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Welcoming Wolves? Governing the Return of Large Carnivores in Traditional Pastoral Landscapes

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Wolf populations are recovering across Europe and readily recolonize most areas where humans allow their presence. Reintegrating wolves in human-dominated landscapes is a major challenge, particularly in places where memories and experience of coexistence have been lost. Despite the observed expansion trends, little has been done to prepare communities for the return of these apex predators, or to understand what fosters and perpetuates coexistence. In this study, we present a theoretical framework for resilient coexistence based on four conditions: Effective institutions, large carnivore persistence, social legitimacy, and low levels of risk and vulnerability, nested within the social-ecological systems (SES) concept. To empirically show how the conditions can be manifested and interconnected, and how this knowledge could be used to improve local coexistence capacities, the framework is applied in a case study of human–wolf relations in Spain. We examined three traditionally pastoral landscapes at different states of cohabitation with wolves: uninterrupted presence, recent recolonization, and imminent return. We found that both the perceptions of wolves and the capacity to coexist with them diverged across these states, and that this was largely determined by a diversity of vulnerabilities that have not been recognized or addressed within current management regimes, such as economic precarity and weak legitimacy for governing institutions. Our results illustrate the importance of working in close contact with communities to understand local needs and enhance adaptive capacities in the face of rural transitions, beyond those directly related to wolves. The framework complements emerging tools for coexistence developed by researchers and practitioners, which offer guidance on the process of situational analysis, planning, and resource allocation needed to balance large carnivore conservation with local livelihoods.

Keywords: wolves, biocultural diversity, coexistence, traditional landscapes, human-large carnivore relations, co-adaptation

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INTRODUCTION

Current plans for socio-ecological transitions, such as the EU biodiversity strategy (The European Commission., 2020) and the UN Decade on Ecosystem Restoration (UNEP., 2019), call for new ways of thinking about how humans and wildlife might share space. In Europe, expanding large carnivore populations (Chapron et al., 2014; Cimatti et al., 2021), rural land abandonment

(Bürgi et al., 2017), and a growing rewilding movement (Ceausu et al., 2015) have brought human–carnivore relations (HCR) into focus, meaning the multifaceted interactions between humans and large carnivores. In recent decades, European conservation policies have supported the integration of large carnivores within human-dominated landscapes (Boitani and Linnell, 2015; Cretois et al., 2019). As carnivore populations increase, institutions across the continent face the challenges of (re)integrating these species, balancing the aims of biodiversity conservation, livelihood protection, and the welfare of carnivores and domestic animals (Redpath et al., 2013; van Eeden et al., 2018).

Large carnivores often become symbols of incompatible human-nature worldviews, primarily between those who uphold traditional rural practices, and those with urban lifestyles (Pooley et al., 2017; Ericsson et al., 2018). The negative impacts of large carnivores are disproportionally experienced in rural communities, some of whom are vulnerable due to market globalization, rural depopulation, and inequitable agricultural policies (Leal Filho et al., 2017; Pe'er and Lakner, 2020). Growing carnivore populations will result in increased overlap between these communities and carnivores (Milanesi et al., 2017; Hinojosa et al., 2018). However, little has been done to proactively enhance their ability to adapt to this. Moreover, while research has revealed the causes and components of dysfunctional HCRs, mostly through the lens of human-wildlife conflicts, there are fewer studies on what constitutes functioning human-carnivore coexistence (Lozano et al., 2019; Pooley et al., 2020). This could give the impression that conflict is a dominant and inevitable outcome of living with large carnivores, rather than one of multiple possible and often simultaneous relations (Peterson et al., 2010; Rode et al., 2021). Identification and amplification of functioning HCRs could greatly benefit conservation agendas, by providing effective and optimistic messages and examples (Madden, 2004; Bennett et al., 2015).

In response to calls for in-depth research on coexistence (Carter and Linnell, 2016; Pooley et al., 2020), we explore the conditions that influence human–wolf relations in traditional pastoral landscapes, focusing on the factors that enable coexistence. We present a theoretical framework of resilient coexistence, and apply it to human–wolf relations in three rural communities in Spain that are at different states of coexistence with wolves; uninterrupted presence, recent recolonization, and imminent return. Through key informant interviews and participant observation, we explore how coexistence conditions are manifested and interconnected at each location, and how capacities to coexist are influenced by socio-ecological trends. Finally, we explore the associated lessons and aspirations for carnivore governance in the future.

THEORETICAL FRAMEWORK

This research draws on recent advances in the study of human–wildlife interactions, which aim to understand the factors that shape coexistence in multi-functional landscapes (Peterson et al., 2010; Lozano et al., 2019; Pooley et al., 2020). In the case of large carnivores, the desired states of HCR are usually described as "resilient coexistence" (Carter and Linnell, 2016, p. 575), in which both humans and carnivores flourish without substantially compromising the means of the other, and where effective and legitimate institutions have the capacity to address problems and disputes as they arise (Chapron and López-Bao, 2016; Hovardas and Marsden, 2018).

What makes coexistence resilient is location specific and influenced by various social and ecological processes, which improve or undermine communities' coexistence capacity (Lischka et al., 2018; Lozano et al., 2019). In order to facilitate the analysis of coexistence in different contexts, we theoretically expand on each condition necessary for resilient coexistence: effective institutions, large carnivore persistence, social legitimacy, and tolerable levels of risk (Carter and Linnell, 2016), and nest them within the social-ecological systems concept (SES; see **Figure 1**). The framework draws on insights from multiple fields, including adaptation (climate change), anthropology, ecology, and human–wildlife interactions, which are necessary to understand the links between human society, the environment, and large carnivores (Hartel et al., 2019).

Social-Ecological Systems and Biocultural Diversity

The SES approach understands people, communities, economies, societies, and cultures as embedded parts of the biosphere. It takes into account the spatial, temporal, political, and organizational processes (including considerations of power and justice) that influence human and animal behaviors and how they shape and are shaped by the system (Folke et al., 2016; Lischka et al., 2018). For coexistence in traditional landscapes, the overlap of human and large carnivore activities, the historical presence, absence, and governance of the species, and the characteristics of the landscape are especially important considerations (Linnell and Cretois, 2018). Traditional landscapes are a product of the connection between people and place, which form part of local identities, memory and heritage (Pretty et al., 2010). It is the setting for an area's biocultural diversity; a coevolving convergence of historical and ongoing environmental and social processes and its resulting flora, fauna, and cultural expression (Pretty et al., 2010; Agnoletti and Rotherham, 2015). Combining these perspectives allows us to view nature and culture not as separate, but as coevolving entities whose interactions continuously shape the conditions of coexistence (Pooley et al., 2017; Gavin et al., 2018).

Effective Institutions

We define institutions as the bodies and/or systems of formal or informal rules that structure social interactions, i.e., all customs and practices, organizations, and agencies, and policies and laws (Hodgson, 2006; Decker et al., 2016). Institutions must be attuned to SES dynamics if they are to enable humans and carnivores to co-adapt, such as in response to changed cultural values of nature. They must also be accountable across multiple scales to ensure public trust and stewardship, from international agendas (such as the Habitat Directive) to local communities (Trouwborst, 2010; Decker et al., 2016). Institutions can facilitate or constrain the behaviors and activities that underpin HCRs

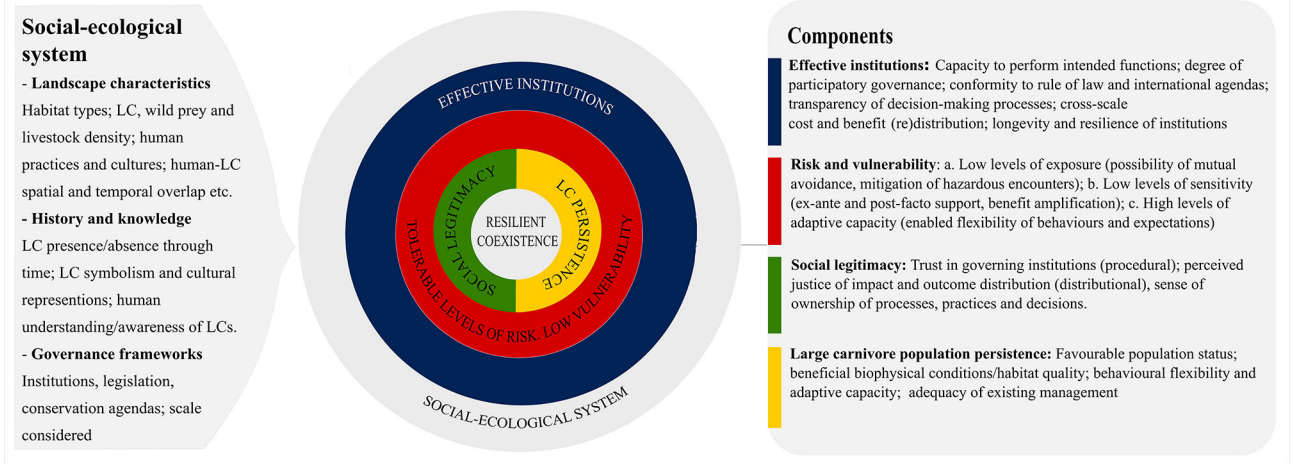

FIGURE 1 | Schematic illustration of the conditions of resilient coexistence with large carnivores (LCs) within a given system. Synergies within the model can work in both directions: Institutions can mediate the influence of social and ecological processes on human and wildlife communities, and ensure that human-LC interactions are not undermining the integrity of the ecological and cultural system.

in many ways, for example by implementing conservation laws and habitat management actions (e.g., protecting and restoring habitat conditions); providing incentives (e.g., conservation payments); support (e.g., information sharing and provision of infrastructure); and by impacting frames of thought (through regulation, education, and staking out future visions) (Carter and Linnell, 2016; Milanesi et al., 2017). By appropriately combining these measures, institutions can have an instrumental role in enhancing the other conditions of the framework (see **Figure 1**). Effectiveness refers to the capacity of formal or informal governing bodies to carry out decision-making and interventions in a way that is adequate (meeting social and ecological needs) and just (distributive and/or procedural) so that benefits of coexistence are amplified and drawbacks mitigated for both humans and carnivores (Walker, 2009; Lockwood, 2010).

