Shared use of mineral supplement in extensive farming and its potential for infection transmission at the wildlife-livestock interface

Running title: Wildlife/livestock mineral supplement use

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Summary

Recently, the survival of *Mycobacterium bovis* on livestock mineral blocks has been confirmed, but little is known about its implication in the transmission of animal tuberculosis (TB) under field conditions. The objective of this study was to describe the shared use of mineral supplements in four extensive beef cattle farms from a high TB prevalence area in South Central Spain, to identify the main factors explaining their use, and characterize its potential role for the transmission of *Mycobacterium tuberculosis complex* (MTC). This is relevant to design control measures at the wildlife-livestock interface. Animal activity was monitored by camera-trapping at 12 mineral supplementation points during spring and fall. Additionally, swabs were periodically taken from the mineral substrates and analyzed by PCR searching for MTC DNA. Cattle, pig, goat, sheep, wild boar and red deer were all recorded licking on mineral supplementation points. Livestock species were the main users and presented a diurnal use pattern. Wild ungulates presented a nocturnal-crepuscular use pattern, with scarce overlapping with livestock. Wild boar presence was positively related to cattle presence at mineral supplementation points, whereas red deer presence was higher in supplemental points closer to forested areas, mostly in absence of cattle. We recorded 266 indirect wildlife-livestock interactions (i.e. two consecutive visits that occurred within 78h), all of them derived from 21 unique wildlife visits. All the analyzed swabs resulted negative to MTC DNA. Comparing to other environmental sources of MTC in our study area, mainly water ponds, this research evidenced that mineral blocks are less attractive to wildlife. However, the potential for interspecific transmission of MTC or other pathogens cannot be discarded. The risk for interaction at mineral supplementation points and further transmission can be prevented by implementing specific measures in the context of integral biosecurity plans at the wildlife-livestock interface, which are proposed.

Keywords: Bovine tuberculosis; Interactions; Interspecific transmission; Mineral block; *Mycobacterium tuberculosis* Complex; Photo-trapping.

Introduction

Animal tuberculosis (TB, caused by members of the *Mycobacterium tuberculosis* Complex, MTC) is shared by wildlife and livestock in different epidemiological contexts worldwide (Gortázar et al., 2015). The presence of the MTC at such interface is of economical, sanitary (including human health) and conservation concern (Krebs et al., 1998; Gortázar et al., 2010; Gormley and Corner, 2018). The wide range of (domestic and wild) host species together with the combination with cultural and environmental factors leads to many different epidemiological scenarios with their own risks for transmission (Humblet et al., 2009; Fitzgerald and Kaneene, 2013).

Previous studies in Spain highlighted the shared use of resources by wildlife and extensive livestock, namely, cattle, pigs, Eurasian wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*) (Kukielka et al., 2013; Carrasco-García et al., 2016). These species, along with goats and sheep, are part of the MTC maintenance host community in the Iberian Peninsula (Santos et al., 2020). In this complex epidemiological system the transmission of MTC is mainly indirect (Cowie et al., 2016), and it has been attributed to shared pastures and water or feed contaminated with saliva, urine or feces from infected animals (Santos et al., 2015; Barasona, Torres et al., 2017; Barasona, Vicente et al., 2017). It is known that MTC are relatively resistant to environmental factors and under appropriate conditions may persist in the environment for weeks or months, prolonging the likelihood of indirect transmission by ingestion (Fine et al., 2011). Recently, it has been reported that *M. bovis* can be isolated up to 78h post inoculation in mineral blocks, depending on the composition of the block and the environmental conditions (Kaneene et al., 2017). Previous studies highlighted the shared use of mineral blocks and their potential role as aggregation points between wildlife and livestock in extensive farming systems (Payne et al., 2016). However, little is known about their potential for MTC transmission, which depends on both mycobacteria survival and the specific use of the blocks by hosts.

In this context, the aim of this study was to describe and quantify the shared use of mineral supplements by wildlife and livestock during two seasons in beef cattle farms from a high TB prevalence area (South and Central Spain, SCS), and to assess the presence of MTC DNA on the blocks. Results should be relevant to design preventive measures to reduce risk of transmission at the wildlife-livestock interface.

Materials and Methods

The study was carried out in four beef cattle farms from Ciudad Real (Castilla-La Mancha) and Córdoba (Andalucía), two provinces from SCS, during two different seasons, spring (April to May) and fall (September to October) of 2016. The mineral supplements used in the studied farms can be divided in two types: (i) *natural salt rocks* with impurities and variable composition, mainly sodium chloride (NaCl) with mineral traces; and (ii) *artificial mineral blocks* composed of 38% sodium (Na), 1% calcium (Ca) and 0.6% magnesium (Mg). Three mineral supplementation points (MP) were selected in each farm. The type and location of all MPs was those used by the farmers (Table 1).

