



Human-Large Carnivores Co-existence in Europe – A Comparative Stakeholder Network Analysis

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Improving human co-existence with large carnivores (LC) is considered necessary for reaching one of the goals of the EU Council Directive on the conservation of natural habitats and of wild fauna and flora (1992). This study is part of the EU LIFE project EuroLargeCarnivores, providing a scientific analysis of current stakeholder networks of the project partners (mainly WWF offices), a necessary foundation for “Improving human co-existence with large carnivores in Europe through communication and transboundary cooperation.” We conducted systematic participatory and transdisciplinary primary research in 14 European countries. The research design consists of three phases: stakeholder identification (Phase 1), participatory stakeholder-mapping (Phase 2a), a comparative network analysis (Phase 2b), and an Individual Stakeholders’ Perception Survey (Phase 3). We use the realistic method based on perceptions of the stakeholders involved. Phase 1 identifies 10 relevant Stakeholder Categories and specific agents. Phase 2a provides distinct comprehensive regional stakeholder maps with a special focus on the quality of multilateral relationships and stakeholders which are not yet actively involved in the networks. Phase 2b concludes with a comparative network analysis. The composition, density and quality of stakeholder networks as well as the interconnectivity of the project partners differ substantially. We reveal common denominators across Europe, varying relationships between stakeholder categories, and the potential positive role of foresters and veterinarians, for example. Phase 3 provides complementary insights into the involvement of the 10 Stakeholder Categories and their attitudes to large carnivore management. It also tests the institutional representation of membership in formal organizations. We challenge the perception of distinct stakeholder categories and whether involving institutional representatives in networking activities is sufficient. The results indicate the need for a more comparable implementation of EU regulations at national level, and for regional adaptations of support strategies for distinct stakeholders and networks. Based on current conflict constellations and best practice examples, we conclude with recommendations for strategic stakeholder engagement to: (a) broaden and strengthen the stakeholder networks to (b) improve human-human conflict management in the context of expanding large carnivore populations and their management.

Keywords: stakeholder engagement, participatory mapping, network functionality, large carnivores, wolf, bear, conflict management

INTRODUCTION

A significant recovery and expansion of various large carnivore populations, especially of the brown bear (*Ursus arctos*), Eurasian (*Lynx lynx*) and Iberian lynx (*L. pardinus*), as well as the wolf (*Canis lupus*), has been observed throughout Europe (Kaczensky et al., 2013; Linnell, 2013; Chapron et al., 2014). Various reasons are identified in different countries, such as the progressive but uneven implementation of the EU Habitat Directive (Trouwborst et al., 2017; Eur-Lex, 2019) in 28 EU member states, the dismantling of the “iron curtain” as a physical barrier to wildlife migration and the transformation of military training areas into nature conservation areas (e.g., Gerner and Schraml, 2014), generally increased public acceptance of species conservation, increased prey species availability (e.g., red and roe deer, wild boar) (Bragina et al., 2018) as well as continuous human depopulation of rural areas (Raugze et al., 2017). Large carnivores are partially unexpectedly re-appearing, spreading and thriving, not only in natural habitats but also in more or less densely inhabited cultural landscapes (Kaczensky et al., 2013; Fechter and Storch, 2014; Trouwborst et al., 2017; Heurich, 2019).

The growing populations of large carnivores are considered an ecological achievement but also cause various conflicts. Improving the actual or expected co-existence of humans and large carnivores throughout Europe is a declared aim of many nature conservationists, wildlife biologists, and institutions concerned with the environment (European Commission, Environment Directorate-General, 2013; Chapron et al., 2014; Redpath et al., 2015; Chapron and López-Bao, 2016; Ronnenberg et al., 2017; Frank et al., 2019; Hartel et al., 2019; MLR, 2019; Popescu et al., 2019). Achieving this in the field has proven very difficult. The topic of increased land-sharing and land-sparing issues between human and wildlife has received much attention in academia in recent years, especially when concerning large carnivores (Omondi et al., 2004; Treves et al., 2006, 2009; Baruch-Mordo et al., 2011; Pooley et al., 2016; Trouwborst, 2018; Schraml and Heurich, 2019).

Much research has been conducted to analyze “human-wildlife conflicts” (Peterson et al., 2010; White and Ward, 2010) and “human-carnivore relations” (Lozano et al., 2019), or even “conflict between large carnivores and livestock” (Van Eeden et al., 2017) which hamper broader acceptance of large carnivore redistribution and satisfactory management of human-carnivore co-existence. Most publications researching conflicts related to large carnivores focus on animal damage to entities humans care about (Peterson et al., 2010) and on single large carnivore species such as brown bears in the United States or wolves in Europe (Lozano et al., 2019). Very few compare stakeholder attitudes toward two or more species, as do Fernández-Gil et al. (2016). Much research focuses on three stakeholder categories: nature conservationists, hunters and/or livestock owners (e.g., Williams et al., 2002; Naughton-Treves et al., 2003; Luchtrath, 2011; Peterson et al., 2018). Meta-analyses are the main sources of comparative information. Linnell (2013) summarizes a multitude of topic-related studies (e.g., Kaltenborn et al., 1999; Naughton-Treves et al., 2003; Maser and Pollio, 2012; Redpath et al., 2012) and derives a comprehensive set of 17 stakeholder categories

which are likely to be important for large carnivore conservation in various global contexts.

Stakeholders in large carnivore recovery encompass individuals (i) who are influenced by the respective species, (ii) who influence the species population, and (iii) who have an interest in large carnivores (Linnell, 2013). In both popular and academic literature, stakeholders are usually assigned to distinct groups attributed with common characteristics (e.g., occupations such as farmers, scientists) and perceptions (e.g., supporters or adversaries of certain ideas and developments). Stakeholders may strive on behalf of their respective interests individually or as organized institutions, independently, or in communication with each other. Existing positive or negative (but also non-existent) relationships between different stakeholders again form the nucleus of more or less inclusive, interrelated and constructive stakeholder networks which are able to manage conflicts to a greater or lesser extent, including in the context of conservation (Redpath et al., 2012; Gerner and Schraml, 2014; Jacobsen and Linnell, 2016; Manolache et al., 2018). Hartel et al. (2019) emphasize that the size and composition of stakeholder networks and the amount and quality of internal relationships are crucial to conflict management efforts.

Most primary research up to now has focused on one country or region (Peterson et al., 2010) or on one or very few stakeholder categories or single networks. We have conducted comparative social science research on LC-related stakeholder networks in 14 different European countries. Our study is based on the concept that animals can only be the subject-matter of a conflict, but not a party to it, as animals do not enter consciously into a conflict in a human sense (Peterson et al., 2005, 2010; Bouwma et al., 2010a,b; Luchtrath, 2011; Redpath et al., 2012; Linnell, 2013). We therefore distinguish between the “impacts” that large carnivores have on human interests directly (e.g., when a wolf kills a sheep = negative, new income opportunities = positive) or indirectly (e.g., perception of threat = negative, or delight = positive) or impacts humans have on large carnivores (e.g., inhibiting infrastructure, illegal killings), and “conflicts” that occur between humans where different stakeholders have different motives, forms of knowledge, priorities, values, levels of affectedness or benefits, and means to enforce these.

The study is part of the EU LIFE-funded project EuroLargeCarnivores, with the project beneficiaries (European Commission, undated; WWF Germany, undated) (mainly WWF offices and closely related environmental NGOs) also participating as research partners.

We answer the following guiding questions:

- (i) What are the benefits of systematic participatory and transdisciplinary stakeholder identification (Phase 1)?
- (ii) How do the various stakeholder networks compare to each other, with a special focus on composition, density, quality of relationships, and the role of special agents (Phase 2)?
- (iii) Based on Phase 3, does the acceptance of the legal protection status of large carnivores differ from the acceptance of their local presence?

- (iv) Do the attitudes of institutionally organized stakeholders sufficiently represent those of non-institutionally organized stakeholders?
- (v) Do multiple stakeholder occupations challenge the distinctness of stakeholder categories?

We conclude with recommendations for strategic stakeholder engagement to enhance the functionality of stakeholder networks to mitigate conflicts related to the recovery of large carnivore populations in Europe.

MATERIALS AND METHODS

The research took place in 14 European countries. It was conducted in three phases (Figure 1):

1. Phase 1: the stakeholder identification process,
2. Phase 2: a series of participatory stakeholder network mapping workshops (2a) followed by a comparative network analysis (2b),
3. Phase 3: a broad online Individual Stakeholders' Perception Survey.

Austria (AT), Croatia (CR), France (FR), Germany (DE), Italy (IT), Slovenia (SL), Poland (PL), Hungary (HU) Romania (RO), Slovakia (SK), Ukraine (UA), Portugal (PT), and Spain (ES) participated in the study. Primary data collection was conducted by specifically trained project partners, mainly WWF Offices and related NGOs, between April 2018 and March 2019 in 12 local languages, but reported in English. It was essential to engage transdisciplinary researchers to systematically build up upon their primary stakeholder networks, i.e., pre-existing contacts with various stakeholders.