Large Carnivore Population Persistence

Population persistence implies that local conditions enable the long-term presence of self-sustaining large carnivore populations (Trouwborst, 2014; Chapron and López-Bao, 2016). Specifically, this means that the risk of local extinction of the species is kept low over long time scales, which can be achieved through favorable habitat conditions and connectivity, abundant prey populations, and genetic diversity within the populations (Brook et al., 2000; Lacy, 2018). Ultimately, the size and range of large carnivore populations are constrained by humans, influenced by what risk levels are acceptable to people in a particular place (Bruskotter et al., 2017; Mech, 2017). This is impacted by heterogeneous ethical and moral considerations relating to rights, responsibilities, and costs, where social power dynamics influence which viewpoint gains prominence, and which scale is considered (i.e., the local, regional, or national state of populations; Wilhere, 2008; Vucetich et al., 2018).

Social Legitimacy

The presence of large carnivores strikes at the heart of relationships between conservation, development, and justice. Achieving a state of coexistence that is legitimate to as many stakeholders as possible is therefore essential in order to ensure its resilience (Jacobsen and Linnell, 2016; Ceauşu et al., 2018). Social legitimacy refers to both input legitimacy, and output legitimacy. Input legitimacy, connected to procedural justice, is based on judgements about whether decision-making bodies and processes are morally fair, transparent, and appropriate for affected parties. Output legitimacy refers to the quality and equity of policy outcomes, and the extent to which an institution delivers its stated aims (Walker, 2009; Bennett et al., 2019). Governing bodies gain and maintain the social "license to operate" afforded by legitimacy by winning the trust and respect of constituents, and by relating policies to local priorities and values (Jepson, 2005). Public trust in governing institutions can enable public acceptance of expanding large carnivore ranges and populations, notwithstanding the potential risks (Jepson, 2016; Treves et al., 2017).

Tolerable Levels of Risk—Low Levels of Community Vulnerability

The impacts of large carnivores and humans on each other depend on their use of local resources, their spatial and temporal overlap, and their ability to withstand stressors (Treves and Karanth, 2003; Redpath et al., 2015). Resilient coexistence does not imply a risk-free state. Rather, the risks are mitigated so that they become "tolerable" (Carter and Linnell, 2016, p. 575), although this is not well-understood or contextualized. It is not only the risk to livelihoods that affects people's willingness to coexist, but also whether the risk is perceived as inherent within the system or imposed, and by whom (Redpath et al., 2017; von Essen and Allen, 2019). Of equal importance is subjective judgement about how coexistence may affect well-being, way of

life, identity, and community (Madden, 2004; Pooley et al., 2017). Within the framework, we therefore expand this condition to consider vulnerability of coexistence communities. Vulnerability is a function of exposure, sensitivity, and adaptive capacity to change and shocks within a system. Together they illuminate the probability and severity of an event, and the ability of the impacted party to cope (Adger, 2006; Nelson et al., 2007). This contributes to a more holistic understanding of the long-term well-being of both people and large carnivores in an area, beyond simply an assessment of livestock and wolf mortality or economic impacts.

Exposure

Large carnivores in Europe predominantly persist outside of protected areas (Chapron et al., 2014), which increases the probability of interactions with humans (Crespin and Simonetti, 2018; Rode et al., 2021). Reducing negative interactions is possible by spatially or temporally segregating human and large carnivore activities (Bruskotter et al., 2017; Reinhardt et al., 2019). To achieve this separation, large carnivore behavior can be influenced by ensuring favorable habitat conditions in areas away from human settlements, and using physical deterrents to protect livestock, such as fences and guardian dogs (Eklund et al., 2017; van Eeden et al., 2018). Human behavior can be influenced by restricting activities, e.g., grazing of livestock in certain areas (regulation and zoning), social and economic incentives, and information campaigns (Penteriani et al., 2016; Linnell and Cretois, 2018).

Sensitivity

Sensitivity refers to the degree to which a community is affected by perturbations (Adger, 2006), such as the return of a species. Low sensitivity implies that the adverse impacts that large carnivores and humans have on each other are moderated to a level at which the identity, function, and feedbacks of the system can persist, while retaining flexibility to develop (Nelson et al., 2007). Approaches to reduce sensitivity are usually based on economic instruments. They can be important to increase perceived distributive justice, since they enable the (re)distribution of resources to those whose livelihoods are directly affected by large carnivore conservation (Hovardas et al., 2017; Kojola et al., 2018). Instruments can consist of compensation and insurance schemes (ex post facto), payment based on risk (ex-ante), or incentives for conservation outcomes (e.g., payment for presence) (Ravenelle and Nyhus, 2017; Linnell and Cretois, 2018). Their success is contingent on cost-effective and viable verification (of carnivore range or predation), fair and timely payments, incentives for damage prevention and financial sustainability (Wilson-holt and Steele, 2019).

Adaptive Capacity

Adaptation refers to the ability of individuals or groups of humans or carnivores to adjust their behavior to better withstand changing conditions or hazards (Smit and Wandel, 2006). Large carnivores exhibit several behavioral and spatial-temporal adaptations to anthropic environments (Chapron et al., 2014; Carter and Linnell, 2016). Some decrease risk of negative interactions, such as nocturnal or crepuscular activity patterns (Gaynor et al., 2018), while others increase predation on livestock or exploitation of urban food sources (Milanesi et al., 2017; Evans et al., 2018). By understanding and addressing population and individual behavior, wildlife managers can decrease risks to both humans and carnivores (Linnell and Cretois, 2018). Human adaptive capacity is an emergent property connected to social and psychological characteristics, as well as the physical and economic elements that impact willingness and ability to adjust behavior (Nelson et al., 2007; Dorresteijn et al., 2016). For cultures to persist, communities need to be able to build on traditional knowledge while adjusting and forming new expectations that enable well-being under social and environmental transitions (Smit and Wandel, 2006; Pretty et al., 2010). With regards to large carnivores, physical and psychological barriers that inhibit adaptation are often present, such as certain farming practices or perceptions about large carnivores and what they represent. By identifying and addressing these barriers, it is possible to influence people's expectations and narratives of HCR and local landscapes (Hovardas et al., 2017).

MATERIALS AND METHODS

Case Study Rationale

We operationalized the framework through a case study on human–wolf relations in three rural areas of Spain. The areas are characterized by traditional land-use systems, specifically extensive rearing of sheep and/or goats (small-scale, low input family farms), which are experiencing changes in the presence or impacts of wolves. The wolf is a highly adaptive apex predator, which may attack livestock and pets, and can be perceived by hunters to compete for game (Linnell and Cretois, 2018). Wolves are moreover considered a flagship species, invoking opinions, feelings, and meanings among those who live alongside them as well as those who don't (Mech, 2017; Kuijper et al., 2019). Exploring the conditions of coexistence with such a multi-faceted species in traditional landscapes could thereby inform work with other species often involved in disputes over wildlife.

We selected three states of wolf presence since the 1970s, when the population was at its lowest point. Location A has had an uninterrupted experience of cohabitation with wolves; location B has experienced their recent return; location C is anticipating their arrival within the next decade (see **Figure 2**). This approach allows us to shed light on processes of co-adaptation by piecing together insights across the three locations. Within each state, we selected locations that appeared to have favorable conditions for coexistence; marginal; and/or mountainous areas with relatively low human population density, abundant game populations, and some type of area designation, see **Figure 4**. The selection was based on literature searches and consultation with national experts.

