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Wolf in the Alps: Recommendations for an internationally coordinated management

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Wolf pictured above Pfäfers, SG, Switzerland on 8 March 2014 © ANJF, Amt für Natur, Jagd und Fischerei St. Gallen, and KORA

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Wolf in the Alps: Recommendations for an internationally coordinated management

Report of the RowAlps Project (Recovery of Wildlife in the Alps) in the framework of the WISO (Wildlife and Society) Platform of the Alpine Convention

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Abstract

The RowAlps (Recovery of Wildlife in the Alps) Project was founded in order to support the Platform "Large Carnivores, Wild Ungulates and Society" (WISO – Wildlife and Society) in fulfilling its Alpine Convention Mandates for the periods of 2013-2014 and 2015-2016: Develop practical goals and management options for the recovery and conservation of wolf, lynx and bear populations in the Alps and present these to the relevant bodies of the Alpine Convention.

Therefore, the overall goal of the RowAlps project is to develop practical goals and management options for the recovery and conservation of wolf and lynx populations in the Alps. To reach this goal three objectives were defined. In brief these objectives are: 1) To review and assess the present situation of wolf, lynx and prey populations in the Alps, the expected development of the populations and discuss challenges in wildlife management as a consequence of the return of the carnivores; 2) To describe mechanisms to achieve tolerance for lynx and wolf for different interest groups and to identify factors defining the tolerance and the potential measures to influence these factors and 3) To assess the output from objectives 1 and 2 and develop management scenarios for the recovery and conservation of favourable wolf and lynx reference populations in the Alps and discuss them with interest groups.
For objectives 1 and 2, each a working group was established with experts and interest groups. For objective 3 a working group with delegated representatives of the country delegations of the WISO Platform was established.

The current report is the product of the working group assigned with fulfilling the 3rd objective. In seven chapters the following contents are presented: 1) Introduction; 2) Framework for large carnivore management; 3) Current situation of the wolf population in the Alps; 4) Discussion, interpretation and assessment of a future Alpine wolf population and main threats; 5) Practical goal; 6) Management options and implications and 7) Suggestions for priorities in time and space.

The RowAlps Project identified its *overall practical* goal as achieving a favourable conservation status (FCS, according to Linell et al. (2008)) of wolf in the Alps. To reach FCS for the Alpine wolf population, *at least 125 packs need to be widely and evenly distributed according to suitable habitat across the Alps* and connected to neighbouring populations. The *main threats* to the present and future Alpine wolf population were identified as human caused mortalities (illegal killing, accidental mortality), livestock depredation, low acceptance and poor management structures. To address these threats, a set of *five general management options* for the entire Alpine wolf population were identified: 1) Secure sustainable damage prevention and compensation systems for livestock damages; 2) Foster dialogue among authorities, with wildlife managers, hunters and foresters by establishing information and consultation mechanisms for the wolf, 3) Integrate local people in the wolf monitoring, 4) Prevent and persecute illegal action through law enforcement and 5) Control of wolf-dog hybrids and domestic dogs. Although there may be some regional and national variation in the priority of implementing these management options, *the level and timing of priority* for each of the five management options were identified.

The current conclusions were elaborated on the basis of the suitable approaches and data available at the time of writing this report.

1. Introduction

1.1 Assignment and context of the present recommendations for an internationally coordinated management

The Platform "Large carnivores, wild ungulates and society" (WISO – wildlife and society) was set up by the X Alpine Conference in 2009 (Evian). Liechtenstein was assigned with the first presidency. Switzerland was allocated the second presidency by the XI Alpine Conference and Italy the third presidency by the XII Alpine Conference.

For the period of 2013-2014 the Platform dealt with the following mandate:

- Development of practical goals and management options for the recovery and conservation of wolf, lynx and (according to availability of funds) bear populations in the Alps and presentation to the relevant bodies of the Alpine Convention;
- Working towards an Alpine-wide genetic monitoring programme for large carnivores;
- Development of a map with the distribution and abundance of the Alpine ibex population in cooperation with the Alpine Ibex Group.