Camera traps (Ltl-5310, Ltl ACORN® Futian, Shenzhen, China), one by MP, were attached to trees or wooden posts at 5 meters from the mineral supplement to record the presence of animals. Camera traps were set to take 3 consecutive pictures after animal detection, with 1 min interval between consecutive activations. Camera traps remained on the field a minimum of 14 days per season, resulting in 315 operative camera days that were used for the statistical analysis (147 camera-days were discarded due to operativity failures).

In order to measure wildlife activity independently to the MP, we set camera traps in two active wildlife trails per farm and season. Two cameras per farm were installed in natural and obvious wildlife trails up to 250 m from a MP and separated an average of 1 km from each other to assure spatial independence.

The pictures recorded by each camera trap in MP were visualized to determine the animal activity at "visit" level. A *visit* was defined as a consecutive series of pictures where a single animal or a group of them (belonging to the same species) were recorded in a given camera, and separated more than 15 minutes of the next series of the same species. The interval between visits (IBV, 15 min) was established following the procedure described in Kukielka et al. (2013). Briefly, IBV was assessed after a trial of 5, 15, 30, 45 and 60 minutes carried out with the data from three randomly selected CT. The smallest changes of number of visits per IBV at each camera appeared when selecting for 15 minutes IBV or more (i.e., defining IBV as 15 or 30 or 45 or 60 minutes resulted in similar number of visits). For each visit we recorded date, time, visit duration (difference between the first and last picture of the series), the species involved (cattle, sheep, goat, pig, wild boar or red deer), the maximum number of individuals in the group and number of pictures in each visit where at least one individual is licking directly on the mineral supplement .

Due to grazing management conducted by farmers, not all the livestock species could access to MP at any time (they rotate over grazing plots). In order to address this condition, when assigning the camera traps with presence of a given species, we used only the days in which the given species could potentially be captured by camera traps (Potentially Camera-trap day, PCT day; data provided by the farmers). For wildlife species, we assume that all camera-trapping days were PCT days, since fences were permeable to wildlife.

To characterize animal activity at the MPs, we calculated different parameters for each species: i) the daily presence rate (PR), calculated as the proportion of PCT days with presence of a given species, (ii) the daily visit rate (VR) per species, calculated as the number of visits per PCT day, (iii) the animal rate (AR), calculated as the sum of the maximum number of individuals of each species per visit and PCT day, (iv) the use index (UI), calculated as the time spent (in seconds) by each species in each visit per PCT day and (v) the daily use pattern (DUP), assessed as the proportion of visits to MPs by hour of the day. Differences in the activity parameters among species and seasons were explored using non-parametric statistical tests.

Concerning the interactions between livestock and wildlife, a *direct interaction* was defined as a visit where two or more individuals of different species were captured in the same picture. Otherwise, an *indirect interaction* was defined as two consecutive visits that occurred within a specific Critical Time Window (CTW). We stablished a conservative CTW (78h), based on risk of TB transmission, using the maximum survival time of *M. bovis* on a mineral substrate reported by Kaneene et al. (2017). Both types of interactions can be classified as *interspecific* or *intraspecific*, depending on if the subsequent (or simultaneous) visit is a different species or not, respectively. Additionally, indirect interactions were classified depending on the number of visits that occurred between the first visit and the visit that produced the interaction (interaction visit) within the CTW. For that purpose, we named as first order interactions those in which the interaction visit first occurred after the first visit, second order interactions those in which the interaction visit happened after a first order interaction, and so on.

We followed the protocol for data exploration described by Zuur et al. (2010) in order to avoid type I or type II errors and potentially erroneous ecological conclusions. We tested if the animal activity parameters differed between species using non-parametric tests (Kruskal-Wallis and Mann-Whitney-Wilcoxon), since data was not normally distributed. Multivariable Poisson regression models were developed to identify the factors related with the activity of red deer and wild boar in MPs in each MP. We used as dependent variable the VR of a given species per camera trap and season, since this parameter reflects the use of mineral supplementation, and the potential for interaction and consequent transmission of pathogens. Models were run separately for wild boar and red deer. Regarding the explanatory variables, we used: season (spring vs fall, categorical), the UI of each livestock species (seconds, as indicative of livestock presence), the distance to cover (distance in meters from each camera to the nearest forest/scrubland patch, as a measure of proximity to wildlife habitat), and the relative abundance of wildlife (visits/PCT day in wildlife trails). Farm was included also as a fixed categorical factor. We selected the most parsimonious model, with a difference in the Akaike Information Criterion (AIC) lower than 2 with the preceding model (Δ_i AIC > 2; Burnham and Anderson, 2004). All statistical analyses were conducted using computing software R 3.5.1 (R Core Team, 2018).