Case Study Characteristics: Three States of Wolf Presence in Spain

Increased wild prey populations and vegetation cover have since the seventies led to improved conditions for the Iberian wolf (*Canis lupus signatus*) in Spain. Widespread and government incentivized persecution had during the twentieth century

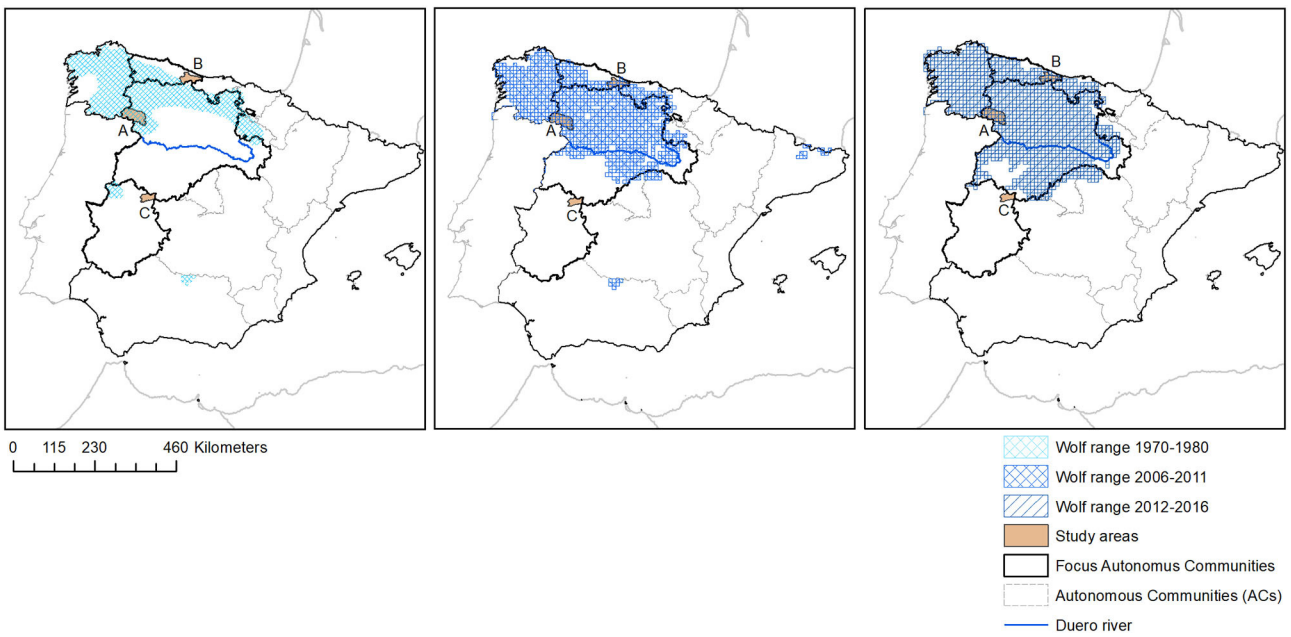

FIGURE 2 | Iberian wolf expansion from the 1970s until the present, and its relation to the study locations (A–C) (Data sources: Valverde, 1971; Chapron et al., 2014; Linnell and Cretois, 2018).

limited the population to the northwest of the country (Blanco and Cortés, 2009). In 1970, the status of the wolf changed from "vermin" to game species, which restricted the time and methods with which they could be hunted (Jefatura del Estado, 1970). When Spain ratified the European Habitats Directive in 1992, wolves in northwestern Spain were listed on Annex V, which must ensure favorable conservation status, while populations south of the Duero river became strictly protected on Annex II and IV (Trouwborst, 2014). Wolf populations have consequently been recovering, and the species can now be found across northwestern Spain (see **Figure 2**). Their diets vary—some packs mainly predating on domestic cattle, and others mainly on wild fauna (Llaneza et al., 2000; González-Díaz et al., 2020). Today Spain harbors one of the largest populations of wolves in Europe, estimated at 2,000–2,500 individuals in close to 300 packs (MAPAMA., 2016; Blanco, 2017).

In Sanabria-La Carballeda (S-LC), Zamora (**location A, see Figure 3**), wolves have had a constant presence, and hunting has remained legal due to the flexible regime of Annex V (Trouwborst, 2014). The area is dominated by a low mountain range (800–1,200 MAMSL), which contains the 67,000 ha regional Sierra de la Culebra hunting reserve, and the 23,000 ha adjacent Lake Sanabria Natural Park. The landscape is dominated by a mosaic of forests and rangelands, with marginal soils, traditionally grazed by free-roaming sheep and smaller numbers of cattle and goats (Fernández Gónzalez, 2013). Traditional protection measures for livestock have remained in use, including accompanied shepherding, night-time enclosure, and management of livestock guardian dogs (Vicente et al., 2000). La Culebra has become notable in recent decades for its dual fame as an exclusive wolf trophy hunting reserve and as one of the most prominent wolf-watching destinations in Europe, both facilitated by its smooth topography which makes wolves easier to observe (Martínez, 2019). In 2015, an interpretation center dedicated to the wolf was inaugurated in Sanabria (The Iberian Wolf Center), reinforcing the area's emerging reputation as "Tierra de lobos," lands of the wolf (Lora Bavo and Villar Lama, 2020).

Wolves in Oriente de Asturias (**location B, see Figure 3**) became extinct in the 1950s or 60s (Llaneza, 2017). Their absence enabled communities to abandon protection measures and let livestock (sheep, goats, and cows) graze unsupervised, which facilitated the expansion and diversification of farm operations (Cayuela, 2004; Llaneza et al., 2016). In recent decades, a burgeoning artisanal cheese industry has emerged, including several cheeses with protected designation of origin. This has maintained a local market for milk and a relatively high profitability among producers, despite challenging conditions that restrict flock size and management (González-Álvarez, 2015; López and Pardo, 2018). The landscape is characterized by abrupt limestone peaks (0–2,600 MAMSL), intermingled with forest patches and biodiverse temperate grasslands (García Manteca et al., 2018; OECC., 2019). The region contains Spain's first national park, Picos de Europa (PENP, 67,455 ha), declared in 1917. It is one of only two national parks that are inhabited by people, and is the third most visited in Spain (López and Pardo, 2018). Wolves started recolonizing the area in 1986 (GPA., 2016). Although wolves in Asturias are listed on Annex V, they have been declared a non-hunting species since 1991 (Trouwborst, 2014).

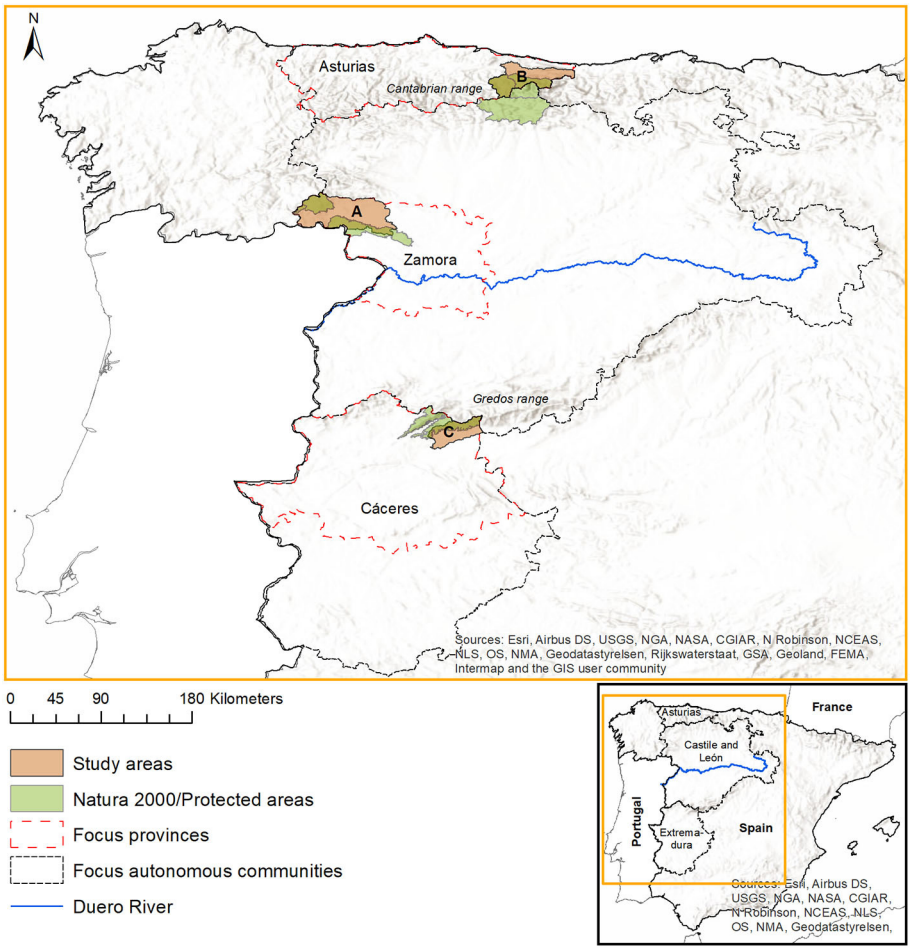

FIGURE 3 | Map of case study areas (orange), and relevant protected areas (green). *Location A:* Sanabria-La Carballeda, with Sanabria National park to the left and Sierra de la Culebra hunting reserve to the right. *Location B*: Oriente de Asturias district, with Ponga Natural Park to the left and Picos de Europa National Park to the right and center. *Location C:* La Vera, with the Sierra de Gredos y Valle de Jerte Natura 2000 area. Additional information about the characteristics of each location can be found in **Supplementary Table 1**.

