference between countries, the number of WPIU per country varied greatly. While in Italy and Slovenia, they were sufficiently numerous to regularly intervene in the alpine area of each country, in France and Austria, the action was deployed in a less extensive manner partly because of the lower number of personnel. In these latter two countries, Action C1 was deployed as a pilot action, to test whether breeders would be willing to engage with the project and an initiative that, to a certain extent, is based on evaluating their work. Together with the point made above concerning the perceived legitimacy of partners, the pilot action aspect of action C1 in France and Austria helps explain why the evaluation of the effectiveness of WPIU interventions in these two countries was poorly achieved.

Despite strong differences between countries, some elements were common to all. When direct contact between WPIU staff and breeders and shepherds on the ground could be established, exchanges were most often fruitful. Trust was obtained and maintained particularly when WPIU agents had the possibility of intervening often with the same breeder or group of breeders. Ensuring the long-term engagement of staff therefore appears paramount.

In addition, a growing trend observed in all countries is the increase in the number of wolf attacks on cattle, presumably because flocks of sheep are increasingly better protected. Solutions are also available to protect cows and other relatively large domestic animals, but this point needs to be made with greater emphasis. In some areas, additional public funds will also need to be allocated to finance preventive measures for livestock other than sheep and goats.

Two other challenges were common to all countries, although more prevalent in places where wolves have returned for longer: attacks during the day and in plain and hilly areas closer to human villages and towns. In the first case, as with attacks on cattle, the pattern

seems to be the consequence of wolves shifting their predation in response to the preventive measures. Flocks cannot be however kept in fences during the day, which renders the work of LGD and shepherds more challenging if and when wolves decide to attack, as the flock can be spread out and dispersed over a large area. To a certain extent, this can be seen as evidence that preventive measures work at night. Yet solutions to counter livestock depredation by wolves during the day are yet to fully emerge. Finally, as the abundance and distribution of wolves increase in the Alps, they are more likely to come into contact with livestock kept in lower-altitude areas. Here the more prevalent presence of humans means that livestock management and use of preventive measures occurs in a different context. Livestock are usually dispersed in relatively small allotments over a wide area around villages and towns. Use of LGD is thus challenging, and they can moreover be a source of conflict with people. As with daytime attacks, solutions in such scenarios are yet to fully emerge.

5. EVALUATION OF THE EFFECTIVENESS OF APPLIED DAMAGE PREVENTION SYSTEMS AND WPIU INTERVENTIONS

Evaluating the effectiveness of prevention systems set in place is one of the most important steps in terms of promoting preventive methods to livestock breeders. All the methods used within the project have already been confirmed as effective, but the most important factor is their regular application, correct use and routine maintenance.

The project has set two important goals:

- the decrease of wolf depredations by 70% where attacks occurred in wolf presence areas, and preventive measures were implemented by WPIU; and
- the damage prevention methods are used by at least 80% of the farmers involved in the preventive measure action

Within the project, we aimed at evaluating the effects of implemented measures and their effectiveness in reducing the damages caused by wolves on livestock. As reported in the previous chapters, each country faced different issues when trying to evaluate the effectiveness of its damage prevention activities.

The evaluation was very clear and the results were very sound in the cases of Italy and Slovenia.

In Italy, there is a general willingness of farmers to collaborate in damage prevention activities. Most of the farmers already use some kind of prevention system as almost half of the collaborating ones have received prevention tools from LIFE or other projects. Within the project, **more than 99% of farmers that were involved in WPIU activities, used damage prevention tools**. With such a high rate of use of proper prevention systems, it is not surprising that **the reduction of attacks caused by wolves decreased by 81%,** considering all participating regions. In some occasions, where wolf depredations occurred after WPIU interventions, it was evident that the shepherds didn't follow the recommendations proposed by WPIU operators or, in some cases, animals were left outside night enclosures, exposing them to the risk of depredation.