Additionally, samples were collected from the surface of the mineral substrate every 2-3 days with a sterile swab (Copan Diagnostics Inc., Murrieta, CA, USA), properly tagged and frozen at -18°C until laboratory diagnostics were performed. Sixty swabs were selected and analyzed for the presence of MTC DNA. The sample selection was based on the previous presence of wildlife at the MP by camera-trapping in order assign any positivity to the use of the MP, and to maximize the probability of MTC detection. In the laboratory, the swabs were cleaned in buffered tampon and centrifuged. Manual DNA extraction was performed with FluoroLyse Kit (Hain Lifesciences, Nehren, Germany). MTC DNA amplification analyses and control elaboration were carried out following the procedure described in Barasona et al. (2017b).

Results

Within the potential TB reservoir species detected in the 1397 recorded visits, cattle (n=789), pigs (n=453), goats (n=37), sheep (n=92), wild boar (n=11) and red deer (n=15) were identified, and all of them were captured using mineral supplements at some point. Livestock species were the main users of mineral supplements compared with wild ungulates, and their presence was predominant in PR, VR, AR and UI (Mann-Whitney test P<0.05 in any case) (Supporting Information 1). The presence of wild ungulates at MPs was sporadic (in 26 of the 315 days analyzed) and punctual (number of visits on these 26 days ranged from 1 to 3 for red deer, with 1.5 visits on average, and wild boar only visited MPs once each day it appeared. No significant differences between red deer and wild boar were found in terms of the activity parameters (Mann-Whitney test P>0.05 in any case).

Regarding seasonality, there were no significant differences in wild boar or red deer activity parameters between spring and fall (Wilcoxson test P>0.05 in any case). However, we identified seasonal differences in some cases for domestic species (Cattle VR, AR and UI were significantly higher in autumn, while goat PR and VR, pig PR, and sheep PR, VR and AR were significantly higher in spring). In the Supporting Information

1 we show which species where absent per season and farm, where livestock management determined the presence or absence of a given species in the area.

There were also no significant differences in wild boar or red deer activity parameters depending on mineral supplement type (hanging artificial mineral block or natural salt rock on the ground), and neither for cattle (Wilcoxson test $P>0.05$ in any case). Goat and sheep mineral supplement type preference could not be consistently analyzed because their presence was limited to specific farms, but we identified significant differences for pig (Wilcoxson test $P<0.05$ in any case). This results are consistent with our empirical observations, since during picture visualization, it was possible to verify that wild boar and pig were not able to lick directly from mineral supplements on Farm 1, where the mineral blocks were hanging at least at 1 meter from the ground (Figure 1). However, wild boar and pigs were attracted by the mineral remnants on the ground, since they showed rooting behavior immediately below the hanging mineral block.

Regarding the direct licking on mineral supplements (Supporting Information 2), cattle was the most frequent species in absolute terms (527 "licking" visits) and goat was the species with higher relative use (93.90% of the visits). Red deer "licked" MPs in 8/15 visits, and wild boar in 3/11 visits. No statistical differences were found in licking behavior (number of "licking" visits and proportion of visits with "licking" behavior) between seasons for red deer nor wild boar (Mann-Whitney test $P>0.05$ in any case).

The results of Poisson regression models (Table 2) showed that wild boar VR significantly and positively associated with the time spent by cattle in MPs (cattle UI). The red deer model showed that VR was significantly lower in MPs further from the nearest forest/scrubland patch. The model also included a significant interaction between the nearest forest/scrubland patch (distance to wildlife cover) and the time daily spent by cattle in the given MP (cattle UI), indicating that for MPs with low use by cattle, red deer activity strongly decreased with distance to nearest cover habitat, whereas for MPs with high cattle use, deer activity at MP was independent of distance to cover. No seasonal differences in specific VR were observed neither in wild boar nor red deer.

As for the DUP, domestic species were mainly seen during daytime at MPs, while wildlife showed a nocturnal pattern (Figure 2).

Regarding the interactions, 42 direct interspecific events (two species in the same visit) were identified at MPs, mostly involving domestic species: 21 cattle-pig, 15 cattle-sheep, 5 cattle-goat, and 1 cattle-wild boar interaction. The only direct livestock-wildlife interaction occurred in fall season at 3:58 AM between one cow and four wild boar. Direct intraspecific interactions were recorded in 878 visits (62.85%), corresponding to those composed by more than one individual of the same species (Supporting Information 3).