In La Vera, Cáceres **(location C, see Figure 3)** the absence of wolves (extinct in the 1960s, Rico et al., 2000) enabled a similar trajectory of abandonment of protection measures as in location B. The area is characterized by the Gredos mountain range (400–2,400 MAMSL), with a forest and rangeland mosaic that has traditionally been grazed by goats. It is cataloged as Natura 2000 and high nature-value farmland (JuntaEx, 2014). In recent years the livestock sector has had significant issues with Bovine tuberculosis, which has a high prevalence in the region (Carrasco-García de León, 2015). The area has a prominent hunting sector and is a famous big game destination, particularly for ibex (*Capra pyrenaica*; Martín Delgado et al., 2019). In 2001, wolves recolonized the northern side of the Gredos range (Ávila province, Castile and León), which is just north of La Vera's border (see **Figure 2**), and in the same year the wolf was listed as critically endangered in Extremadura (Annex II and IV; JuntaEx, 2014; JCyL., 2016).

DATA COLLECTION AND ANALYSIS

Fieldwork took place from January–December 2020, with between 3 and 4 months spent in each location (approved by the Research Ethics Committee at the University of Leeds; AREA 19-018). Primary data sources consisted of observation and key informant interviews, purposively sampled to elicit the knowledge and lived reality of local communities and gain a deeper insight into local perceptions and experiences of coexistence (Smit and Wandel, 2006; Rust et al., 2017). Observation (participant and non-participant) was continuous and included accompanying farmers and wildlife managers during their daily tasks, attending local, and regional events, and informal conversations with local residents. For each location, a stakeholder network was produced through a snowball approach, from which we selected interviewees who were representative of a particular group, value orientation or

coexistence capacity (Berg and Lune, 2014). In total, 92 semi-structured interviews were conducted, 29–31 per site, in addition to three national-level carnivore or traditional landscape experts (see **Supplementary Tables 2A–D**). This sample enabled us to capture various perspectives within the different local groups, and triangulate them with those of civil servants at the regional level and national level experts. The interviews were either tape-recorded and subsequently transcribed or annotated during and after the interview. Questions were focused on rural dynamics, factors relating to wildlife interactions and aspirations for the future. Unless brought up by the informant, questions relating to wolves were asked at the end of the interview, in order to understand if and to what degree wolves were a main concern for local communities. Through this approach we could minimize potential rehearsed or polarized stances related to the wolf topic, encouraging communicative rather than a strategic rationality during the interview (von Essen and Hansen, 2015).

In order to contextualize and compare our findings, we supplemented primary data with an analysis of visual media (documentaries, short films, and promotional videos; see **Supplementary Table 3**) on the topics of human–wolf interactions and traditional farming, all produced in Spain during the last 5 years. We also surveyed local and regional newspapers and social media content during the fieldwork, to gain an overview of active debates and discourses about wolves and rural politics. Finally, we surveyed official documentation, such as management plans and information on wolf status, from Castile and León, Asturias, and Extremadura.

Following a grounded theory-type approach (Mabon et al., 2020), we continuously recorded and summarized observations and reflections during the fieldwork. This enabled us to identify recurring themes across the different coexistence states and to adapt the focus of the research accordingly (Rust et al., 2017). To gain a broad perspective on the entire dataset, the resulting notes, and interview and visual media transcripts were qualitatively analyzed and triangulated through thematic coding. The coexistence conditions of the framework were not used as separate elements of analysis, since they are interdependent and manifested in idiosyncratic ways in each location. Rather, the framework was used to provide an initial coding structure, established in NVivo software (QSR International UK Ltd.), which was then populated by the conditions, issues, trends, and aspirations as they emerged through the coding process. This iterative approach enabled the data codebook (see **Supplementary Table 4**) and the narrative structure of the findings to stem from what was deemed important by the informants, and on how they presented factors relevant to coexistence and their synergies within the system (Smit and Wandel, 2006). Key quotes from informants (coded with number and letter according to the study locations) represent perceptions of the most significant coding categories.

RESULTS

The following sections present the case study findings as seen through the framework, beginning with SES trends, and issues that were shared across the study locations. Next, results from each location are presented, beginning with the current state of the wolf persistence condition (historic presence and absence, current population numbers, and protected status) before presenting themes relating to social aspects of HCR.

Common Trends Across the Coexistence States

Traditional, extensive livestock practices have persisted in the study locations, where they retain their significance for local livelihoods and cultures. In the last 50 years however, the number of farms have decreased drastically (Izquierdo and Barrena, 2006; MITECO JCyL., 2014). Despite the acknowledged quality of the products, the cultural values, and the advantages to animal health and biodiversity, shepherds have struggled to compete as local markets and infrastructure disappeared and the number of intermediaries in the supply chain increased (San Miguel et al., 2017). The limited economic viability of traditional farming has been exacerbated by inequities in agricultural policies, which despite recent greening efforts, are still biased toward farm size and efficiency over environmental and social indicators (Chemnitz et al., 2019). Informants expressed that they often struggled to meet subsidy allocation criteria, such as having enough animals per ha, producing enough per animal, or due to the extent of shrub/forest cover on their pastures. These trends contributed to changed animal husbandry practices, such as the drastic decline of goats and sheep in favor of cattle, which are less vulnerable to predation and less management intensive, with a more reliable consumer demand and higher agricultural subsidies:

> *"Six years ago my son decided to stay in the village […]. As a mother, I couldn't support him to stay with sheep. Because sheep is very "esclavo" [slave-like/work intensive] and here, in addition to the slave-like conditions, we have the wolf […] and I didn't want that life for my son. So I told him that I would support him if he wanted to stay here, perfect, but then we would have to go over to cattle farming, which gives you, within quotation marks, more free-time."* (Farmer and former shepherd, A16).

While the numbers of both shepherds (traditional managers of sheep and goats) and farmers (cattle owners) have declined in the villages, the sizes of the flocks have increased to keep up with rising costs. Some farmers have opted for a second profession to reach economic stability and improve living standards. This has resulted in larger numbers of unaccompanied livestock in the mountains, particularly cattle, and decreased the capacity for oversight and defense against predators. Informants described a homogenization of the landscape matrix, with increasing contrasts between easily accessible, intensively grazed lands and the more remote or marginal areas, which have become abandoned to nature-led processes. The trend has transformed the traditional landscape; infrastructure (trails, shepherd cottages and drinking stations) has fallen into disrepair and open areas have become recolonized by scrub, leading to the loss of flora and fauna associated with alpine grasslands and hay meadows, and increased prevalence of wildfires. This has increased management

FIGURE 4 | Case study locations (**A–C**, from top to bottom), exemplifying local farming systems (left), and village settings (right).

costs for remaining landowners, thus perpetuating the cycle, leading researchers and institutions to call for increased efforts to support and recover traditional farming practices (Izquierdo and Barrena, 2006; MITECO JCyL., 2014; Urivelarrea and Beaufoy, 2019).

Landscape homogenization has also reduced the buffer zones around some of the villages, which has contributed to a sense among informants that wildlife have become more numerous and bold, resulting in increased damage to crops and livestock, traffic accidents, and transmission of zoonotic diseases:

> *"The houses and the villages are nowadays small islands within this territory, and when wolves look for food they may pass by the four houses that are still inhabited. They come close because the food is close. Before the food was one or two kilometers away, now it is next to the houses. So when people abandon the villages, the vegetation "consumes" the territory that used to be cultivated [. . .] and the wild prey reclaim this territory. The more the landscape is depopulated, the more wildlife there will be and the more wolves there will be. [. . .]"* (Biologist, A13).

In recent decades, there has also been a shift in how the landscapes of the study locations are valued by outsiders, from places of production to places of recreation. All three areas are experiencing increasing volumes of visitors, expanding from those arriving to visit resident family members or holiday homes to a diversity of tourist groups. Many are attracted by nature experiences, a trend that is projected to keep growing (MAPAMA, 2017). This has caused friction over the purpose and use of nature and wildlife (GCG, 2018). Farmers and shepherds often felt misunderstood or judged by outsiders, for instance over their role in preserving the landscape:

> *"[. . .] this is a place a lot of tourist come to see. But why are there so many tourists here? Because people like to see the landscape, the look of it. [. . .] But without this [farming], it will disappear, the paths will disappear, the meadows will disappear. No one will "clean it" [from scrub]."* (Shepherd and cheese maker, B5).

Another common theme concerned competition over land-use. This is particularly evident in the summer, when thousands of tourists cycle and hike through the traditional pastures. These trends are altering the space, habitat connectivity and resources available for wolves and people in each study site, with associated effects on local coexistence capacities, which is described with more detail in the following sections.

Location A: A Shift in the Coexistence State?

With regards to population persistence, the combination of regulated hunting and improved policies for nature protection have converted S-LC into a buffer zone for wolves. The area has one of the highest densities of wolves in Europe, which has remained stable around 16 packs since the late 1980s (Sáenz de Buruaga et al., 2015; JCyL., 2019b). It has also contributed to making the area famous as an exclusive hunting destination for wealthy outsiders, particularly for trophy hunting of red deer (*Cervus elaphus*) and wolf within the La Culebra reserve (Vicente et al., 2000; Martínez, 2019). Citing these factors, informants generally agreed that the conditions for long-term wolf persistence in S-LC were very favorable.