The "spirit of WISO" is based on the Alpine Convention and is expressed by the first president of the Platform, Felix Näscher with the following words:

"To ensure the continued existence of viable populations of large carnivores, regional planning must start taking their needs into account, e.g., by guaranteeing migration corridors, by defining tranquility wildlife areas, by conserving functioning ecosystems, by applying adequate management strategies and measures as demanded by the protocols on "Spatial planning and sustainable development" and "Conservation of nature and the countryside".

A functioning ecosystem comprises both large predators and their prey species. Therefore, any concept for the conservation and management of wildlife species – be it large carnivores or wild ungulates – has to be based on a holistic and integral approach. Thus, speaking about large carnivores, you have to take into account the status of possible prey populations and of their habitats over the entire area occupied by these species; and, speaking about wild ungulates, you have to reflect the influence of predation by large predators over the entire area occupied by these species: Finally and above all, you have to go beyond a strictly ecological approach.

Any successful determination of development targets, strategies and measures with respect to these wildlife species will have to take it for granted, that economic and social aspects are duly taken into account on an equal level: Sustainable conservation and exploitation of wildlife can only be ensured when respecting and assessing all of these ecological, social and economical parameters, which are determining the system at stake.

Sustainable wildlife management can't never be a question of purely scientific knowledge – far away from it: Sustainable wildlife management has to be an expression of a will, how to deal with our wildlife species - by taking into account, by balancing and by harmonising ecological, economical and socio-cultural interests: A decision of all stakeholders involved is required - or let`s just say, a decision by society" (Näscher 2009).

To fulfil the overall goal the WISO Platform members understood, that additional expertise is necessary to analyse adequately the data and information of the different countries and to develop

appropriate solutions for the entire Alpine arc. This additional work, which goes beyond the Platform's capacity, is covered by the especially designed RowAlps project[1] for lynx and wolf. The project is financed by the MAVA foundation, Switzerland (Federal Office for the Environment) and Germany (Bundesministerium für Umwelt, Naturschutz, und Reaktorsicherheit). Switzerland coordinates and leads this project. The RowAlps project started in 2012 and will end in 2016.

The Alpine Convention Mandate of WISO for the period of 2015-2016 was adopted at the XIII Alpine Conference in Torino, on November 21st 2014. It focuses on the following tasks:

- "*To finalise drafting of practical goals and management options for the recovery and conservation of wolf and lynx populations in the Alps; to continue the development of practical goals and comprehensive advice for the application of management options in relation to recovery and conservation of bears in the Alpine region; to present all management options to the relevant bodies of the Alpine Convention in 2016.*
- *To develop procedures among the contracting parties concerned, which ensure a transparent flow of information and support decision-making processes as well as the coordination of responding actions for wolves and bears; common interpretations of behaviour of problem bears; and more effective and coordinated conservation actions for the lynxes involving the key stakeholders.*
- *To continue the development of coordinated programmes of genetic monitoring of wolves and bears on an Alpine scale, and to ensure a profound understanding of the genetic risks for the conservation of the lynxes to guide conservation policies in the Alps.*
- *These goals are to be pursued taking into account the results of the RowAlps project and other relevant projects, including EU-funded projects, and exploring synergies with the* EU Platform on coexistence between people and large carnivores *and other relevant initiatives"* (Alpine Convention 2014).

1.2 Main goals and general orientation of the guidelines „Large carnivores, wild ungulates and society" of the Alpine Convention

The work of the WISO Platform (and RowAlps) is based on and guided by the WISO guidelines that were adopted by the XI Alpine Conference in 2011 (Slovenia).

The main goal and general orientation of the guidelines is to achieve and conserve the favourable conservation status of the wolf, lynx and bear in the entire Alps. Subgoals and options define the orientation of the WISO Platform to achieve the main goal.

[1] Recovery and conservation of wolf and lynx in the Alps: Options for transboundary conservation and management.