In addition, 29,632 indirect interactions were recorded, from which 24,726 (83.44%) were intraspecific interactions, and 4,906 (16.56%) were interspecific interactions (Table 3). Wild ungulates were involved in 503 indirect interspecific interactions (10.25% of the interspecific interactions), from which about half (266) presented wildlife-livestock directionality (58 deer-cattle, 41 deer-pig, 147 wild boar-cattle, 13 wild boar-sheep and 7 wild boar-goat), 80 occurring during spring season, and 186 during fall. Time lapse between wildlife-livestock interactions ranged between 1 h 35 min and 77 h 53 min, with 42 h 19 min on average. Only 15 first order wildlife-livestock interactions were recorded (3.05% of the interspecific interactions, 5.63% of those presenting wildlife-livestock directionality), ranging from 1 h 35 min and 45 h 40 min, with 9 h 54 min on average (Figure 3). All 266 wildlife-livestock interactions originated from 21 visits (10 out of 15 red deer visits and all 11 wild boar visits).

All analyzed swabs tested negative to the presence of MTC DNA. Positive control performed correctly, so all the PCRs amplified.

Discussion

We recorded less activity and use of MPs by wild ungulates compared to livestock. As indicative, in terms of the proportion of days when wildlife activity was detected, our values (red deer mean = 2.53% of PCT days, SD = 15.73; wild boar mean = 3.48% PCT days, SD = 18.36) contrast with the 36% and the 28% of days previously reported for red deer and wild boar for other extensive farm resources, such as water points, in the same study area (Carrasco-García et al., 2016). This suggests that wildlife is not as strongly attracted to mineral resources as it is to water (Kukielka et al., 2013). Additionally, we observed that VR, both for deer and wild boar, was higher in wildlife trails than in MPs, and wildlife was not present at all the farms in MPs, even if they were detected at the wildlife trails and were hunted (see hunting yields, Table 1). These findings contrast with the natural attractiveness of this type of resources for North American cervids looking for supplemental dietary Na (Lavelle et al., 2014), and with the behavior reported for red deer in French farm facilities, were salt licking was the most frequently detected behavior and where they performed the longer visits (Payne et al., 2016). Red deer and wild boar access to, and needs of, mineral have not yet been characterized in our study area. As indicative, saline soils and halophilous vegetation that can be found in uncultivated areas of central Spain (Bernáldez et al., 1989), may reduce the needs of mineral from anthropogenic sources, and therefore the behavior of the wild ungulates towards human-borne mineral supplementation devices intended for livestock use. However, the large number of indirect intraspecific interactions (especially for cattle and pig) reinforces the hypothesis that mineral supplementation is a potential source for disease transmission. Consistently with previous studies in extensive cattle farms in SCS (Kukielka et al., 2013; Carrasco-García et al., 2016), domestic reservoirs presented a more diurnal activity pattern at MPs, and a with a wider period of the day performing some activity.

In our study, wildlife-livestock interactions were mostly determined by the intense influx of livestock to the MPs, and not by the presence/abundance of wild ungulates. The best fitted model generated for wild boar VR, suggested that the presence of cattle in MPs is attractive to wild boar or they, independently, select the same MPs, similarly to results previously described between feral swine and cattle in Texas (Cooper et al., 2010), and between wild boar and cattle in SCS (Carrasco-García et al., 2016) in other types of aggregation points. This indicates that, at least, there is no indirect inter-species avoidance. This suggest that wild boar may find attractive resources associated with cattle presence, like the presence of invertebrates in cattle manure piles (Baubet et al., 2003; Acevedo et al., 2019).

Red deer presence was significantly higher as the MPs were closer to cover, in accordance with previous studies in SCS (Carrasco-García et al., 2016). This finding is also supported by the significant and negative correlation between the distance to cover and the presence of red deer on wildlife trails (Table 2). This factor interacted with cattle UI, showing a stronger effect of the distance from wildlife cover in those cases were cattle was almost absent (0 seconds or less than one minute), which evidenced that cattle presence negatively influenced red deer visitation to MPs. It is widely demonstrated that cervid species exhibit a behavioral disturbance in presence of cattle, and that resource competition (specially in presence of cattle at high stocking densities) can lead to shifts in niche breadth and competitive spatial displacement of red deer (Gordon, 1988; Mattiello et al., 2002; Stewart et al., 2002).

The absence of MTC positive swabs is consistent with the low activity detected for wildlife in the studied mineral blocks, along with brevity of the visits and the shortage of visits with “licking” behavior performed by wild reservoirs (including the inability of the wild boar to reach devices located more than one meter high). Domestic species could also potentially contribute to the presence of MTC DNA in MPs, although the development of large TB lesions and MTC excretion is normally prevented by regular TB eradication campaigns (at least 2 in a year), which eliminate animals that are positive to the skin test. Whereas this technique has been described to have a good sensitivity, it is possible that low levels of MTC were undetectable using our sampling protocol. A recent study established that approximately a minimum of one third of TB positive wild boar randomly captured in our study area are potential MTC shedders (Barasona, Torres et al., 2017). Controlled experiments evaluating the survival of MTC in periodically eroded mineral blocks exposed to Mediterranean environmental conditions and its potential for disease transmission are still needed.