When the status of wolves changed to "game species" in 1970, the authority over wolf management was transferred from informal to formal institutions (Blanco and Cortés, 2009). This makes the regional government responsible for compensating damage to livestock within regional hunting reserves, such as La Culebra, while in the rest of northern Castile and León a specific insurance is required (JCyL., 2008, 2018). The regional government also manages the sale of hunting rights. Public auctions are organized and the funds redistributed to landowners on a yearly basis. These responsibilities have provided governing institutions with a clear management aim; to maintain stable wolf populations to enable and justify the continuous harvest of trophy specimens, which they have been effective in achieving since the 1980s (Blanco and Cortés, 2009; JCyL., 2018). According to local wolf experts, hunting has also been instrumental in retaining a sense among locals that wolves are being "controlled" and contributing to economic development, which has improved tolerance for their presence:

> *[Without hunting,] the wolf wouldn't be here. It would have been exterminated like in other sites. Thanks to the fact that it is a game species, and that it moves money they hate it less here. And there is no poaching. Because it generates money, anyone who wants to*

poach a wolf here will be reported by their neighbors, because it deprives them of money [. . .] (Biologist, A13).

The pre-existing frameworks for monitoring and capitalizing on wolves have facilitated the emergence of tourism activities. There are now 12 wolf-watching businesses that completely or partly base their operations in the area, four of which have local offices (Lora Bavo and Villar Lama, 2020). In 2017, there was an estimated 3,100 visits, and almost half of the overnight stays in the La Culebra villages were attributed to wolves. To appeal to these tourists, various local businesses and producers have started using the wolf as a branding tool, visible as symbols, and names across the area. The burgeoning sector led some informants to perceive that wolf tourism had overtaken both agriculture and hunting in economic importance: *"So what is left to work with, as far as I can see as a mayor, and the government is supporting me in this, is tourism. They say [. . .] that not everyone can live off of tourism. But the tourism is helping us to not go under."* (Mayor, A1).

Wolves were also widely believed to regulate the area's ungulate populations, which were causing significant damage to agriculture: *"the wolf is needed to control all of the other fauna, the wild boar [Sus scrofa], they are invading us."* (Mayor, A22). When local issues were discussed with informants, problems with ungulates were often mentioned before damage caused by wolves, which despite the high wolf density have remained comparatively low (JCyL., 2016). This has been possible because of local farmers' and shepherds' continued use of traditional protection measures (guardian dogs, shepherds and enclosures), which they described as the only way to avoid being ruined by depredation. Various shepherds and farmers emphasized that it is crucial to complement these measures with clearing scrub, not only to maintain pasture, but also to decrease hiding-places for predators (including wolves), and for guardian dogs to effectively survey livestock (see **Figure 4**). Although these measures are work and resource intensive, their effectiveness were widely acknowledged, since they have been validated and passed on from generation to generation. Farmers and shepherds often perceived them as an integral part of local animal husbandry, as expressed by an elderly shepherd: *"Here, it would never occur to anyone to let the sheep out alone"* (A23). A young farmer elaborated:

"7000 [euros] is what I have to spend on the dogs each year. For insurance and for food for the dogs [he had 21]. And if I wouldn't have had to spend that on the dogs, that money would be for me, and I would live better. I could have done a lot with that money. So what happens? Well, if I notice that I can have a calmer life and calmer cows with some dogs, then I sacrifice myself." (A15a)

Although opinions diverged over the acceptable size and impact of wolf populations, we encountered remarkably few expressions of fear or intolerance toward the presence of wolves among livestock owners or villagers. With the surge of pro-wolf agendas in Spain, this tolerance and the ability of S-LC's farmers and shepherds to live alongside wolves is becoming increasingly admired and politicized (see **Supplementary Table 3**). One example is a young shepherd family who manage their flock with 18 guardian dogs, and who have launched their own "Grazing with Wolves" product brand (http://www.pastandoconlobos.com/). They are often featured in NGO campaigns or to demonstrate the viability of coexistence in newspapers and social media.

However, according to the area's shepherds and farmers, their coexistence practices were not acknowledged in any practical sense and did not positively influence the value of their products. Conversely, local market initiatives, such as the wolf-brand, have struggled to gain local uptake and have been hampered by bureaucratic requirements for the agro-food industry, which largely fails to consider artisanal producers (Hinojosa et al., 2018). The narrow economic margins reported by informants meant that the relative costs of preventing and withstanding wolf damage were significant, yet support for preventative mechanisms is limited to the conflictive regions in the south of Castile and León, where the wolf is strictly protected (JCyL., 2018). In addition, the damage compensation scheme is slow (informants reported delays of up to 2 years), cumbersome and the amounts received are considered small, making it ineffective at reducing livelihood sensitivity to wolf predation. Similar issues were reported for the wolf insurance scheme: *"the cost of the insurance is more than the cost of those 5 or 6 sheep that you lose [per year]."* (Shepherd, A11). These problems lead to poor local uptake and often caused farmers to abstain from reporting damage, thus skewing the area's damage statistics.

Nearly all informants expressed that they felt neglected or abandoned by the regional government, which was perceived as corrupt and disinterested in the concerns of small farms. There are few alternative livelihoods, and the resulting depopulation perpetuates the dismantling of social services and infrastructure in the region (MITECO JCyL., 2014). While tourism is increasing, it is concentrated on summers and holidays and for relatively few stakeholders, whose income is limited during the rest of the year. Informants therefore often had pessimistic views of the future, for their village in general, and the shepherd culture in particular: *"No no. This won't continue. It won't continue because there is very low profitability. And then it is quite a hard job. There are no weekends, no parties, no vacations."* (Shepherd, A23).

"So the future, black. Because the people don't have jobs. And the tourism, yes, but there needs to be incentives so that restaurants and hotels can survive with few people, because if there are no hotels and no restaurants, how will tourists generate money?" (Owner of a wolf-watching business, A4).

Location B: Lessons From 30 Years of Wolf-Related Disputes

In location B, informants described how the conservation and vigilance protocols for wolves, which were established in the eighties, had prevented the re-emergence of previous practices for "keeping wolves at bay." These included hunting, traps, and poison, often conducted by specialist "vermin" hunters (Vielba Infante, 2018). The absence of these practices enabled wolves to recolonize the Asturian part of PENP, originating from

the southern slopes of the Cantabrian range (Cayuela, 2004; GPA., 2016). In 1992, 20 years after the first pack had become established, the population had expanded across the whole area of the park and into neighboring areas (Llaneza, 2017). With the current six family groups, local experts estimated that the population in PENP has reached ecological carrying capacity. The adjacent areas (Centro-oriental/PENP management zones) are also considered fully colonized. In 2019, the population was estimated at approximately 12 stable packs, including those within PENP (GPA., 2019).

Despite protests from conservation NGOs (Llaneza et al., 2016), the regional government has, since the eighties, implemented a program of wolf culling within delimited management zones where coexistence is deemed feasible, including within PENP (GPA., 2019). Even so, wolves have continued to expand toward the ocean and into areas that are considered unsuitable due to high densities of livestock and/or people. In these areas, culling is conducted whenever considered necessary, and in exceptional cases whole packs are removed (GPA., 2016). Civil servants deemed this approach necessary to address the accelerating levels of livestock damage and ensuing social upheaval since wolves returned: *"It is clear that if you have damages and you eliminate the wolf, the damages [to livestock] will decrease. We have a series of data that show that when you remove a significant amount of wolves, the damages decrease."* (Civil servant, B2).

However, communities were not consulted about when and where controls were to take place. According to civil servants, restricted hunting methods and challenging conditions (see **Figure 4**) have also meant that established quotas were rarely fulfilled. This exasperated livestock owners, who overwhelmingly considered the regional government ineffective at realizing the promises of the wolf management plan and addressing the wolves that were causing damage. In additions to control, a damage compensation scheme has been operated since 1989 (García Hernández et al., 2019). In recent years some minor funds for guardian dogs and livestock fencing have also been provided (GPA., 2019), although evidence of the local efficacy of these methods is limited (Llaneza et al., 2016). Both schemes were generally perceived as ineffective by locals. Farmers and shepherds were unanimously dissatisfied with the bureaucratic and evidence burden of the compensation scheme, as well as how livestock was valued within them. The uptake of preventative methods was limited, since a variety of social and ecological factors were deemed to make them unfeasible:

> *"I don't have any dogs. [. . .] The mastiffs are very defensive, and here there are a lot of tourists. And another factor is that this area is very steep, so there might be four goats over there and four over there. How many mastiffs can you have? Should you have 70 mastiffs in order to have one for each individual [goat]?!"* (Shepherd and cheese maker, B5).

> *"With how mountainous and agrarian it is [in PENP], [. . .] the preventative methods will never be 100 % effective. [. . .] we have to keep in mind that they will not be a panacea."* (National wolf expert, B3).