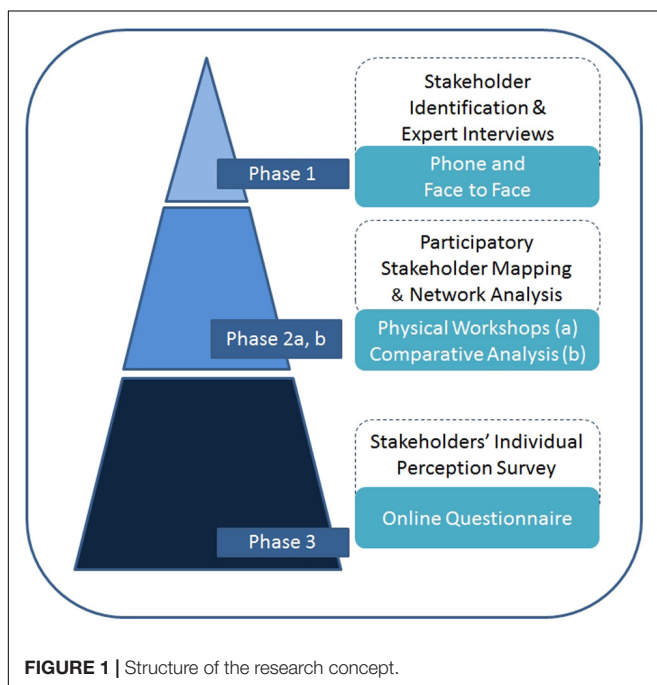


TABLE 1 | Data sets derived from three research phases.

Phase	No. of Countries	Type of Data Set	Amount
1	14	Expert Interviews	161
2	13	Stakeholder maps	15
3	12	Filled questionnaires	1262

Throughout the three phases of data collection, we gathered expert interviews, stakeholder maps and questionnaires from a total of 14 countries on the European continent (Table 1).

Stakeholder Identification (Phase 1)

In Phase 1, we pursued a step-wise participatory stakeholder identification saturation process until no additional stakeholders were identified by (i) systematic compilation of existing contacts with stakeholders in each country, (ii) internet research to determine further interest groups positioning themselves publicly in the context of management of large carnivore populations in regional languages, (iii) telephone interviews with regional experts identified beforehand, which included asking for recommendations of further relevant stakeholders (Supplementary Material 1).

We applied the realistic method of network member identification based on the perceptions or the behavior of the agents themselves. Our snowball-identification process is a sub-method of the realistic one, in line with the reputation method according to Jansen (2006) where experts define a core set of agents who then add further agents that are relevant within the network. In our study, the project partners are defined as experts, and not external scientists as described in Manolache et al. (2018). In these three steps of Phase 1, project partners were encouraged to explicitly consider and enlist stakeholders with different or even contradicting points of view.

In a next step, we compared Linnell's (2013) stakeholder categories with the range of stakeholders identified in Phase 1. We derived 10 Stakeholder Categories, for which representatives were interviewed by telephone or recommended at least 5 times.

Regional foci were set by the project partners' locations and operating range, usually on provincial scale, but no geographical criteria were prescribed.

Participatory Mapping of Stakeholder Networks (Phase 2a)

The first step of the participatory stakeholder network mapping process aimed to conduct workshops, involving ideally two representatives of each stakeholder group previously identified in each study region, as well as relevant individual stakeholders. The last step of the stakeholder identification process took place during these physical workshops. Based on the resulting list of stakeholders (individuals, public institutions, associations, non-governmental organizations, private parties) the participants were guided by impartial moderators to develop a map of their common network. They were asked to position all stakeholders using paper cards and a pin board and to discuss and depict the quality of their respective bilateral relationships.

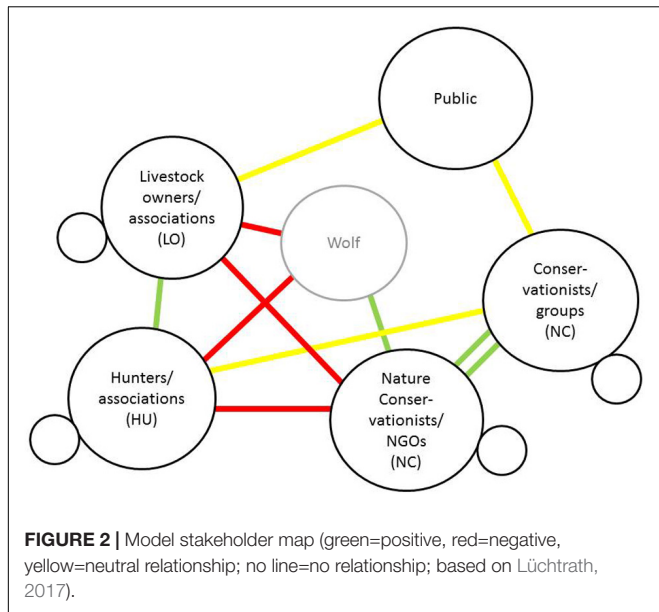


FIGURE 2 | Model stakeholder map (green=positive, red=negative, yellow=neutral relationship; no line=no relationship; based on Lüchtrath, 2017).

Even though the process was aiming for classical sociograms, the instructions developed for the participatory mapping process offered the option to put the large carnivore species in focus on the map (Latour, 2005; Lüchtrath, 2017). **Figure 2** shows our illustrative model of a stakeholder map used as instructive material and as visual aid for the regional participatory stakeholder mapping workshops.

Comparative Stakeholder Network Analysis (Phase 2b)

All regional stakeholder maps (see Phase 2a) were transformed into tables displaying the same information in a numeric format – called socio-matrices (**Table 2** and **Supplementary Material 2**). Socio-matrices can be analyzed through matrix algebra, which is of great importance, especially to large networks (Lovric, 2014). As a first step, we listed all stakeholders identified as relevant in each stakeholder map symmetrically in both axes of the matrices and depicted existing relationships between them in the intersecting cells. We equalized relationships between different stakeholders to be mutual non-directed: absent (gray) or present (colored) (**Table 2**). Present relationships were given algebraic signs and specific colors for different qualities: positive (“+”, green), negative (“-”, red), neutral (“0”, yellow). The intensity levels of the relationship are indicated in absolute numbers from “1” (normal intensity) to “3” (very high intensity). The gray intersecting cells, indicating pairs of stakeholders that did not define any sort of mutual relationship, have been given the value -4. In social sciences, having no relationship is valued as even less promising for future co-operation than having a poor relationship (Jansen, 2006). As the mutual relationships are undirected, the matrix is symmetric along the diagonal (Fuhse, 2018) (**Table 2**).

All stakeholders documented in the original socio-matrices (Phase 2a) were then allocated to their respective Stakeholder Categories. The condensation of the original socio-matrices

TABLE 2 | Model socio-matrix based on the model stakeholder map (see **Figure 2**).

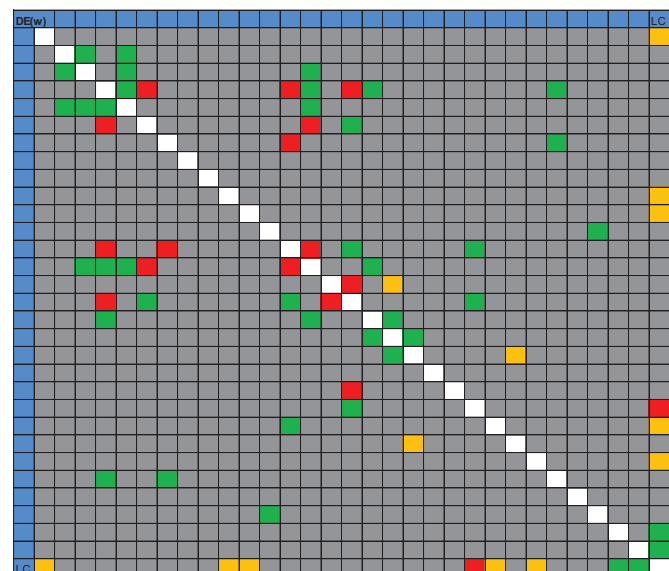
	Livestock owners / ass. (LO)	Hunters / ass. (HU)	Nature Conservationists / NGO (NC)	Conservationists / groups (NC)	Public
Livestock owners / ass. (LO)	0	+1	-1	-4	0
Hunters / ass. (HU)	+1	0	-1	0	-4
Nature Conservationists / NGO (NC)	-1	-1	0	+2	-4
Conservationists / groups (NC)	-4	0	+2	0	0
Public	0	-4	-4	0	0

The intersecting cells depict the quality of the relationship between the different pairs of stakeholders: +2 (green) = very good; +1 (green) = good, 0 (yellow) = neutral, -1 (red) = bad, -2 (red) = very bad, -4 = no relationship.

resulted in standardized 11 × 11 socio-matrices. If different stakeholders belonging to the same category display similar, e.g., only positive (+), relationships to another category, the standardized matrices again depict these relationships as positive (+). The same method was applied to negative (-), or neutral (0) relationships. Combinations of neutral and positive, or neutral and negative relationships were simplified toward the overall tendency of the relationships (positive or negative). If different stakeholders of the same category display contradictory relationships in relation to another category, this is documented as an “internally contradictory” relationship, e.g., “-1 to + 1” highlighted in orange color (**Tables 3, 4**).

Chord diagrams (Chen and Yang, 2010; Hennemann, 2013; Nita et al., 2019) are used to visualize the aggregated relationships

TABLE 3 | Scheme of the original actors-matrix with all stakeholders mapped around “Wolf” in Germany (DE).



LC stands for the large carnivore species in focus. The blue cells represent the respective amount of individual stakeholders listed during the workshop. Colors of the intersecting cells reveal the quality of the relationships between any pair. Green = positive relationship, yellow = neutral relationship, red = negative relationship, gray = no relationship.

TABLE 4 | Standardized socio-matrix for Germany (DE) categorized for wolf (W) as focus animal species and 10 Main Stakeholder Categories.