"MAIN GOAL – GENERAL ORIENTATION

Large carnivores and wild ungulates are preserved in balance with their habitat, other wildlife and human interest. Conflicts with human interests are addressed and negative impacts are counterbalanced. […]

Subgoals

1 - Dialogue: We inform, sensitize, and promote dialogue concerning the relations between wildlife, habitat, and society;

2 - Wildlife populations: We respect the intrinsic value of our wildlife as central components of our environment and steer the development of native wildlife populations in harmonization with their habitat and human interests, with the goal of securing viable wildlife populations;

3 - Wildlife habitat: We support close to nature land-use forms when using mountain pastures, agricultural areas and forests and aim for the conservation and improvement of wildlife habitats in terms of surface and quality;

4 - Integrative sustainable use: We use our wildlife sustainably, in recognition of and in harmonization with the various human interests in protection and use, and we further develop the various land use forms in a balanced manner;

5 - Cooperation: We cooperate transboundary in a cross-sectoral way and harmonize measures, as far as it is needed to reach common objectives, such as the amelioration of living conditions for wildlife species or the prevention of conflicts as regards different user interests as well as compensation of damages" (WISO 2011).

The WISO (wildlife and society) Platform, takes the role of a "Think Tank". WISO supports the member states and decision makers on a national and international level to achieve and conserve the favourable conservation status of the lynx, wolf and bear in the entire Alps. A special focus is given to cross border issues, international cooperation and necessary harmonization of processes relevant for a population level management.

1.3 Goals of the RowAlps project and current specification of the tasks

The overall goal of the RowAlps project is to develop practical goals and management options for the recovery and conservation of wolf and lynx populations in the Alps. These suggestions will support WISO to fulfill its current mandate.

To reach this goal, three objectives were defined and for each of them a working group was established.

Objective 1: To review and assess, based on available scientific publications and reports, statistical materials and up-to-date experience, the present situation of wolf, lynx and prey populations in the Alps, the expected development of the populations and discuss challenges in wildlife management as a consequence of the return of the carnivores.

Objective 2: To describe mechanisms to achieve tolerance for lynx and wolf for different interest groups and to identify factors defining the tolerance and the potential measures to influence these factors.

Objective 3: To assess the output from objectives 1 and 2 and develop, considering these biological-ecological and socio-economic findings, management scenarios for the recovery and conservation of favourable wolf and lynx reference populations in the Alps, discuss them with interest groups (in the frame of the WISO Platform), and report to the relevant bodies of the Alpine Convention.

These recommendations are based on the reports of the RowAlps objectives 1 and 2, further on the fact finding of the WISO Platform, on inputs of the members of working group 3 of the RowAlps project and finally on different documents, that have been drafted by WISO since its establishment in 2009.

The overall goal and objectives were fine-tuned during the discussions of the RowAlps workshops as well as the WISO Platform meetings during 2014. The working groups of objective 1 and 2 produced two separate reports[2].

1.4 Management definition

The members of the RowAlps project define management as follows: "Management is any goal-oriented and deliberate intervention within the existing legal framework, carried out by an authorised or mandated actor. The WISO Platform defines management as a value-neutral term that can embrace a wide variety of involvements with large carnivores, their wild or domestic prey species, and habitats or with people. Regarding the carnivores, it could include activities such as translocation and reintroduction, culling and capturing, or also intentional (temporary) non-intervention, but implies always, as it is goal-oriented, a kind of monitoring. Regarding society, it could include activities such as communication, participation, compensation and damage prevention and social monitoring."[3]

Management in the present recommendations is understood as: All legal activities in the biological and socio-political sphere with the goal of achieving a favourable conservation status of lynx and wolf:

- on a biological level "management" includes different actions such as conservation, maintaining habitats, lethal removal of single specimens which e. g. are posing a threat to the human population (under the strict conditions laid down in § 16 of the Habitats Directive and the Bern convention) and other actions,
- on a socio-political level "management" means also dialogue, communication and cooperation.