Informants also reported that wolves had altered their hunting patterns, more frequently attacking during the day to access the "easy pickings" constituted by sheep and goats, thereby rendering night-time enclosure less viable as a solution. Increased attacks on cattle were also reported, particularly on young calves. Informants often attributed the continuing decline of free-range shepherd cultures and the increase of stabled animals in the valleys to the return of wolves, since people struggled to cope with the worry and trauma of finding one's livestock injured and killed. The pastoral landscapes and artisanal cheese making are emblems of the area and crucial for local economies, identities and cultural heritage (Izquierdo and Barrena, 2006; González-Álvarez, 2015). Among locals, it represented the toil of previous generations, and preserving its beauty and function was considered vital. Damage to the livestock sector was therefore a major concern among informants across different groups. While conservationists and some civil servants emphasized the symbolic and ecological importance of harboring a flagship species such as the wolf in PENP, efforts to gain local support for wolf presence have generally been unsuccessful. Anti-wolf groups and discourses are still prevalent in the social and public media, and protests tend to reignite as soon as there is a surge in livestock damage (Llaneza et al., 2016). However, after over 30 years of entrenched disputes, informants described an emerging pragmatism, chiefly among locally based stakeholders:

> *"For the farmers, there have been years and years of pressure and threats [. . .]. And then they get tired. [. . .] They have noticed that society would not allow it, they would not accept zero wolves. That is a part of it. So now, when the farmers come here, you can talk to them without a problem. That before was very hard. [. . .] the conservationists too. And they notice, I think, [. . .] that they have been fighting for many years against the killing of wolves, especially when many have been killed, but they see that the wolves are still there, even increasing."* (Civil servant, B2).

> *"People nowadays are less fanatic. Both the conservation sector and the farmers [. . .] It would be very rare for you to find a farmer that will talk about extinguishing the wolf. Maybe they will say that in this particular area it is incompatible, but not about general extinction.* (Farmer and sector representative, B1).

Some initiatives are exploring new ways of improving local coexistence capacities, independent of public institutions. An interesting model is provided by a NGO for the preservation of the bearded vulture (*Gypaetus barbatus*; Fundación Quebrantahuesos., 2020). They are vulnerable to the use of poison and certain livestock medication (such as diclofenac), which they ingest when feeding on livestock carcasses. These properties link the vultures with the fate of both wolves and shepherds, leading the NGO to launch a "Pro-biodiversity" certification for producers of lamb. Improving coexistence with local fauna, including wolves, is one of the main criteria for inclusion, although it is not prescriptive about which methods should be used. The certification, which is free of charge, provides shepherds with a price premium for their products, in addition to publicized recognition of the environmental benefits of their labor. The project won the EU Natura 2000

award within the "socio-economic benefits" category in 2020 (European Comission., 2020), and after some initial apprehension there is now a waiting-list to join the scheme (Fundación Quebrantahuesos., 2020). A shepherd who was incorporated from the start was content with the needs-based approach of the project managers:

> *"They are the only foundation that has come here, gotten out of their car, and asked us what could be done. He did. And we are very satisfied. [. . .] And they pay us well. I mean, it is a reasonable price, not like before, and it is all on paper, signed. So then you can work in a different way. If you know that you have a goal that you need to fulfill, it is much easier to work. You know that someone will buy it, you know which day and how much you will get paid. You know it all."* (Shepherd, B26).

This project, in addition to the profitable artisanal cheese industry and the comparatively strong farming culture of the area, contributed to more optimistic views about the future of traditional farming than in location A and C. However, attacks on livestock and the associated trauma remain a challenge, notwithstanding the decreased economic severity on shepherds' and cheese-makers' livelihoods. Thus, when asked for their advice to areas where wolves may return, two civil servants who have worked throughout the process emphasized:

> *"The most important thing is to take those affected into account. Farmers, hunters, local councils. And with them achieve a "closer" [place-based] management. [. . .] They have to be part of the solution." (B31).*

> *" To sum up; I think that you have to protect the traditional activities that still remain, the few flocks that still remain, because they also have biodiversity function that is very important [. . .]. So we have to have a bit of everything, actions of mitigation, money [compensation], and, once in a while, some population controls of course." (B2).*

Location C: The Wolf, a Friend or a Foe for the Area's Goat Sector?

Due to their critically endangered status, the regional government is required to facilitate the process of wolf recovery in Extremadura, with the aim of restoring self-sustaining populations (JuntaEx, 2014). Ecological conditions for wolves in La Vera were deemed favorable by local civil servants; human population density is relatively low (27 habitants/km^2 in 2017), there are abundant ungulate populations and increasing expanses of woodlands. Except for wolf mortality in the north of Gredos, due to culling and reprisal killings (JCyL., 2019a), no physical or legal barriers prevent wolves from recolonizing the area. Some informants claimed it had already occurred (there were rumors of wolves roaming the uplands), while others believed it could be delayed by up to 10 years.

According to a stakeholder within the regional government, plans for wolf return have been made, including programs for locally based community workers, vets, and field staff, as well as economic support for general farm improvements for those residing in wolf areas (ex-post payments). There were also plans for ecological monitoring schemes before and after wolf return, in order to improve data on trophic impacts of wolves on local ungulate and mesopredator populations, and associated benefits to people (JuntaEx, 2014). The plans are partly modeled on reintroduction programs in which some of the project staff have been involved: the Iberian lynx reintroduction project in the south of the region (http://www.iberlince.eu/), and the Iberá rewilding project in Argentina (Zamboni et al., 2017), both of which have had some success at decreasing local vulnerabilities and increasing support for species recovery (Jiménez et al., 2019; Pettersson and de Carvalho, 2020).

However, the government has not communicated these intentions and has been critiqued for its failure to produce and publish a species recovery plan, which is a legal requirement for critically endangered species (Fernández Marugán, 2020). Local informants generally believed that preparation for wolf return was completely absent, and worried about the resulting proliferation of disinformation and social disputes:

> *"If we don't start talking about the wolf now, there are going to be big killings [of livestock and wolves]. And problems between neighbors, problems between people. Because there are people who are against and people in favor. But there are also people who are afraid and who don't know whether to be in favor or against."* (Local civil servant, C3).

In order to mitigate polarization, informants called for transparency and for local consultation with those susceptible to negative wolf impacts, mainly the local livestock sector. Informants within this group expressed the most apprehension toward imminent recolonization. Elderly shepherds who still remembered co-habitation agreed that the disappearance of wolves greatly facilitated livestock practices, and preferred maintaining this status quo: "*People could relax, it was marvelous! It was like they had imprisoned one of those who does a lot of robberies."* (Retired shepherd, C6).

The absence of wolves did not prevent the demise of the farming sector, however. A major driver has been the regional government's tuberculosis eradication program, which mandates killing or immobilization when cases are detected in herds (Majadas Andray, 2020). It drastically increased farmers' vulnerability, and the uncertainty over its efficacy to curtail the disease caused widespread distrust in the regional government. It has also increased friction between farming and game managers, since game are vectors of the disease, while only livestock are subject to sanitary controls. This has led some stakeholders, including livestock owners, to ponder alternative solutions and the role of the wolf in regulating ungulate populations, notwithstanding the limited evidence of this relationship: *"[. . .] the only way is the wolf, that they come back. So that it [the boar population] goes down."* (Shepherd, C26).

> *"But you know what, in Asturias and such they don't have tuberculosis, but they have the wolf. And of course, it has removed all of the game. [. . .] So in the groups [of livestock owners], among us, we have talked about it. We said "what do we want, the wolf or tuberculosis?" Because for the wolf I have management approaches, but against tuberculosis. . . "* (Shepherd, C17).

The management approaches referred to were the use of guardian dogs and night-time enclosures, which several of the shepherds had maintained, albeit to a lesser extent, to protect flocks from mesopredators and to facilitate milking. Among farmers, whose cattle often roam in the mountains with minimal supervision throughout the summer (see **Figure 4**), these measures were generally not perceived as feasible.

Notwithstanding the uncertain benefits and the potentially adverse impacts of wolf return, none of the shepherds or farmers expressed strong views against the animal itself. It was generally agreed that they had to exist, although often with caveats such as "but not here," "behind fences," or "strictly controlled." These views may be driven by changing values and a similar pragmatism as that of location B, as exemplified by a recent newspaper article: "*That's the way it is, society is going this way [toward wolf tolerance], and you have to adapt [. . .] in my opinion it is best to be aware and follow where the tide is going because going against it is not going to be possible*" (Shepherd, interviewed by Arrebola, 2021). Their main concern was usually related to how the species would be governed. This stemmed from negative experiences of top-down conservation legislation over recent decades, which they felt had limited their autonomy and ability to address the problems they faced on a daily basis (such as regeneration of scrub). Reticence toward conservation projects and legislation was prevalent, since the government failed to provide effective alternative tools, and since local participation in related decision-making was limited.