In Slovenia, 131 livestock breeders were involved in WPIU interventions. **92% of them received the damage prevention tools from LIFE or other financial sources and have regularly used it to protect their herds.** Similar to the data from Italy, also **in Slovenia the number of damage events decreased by 90,27 % and the number of affected animals (dead or injured) dropped by 95,87 %.** Moreover, 84,73% of farmers involved have not experienced damage events after WPIU interventions, emphasising the importance of proper and effective protection. The majority of farmers, who experienced damage cases after the implementation of recommended damage prevention tools, have suffered only one attack.

On the other hand, in Austria and France we find difficult to compare the results to other countries, mainly due to the unwillingness of farmers towards the implementation of damage prevention methods.

In Austria, the main issues were linked to social and environmental factors. Austrian livestock breeders are not obliged to follow the WPIU guidelines and often opt for keeping the grazing herds free without any fences. The electric fences are implemented only if the wolves are detected in the area. And even in these periods, fences are poorly setup and maintained.

The other fact is linked to the presence of wolves in Austria. Most of the population is represented by individual wolves roaming the country without a stable territory. From 2019 to 2023, the number of wolf packs has doubled from 3 to 6, but the situation is still unpredictable, causing farmers to risk the attacks rather than opt for prevention.

Although no wolf attacks have occurred after the WPIU interventions, this can hardly be attributed to the interventions themselves, as it could be caused by the occasional presence or absence of wolves in the area. This is the main reason Austria could not provide the evaluation of the effectiveness of the prevention systems.

At the moment, electric fences are the main damage prevention method used in Austria and farmers prefer to use barbed wires to keep the animals on the pasture. In the Alps, however, the flocks are usually unguarded. Shepherds are considered too expensive, while livestock guarding dogs are slowly making their way as an alternative to prevent damages from wolves, but the practice is still not widely considered in the country.

In France, breeders are obliged to use at least two of three main preventive measures (electrified night pens, LGD and shepherd) in order to be able to receive compensation in case wolves cause damage. **Overall, 89,5% of breeders collaborating with the French WPIU used prevention systems**. On the contrary, when considering the effectiveness of WPIU activities, it was impossible to perform a correct evaluation as most preventive systems were not modified or changed after WPIU interventions. It is almost impossible not to consider that this was the main reason that attacks on livestock continued after interventions. However, even when attacks or the number of depredated animals decreased after a WPIU intervention, it is questionable whether the cause of the reduction was the WPIU intervention. As the wolves are often shot in France to protect livestock, this might explain the reduction in the number of attacks in an intervention area, regardless of modifications to the preventive system. There are several reasons why farmers did not implement the suggested modifications. In general, livestock breeders prefer to benefit from lethal interventions. Other reasons are the lack of financial support required to implement better protection and sometimes the proposed solution are difficult to apply. **For these reasons, the French WPIU do not appear to have been successful in reducing the number of attacks or the number of depredated animals in the areas they intervened.**

Within the project we have experienced, examined and learned from many interactions with livestock breeders in different countries. Country-specific resources and factors affect the

general perceptions of the conflicts between wolves and humans. The lack of a supportive systematic approach for applying damage prevention seems to represent the main challenge for alpine countries, resulting in low interest in finding solutions to decrease and prevent the impact of wolves on farming practices in the Alps.

In this regard, the main goal for the future is to actively promote damage prevention measures, support livestock breeders and actively collaborate with them in order to achieve a better feasibility and acceptability of damage prevention measures. Our report shows that, when applied, damage prevention measures can provide a good solution for long-term coexistence of animal husbandry and wolves in the Alps.

6. LONG TERM GUIDELINES FOR THE WPIU ACTIVITIES

Livestock breeding is the economic activity on which the wolf presence causes the greatest negative impact. The economic loss and the psychological and social hardship experienced by farmers leads to local conflicts, resulting in one of the biggest threats to wolf conservation in the Alps, causing the low acceptance of this large carnivore.