1.5 Scope of the recommendations

The geographical focus for the present recommendations is the Alpine arc. The overall management of the wolf across the Alpine arc focuses on international cooperation, whereas the concrete management options and strategies are understood as a transboundary framework.

[2] RowAlps report objective 1: The recovery of wolf Canis lupus and lynx Lynx lynx in the Alps: Biological and ecological parameters and wildlife management challenges. April 2015
Row Alps report objective 2. December 2014
[3] Workshop of the working group 3 of the RowAlps project, Vienna, 6th – 7th December 2012

1.6 Addressees

These recommendations address in the first place the official authorities of all member states of the Alpine Convention responsible for strategic planning and in charge of concrete actions concerning the conservation of large carnivores and wild ungulates. The recommendations provide a basis for decision-making regarding:

- strategic planning activities;
- concrete actions to balance large carnivores and wild ungulates with their habitat, other wildlife and human interest; as well as to address conflicts with human interests and counterbalance negative impacts.

Furthermore, they may serve as orientation for all non-governmental actors involved in wildlife management and finally as common vision for the realization of the overall goal to achieve a favourable conservation status of the wolf throughout the Alps.

More detailed reports, good practices, links on initiatives, references are available on the Alpine Convention web site[4] and MALME website[5].

2 Framework for large carnivore management

2.1 Legal framework of international and national treaties on large carnivores and population level management

Large carnivores have populations distributed across several countries and can have large individual home ranges, often >100 km^2. Therefore, legal instruments to protect these species need to be coordinated at an international level, and several international treaties have been established to address transboundary conservation.

The EU Habitats Directive

The EU Habitats Directive ("Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora") is a European Union directive adopted in 1992[6]. All the large carnivore species as well as their habitat are strictly protected by the Habitats Directive (annex II, which requires Natura 2000 sites, and annex IV). Wolf and brown bear, but not lynx, are additionally *designated as priority species.*

"Formally, the Habitats Directive does not explicitly specify that Favourable Conservation Status (FCS) should be achieved at the population level. Its reporting routines require that FCS be evaluated within each country (or within each biogeographical region present within each country), indicating that its intention is to operate on a national or sub-national scale. This scale of consideration may be suitable for a wide range of smaller species, but large carnivores present a wide range of very special challenges. As large bodied top-predators they naturally move over very large areas and occur at relatively low densities. This implies that many (maybe most) countries will never be able to host enough individuals to have a population that can reach FCS. In order for the intention of the Directive

[4] http://www.alpconv.org/en/organization/groups/WGCarnivores/default.html
[5] http://www.kora.ch/malme/20_malme/home/index_en.html
[6] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

to be achieved for a species group like large carnivores, it must consider spatial scales that span borders. This is actually specified in the Directive's preamble as one of the prime objectives of the Directive. These population level management plans can simply be viewed as an instrument to achieve this goal. The Commission also says in its technical specifications for the tender of this project that "coordinating the management across national boundaries might be the solution to maintain viable populations over the long-term, an approach that is also important to put large carnivore conservation into the broader context of biodiversity conservation". A certain legal clarification is, however, required from the European Commission concerning the proposed practice of attaching favourable conservation status assessment to the population level, which in some cases may free member states from the obligation to achieve it on their own" (Linnell et al. 2008).

Formal requirements towards EU member states are more than "just avoiding extinctions". The requirement is to reach the Favourable Conservation Status (FCS), based on two reference values: Favourable Reference Range (FRR) and Favourable Reference Population (FRP). The "*Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2 with particular regard to priority natural habitat types and priority species.*" (Article 11, EU Habitats Directive).

On behalf of the European Commission, the Large Carnivore Initiative for Europe elaborated the "Guidelines for Population Level Management Plans for Large carnivores" in 2008. The goals of these guidelines are:

1. To shift the focus from the species and the management unit to the (meta-) population.
2. To interpret FCS-term „Favourable Conservation Status" for correct and concrete use.
3. To recommend „best management practices" for large carnivores.