D*	DE(W)	LO	HU	NC	MA	POL	SCI	FOR	TOUR	LOCR	MEDIA	OTHER
0,3	LO		0 to +1	-1 to +2	-4	-4	-4	0 to +2	-4	-4	-4	-4
0,3	HU	0 to +1		-1 to +2	-4	-4	-4	-1 to +2	-4	-4	-4	-4
0,3	NC	-1 to +2	-1 to +2		-4	-4	-4	-4	-4	-4	-4	0 to +2
0,1	MA	-4	-4	-4		-4	-4	-4	-4	-4	-4	2
0	POL	-4	-4	-4	-4		-4	-4	-4	-4	-4	-4
0	SCI	-4	-4	-4	-4	-4		-4	-4	-4	-4	-4
0,3	FOR	0 to +2	-1 to +2	-4	-4	-4	-4		-4	-4	-4	-4
0	TOUR	-4	-4	-4	-4	-4	-4	-4		-4	-4	-4
0	LOCR	-4	-4	-4	-4	-4	-4	-4	-4		-4	-4
0	MEDIA	-4	-4	-4	-4	-4	-4	-4	-4	-4		-4
0,2	OTHER	-4	-4	0 to +2	2	-4	-4	-4	-4	-4	-4	

LO = Livestock owners, herders, domestic animal keepers and farmers & associations, HU = Hunters and associations, NC = Nature Conservationists, MA = Ministries and Administration, POL = Policy makers, SCI = Scientists, For = Foresters, TOUR = Tourism Sector, LOCR = Local Residents, MEDIA = Media, OTHER = Other. Green cells (0 to max +2) summarize neutral to positive relationships between these aggregated stakeholder categories. Gray cells (4) indicate no relationship. Orange cells reveal that different stakeholder belonging to the same category maintain relationships of different qualities with partners from another category. Striped orange cells at the intersections within one stakeholder category therefore indicate inconsistent standard stakeholder categories with contradictory relationships. D* indicates the standardized degree of interconnectedness of the resp. Stakeholder Category (without LC). The Density of this Network is 0.13.

between the 10 Stakeholder Categories at European level, after reducing relationship indicators to binominal values:

1. any type of relationship existing: yes = 1, no = 0.
2. negative relationships: yes = 1, no = 0.
3. positive relationships (including existing neutral relationships): yes = 1, no = 0.
4. “internally contradictory” relationships received a 1 in both categories (positive and negative).

During the second step of the comparative network analysis, we use the standardized socio-matrices to assess and compare the quality of the stakeholder networks according to three criteria: (1) density of the network, (2) degree of interrelatedness between the stakeholder categories and (3) involvement of “other” agents.

The density of the network describes how many relationships are developed between all agents, in comparison to the amount of possible relationships. It can vary from 0 to 1, with 1 as all and 0 as none of the possible relationships being established (Fuhse, 2018). The standardized degree provides information about how many relationships one agent or stakeholder category has established within the network. Agents with many relationships are supposed to be more important players within the network or at least better connected than others (ibid.).

Individual Stakeholders' Perceptions Survey (Phase 3)

The Individual Stakeholders' Perception Survey was conceptualized as an online survey (Google, 2008). During the ongoing project activities it was called “Baseline Survey Large Carnivores in Europe 2018” (Supplementary Material 3). It covers 10 general topics plus socio-demographic information with a total of 77 questions (single and multiple choice; open questions). In this paper, we focus on the topic: “Acceptance of LCs, their conservation status, and belief in future management potential” (Questions 3, 4, 12 of the original questionnaire).

The demographic section (original questions 67 ff.) offered respondents a multiple-choice self-allocation to 17 preselected occupations related to large carnivore issues, to be able to account for individuals who may be affiliated with more than one stakeholder category. We used snowball sampling to disseminate the survey, starting with all project partners who distributed it to their network contacts and other stakeholders identified in Phase 1 and Phase 2 (Atkinson and Flint, 2004; Lüchtrath, 2011). We used a mixed-mode mail and web survey (Dillman et al., 2014; Poudyal et al., 2020). Some stakeholders were contacted and interviewed in person with a subsequent transfer of the protocol into the online form, to also reach important stakeholders with little or no internet access. All respondents were explicitly asked to further recommend survey participation to other potential stakeholders and to share the link with other interested parties.

Comparing Attitudes Toward (Future) Wolf Management in Europe

We performed a quantitative statistical comparison of the response behavior of institutionally organized members of three selected stakeholder categories, namely Hunters, Livestock Owners (including herders and other domestic animal keepers) and Nature Conservationists. They are considered highly relevant in most related scientific literature (Linnell, 2013) and will be shown to be active in all stakeholder networks described here. The analysis is based on the following three questions (out of 77):

1. Q1: *Do you think the wolf, bear, and lynx should be legally protected?*
Answers: single choice on a 3-level nominal scale (Chi-Square-Test).
2. Q2: *Do you think that these animals should be actively kept out of your local region?*
Answers: single choice on a 3-level nominal scale (Mann-Whitney U-Test, Kruskal Wallis H-Test).

3. Q3: *Currently, some populations of large carnivores are growing and animals are increasingly migrating within Europe. Do you believe that an increase of large carnivore populations could be managed to your satisfaction?*

Answers: Single choice on a 4-level ordinal scale (Mann-Whitney U-Test, Kruskal Wallis H-Test).

Testing Representation by Institutionally Organized Stakeholders

To probe the assumption of institutional representation, we compared the response behavior of institutionally organized stakeholders with those stating no institutional affiliation within the same three ubiquitous stakeholder categories.

RESULTS

Stakeholder Identification (Phase 1)

As a result of Phase 1, we identified 10 Stakeholder Categories:

FOR: Foresters, including forest owners, managers, workers; all types of forest ownership and related occupations; individuals and associations.

HU: Hunters, individuals and associations.

LO: Livestock owners, herders (shepherds), domestic animal keepers and farmers, mainly of sheep, goats, but also cattle, horses and other domestic animals in extensive production systems, as well as other farmers; individuals and associations.

LOCR: Local residents, especially stakeholders with residence in or near LC territory or migration paths. In particular, this addresses people without specific affiliation to one of the other categories.

MA: Ministries and administration for the environment, nature conservation, agriculture and/or forestry.

MEDIA: Media, including journalists, video/film, photographers.

NC: Nature Conservationists, Environmentalists, NGOs, National Parks; professional conservationists, practitioners, volunteers, interested individuals.

OTHER: stakeholders mentioned rarely (≤ 5), social services (e.g., police, educational institutions), poachers, veterinarians, game/wildlife managers, berry/mushroom pickers).

POL: Political representatives at local, regional, and/or national level.

SCI: Scientists and researchers, esp. wildlife biologists, ecologists, sociologists, geneticists.

TOUR: Tourism Sector, tourism in general, eco-tourism, tourism operators, and tourists.

Table 5 depicts the numbers of representatives of each category interviewed in comparison to those categories recommended by interviewees for more involvement. Ranked according to amounts of interviews, results show that NCs (41) and representatives of related MAs (35) were interviewed more often than LOs (23) and HUs (19). Representatives of these four stakeholder categories were contacted in each study region, contrary to those of other categories. Project partners'

TABLE 5 | Quantitative comparison of interviews and recommendations for further involvement by stakeholder category (on European scale).

Stakeholder Category	No. of Interviews	No. of Recommendations	No. Interviews Δ Recommendations
NC	41	50	22%
MA	35	55	57%
LO	23	74	222%
HU	19	55	189%
SCI	12	22	83%
TOUR	11	16	45%
POL	10	27	170%
MEDIA	6	4	-33%
FOR	2	20	900%
LOCR	0	15	+++
OTHER	2	6	+

The stakeholder categories are ranked according to number of interviews. NC = Nature Conservationists, MA = Ministries and Administration, LO = Livestock owners, herders, domestic animal keepers and farmers, HU = Hunters, SCI = Scientists, TOUR = Tourism Sector, POL = Policy makers and pol. representatives, MEDIA = Media, FOR = Foresters, LOCR = Local Residents. The colors indicate the rated sufficiency of project partners' contacts to the different stakeholder groups: green = sufficient (high amounts of interviews and <100% additional recommendations for involvement by interview partners), yellow = need for increased involvement (high amounts of interviews and >100% additional recommendations for involvement by interview partners), red = strong need for more involvement (very few or no interviews but >>100% additional recommendations for involvement by interview partners).

contacts to NCs and related MAs as well as to SCIs are rated as sufficient (high amounts of interviews and <100% additional recommendations). More importantly, the comparison gives a first indication of the importance of expanding the respective networks. Interviewed experts strongly recommended the increased involvement of LOs and HUs (high amounts of interviews but also >100% additional recommendations), as well as of other stakeholder categories such as POLs (10:27), FORs (2:20), and LOCRs (0:15) (very few or no interviews but >> 100% additional recommendations). SCIs (12), TOURs (11), and MEDIA (6) are collectively not considered as very important stakeholders (few interviews but also <100% additional recommendations).

Stakeholders and individual agents identified as relevant in fewer than 5 cases are summarized as "Other." These specific agents are noted separately and their potential relevance is discussed individually.

The interview results provide a first indication that other institutions and individuals beyond these 10 stakeholder categories may play an important role in different circumstances. The ones interviewed or recommended in the expert interviews are social services (police, education), veterinarians, poachers, and infrastructure developers, summarized in the "Other" category.

Participatory Mapping of Stakeholder Networks (Phase 2a)

In 12 workshops, participants mapped stakeholder networks with wolves as the focus animal (see **Table 6**). HR and SL convened

TABLE 6 | Focus animals of stakeholder maps per country.