Having expert personnel who are able to assist, help and advise farmers who experienced damages to their domestic animals or who want to act proactively and protect their property, is very important in terms of preventing conflicts with large carnivores. Within the project, we tested and adjusted different technical solutions to fit specific landscape features and other environmental factors in the Alpine region. Despite the availability of a range of approaches, every case has to be considered and approached individually and without the underestimation of importance. In order to prevent conflicts, we have to find the best technical solution for each case and the prerequisite is to have expert personnel to convince the farmer to accept the solution. The Wolf Prevention Intervention Units are a first-aid prevention approach that provides the breeders, whose livestock is at risk of predation, direct and immediate support.

In the long-term perspective, the main goal is to limit, prevent and also decrease the impact of wolves on the existing farming practices, in order to ensure acceptable conditions for coexistence.

Communication with farmers, local communities and other stakeholders

The acceptance of protection measures is still critical among many stakeholders. Regular, objective and direct communication is necessary in order to foster acceptance and allow adaptation of protection measures. The promotion of livestock protection measures is essential and can prevent many conflicts, even before first depredation events occur. In areas where the presence of wolves is frequent or where new territories have been established recently, education on preventive systems has to be implemented prior to depredation events in order to discuss the potential impact of the species on livestock breeders' community. In such areas, having an organised consulting system of competent experts is the key to success for the sustainable implementation of herd protection measures through trust and competence.

Regular trainings and education for WPIU members

WPIU members are usually locally established personnel. They know both the social and natural environment; therefore, they act as mediators to ensure farmers do not feel abandoned by the regular officials. Often WPIU members are also involved in damage assessment and monitoring of large carnivore species, thus they really have all the knowledge they need to have a trustworthy and professional debate with all stakeholders in the area.

To maintain the level of professionalism and credibility it is crucial to provide regular trainings and educations, with both national and international reach, for WPIU members and possibly including these topics:

- damage prevention techniques,
- detection of large carnivore presence in the environment,
- determination of signs of predation,
- use of camera trapping techniques,
- communication with stakeholders in specific conditions (after psychological and social impact of depredations),
- agricultural policies and support for farming practices, such as the Common agricultural policy.

Creating trust networks in hot spot areas

Experiences from different countries show the importance of including a peer-to-peer way of disseminating best practice examples. Livestock breeders play a crucial role when spreading the word about how to cope with different issues and challenges in livestock rearing practices. In our experience, in hot-spot areas where conflicts are common and constant, building trust networks, where (preferably local) farmers introduce best practices to other farmers (peer-to-peer communication and transfer of experiences and knowledge) is the best way to introduce the damage prevention topic to local communities. Moreover, these networks are also the opportunity to test new approaches and technologies in practice, as farmers and technicians themselves are involved in the process.

Controlling of the effectiveness of implemented measures

Throughout the project we emphasised the importance of having a controlling system in place to monitor the use of implemented (subsidised, co-financed or distributed) prevention measures. Regular visits to breeders do not act only as a systematic control, but also represent a way of exchanging experiences between livestock breeders, expert technicians and other stakeholders. Technical support, control and monitoring of the correct implementation of damage protection measures need to be done on a regular basis in order to assure their effectiveness. The main risk of having implemented measures without performing field controls is their ineffectiveness and the subsequent mistrust in the overall context of damage prevention.

Standardising the way data is collected

When preparing this document, we encountered many difficulties when trying to compare the results and the data from different countries, especially when assessing the effectiveness of implemented measures. Although the protocols of collecting data were standardised and reviewed among the coordination group, there were too many specific contexts that crucially influenced the assessment of effectiveness. The most obvious limiting and contradictory factors that hampered the overall assessment:

- differences in livestock breeding practices (a small number of farmers with large herds (hundreds of animals) versus a large number of “hobby” breeders with small herds (up to 50 animals in the herd);
- the “specialisation” towards one prevention method (e.g., in Slovenia most of the farmers use electric fences alone while in France they need to apply at least two measures: fences and LGDs);
- the level of acceptance of the idea of damage prevention (in Austria is very low), hence the processing of data is not relevant with a very small number of livestock breeder taken into account;
- and connected with the previous indent, the presence of wolves or wolf packs (in Austria there was no regular presence of wolves in areas where WPIU performed their activities).