The Natura 2000 network was established under the Habitats Directive and comprises of a series of protected areas within the European Union (Emerald-Network for Switzerland and Liechtenstein).

The Bern Convention

All Alpine States and the European Union have signed the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). It lists wolf and brown bear as strictly protected (Appendix 2), while lynx is listed as protected (Appendix 3) together with the ungulate species. For species in Appendix 3 hunting is allowed as long as the population is not threatened.[7.]

"*The Bern Convention places considerable emphasis on the need to foster transboundary approaches in the preamble and in articles 1, 10 and 11. Recommendation 115 (2005) also calls for countries to work towards transboundary action plans for large carnivores, and the topic was given considerable attention in a workshop held in Slovenia in 2005 (Bath 2005)*" (Linnell et al. 2008).

The Bonn Convention

Furthermore, the Alpine countries are signatories to the Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn Convention)[8], which is specifically tailored to migratory species that cross international borders. The Bonn Convention even allows for states sharing migratory populations to sign legally binding treaties to govern the management of these

[7] WISO Platform. Results of fact finding in the frame of the Platform, "Large Carnivores and Wild Ungulates". 2010

[8] http://www.cms.int/

species. Although the movements of large carnivores across borders does not follow the strict definition of seasonal migration, it may be worthwhile exploring the potential for use of this convention, which has already been applied to several similar issues.

Whereas given that threatened habitats and species form part of the Community's natural heritage and the threats to them are often of a transboundary nature, it is necessary to take measures at Community level in order to conserve them:

"*The combined weight of the Habitats Directive and these two conservation conventions should be enough to motivate EU countries to develop population level management plans, especially if in so doing they will be permitted to adopt more flexible management practices than those allowed by a strictly national perspective. Furthermore, the Bern and Bonn Conventions should be useful frameworks to induce non-EU countries to take part in these plans. Although many Bern Convention signatories have taken reservations for wolves and bears concerning their placement on appendix II – these species are still covered under the Conventions general goals as expressed in articles 1 and 2*" (Linnell et al. 2008).

The Alpine Convention

The Alpine Convention is an international treaty (convention) for the protection of the Alps. It was signed beginning from 1991 by the eight countries of the Alpine Arc: Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland and the European Community. Every two years is conducted an Alpine Conference in the country holding the presidency.

The Convention works with integrated policies and approaches for the sustainable development of the Alpine Space. Twelve key themes and out of them eight protocols, support the parties to navigate the implementation highly complex sustainable developments in the Alps.

The Permanent Committee and the competent administrations are the main institutions primarily responsible for the Convention implementation. Working groups, platforms, committees etc. support and supervise the implementation of the Convention. One Platform of the Convention is the WISO (Wildlife and Society) which deals with large carnivores and wild ungulates.

Main themes and the protocols with relevance for large carnivores and wild ungulates in the Alpine Convention are

1. Spatial planning
2. Nature protection and landscape conservation
3. Mountain agriculture
4. Mountain forestry

Protocol „Spatial planning and sustainable development"
Article 3 of the protocol aims at considering of the criteria for environmental protection in the policies for spatial planning and sustainable development:

The spatial planning and sustainable development policies aim to achieve swift harmonisation of the economic interests with the needs for protecting the environment, with particular attention inter alia to:

a) safeguarding and restoring the ecological balance and the biodiversity of the Alpine region, […]

d) the protection of ecosystems, the species and rare landscape elements

And Article 9 of the protocol asks the countries that spatial and sustainable development plans and/or programmes include, at the most appropriate territorial level and taking account of the specific territorial conditions,: […]

4. Protection of nature and the landscape

a) delimiting of the areas for protecting nature and the landscape, and also for safeguarding the water courses and other vital natural resources,

b) delimiting of tranquil areas and areas in which construction of buildings and infrastructures is restrained or prohibited, as are other damaging activities.