Throughout this work we have been able to verify how all present ungulate reservoirs, both domestic and wild, have been recorded licking on the mineral supplementation points. Livestock species, for which mineral blocks were intended, were the main users and presented a diurnal use pattern, while wild ungulates presented a nocturnal-crepuscular use pattern, with scarce overlapping with livestock. Wild boar presence was positively related to cattle presence at mineral supplementation points, suggesting the possible attraction of this suid for resources associated with livestock, whereas red deer presence was higher in supplemental points closer to forested areas, mostly in absence of cattle. We recorded 266 indirect wildlife-livestock interactions, all of them derived from 21 unique wildlife visits, raising the possibility that, by controlling the low number of wildlife visits, most of the interspecific interactions with greater potential for pathogen transmission can be avoided. All this, together with the fact that none of the analyzed swabs resulted positive to MTC DNA, suggest that mineral supplement are less attractive to wildlife comparing to other environmental sources of MTC in our study area, mainly water ponds.

However, the potential for interspecific transmission of MTC or other pathogens cannot be discarded. The risk for interaction at mineral supplementation points and further transmission can be prevented by implementing specific measures in the context of integral biosecurity plans at the wildlife-livestock interface, which are:

(i) Withdrawing mineral supplementation overnight may prevent most visits by wild ungulates. It can be carried out by mechanically removing the mineral supplement or using a device that can be closed (by a lid or trapdoor).

(ii) Placing the mineral supplement at least one-meter high may prevent its use by wild boar, although not by red deer.

(iii) Establishing mineral supplementation points in open pastures far from cover may reduce visits by red deer, and to a lower extent, wild boar.

(iv) Segregating the use of MPs for the different livestock species making use of them, to prevent interspecific interactions, and hindering the indirect transmission of pathogens.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

The datasets generated for this study can be found in the Mendeley Data repository (DOI: 10.17632/bndtp9sx7w.1). Link: https://data.mendeley.com/datasets/bndtp9sx7w/1.

Ethical Statement

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. No ethical approval was required as there were not sample collection from animals or humans.

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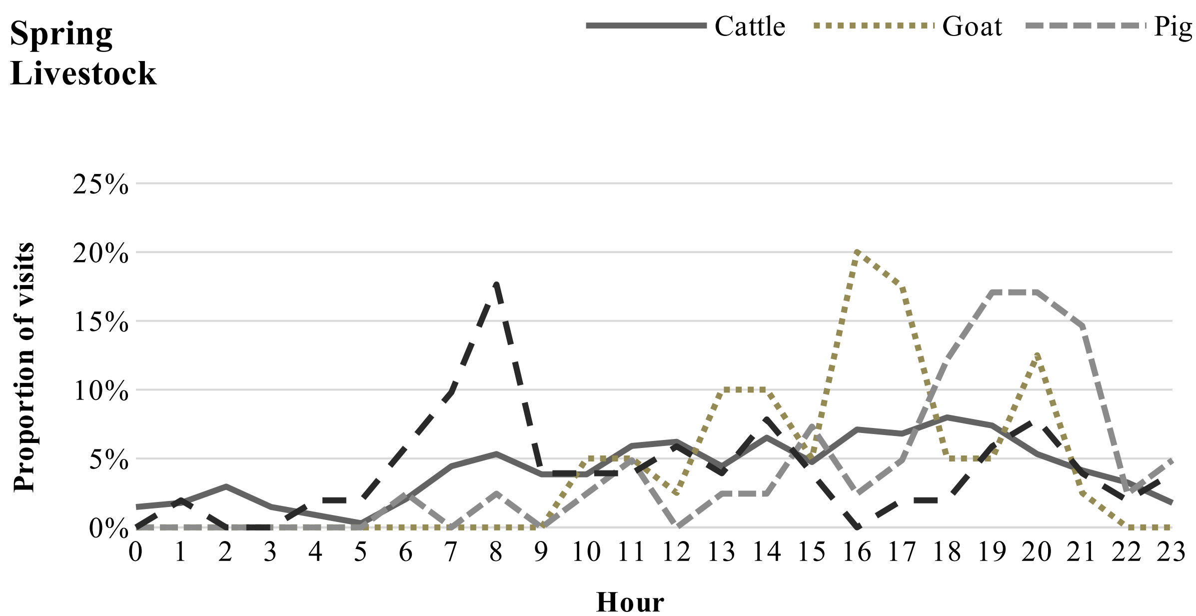
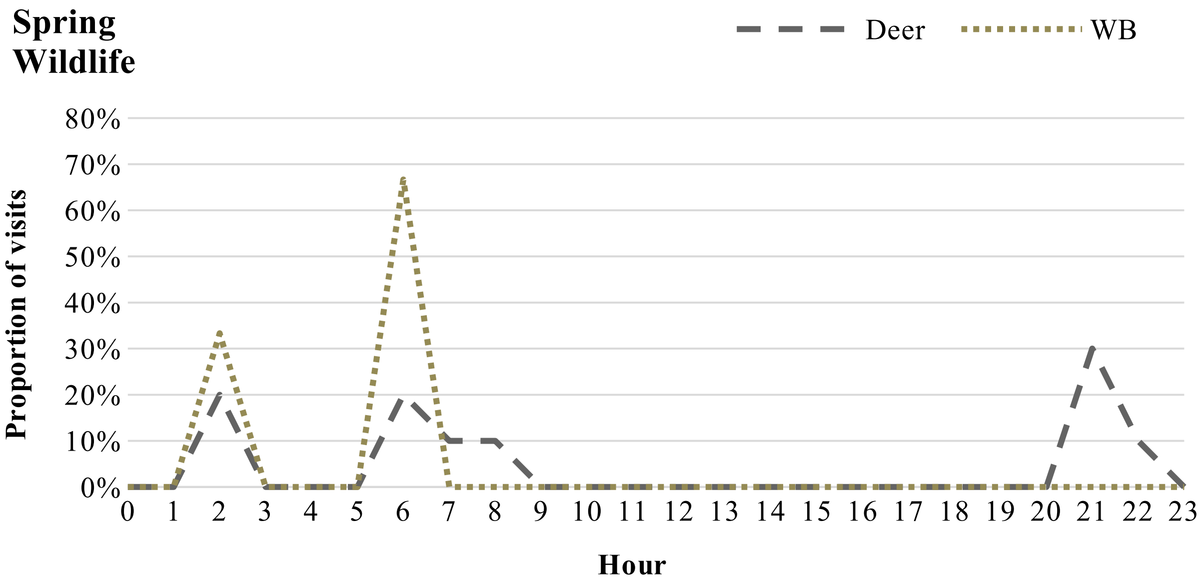
Figures