Country	AT	DE	ES	FR	HR	HU	IT	PL	PT	RO	SL	SK	UA
Focus Animal													
Wolf	X	X	X	X	X	X	X	X	X		X	X	X
Lynx													X
Bear										X			X

their stakeholders in one common workshop, but developed two distinct maps for each country. In RO, the workshop participants and the stakeholder network mapping process were primarily concerned with bears, developing one map with this LC in focus. The reasons given for this in the original workshop report were that “the stakeholders considered that the wolf [does] not attack people, and [...] is not of ‘hunting interest.’” In one workshop (UA) three different network constellations were mapped, depending on the animal species in focus (wolf, lynx, and bear). We will therefore primarily present and interpret results in the context of wolves. Specific bear and lynx related results are presented as exemplary insights.

The resulting 15 original stakeholder maps depict the stakeholder networks of the project partners as perceived by the workshop participants. They are therefore topical reflections and do not necessarily give the full picture of existing stakeholder networks related to LCs in each country. The maps display a great structural variety. Three maps are classical socio-grams depicting only human interest groups and their relationships. Twelve maps resemble actors’ networks and include relationships with the LC in focus. The number of individual stakeholders, groups and institutions depicted differs substantially from country to country. The comparison of all original socio-matrices shows that the depicted number of stakeholders per network ranges from very high and detailed (56 in FR, 30 in DE, 21 in AT) to very small and generalized (9 in ES, 8 in RO). Some stakeholders were depicted as relevant by the workshop participants even if no relationships were identified between them and any other stakeholders (see Phase 2b).

Comparative Stakeholder Network Analysis (Phase 2b)

Following the exemplary aggregation and analysis of stakeholder mapping data from Germany, we present the comparative analysis of the different stakeholder networks based on the respective standardized socio-matrices.

The following contrasting juxtaposition of an original actors’ matrix and the standardized socio-matrix derived from it exemplifies the analytical potential of this method. In the case of Germany, 30 individual institutions were identified as stakeholders in the project partner’s context. Eighteen of these institutions were depicted as interrelated with 1 to 7 other institutions out of 29 possible relationships. Twelve additional institutions were listed on the map, but without depiction of any relationships with other stakeholders.

This initial situation can be seen in **Table 3**. It tabulates the original stakeholder map as an actors’ matrix with the original number of stakeholders ($N = 30 + LC$), and the depicted qualities of interrelationships: positive (green), neutral (yellow), bad (red). Gray cells indicate that no relationship between the respective two stakeholders has been depicted during the workshop.

The allocation of these 30 institutions to our 10 Stakeholder Categories produces a surprising result: They only represent four stakeholder categories (LO, HU, NC, and FOR).

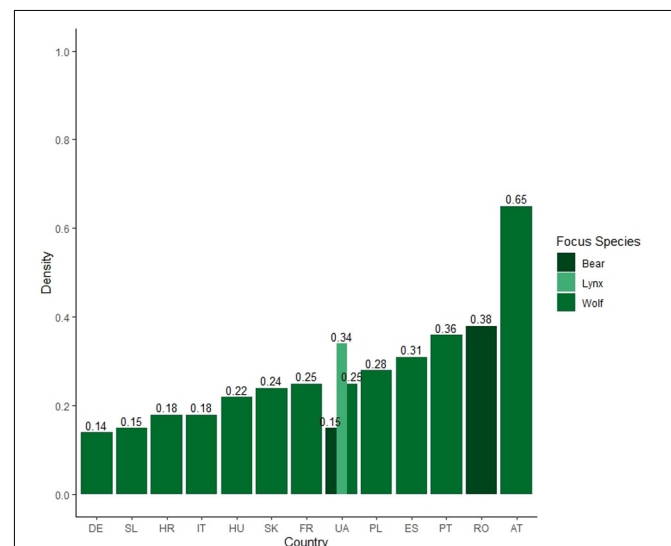
Table 4 exemplifies the respective standardized socio-matrix derived from this actors’ matrix, modeling the current German project partner’s stakeholder network with a focus on wolves.

The maximum standardized degree identified for any stakeholder category is 0.3. In addition, the agglomeration shows that HU and NC display internally contradictory relationships to other stakeholder categories, from bad (−1) to very good (+2); shaded orange cells visualize this internal inconsistency. No active relationships are depicted between them and the other 6 stakeholder categories resulting in a low network density of 0.13.

In **Table 4**, it also can be seen that there is no relationship depicted between NC and FOR, even though the latter seem to play an active and mostly positive role in communications with LO and some HU, as well as “OTHER.” In the German case these other stakeholders are educational institutions, carnivore damage experts, voluntary wolf commissioners and Wiki Wolves (Voluntary Herd Protector Society), depicted to have neutral or positive relationships with NCs and MAs, though not in relation to LOs and HUs.

Varying Densities of Stakeholder Networks

The densities of the different standardized socio-matrices are depicted in **Figure 3** with Germany (DE) displaying the lowest and Austria (AT) the highest density. The maximum 1 would be

**FIGURE 3** | Densities of the different stakeholder networks based on standardized socio-matrices.

reached if all 10 Stakeholder Categories plus “OTHER” had been depicted to have direct relationships with each other.

The three different columns displayed for Ukraine (UA) present the different densities derived from three stakeholder maps prepared separately for the three different LC species in focus during the same workshop. Compared to the network concerned with wolves, the density of the project partner’s network is distinctly higher when addressing lynx issues and lower for bear issues. Contrary to this finding, a discussion between RO workshop participants came to the consensus that all human-human stakeholder relationships in their network would “remain unchanged (same as for brown bear)” if wolf were the LC species in focus (original workshop report, unpublished).

Comparison of Stakeholder Networks at Country Level (Three Examples)

All 15 standardized socio-matrices, including their calculated densities and each stakeholder category’s standardized degree of interconnectivity, can be found in an easily readable format in **Supplementary Material 2**.

The main network characteristics can be detected by following the exemplary analysis and comparison of the three standardized socio-matrices of Austria (AT), Slovenia (SL), and Poland (PL) (**Table 7**). Numerous colorful columns and cells in a standardized socio-matrix indicate actively interrelated stakeholders from many categories, i.e., they reflect large networks with a high density (e.g., AT). Conversely, socio-matrices of small and poorly interconnected networks are dominated by gray columns and cells indicating the involvement of stakeholders from only few categories with few relationships depicted between them (e.g., SL). In socio-matrices with mostly positive relationships between stakeholder categories, the color green dominates (e.g., PL), in contrast to predominantly conflictual relationships dominated by red and orange cells (e.g., SL).

Results from Austria display a large network of the project partners (9 of 10 Stakeholder Categories involved) with a comparatively high density (0.65) and an almost balanced distribution of positive, neutral, and negative relationships. The parties perceived as the main conflictual network members are HUs and MEDIA followed by NCs, MAs and LOs (in the order of the amount of negative relationships and their intensity). All stakeholder categories involved are depicted with an identical degree of interrelatedness of 0.8.

In the Austrian project partners’ network, SCIs stand out as the only stakeholder category with only neutral or positive relationships to stakeholders from other categories, followed by POLs, FOR, and TOUR with mainly neutral and positive relationships with otherwise conflictual parties (LO, HU, NC). HU are depicted with negative relationships in relation to 5 other categories. The MEDIA displays highly inconsistent relationships with other stakeholder categories. This is based on the fact that different highly specialized journals address the interests of specific target groups and their contents are consequently perceived as very supportive or very detrimental by different stakeholder categories, (Nietlispach, personal comment 2019). Stakeholders of the LOCR category or “OTHER” stakeholders are not depicted in the stakeholder map and consequently

do not appear in the socio-matrix as members of the project partners network.

The results from Slovenia display a rather small network of the project partners (4 of 10 standard stakeholder categories involved) with the second lowest density of all networks (0.15), and predominantly neutral to negative relationships. The parties depicted as the main polarizing network members are NCs, followed by MAs, LOs and HUs (in the order of the amount of negative relationships), with HU and MA displaying the highest degrees of interrelatedness (0.4) but HU displaying more neutral than negative relationships.

The Slovenian project partners are recommended to actively broaden their network by contacting existing and constantly developing committees, established by SCI and MA, to implement a Wolf Management Plan designed in 2005 (Cattoen, own observation 2020). To do so, a suggestion to partners is to identify and, as a first step, engage primarily with stakeholders from categories directly and indirectly related, neutrally, to otherwise conflicting parties as indirect contacts (e.g., SCI and FOR). The positive relationship of the “OTHER” stakeholder, in this case “the EU,” to MA, also has potential to serve as a supportive partner for the process, but is currently perceived to play an ambivalent role in its influence on current LC-related politics, polity and jurisdiction in Slovenia (*ibid.*).

The results from Poland display a medium-sized network (7 of 10 Stakeholder Categories involved) with a medium density (0.28), and predominantly neutral to positive relationships. Only MEDIA are perceived as conflictual network members by part of the HUs. FORs, followed by MAs and NCs, display the highest amounts of positive relationships followed by SCIs and the MEDIA (in the order of the amount of positive relationships and their intensity). LOs are depicted to be mainly neutrally related to other stakeholder categories. In this network, FORs display the highest degree of interrelatedness (0.6).

The Polish project partner’s network has a high potential to find common goals, strategies and approaches across many stakeholder categories concerning the management conflicts in the context of growing wolf populations. Indirect relationships show additional potential to broaden the network to include stakeholders from other categories which are also known to be relevant for LC management.

In line with these 3 examples, the following synopsis of results derived from the analysis and comparison of all 15 standardized socio-matrices highlights varying representations of stakeholder categories in the project partners’ networks; direct and indirect positive relationships and their potential for broadening the networks; indications of heterogeneous stakeholder categories; and details on “OTHER” stakeholders and their exemplary roles for other networks.