However, since the livestock sector continues to decline, a common perception was that its resistance was less of an impediment to wolf recolonization and coexistence than that of the hunting sector, which has increased in political and economic influence with the increasing demand for big game (San Miguel et al., 2017). Game managers expressed worry at the prospect of wolf return, particularly with regards to ibex, which attracts wealthy hunters from across the country and the world. Prices for old males (which have larger horns) can exceed 10,000 euros at auctions, money that would be lost in the case of wolf attacks:

> *"economically, it will be us who are affected [. . .]. With the wolf, in the Ávila area 3 years ago, we noticed the expansion from north to south toward this area. And honestly, over there it is has done a lot of damage. [. . .]. Because the wolf has killed the old animals, especially the old ones. And the problem with killing old animals is that they are the ones that are worth the most money."* (Manager of hunting association, C9).

Among village residents, trophy hunting often invoked negative emotions, and damage to the sector was not viewed with the same concern as those in the livestock sector. This is probably a legacy of deep-rooted connections to traditional landscapes and cultures, which in La Vera (as in the other study areas) form part of local identities (Urivelarrea and Beaufoy, 2019), whereas trophy hunting is attributed to foreign upper classes. However, shifting livelihoods are leading to a gradual decoupling of people's lifestyles from the landscape: "*No matter how much they live in a village, they are increasingly urbanized*" (Village resident, C16). Many of those who own land in the mountains live remotely, leasing to farmers or game managers, or leaving it in abeyance. These trends caused weaker cohesion among land managers and confusion over management responsibilities, e.g., who should clear shrub and where. Arson, which was driven by tensions between uses and the need to regenerate pastures, fed into this cycle and increased the prevalence of wildfires: "*So that abandonment, if we look at it in the short and medium term, is very worrying. Because quite immediately it is followed by fires. But are these fires because they are the natural dynamics of abandoned spaces or it is because tensions persist in that transition? I think it is more because of tensions.*" (Regional agro-ecology expert, C11).

Fire prevention constitutes a significant economic burden for the region, leading to calls for a recovery of traditional grazing practices among locals and organizations (Urivelarrea and Beaufoy, 2019; Majadas Andray, 2020). The calls cite a scheme which has proven effective in other parts of the country: the provision of commons and municipal infrastructure for shepherds, to use for minimum expense in return for environmental services (Lasanta et al., 2018; Sánchez-Mesa Martínez, 2019). One such initiative is currently being considered in one of the study municipalities, and could be instrumental in improving conditions for local shepherds. The success of this program (i.e., more goats in the mountains) could increase the risk of damage and disputes once wolves return.

DISCUSSION

Viewing our findings through the Resilient Coexistence Framework illustrates the complexity of local HCRs, and their contingency on wider SES processes. In the following section, we argue for proactive and participatory approaches to increase community capacity and willingness to coexist with large carnivores, and discuss the importance of reconciling the preservation of biological and cultural diversity.

A Systems Perspective of the Conditions of Human–Wolf Coexistence

Tracing the process of Iberian wolf expansion through our study sites, it was clear that they could adapt and flourish in habitats of varying human population density and resource availability, from the mountains of Asturias to the plains of Castile and León. Given their behavioral plasticity and dietary flexibility, wolves could probably recolonize most of rural Spain, as long as they are not hindered by people (Blanco and Cortés, 2009). This was exemplified by the increasing levels of human–wolf interactions and "bold" behavior in the vicinity of the study villages, due to decreasing buffer zones and intensity of human persecution. This phenomenon is supported by earlier findings from a nearby region of Asturias (García Hernández et al., 2019) and has been described for other large carnivores elsewhere (Ghosal et al., 2015). In conjunction with supporting conservation frameworks (Cretois et al., 2019), this points to a promising future for the persistence of self-sustaining wolf populations in Spain. As concluded by Mech (2017, p. 314), wolves "*could live almost anywhere. The real question society must face is where will people tolerate them?*"

With regards to people, the systems perspective adopted for this research revealed a more complex picture of coexistence. In our study locations, it was important to distinguish between the tolerance of wolf presence and the tolerance of wolf governance, which had different roles in driving positive or negative synergies between coexistence conditions. In location A, the continuous presence of wolves led people to think of them as an integrated part of the local system. This facilitated adaptation and an uninterrupted evolution of informal coexistence institutions, for instance visible in how livestock owners have continuously adjusted the number of guardian dogs, the relatively nuanced media coverage of wolves from the region (Delibes-mateos, 2020), and in the wolf-branding of local products to follow social trends (Martínez, 2019). The wolf was integrated, not only as a part of the economic, social and ecological system, but also in the story of S-LC (i.e., "lands of the wolf"), thus legitimizing coexistence as a way of life (Martínez, 2019). This could explain the relatively harmonious coexistence state over the last 20 years, despite its challenges and despite failing support from and for governing institutions. Similar findings were made by Dorresteijn et al. (2014) in Romania, where continuous coexistence with bears fostered the development of management tools and attitudes that effectively reduced conflicts.

Where these habits and institutions are absent, and where there are risks to carnivores and human interests, formal institutions have a crucial role to ensure that the process and outcomes of carnivore return are acceptable to local communities (Decker et al., 2016; Linnell and Cretois, 2018). Our findings from location B indicated that the failure to achieve procedural or outcome legitimacy for conservation agendas had been a major driver of wolf-related disputes in the area. Distrust in governing bodies was ubiquitous, and there were few opportunities for participation in decision-making processes. The regional government struggled to balance the preservation of natural and cultural elements of the area, also before wolves returned, which was illustrated by the continuing decline of traditional shepherd cultures within PENP (Izquierdo and Barrena, 2006; López and Pardo, 2018). This resulted in nature conservation and the survival of traditional cultures becoming framed as incompatible policy choices, by locals and in the media, and the wolf has come to embody the former. This contributed to the rejection of wolves and refusal to adapt, since the traditional land-use systems were important for local economies and identities (González-Álvarez, 2015). This fear of "losing the landscape," and its links to large carnivores, has been observed elsewhere, for instance India, Sweden, and Norway (Ghosal et al., 2015; von Essen and Allen, 2018). A shared finding between these cases was the perception that traditional management is becoming impossible due to the increasingly hegemonic position of the wilderness ethos (promoting protection over production) within public opinion and policymaking. A contributing factor in location B may be the lack of tangible benefits of wolves for locals. In contrast to location A, the topography and controversial status of wolves have deterred wolf-watching businesses, ungulate overpopulation was not among the major local concerns, and there were no incomes from hunting wolves. If effective coexistence programs are not established by the regional government within the near future, the same problems could emerge in location C, since many of the same risk elements are present: unprotected livestock, cultural importance of traditional land-use systems and distrust in governing institutions (Majadas Andray, 2020).

We contend that considerations of vulnerability and relationships to the land are imperative to understand how governance can be improved and coexistence capacity increased. Consulting locals about these factors could elucidate barriers or risks to coexistence, for instance economic precarity, and the synergies between wolves, local livelihoods, identities, and wider trends (Salvatori et al., 2021). Our findings indicate that this perspective has hitherto been missing or hampered by institutional silos in both location A and B's conservation programs. Their approaches to maintain or increase coexistence have primarily centered on ex-post payment schemes, established under the assumption that they would decrease farmers' sensitivity to and intolerance of carnivore depredation. As we have shown, and as found elsewhere (Ravenelle and Nyhus, 2017; Marino et al., 2018), these schemes have not been effective in either of these regards. Conversely, they have exacerbated distrust of the national and regional governments and official statistics, since validation and payments are slow, cumbersome, and underfunded (GCG, 2018).

The other prominent approach was to decrease exposure between livestock and wolves. The focus had been lethal control of wolves and support for a predefined set of preventative mechanisms, which was also associated to resilience issues. Some form of lethal control was strongly supported among local livestock owners and civil servants. It has been acknowledged as a necessary element of European large carnivore management, to address bold individuals that evade preventative mechanisms (Linnell and Cretois, 2018). However, locals felt that current programs failed to target the right wolves at the right time. Furthermore, both hunting and lethal control is controversial among the wider public and increasingly generate backlash and legal procedures against the regional governments (Bruskotter et al., 2017), which has been recurrent in location A and B (Blanco, 2017; Camazón, 2020). Consistent with findings in other countries (e.g., Niedziałkowski et al., 2021), pressure to expand the protected status of carnivores across Spain has mounted over the last decade (Blanco, 2017). The national government recently tabled a proposal for a complete ban on wolf hunting (MITECO., 2020), which would alter coexistence conditions in the northwest of the country. While non-lethal mechanisms have proved effective in location A, wider application, research, and innovation (for instance technological solutions) are needed to illustrate their viability under conditions such as those in location B (Eklund et al., 2017; GCG, 2018). For instance, a study from the Alps, which have similar conditions (abrupt topography, small and scattered flocks, and high tourists numbers), showed that damage continued to increase despite widespread implementation of guardian dogs and enclosures, since wolves had adapted their hunting patterns (Meuret et al., 2021). There was also weak support for these measures among cattle farmers, such as those in location B and C, since they would imply drastic changes in husbandry regimes.