Protocol „Conservation of nature and the countryside“

The objective of this Protocol is to lay down International laws, implementing the Alpine Convention and also taking the interests of the local population into account, in order to protect, care for and, to the extent necessary, restore nature and the countryside, in such a way as to ensure the lasting and widespread functional efficiency of the ecosystems, the conservation of countryside elements and wild animal and plant species together with their habitat, the regenerative ability and lasting productivity of natural resources, and also the diversity, specificity and beauty of the natural and rural landscape; and also, in order to encourage cooperation between the contracting Parties for these purposes.

The Contracting Parties undertake to cooperate particularly for: map surveying, drawing the boundaries and then managing and controlling protected areas and other natural and rural elements of the landscape worthy of protection, interconnecting a network of biotopes, defining landscape models, programmes and/or plans, preventing and rebalancing damage to nature and the landscape, systematically monitoring nature and the countryside, scientific research, and any other measure for protecting wild animal and plant species, their diversity and their habitat, and for defining the relevant comparable criteria to the extent that this is necessary and functional (Art. 3.1).

The Contracting Parties undertake to pursue the measures appropriate for preserving the indigenous animal and plant species with their specific diversity and in sufficient populations, particularly ensuring that they have sufficiently large habitats (Art. 14.1).

Finally the Contracting Parties shall undertake to promote the reintroduction and distribution of wild, indigenous animal and plant species and also subspecies, breeds and ecotypes, on condition that there are the necessary prerequisites and, by doing this, there is a contribution to the preservation and strengthening of those species and that no effects unsustainable to nature and the landscape, or to human activities, are caused (Art. 16.1). Scientific knowledge is to be applied for reintroducing and distributing these species. The Contracting Parties shall agree on common directives in this respect. Following the reintroduction, it will be necessary to control and, if required, regulate the development of these animal and plant species (Art. 16.2).

Protocol „Mountain farming“

In Article 13 of the protocol the Contracting Parties agree that the complementary nature and partial interdependence of farming and forestry in mountain areas necessitate an integrated approach. Consequently, they shall encourage:

(a) forestry compatible with nature both as an additional source of revenue for farms and as a sideline activity for farm workers;

(b) consideration of the protective, productive and recreational as well as the environmental and biogenetic functions of forests, in relation to farmland, taking account of the specific local conditions and in harmony with the countryside;

(c) regulation of grassland farming and of the game population, to avoid any intolerable damage to forests and crops.

Protocol „Mountain forests“
The Contracting Parties undertake to also consider the objectives of this Protocol in their other policies. This primarily applies to the following areas: […]

b) Populations of game. The game population is to be contained within limits permitting the natural reforestation of the mountains by indigenous trees, without having to take recourse to special protective measures. In the border areas, the Contracting Parties undertake to harmonise their measures for regulating the game animals. To restore a system of natural selection on the hoofed species, and also in the interest of protecting nature, the Contracting Parties shall encourage the reintroduction of predators, to an extent appropriate for the general needs of the region (Art. 2).

CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora, is an international agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten their survival. It came into force in 1975. Wolf is listed in Appendix 2 (www.cites.org). In the EU countries CITES is implemented by Council regulation (EC) No 338/97.

The national laws on hunting and on large carnivores

In the Alpine countries wildlife is managed through legal and practical means such as protective laws and selective hunting.

The wolf is strictly protected in all Alpine countries. This status is however subject to restrictions in some countries in order to reduce conflicts with livestock husbandry.

In Germany however there are no such restrictions but only exceptions from the rule (strictly protected) in compliance with Art 16 of the Habitats Directive. In Switzerland, livestock raiding individuals are selectively removed. In France and Slovenia, exceptional culls are permitted.