The stakeholders concerned with large carnivore issues and represented in all networks are HUs, LOs, NCs and, with one exception, MAs. They are also related to each other in all networks, if in diverging qualities. The perceptions and degrees of relationships between these four categories and other categories, such as SCIs, FORs, MEDIA, and TOURs, vary greatly from study region to study region. Generally low representation of POLs, LOCRs and OTHERs may indicate that they have either been

TABLE 7 | Standardized socio-matrices for Austria, Slovenia and Poland categorized for Wolf - 10 Main Stakeholder Categories.

AT (Austria)												
D*	AT(W)	LO	HU	NC	MA	POL	SCI	FOR	TOUR	LOCR	MEDIA	OTHER
0,8	LO		2	-1	-1 to +1	0	0	0	0 to +1	-4	-1 to +2	-4
0,8	HU	2		-2	-2	-1	0	-2 to -1	-3 to 0	-4	-2 to +2	-4
0,8	NC	-1	-2		0 to +1	1	1	1	0	-4	-2 to +2	-4
0,8	MA	-1 to +1	-2	0 to +1		1	1	1 to 2	0	-4	-2 to +1	-4
0,8	POL	0	-1	1	1		1	1	0	-4	-1 to +1	-4
0,8	SCI	0	0	1	1	1		0 to +1	0	-4	0 to +1	-4
0,8	FOR	0	-2 to -1	1	1 to 2	1	0 to +1		0 to +1	-4	-1 to +1	-4
0,8	TOUR	0 to +1	-3 to 0	0	0	0	0	0 to +1		-4	0 to +1	-4
0	LOCR	-4	-4	-4	-4	-4	-4	-4	-4		-4	-4
0,8	MEDIA	-1 to +2	-2 to +2	-2 to +2	-2 to +1	-1 to +1	0 to +1	-1 to +1	0 to +1	-4		-4
0	OTHER	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	
SL (Slovenia)												
D*	SI(W)	LO	HU	NC	MA	POL	SCI	FOR	TOUR	LOCR	MEDIA	OTHER
0,2	LO		-4	-1	0 to -1	-4	-4	-4	-4	-4	-4	-4
0,4	HU	-4		0 to -1	0	-4	0	0	-4	-4	-4	-4
0,3	NC	-1	0 to -1		-1	-4	-4	-4	-4	-4	-4	-4
0,4	MA	0 to -1	0	0 to -1		-4	-4	-4	-4	-4	-4	1
0	POL	-4	-4	-4	-4		-4	-4	-4	-4	-4	-4
0,1	SCI	-4	0	-4	-4	-4		-4	-4	-4	-4	-4
0,1	FOR	-4	0	-4	-4	-4	-4		-4	-4	-4	-4
0	TOUR	-4	-4	-4	-4	-4	-4	-4		-4	-4	-4
0	LOCR	-4	-4	-4	-4	-4	-4	-4	-4		-4	-4
0	MEDIA	-4	-4	-4	-4	-4	-4	-4	-4	-4		-4
0,1	OTHER	-4	-4	-4	1	-4	-4	-4	-4	-4	-4	
PL (Poland)												
D*	PL(W)	LO	HU	NC	MA	POL	SCI	FOR	TOUR	LOCR	MEDIA	OTHER
0,3	LO		0	-4	0 to +1	-4	0	-4	-4	-4	-4	-4
0,4	HU	0		0 to +1	-4	-4	-4	+1 to +2	-4	-4	0 to -1	-4
0,4	NC	-4	0 to +1		-4	-4	0 to +1	0 to +2	-4	-4	0 to +1	-4
0,4	MA	0 to +1	-4	-4		-4	1	1	-4	-4	1	-4
0,1	POL	-4	0 to +1	-4	-4		-4	-4	-4	-4	-4	-4
0,4	SCI	0	-4	0 to +1	1	-4		1	-4	-4	-4	-4
0,6	FOR	0	+1 to +2	0 to +2	1	-4	1		-4	-4	1	-4
0	TOUR	-4	-4	-4	-4	-4	-4	-4		-4	-4	-4
0	LOCR	-4	-4	-4	-4	-4	-4	-4	-4		-4	-4
0,5	MEDIA	0 to +1	0 to -1	0 to +1	1	-4	-4	1	-4	-4		-4
0	OTHER	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	

LO = Livestock owners, herders, domestic animal keepers and farmers and associations, HU = Hunters and associations, NC = Nature Conservationists, MA = Ministries and Administration, POL = Policy makers, SCI = Scientists, For = Foresters, TOUR = Tourism Sector, LOCR = Local Residents, MEDIA = Media, OTHER = Other. Green cells (0 to max +2) summarize neutral to positive relationships between these aggregated stakeholder categories. Yellow cells summarize only neutral relationships. Red cells (0 to -3) summarize neutral to negative relationships. Gray cells (-4) indicate no depicted relationship. Orange cells (in-between -2 to +2) reveal that different stakeholder belonging to the same category maintain negative as well as positive relationships with partners from another category. Striped orange cells at the intersections within one stakeholder category therefore indicate inconsistent standard stakeholder categories. D* indicates the standardized degree of interconnectedness of the resp. Stakeholder Category (without LC). The Density of the AT network is 0.65, for SL 0.15 and for PL 0.28.

overlooked as relevant stakeholders by some experts and project partners, or that has been too difficult to successfully establish relationships with them.

We are able to point out cases where stakeholders from different categories are engaged in reciprocal negative relationships but are both positively related to the same third category. Therefore, these have potential as indirect positive relations. Examples of such stakeholders which are

primarily positively related to otherwise conflicting parties are FORs in PT, SCIs in RO and SK, and TOURs in UA, for example.

We explained that orange cells indicate positive as well as negative relationships from within the same stakeholder category toward others. These findings suggest heterogeneous compilations of stakeholders within one category. This has been observed in 4 stakeholder networks out of 15 (27%). Firstly, this is observed within the NC group, e.g., with public and

a variety of private organizations pursuing different aims and strategies within nature conservation. Secondly, it is seen within the MA group, usually if governments deal with agricultural, environmental and/or forestry objectives in different ministries (4 cases, 27%). It applies within the HU category, which encompasses hunters associations with potentially contradictory values (4 cases, 27%), or within the LO category, indicating at least partially contradictory positions, e.g., of different livestock owners, herders, and farmers associations (3 cases, 20%).

Regionally specific “OTHER” stakeholders play various roles. Up to 7 such additional stakeholders were indicated as relevant in different networks. The following list specifies and provides more in-depth information. The figures in brackets indicate the frequency with which these types of stakeholders were identified as relevant special agents in the network mapping processes: poachers (5), police (different types of executive bodies) (5), planners, engineers and users of infrastructure (4), veterinarians (3), educational institutions (3), carnivore damage experts (2), animal welfare activists (perceived as distinct from nature conservationists and/or environmentalists) (1), voluntary herd protectors (1), voluntary wolf commissioners (1), bee keepers (1), dog owners (1) berry and mushroom pickers (1), restaurant owners (1), local development agents (1), financial institutions (1), the EU (1).

A view of these special agents’ individual relationships with other stakeholders in the original stakeholder maps displays poachers as not officially organized and mainly perceived as very critical and polarizing agents; this group is counterbalanced in some maps by National Guard/Police as partners considered indispensable for legal support. Veterinarians are identified as trusted experts with frequently positive relationships with various otherwise conflictual stakeholder categories, and schools are depicted as neutral partners with educational activities. Infrastructure developers are only indirectly connected but are repeatedly considered strategically important. Very specific aspects of regional governance (e.g., day-to-day implementation of laws and prosecution of willful misconduct), roles and attitudes of individual people in key positions, unique local developments (e.g., Voluntary Herd Protection, like Wiki Wolves in Germany), and the role of restaurant owners (as potential contact points with poachers) in Romania could not be compared across all partner regions due to their singularity.

Many cells at the cross section of two different stakeholder categories are marked as “no relationship” (gray, -4). This may have different reasons: The stakeholders know about each other but are not in contact, or stakeholders from this category have not been considered as relevant network members by the workshop participants.

Stakeholder Networks With Different Carnivore Species in Focus (Examples)

The majority of stakeholder maps focus on wolves. In the Ukrainian workshop three distinct stakeholder maps were depicted with a special focus on wolf, lynx and bear, respectively (see **Table 6**). Here, all three species have recovering populations and are considered conflict issues by various stakeholders. Almost identical stakeholders were depicted

as members of the three respective networks. One main difference lies in the amount of active relationships depicted between the different stakeholder categories. The standardized socio-matrix of the UA (wolf) network encompasses 8 of 10 stakeholder categories with a network density of 0.25 (**Figure 3**). UA (lynx) includes LOCs with a high standardized degree of relationships (0.6) but not MAs (stand. degree 0) with a total network density of 0.34. UA (bear) does not include LOCs (stand. degree 0) but includes MAs (stand. degree 0.3) in a network with low density (0.15). SCIs and POLs are not depicted in either one of these stakeholder maps.

The second main difference lies in the composition of “OTHER” stakeholders. In all three stakeholder maps, poachers are depicted to be critical agents engaged in negative relationships with HU, LOC, and MEDIA. In the socio-matrix related to wolves, poachers are the only “other” stakeholders. In bear contexts, poachers are complemented with beekeepers and berry- and mushroom-pickers as “other” parties which do not agree with or are negatively affected by the presence of bears. They are not listed as relevant stakeholders in the context of lynx. The stakeholder map focusing on the lynx includes “Forest Roads,” i.e., infrastructure developers and users of infrastructure, as a relevant actor with negative impacts on lynx, in addition to poachers.