A major problem with both these approaches has been their narrow focus on livestock damage and their limited effectiveness at increasing adaptive capacities in our study locations, whether to prepare for or maintain coexistence. For instance, shepherding and guardian dogs come at a significant sacrifice of time and resources for shepherds and farmers in location A, which in addition to depopulation and market globalization, decrease their economic margins and exacerbate their sensitivity to shocks. The failure to incentivize coexistence practices, for instance by subsidizing dog food and insurance, has contributed to the present situation in which the most wolf-compatible farming cultures are increasingly pushed toward intensification or abandonment (Chemnitz et al., 2019). As shown by Madden and McQuinn (2014), the resulting threat to local identities risks antagonizing local communities and fuels the narrative of the wolf as incompatible with farming. In addition to the loss of cultural heritage, the disappearance of S-LC's shepherds could undermine both the outcome and pragmatic legitimacy for coexistence, in location A and elsewhere, since they have become emblematic for their successful coping mechanisms. Location A also illustrates that the mutual adaptation on which resilient coexistence depends extends beyond protecting wolves and livestock. As shown elsewhere (e.g., Pettersson and de Carvalho, 2020; Rode et al., 2021), the whole range of these interconnections between wildlife, ecosystem dynamics, and human communities must be taken into account to gain, explain, and maintain legitimacy and coexistence capacity.

Place-Based Approaches to Prepare for Carnivore Comeback

Community adaptation to returning large carnivores should not be pursued in isolation, since it represents just one of many social, political, and ecological challenges for rural communities. Creating enabling environments for coexistence between humans and large carnivores should form part of a broader agenda to improve adaptive capacities and good governance in the light of these challenges (Darnhofer et al., 2010; Whitehouse, 2015). The associated imperative to create partnerships and bridge academic and governance silos could revitalize environmental governance, making it transformative rather than palliative (Redford and Sanjayan, 2003; Hartel et al., 2019).

Reconciling the preservation of carnivores and high nature-value farming systems, and being transparent about how and on which scale it is to be achieved (national or regional, within and/or outside protected areas), will be essential to mediate disputes and achieve just and sustainable conservation solutions (Pretty et al., 2010; Gavin et al., 2018). In our study locations, this approach could contribute to repairing the social license to operate of governing institutions (Jepson, 2005). If combined with effective communication efforts, it could also be an important element of people-people reconciliation, i.e., deliberative exchange and enhanced understanding between different social groups and worldviews (Treves et al., 2017; von Essen and Allen, 2019). Promising examples from our research include interpretation centers that jointly display the natural and cultural heritage of the region, such as that of the Iberian wolf center in Sanabria (https://centrodellobo.es/), shepherds welcoming visitors into the traditional cottages and caves to learn about local cultures and products (i.e., https://quesosdecabrales.es/), and a participatory multi-stakeholder think-tank where wolf-policy recommendations are debated and promoted (GCG, 2018). Such initiatives can contribute to decreased polarization over wolves in traditional landscapes, and prevent behaviors that increase the risk of wolf attacks (Penteriani et al., 2016) or cause friction between locals and visitors.

Other projects lead the way to more proactive coexistence approaches through their work with rural problems. The Pro-biodiversity certification in location B illustrates that when the drivers of local vulnerability (e.g., low product yield and profitability) are understood and addressed, it can enable institutions to transform disadvantages into coexistence preconditions (i.e., exclusive, environmentally beneficial products with associated recognition, and economic return for producers) (Mathie and Cunningham, 2003). Similarly in location C, plans for ex-ante payments within wolf areas, and the provision of municipal shepherd infrastructure, have the potential to reverse negative trends within the traditional sector, addressing its inherent issues with dignity, security, and profitability (Lasanta et al., 2018). Rather than being prescriptive and retrograde, "custody of the territory" and ex-ante schemes enable stakeholders to seek inspiration from traditional knowledge and practices, while retaining flexibility to adapt to current societal, technological, and land-use trajectories (Fuentes et al., 2011; Persson et al., 2015). When realized under the banner of coexistence, the projects could render large carnivores a positive force for change in traditional landscapes, where the loss of biological and cultural diversity often share drivers, e.g., wildfires or ungulate overpopulation (Henle et al., 2008; Pretty et al., 2010; Varga, 2020). Gaining local legitimacy for compensation performance schemes would benefit greatly from the presence of positive demonstration places and projects, which illustrate that functioning HCR's are possible. It is therefore imperative to ensure livelihood resilience and acknowledge existing coexistence areas such as location A, so that they can remain a source of hope and inspiration for recolonization areas (Bennett et al., 2015; Pound, 2015).

Addressing conflicting needs and value framings with limited space and funding will remain a continuous challenge. This could become evident in location C, where programs to improve coexistence between shepherds and wolves may be unpopular with the hunting sector. Similarly, within certification schemes, the inclusion of some usually implies the exclusion of others, and since they are based on exclusivity, they cannot exceed certain quantities of output without reducing prices. These issues may never be fully resolved, and compromises will require an active dialogue about societal priorities, in addition to transparent decision-making, to ensure procedural as well as distributional justice of large carnivore governance (Bennett et al., 2019; Salvatori et al., 2021). As emphasized by Redpath et al. (2013), the co-occurrence of conservation and livelihood preservation depends to a large extent on the willingness of parties to acknowledge and discuss shared problems, stresses and uncertainties, and address them collaboratively.

Reflections on the Coexistence Approach and Future Research Directions

Elucidating conditions that permit large carnivores to survive and reclaim territory, and that enable people to adapt, is vital to aid decision-makers in ensuring resilient coexistence in the face of global change (Carter and Linnell, 2016; Pooley et al., 2020). The combination of a coexistence lens with the proposed theoretical framework proved useful in expanding knowledge of how we can explain and support adaptive capacities. By focusing on coexistence and its underlying drivers, rather than conflict, and using the framework to explore relevant interconnections, we could illuminate positive factors and drivers that otherwise risk being overlooked, since harmonious relationships generate less attention and resources than dysfunctional ones (Fernández-Gil et al., 2016; Pooley et al., 2017). The framework also enabled us to understand past issues and failures within their wider social-ecological context, and to identify trends that may alter current HCR for better or worse. It is thereby useful as a heuristic tool for descriptive analysis of both states and pathways to coexistence. This knowledge can be used to generate future scenarios based on local conditions, and help articulate the transformations needed to progress toward them (Bennett et al., 2015).

However, thinking of HCR as a complex adaptive system means that the approach requires and yields intricate and large quantities of data. It is important that the user(s) have good connections to the location under analysis, in order to select and correctly interpret the factors that are most relevant to local coexistence capacity. We therefore encourage the use of the framework by inter- and trans-disciplinary working groups (see Hartel et al., 2019), or to apply it in iterative processes with community groups to co-produce knowledge and ensure the validity of the research outcomes. For instance, it could be useful to support focus groups and scenario workshops within participatory action research (see Milich et al., 2020).

More empirical studies of the social and ecological impacts of large carnivore (re)colonization, the local viability of different preventative mechanisms, and of the various functioning institutions that are already in place (including novel and traditional, participatory or top down) are needed. Building this evidence-base is essential to corroborate and validate the increasingly contested theory and rationale of large carnivore restoration and reintroduction (Treves et al., 2017; van Eeden et al., 2018). This knowledge is also needed to expand large carnivore discourse and policy beyond its current focus on the past (both practices and states of nature), to more flexible and inclusive models for the future. Lastly, continued research on how to achieve equitable representation and knowledge co-production in participatory processes are needed to ensure legitimate outcomes. For instance, on who and how to represent the rights of wildlife, and how to avoid "tyranny of the majority" while adhering to the legitimate concerns of non-local people regarding the intrinsic values of nature and the use public goods (Lockwood, 2010; López-bao et al., 2017).

CONCLUSIONS

In a time where environmental agendas are being advanced to address the climate change and biodiversity crisis, it is crucial to establish just and effective methods of working with rural communities (Salvatori et al., 2021). We contend that facilitating coexistence with large carnivores in traditional pastoral landscapes can be symbolic of a wider pursuit to achieve sustainable and legitimate conservation governance and rural development programs. Given the continued expansion of large carnivores across Europe (Chapron et al., 2014; Cimatti et al., 2021), more inclusive and innovative approaches are needed to manage these species across human-induced borders, learn about local barriers and opportunities to coexistence, and how to (re)distribute resources to ensure that co-adaptation is possible. Existing knowledge, institutions, and projects that could shorten the transition period for coexistence abound, but more effective methods to identify, learn from, and support them are needed (Bennett et al., 2015; Hovardas et al., 2017). This requires reconfigured relationships and knowledge exchange between urban and rural stakeholders (including policy-makers, scientists, locals, and NGOs) to achieve productive dialogues and reconcile the many needs and priorities for the countryside in the future. Ultimately, the aim of conservation policy is not limited to saving contested species, but about fostering harmonious relationships between humans and the other species that inhabit this planet (Adams, 2015).

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available. In order to protect the anonymity of study participants according to the terms of our ethics approval, we cannot share the raw data, which may contain identifiable information. Requests to access the datasets should be directed to Hanna L. Pettersson, eehlp@leeds.ac.uk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee at the University of Leeds AREA 19-018. The patients/participants provided their written or oral informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HP was responsible for conception, study design, data collection, data analysis, drafting of manuscript, and visualization. JL-B contributed wolf expansion data and input on relevant study sites. All authors assisted in review and editing of the manuscript and approved of the final version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcosc.2021.710218/full#supplementary-material

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