Figure 1. Example of different species interacting with a hanging mineral block MP. The species (from left to right and from top to bottom) are: goat, cattle, wild boar, Iberian pig and red deer.

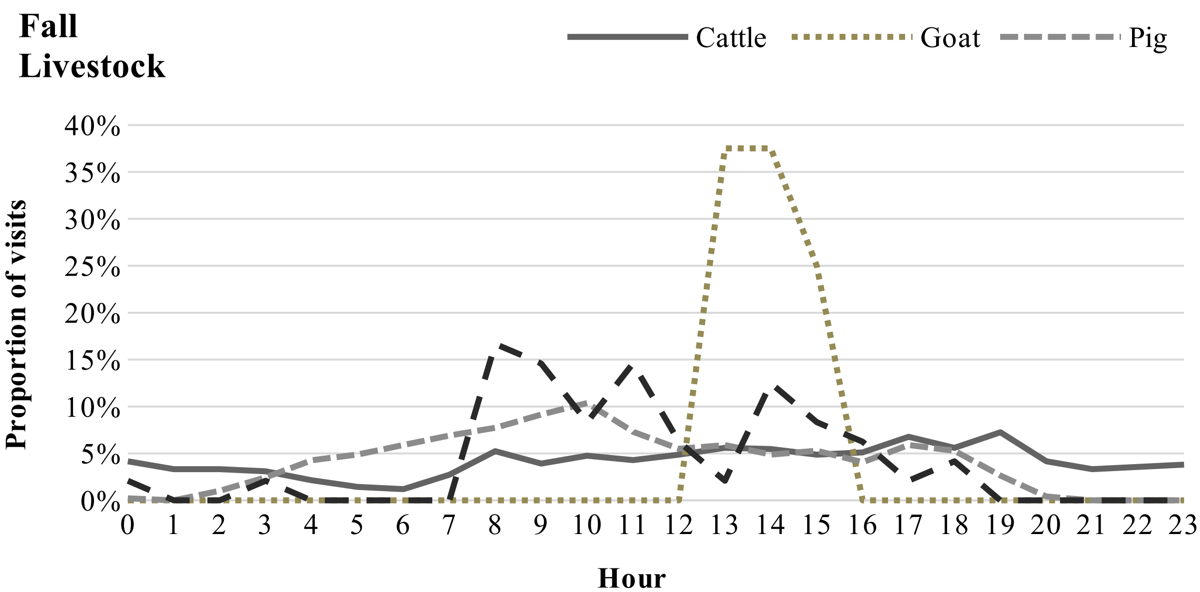
Figure 2. Livestock (above) and wildlife (below) daily use profile at mineral supplementation points during spring and fall seasons assessed as the proportion of visits to mineral supplementation points by hour of the day.