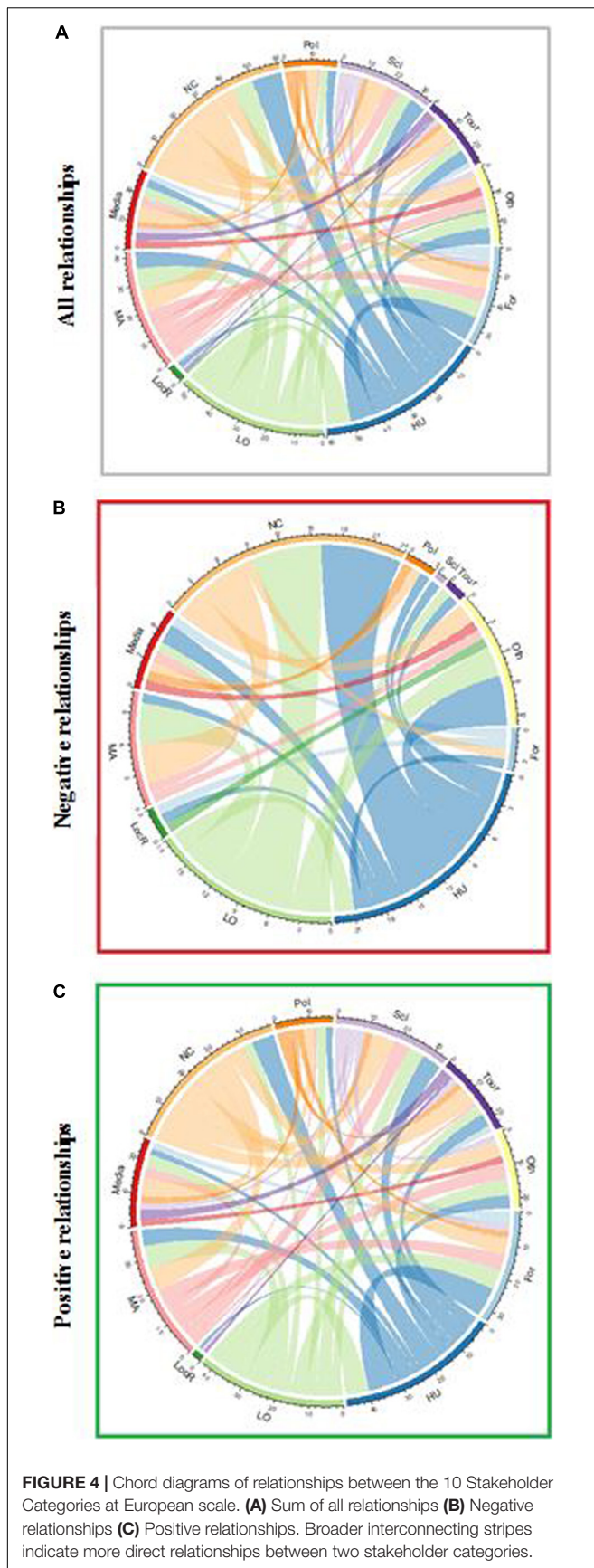
The third main difference between these three networks lies in the changing qualities of the relationships between the stakeholder categories. In the context of wolves only NCs and HUs are assigned mutual negative relationships; all other relationships are depicted as neutral or positive. In the context of bears only NCs and LOs are assigned mutual negative relationships, all other relationships are again depicted as neutral or positive. In the case of lynx, negative relationships are depicted between all three of them (HU, LO, and NC).

This single example shows that regional stakeholder network settings may change in the contexts of the different LCs in focus, partially in the array of stakeholders considered to be relevant but even more in the different qualities of the perceived relationships between the same stakeholder categories.

Stakeholder Relationships at European Scale

Figure 4 provides an overview of relationships and the quality of these relationships between the 10 Stakeholder Categories at European scale as identified in Phase 2b. At European scale all 10 Stakeholder Categories are represented and interlinked to varying degrees (**Figure 4A**). The result indicates that HU, NC, and LO (in that order) maintain relationships with each other and with most other stakeholder categories in all study regions. The remaining stakeholder categories are ranked according to their perceived interconnectedness as follows: MA, FOR, SCI, MEDIA, TOUR, POL, LOC. “OTHER” consists of many different types of stakeholders therefore we did not include their interconnectivity value in the ranking.

The mid-ranked interconnectivity of FORs supports the results of the telephone expert interviews, which indicated that they are a highly relevant stakeholder category in many



networks. At the same time, it is clearly visible that LOCs and POLs are currently not well-represented and interconnected in most networks.

Figures 4B,C differentiate negative and positive relationships. NCs very often relate negatively to the other three predominantly represented stakeholder categories of HUs, LOs, and MAs. An almost similarly high amount of negative relationships is displayed for HUs and LOs (**Figure 4B**). Compared with the chord diagram of positive relationships (**Figure 4C**), the situation becomes more complex. There are also positive relationships between all stakeholder categories, in some cases even between NCs, HUs and LOs. FORs have almost three times more positive relationships with other stakeholders than negative ones. In many cases they maintain positive relationships with NCs, HUs as well as LOs. The same seems to be the case for TOURs, if on a smaller scale. Positive relationships with NCs, HUs and LOs are also displayed for MAs, but less often than negative ones. The individual socio-matrices also indicate that MAs are often internally incoherent in their relationships with other categories. MEDIA is an example of a stakeholder category with a medium degree of relationships, but with as many positive as negative ones to the same stakeholder categories.

Individual Stakeholders' Perception Survey (Phase 3)

Our online survey received 1262 responses. The number of returns per country varies substantially, ranging from 4 (Portugal) to 374 (Hungary). Austria and Hungary combined provide 52.1% ($n = 658$) of the total return, all the other 10 countries contributed 47.9% ($n = 604$). The majority of respondents live in Central Eastern Europe, are of working age (87%, $n = 1081$), college educated (71%, $n = 880$), and male (64%, $n = 790$).

We focus on two topics of the survey: (1) stakeholder occupations and membership in stakeholder organizations and their influence on (2) attitudes toward wolf conservation and management.

The self-affiliations of respondents to different occupations ($n = 1191$, 94%) were allocated to the 10 stakeholder categories. Of the respondents, 45% ($n = 538$) consider themselves NCs. 39% ($n = 459$) belong to the FOR group. This high participation rate in Phase 3 decisively contrasts the finding from Phase 2 that FORs are sometimes not included in the current networks at all (ES, IT, SI), or are not significantly interrelated, as shown by standardized degrees of relationships equal to or less than 0.4 (DE, HR, HU, PT, SK, UA). At the same time, they are depicted as playing a mainly positively connoted role with at least 5 positive relationships with other stakeholder categories in 3 networks (AT, FR, PL). The following top ranks of survey participation consist of HUs ($n = 431$), SCIs ($n = 427$) (36% each), and LOs (27%, $n = 321$). Also, relevant numbers of representatives from MA (26%, $n = 307$), TOUR (20%, $n = 240$), POL (10%, $n = 119$), LOCR (esp. "primary household managers," 6%, $n = 74$) participated in the survey, stakeholders who are all chronically underrepresented in the stakeholder maps (the sum of affiliations per category

exceeds the number of respondents, due to the multiple selection option offered in the survey).

Attitudes of HUs, LOs and NCs Toward (Future) Wolf Management in Europe

For Q1 (“Do you think [wolves] should be legally protected?”) the majority (>70%) of institutionally organized respondents of all three stakeholder categories (HU, LO, NC) answered: “Under the current circumstances it makes sense to protect them” (HUs org: 72%, LOs org: 75%, NCs org: 84%), while 28% (HUs org), 25% (LOs org), and 16% (NCs org.) respectively take the position: “Under the current circumstances they should not be protected.” The difference between NCs org and each of the other two categories is significant ($p < 0.05$), while between HUs org and LOs org, the distribution of these opposing positions does not differ significantly.

For Q2 (“Do you think that these animals should be actively kept out of your local region?”), again, the majority of institutionally organized respondents from all three stakeholder categories express the opinion that wolves should not (“certainly not/probably not”) be actively kept out of their local region (HUs org 65% ($n = 148$), LOs org 68% ($n = 90$), NCs org 77% ($n = 266$), but with a lower percentage than the agreement on legal protection. All three groups differ significantly in their response behavior (Kruskal-Wallis $p < 0.001$). HUs org take the position that wolves should “certainly” be kept out of their region twice as often as NCs org. Still, not all NCs org fully support legal protection, 16% do not, and almost a quarter (23%) would prefer (certainly or probably) to keep them out of their neighborhood (see **Figure 5**).

According to responses to Q3 (“Do you believe that an increase of large carnivore populations could be managed to your satisfaction?”) more than 3/4 of all institutionally organized respondents over all three categories believe that population growth could be managed in their interest (“Yes, probably/yes,

certainly”: HUs org: 77%, LOs org: 79%, NCs org: 82%), with no significant differences between them.

Testing Institutional Representation

Institutionally organized respondents within each stakeholder category do not differ from non-institutionally organized ones in the distribution of their positions on whether wolves should be legally protected. This holds true for all three categories.

Concerning the question of whether wolves should be actively kept out of the local region, the positions of organized and non-organized members of each stakeholder category do differ significantly (Mann-Whitney-U-Tests $p < 0.001$). While the majority of respondents of all sub-groups respond that wolves should not be actively kept out of their region (HUs org vs. non-org 65%:64%; LOs org vs. non-org 68%:69%, NCs org vs. non-org 77%:68%), the differences mainly lie in the intensity of their convictions. Amongst HUs, more non-org respondents “certainly” disapprove of actively keeping out wolves, while more HUs org tend to “probably” not want to keep them out. In sum though, HUs org, more often than HUs non-org, are of the opinion that wolves should not be kept out of their region and often express less extreme positions.

Amongst NCs, more NCs org state that wolves should certainly or probably not be actively kept out of the local region than NCs non-org. In this case NCs org. do not adequately represent the positions of all NCs. Even as the opinions of NCs non-org tend to go in the same direction, they are less pronounced.

Amongst LOs, LOs org are more often than LOs non-org of the opinion that wolves should be actively kept out of their local regions and are therefore more disapproving of the presence of these large carnivores.

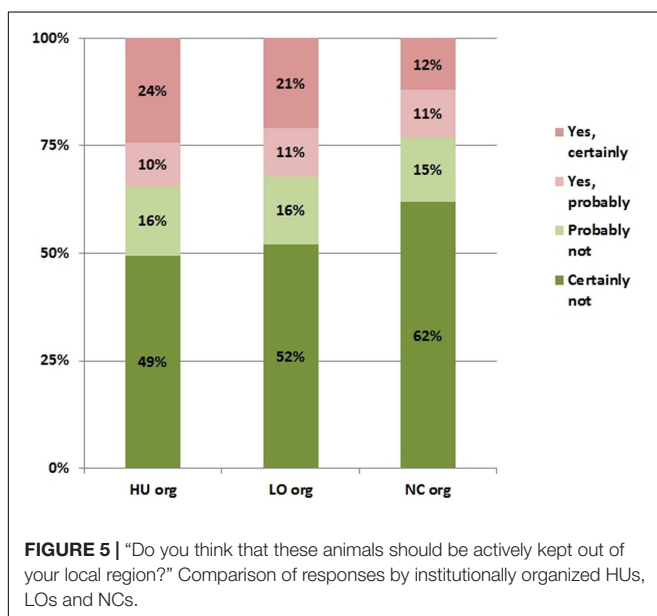
LOs org and NCs org therefore express extreme positions somewhat more often than their non-organized counterparts.

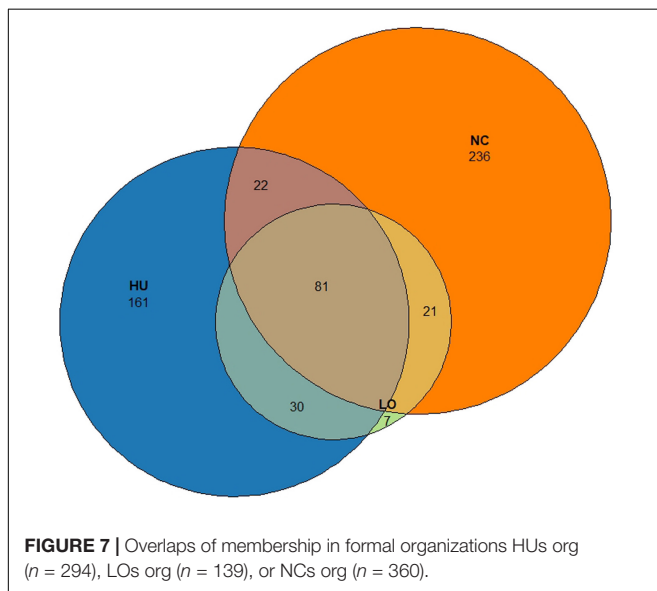
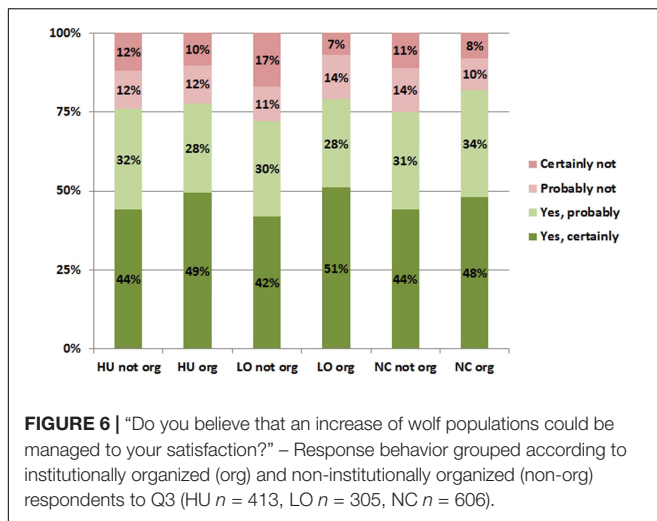
Figure 6 visualizes the confidence in future satisfactory management of growing populations of large carnivores, comparing formally organized and non-organized respondents. Their positions differ significantly across all three stakeholder categories (for each category Mann-Whitney U Test $p < 0.001$). In all three categories the tendency points in the same direction: organized respondents are more optimistic.

Blended Professions – The Multiplicity of Individuals’ Occupations

Of the 17 occupations offered as choices in the survey, most respondents marked 3 to 5 (3.5 on average), ranging from one main (professional) occupation to 14 as the maximum. At the top of these findings, the occupations of 74.3% ($n = 885$) of the respondents are related to at least one of the three ubiquitous stakeholder categories: HUs (36%), LOs (27%), and NCs (45%) ($\Sigma \geq 100\%$, due to multiple allocations). Of this, a total of 63% ($n = 558$) state that they are official members of at least one institutional organization of HUs (HUs org 68%, $n = 294$), LOs (LOs org 43%, $n = 139$), or NCs (NCs org 58%, $n = 360$).

Figure 7 visualizes that 27.6% ($n = 154$) of the formally organized stakeholders in the categories HU, LO, NC stated that they were a member of organizations from at least two of these





categories. 14.5% ($n = 81$) are even members of organizations in all three categories.

DISCUSSION AND CONCLUSION

The results of our participatory, transdisciplinary, and comparative stakeholder network analysis contribute to better management strategies for mitigating conflicts related to the expansion of large carnivore populations in Europe. The study balances local and international insights as recommended by IUCN (Madden, 2004) and Trouwborst et al. (2017) even though not all project partners were able to participate in all three participatory research phases. We provide the connection between systematically mapped specific stakeholder networks of our project partners and an external international comparative overview of the challenges and strengths of these networks. We point out exemplary common characteristic, individual special

features, as well as stakeholder categories and specific agents which could potentially be supportive of conflict management. These findings provide new insights, ideas, and starting points to broaden and strengthen regional stakeholder networks related to large carnivore management and conflict mitigation.

Phase 1 identifies 10 Stakeholder Categories as relevant in the European context and a variety of relevant individual agents. These categories largely intersect with those described in literature (Linnell, 2013) but deviate in some aspects from those described for other regions and continents. Some are either plausibly not relevant in this study's focus regions (e.g., reindeer herders in Scandinavia) or perceived as more or less differentiated (e.g., ministries and administration vs. political representatives).

We analyze the project partners' current stakeholder networks (Phase 2a) as developed and depicted by network members themselves. We thereby follow the concept described by Schuck-Zöller et al. (2017) which has users participate in research and development activities to actually co-create results. By choosing this transdisciplinary approach, we integrate actionable knowledge from science and topic-related stakeholders to address real-world problems (Johnson et al., 1993; Lang et al., 2012; Hartel et al., 2019). The resulting stakeholder maps differ greatly in composition, number of more or less specifically named stakeholders, and quality of relationships. The high variety of the original stakeholder maps may be explained with various factors related to general socio-political and biological framework conditions or project-related circumstances: The main influential framework conditions in our context seem to be the historic-political backgrounds of the countries involved (e.g., duration of membership in the EU and their former political system); the current legal framework of large carnivore management (e.g., potential deviations from the current EU directive on the protection of large carnivores); the degree of human habituation to the presence of LCs (e.g., based on long term co-existence or LCs being newcomers to a region). Noticeable project-related factors are the organizational structure and experience of the project partners participating (e.g., long history of co-operations or conflicts with other network partners on various issues or only recently established offices); the level of detail in which project partners name their stakeholders (e.g., as categories or specific organizations); the choice of animal species in focus (e.g., mainly wolves, but in two cases bears or lynx); the success in inviting stakeholder representatives to participate in the workshops (e.g., stakeholders invited but not able to participate in the mapping workshop, with the potential consequence of their relationships being depicted differently by third parties than if had they been actively involved in the discussions); and last not least the on-site development of the continuous participatory stakeholder identification and mapping processes in different cultural settings. These framework conditions are expected to approximate and level out as EU directives and regulations are progressively translated into national laws with comparable implementation. Cross-border exchanges and intercultural projects are expected to increase successful international cooperation. Habituation to co-existence with LCs is also expected increase as their populations spread, with de-escalation of conflicts as a result. This development

might be accelerated if it is accompanied by professionalized stakeholder network engagement and communications. The relevant competencies of all project partners will further improve through project-related experiences and training. To test the validity of these hypotheses, further research and especially longitudinal studies would be required.

Standardization of the 15 individual stakeholder maps into similarly structured socio-matrices resulted in comparable data sets (Phase 2b). The comparative analysis reveals that even in stakeholder maps with large numbers of individual stakeholders and related institutions, not all 10 stakeholder categories are represented or depicted as related to each other. LOs, HUs, and NCs are represented in all networks. MAs, SCIs, and FORs are also often, but not always, represented in the stakeholder maps, while POLs, TOURs, the MEDIA, and LOCR are rarely depicted as integral members of the current stakeholder networks.