34



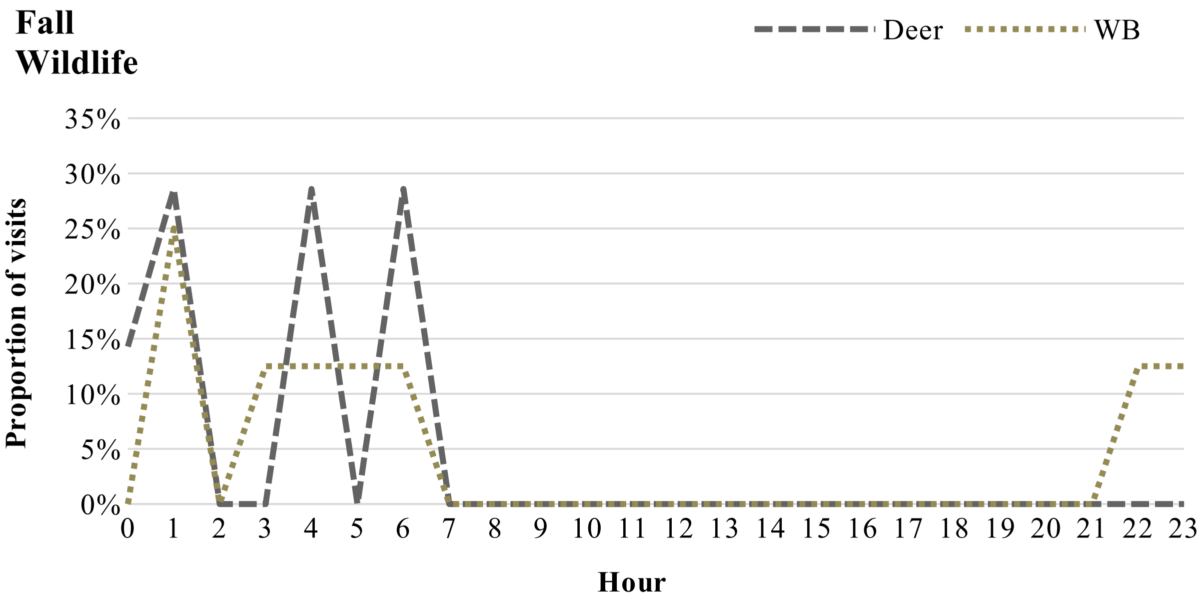
Spring
Wildlife
Deer
WB
80%
70%
60%
50%
40%
30%
20%
10%
0%
Proportion of visits
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour



Fall
Livestock
Cattle
Goat
Pig
40%
35%
30%
25%
20%
15%
10%
5%
0%
Proportion of visits
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour

35

36

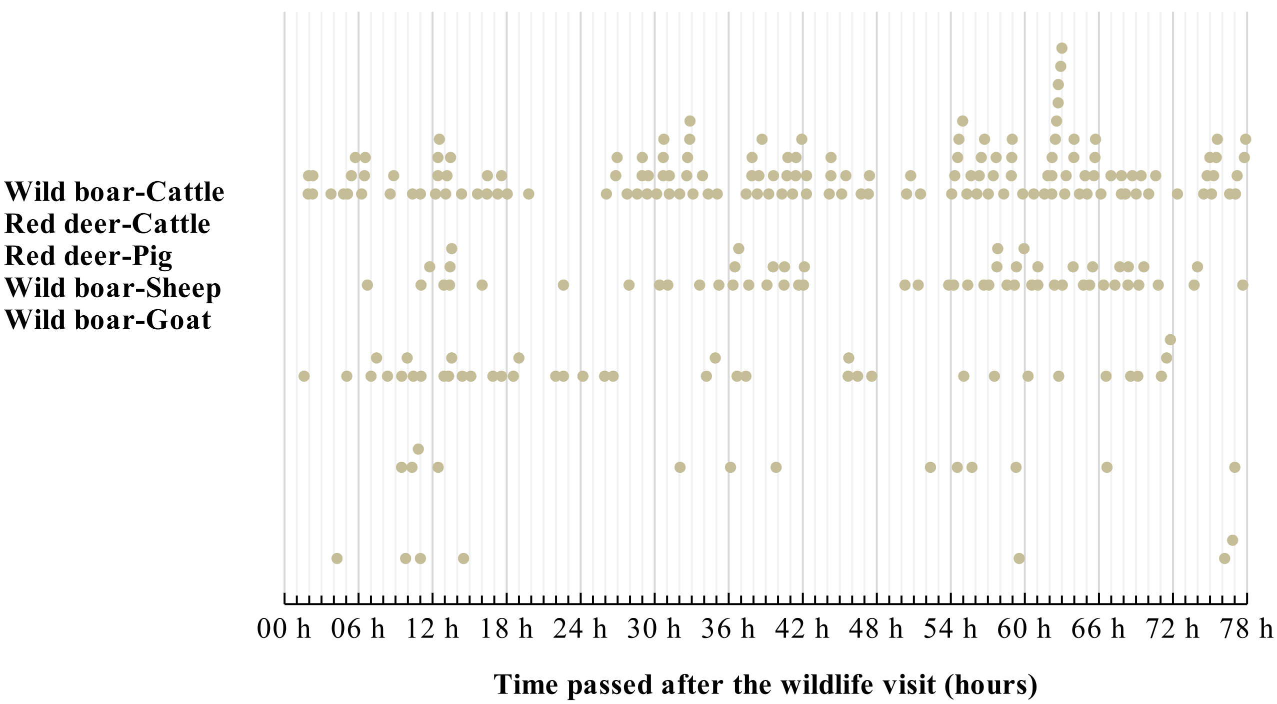


Fall
Wildlife
Deer
WB
Proportion of visits
35%
30%
25%
20%
15%
10%
5%
0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour

361

37

Figure 3. Indirect wildlife-livestock interactions and time passing between the wildlife visit and the following visit (dots) to MP. The interactions in which livestock visited the MP immediately after wildlife are marked as black dots (first order, n=15), grey dot interactions are second order or higher (n=251). Interactions are grouped by hour ranges within the critical time window (0 to 78 hours). First interaction in the hour range is presented in the baseline, and subsequent interactions in the same hour range are presented in successively upper lines.



Tables

Table 1. Characterization of the selected farms in terms of livestock census, mineral supplementation, land use and game management. Game information includes hunting bag data (hunted animals/year) and trapping rates (TR, visits/camera·day) for both red deer and wild boar (see below).

		Farm 1	**Farm 2**	**Farm 3**	**Farm 4**
Census	Goat	80	0	0	6
	Pig	110	200	250	0
	Sheep	0	16	0	340
	Cattle	80	150	60	306
Mineral supplement	Composition	Artificial	Natural	Artificial	Natural
	Disposal	Hanging (1.2m)	Iron grid (0m)	Hanging (0.4m)	Ground (0m)
Land use	% *dehesa* (open oak woodland)	50%	61%	99%	11%
	% scrubland/woodland	50%	39%	1%	89%
	Total (ha)	300	560	181	728
	Use (livestock/hunting)	Both	Both	Livestock	Livestock
Hunting bag/ year	Red deer (n)	30	0	3	0
	Wild boar (n)	20	20	3	0
Wildlife trail camera	Red deer (TR)	2.58	0.65	0	0.83
	Wild boar (TR)	0.27	0.83	0.36	1.05

Table 2. Best Poisson regression models for wild boar and red deer daily visit rate (VR) in mineral supplementation points.

VR Models	**Wild boar**				**Red deer**			
	Estimate	S.E.	*z*	*p*	Estimate	S.E.	*z*	*p*
Intercept	-3.333	0.771	-4.324	*P*>0.05*	4.118	2.285	1.802	0.072
Farm 2	-19.840	0.007	-0.003	0.998	13.200	7.507	1.759	0.079
Farm 3	-16.190	0.007	-0.002	0.998	-11.160	12470	-0.001	0.999
Farm 4	0.272	0.987	0.276	0. 783	27.760	17.130	1.621	0.105
Distance to wildlife cover	-0.001	0.001	-0.905	0.366	-0.045	0.022	-2.096	0.036*
CattleUI	0.001	2.635E-4	2.695	0.007*	-0.013	0.001	-1.843	0.065
CattleUI*Distance to wildlife cover					1.592E-5	7.813E-6	2.038	0.042*

Table 3. Number of total indirect interactions in mineral supplementation points from extensive cattle farms using a critical time window of 78 hours. The average indirect interactions per MP and week, excluding the days when they were not present, are presented in brackets.

Second species	First species: Cattle	Goat	Pig	Sheep	Red deer	Wild boar
Cattle	16,431 (432.9)	158 (26.3)	478 (95.6)	1342 (112.9)	58 (2)	147 (3.9)
Goat	159 (19.9)	103 (17.2)	0	0	0	7 (2.3)
Pig	954 (190.8)	0	7375 (351.2)	0	41 (4.6)	0
Sheep	1312 (118.7)	0	0	795 (73.2)	0	13 (1.3)
Red deer	37 (1)	0	65 (7.2)	0	19 (0.316)	4 (0.1)
Wild boar	103 (2.8)	3 (1.5)	0	17 (1.7)	8 (0.1)	3 (0.1)