“OTHER” relevant stakeholders detected are only partly described by Linnell (2013), part are new findings. The descriptions of their roles in the different networks are intended to serve as explicatory or exemplary cases, such as the potentially important role of generally trusted veterinarians in conflicts related to wolf damage experts, who in turn are often associated with nature conservationists and often perceived as biased by other stakeholders. Other positive examples are restaurant owners, who may provide indirect contact with hard-to-reach poachers (Pohja-Mykrä, 2016), or schools as contact points for reaching out to local people who are not otherwise organized or sufficiently involved in the networks (Ericsson and Heberlein, 2003).

Our three-phase data collection design resembles, in parts, the approach described by Rozyłowicz et al. (2017) of document analysis complemented by a survey, while methods for data analysis and network comparison are not as detailed and comprehensive. The participatory transdisciplinary research approach of this study (Phase 1 and 2) and the non-random snowball sampling for the Individual Stakeholders' Perceptions Survey (Phase 3) contravenes many conventional notions of scientific neutrality, random selection and representativeness (Atkinson and Flint, 2004). However, social systems are beyond researchers' ability to recruit randomly, so snowball sampling is inevitable. Consequently, the responses to our survey are neither statistically representative for the societies in the partner countries, nor a proportional representation of the different stakeholders in large carnivore management. An additional challenge is the coordination and compilation of interview and survey results from different languages and cultures (Kruse et al., 2012). However, the high return rate and the receipt of some filled questionnaires with long answers are taken to reflect the high interest in the topic of people with many different professions and occupations. The fact that all 10 stakeholder categories are well-represented by the 1262 respondents, and the high return rate of respondents who belong to as of yet underrepresented categories in the stakeholder maps, are interpreted as indicators that we have reached a sufficiently broad range and amount of stakeholders in our data base.

High response rates by NCs, HUs, and LOs in the telephone interviews (Phase 1) as well as in the Individual Stakeholders'

Perception Survey (Phase 3), has been expected; they are also active in all LC related stakeholder networks (Phase 2).

Comparing the survey response rate (Phase 3) with the rate of interviews vs. recommendations in the telephone interviews (Phase 1), we find that representatives of MAs, FORs, POLs, and LOCRs are clearly relevant actors and highly interested-parties, but are not yet adequately involved in the stakeholder networks of most of our project partners. The high survey response rate from employees of Ministries and Administrations (MA) requires further analysis of the data, with a special look at the often internally inconsistent relationships of this category in the stakeholder networks (Phase 2). Internal inconsistency or even conflicts within the MA category is especially pronounced in countries where different ministries or subunits thereof are responsible for different management aspects of LC habitats and populations. Mitigating such internal conflicts may well be beyond the capacities of other stakeholders in the network.

Foresters (FOR) are often influential and responsible for the ecosystems large carnivores depend upon (Niemela et al., 2005). Finding few interviews and a very high recommendation rate (Phase 1), a rather low representation and interrelatedness in the stakeholder maps (Phase 2) in combination with a high return rate in the survey (Phase 3) suggests that especially the forest sector and its relevance in the management of large carnivores is underrated and underrepresented in the current stakeholder networks of many project partners. As primarily positive relationships have been depicted for FORs where they are already actively involved, we conclude that their integration may strengthen those networks in which they are currently not represented. Other examples of stakeholder categories which are not frequently represented in the networks, but despite this are primarily positively related to otherwise conflicting parties are Scientists in RO and SK, and the Tourism sector in UA. Their role could be reflected in other contexts and they could potentially be invited as indirect contact points with perceived antagonists, or they may even be able to act as mediators in conflictual meetings with different polarizing agents.

Well-balanced and high-density stakeholder networks strengthened by stakeholders with agency and relational trust prove to be resilient to change (Convention on Access to Information, Public Participation in Decision-Making and Access to Justice, 1998; Sidaway, 2005; Reed, 2008; Bethmann et al., 2012; Sjölander-Lindqvist et al., 2015). Networks with primarily positive relationships are more apt to deal with new problems or new conflictual parties. If these do appear, well-established networks are usually less shaken in their foundations and are able to more quickly find common strategies to overcome these challenges (own observation). The successive expansion and strengthening of the project partners' stakeholder networks already occurred during Phases 1 and 2a. Comprehension grew why it is necessary to better understand the perspectives of perceived opponents and “new” relevant agents and to strategically engage with them during the process (internal reporting of Phase 2b). These are positive practical results of the participatory research approach already acknowledged by many project partners (own observation).

Stakeholders and their organizations are often generalized as homogenous and distinct. At the same time, common denominators of different stakeholder categories are often overlooked. In Phases 1 and 2, we also used this homogeneity concept to compare stakeholder categories, networks and relationships, but remained critical. In Phase 2b we detected stakeholder categories with obvious internal inconsistencies in their relationships with others. Based on Phase 3, we were able to illustrate the internal heterogeneity of positions of members within hunters' associations (HU org), livestock owners' associations (LO org), and Nature Conservationists' organizations (NC org). We also detected significant differences between the distributions of contradicting attitudes of institutionally organized and non-institutionally organized stakeholders within all three categories. As an example, we point out that not all members of NC organizations fully support legal protection of large carnivores (16% do not) and almost a quarter (23%) would prefer to keep them out of their local region. Last not least, our data suggest that NC org and LO org take significantly stronger stands on their positions than HU org. in comparison to non-institutionally organized stakeholders of the same categories. These findings are already used in further project activities, e.g., "unboxing identities" with trainings aimed at reducing in-group vs. out-group biases and behavior to improve openness to develop common targets and implementation strategies.

It seems promising for future impact and conflict mitigation processes that 77–82% of organized members of these three stakeholder categories believe *"that an increase of large carnivore populations could be managed to [their] satisfaction."* Some of these unexpected similarities may be accounted for by the finding that 27% of institutionally organized respondents hold double or even triple membership of institutions of the HU, LO and NC categories, with no significant differences in the percentages of the intersections. In contrast, small groups of adversaries and even individuals can considerably and negatively impact the development of LC populations, e.g., by illegal killings (Liberg et al., 2011; Carter et al., 2017; Heurich et al., 2018) as well as in human-human conflictual situations (Madden and McQuinn, 2014, Nietlispach, pers. comment 2019). For future conflict management, it will be necessary to address and better include them into well moderated decision-making processes and large carnivore management strategies (Treves et al., 2006, own observation).

These insights refute the common stereotypes concerning the positions of these interest groups. Questions of well-balanced representation within stakeholder categories need to be probed in more detail in the future, for successful participatory conflict management.

Based on our results we suggest different ways to address the frequently insufficient functionality of current stakeholder networks. If there is a history of mistrust between opposing interest groups (Treves et al., 2006), an attempt should be made to identify stakeholders who might serve as trusted intermediaries. These could be either neutral commonly trusted third parties, or individuals who are known to be members of several associations in different stakeholder categories and

therefore able to conciliate between them. This insight may help also to call on different points of view to mitigate conflictual discussions with stakeholders, who present themselves as rather one-sided. A starting point for improvement may be to offer mediators training to people with potential, to be better prepared to actively engage as trusted brokers (ibid.).

Conflicts may be triggered or re-ignited by the negative impacts of large carnivores on humans or vice versa. The majority of topics related research publications have been found to use the catchy and euphemistic term "human-wildlife conflict" rather than correctly addressing human conflicts related to wildlife management. Misleading communications of this kind are reflected in the majority of stakeholder maps, which explicitly depict relationships with the animal species in focus. This is taken an indicator that the concept that humans and animals do not actually engage in relationships has not yet reached many stakeholders at implementation levels. Future workshops, discussions and information material should consider introducing this concept and terminology right at the beginning to foster a more differentiated understanding and thereby improve damage and conflict mitigation strategies.

Large carnivores management strategies and the implementation of damage prevention and mitigation measures are expected to be more sustainable if they have been developed cooperatively by stakeholders. The workshop experiences and outputs support stakeholders with different viewpoints to reframe their issues and find common starting grounds for developing new solutions to these problems. Social conflicts, on the other hand, often ignited by negative impacts or uneven distribution of the positive impacts of large carnivores, are usually based on more fundamental underlying causes that cannot be resolved but only mitigated through various human-human conflict management strategies (Peterson et al., 2005; Lühtrath, 2011) and functional stakeholder networks (Gerner and Schraml, 2014).

While the methodological approach of this study did not provide an-in depth and comprehensive picture of all potentially relevant players for large carnivore management in the different project regions, as e.g., Manolache et al. (2018) for Natura 2000 governance networks in Romania and Ramcilovic-Suominen et al. (2019) for FLEGT in Lao PDR, the participatory research design enabled the project partners themselves to assess the strengths and challenges of their networks. It increased their understanding of why it is important to expand and improve the functionality of stakeholder networks as well as their expertise to pursue this process.

These results have already proven to be a very useful basis for a more in-depth analysis of LC related conflict situations in the different partner countries and resulted in the initiation of participatory conflict-mitigating processes that continue throughout the ongoing LIFE-Project activities. We recommend continuing strategic stakeholder engagement, communications training of key people, and the increased employment of professional mediators with an aim of improving the functionality of the networks as an indispensable approach to improve human-human co-existence and conflict mitigation in times of recovering large carnivore populations.

DATA AVAILABILITY STATEMENT

All datasets generated for this study are included in the article/**Supplementary Material**.

AUTHOR CONTRIBUTIONS

CG was responsible for writing and coordinating the manuscript. DO and EK were co-authors, conducted the comparative analysis of different data sets and first drafts of the respective methods and results sections. LP, E-MC, and US were co-authors, contributed to structuring and internal revisions of the article. All authors contributed to the article and approved the submitted 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/fevo.2020.00266/full#supplementary-material>

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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.

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