In France, wildlife and environmental monitoring are carried out by the Office National de la Chasse et de la Faune Sauvage ONCFS. The role of hunting in Italy is primarily to control wild boar, red deer and roe deer populations (Apollonio et al. 2010). Switzerland has licence hunting across the Alpine range, with 41 federal wildlife reserves where hunting is banned (Imesch-Bebié et al. 2010). Ungulate management and hunting practices in Germany are carried out with the objective of reducing and preventing damage to crops and forests. There is a federal hunting law, but the 16 “Bundesländer” all have additional regulations (Wotschikowsky 2010). Austria uses the "Reviersystem" similar to the system in Germany; the Austrian "Bundesländer" are responsible for legislation and management of game (Reimoser & Reimoser 2010). The current Slovenian Law on Wildlife and Hunting controls the wildlife management system in Slovenia (Adamic & Jerina 2010).

Table 1: Legal status of the wolf, restrictions to the status and authority in charge of wolf conservation and management in the Alpine countries.

Country	Legal status	Management interventions	Authority in charge
France	Strictly protected	Removal of stock raiding individuals (*tir de défense*). A yearly defined number of individuals are removed (*tir de prélèvement*)	Ministère de l'écologie, du développement durable et de l'énergie
Italy	Strictly protected	No derogation has ever been requested for culling under article 16 of the Habitats Directive.	Ministry of Environment; however the implementation is left to the regions.
Switzerland	Strictly protected (young wolfs)	Selective removal of stock raiding individuals. Criteria for population regulation if predation impact is too high.	Federal Office for the Environment FOEN; the cantons for the implementation of the wolf concept.
Liechtenstein	Strictly protected		Amt für Umwelt
Germany	Strictly protected under the jurisdiction of the Federal Nature Conservation Act.		Nature conservation authorities of the Länder (in Saxony also the hunting authorities). In some Länder the regional ministries of the environment are in charge, in other Länder responsibility is further delegated to the district administrations.
Austria	Wolf is mainly subject to the district's hunting laws, but enjoys a year-round closed season.		Hunting and nature conservation authorities of the provinces.
Slovenia	Strictly protected since 2004 (before quota hunting from October to February)	Exceptional culls permitted to decrease conflicts with agriculture.	Ministry of Agriculture and Environment

2.2 Administrative framework concerning current management of large carnivores at national and local level of Alpine countries

The development of a national wolf management plan has been addressed by all Alpine countries. Wolf management plans were elaborated in France as early as 1993. The Italian Ministry of Environment with technical support of the Istituto Superiore per la Protezione e la Ricerca Ambientale ISPRA has established National Action Plans for brown bear and wolf in Italy (Anonymous 2012). A concept for the management of wolf in Switzerland was developed in 2004 (BUWAL 2004) and revised in 2008 and 2010 (BAFU 2008, 2010).

Several Länder in Germany including Bavaria have developed regional wolf management plans. These plans, although called management plans, mainly deal with regional conflict mitigation and management competences. Slovenia has a strategic management plan and a five-year action plan is currently being implemented. Regional management plans for wolf exist in Germany and Switzerland.

Table 2: Countries with operative management plans for large carnivores and for the whole Alpine part of the population ✓ or regionally [✓].

Species	France	Italy	Switzerland	Liechtenstein	Germany	Austria	Slovenia
Wolf	✓	✓	✓		✓		✓
Lynx			✓		✓		
Brown bear	✓	[✓]	✓		✓	[✓]	✓

All Alpine countries have a decree that defines, which species are protected and which ones are hunted. While e.g. the authority in charge is the state in France, in Austria the federal provinces (Länder) are responsible for large carnivores and wild ungulates. In France, wolf and bear management are organized at the national level through national action plans. The actions planned at national level are put in practice by departmental authorities and coordinated at the regional level. In Switzerland and Italy the general conditions are defined in the national laws, but some species are managed on cantonal or regional level, respectively. In Switzerland all three large carnivores are protected by federal law. The federal law also gives the general guidelines about wild ungulate management, but delegates the management itself to the cantons. In Italy large carnivores are protected on ministerial level and the ungulates are contained in the regional hunting law. In Germany all large carnivore species are strictly protected by the Federal Nature Conservation Act. The administrative structure of huntable species in Bavaria is divided in three levels: local, the district and state level (Ministry of Food, Agriculture and Forestry). In Austria, the three large carnivores are managed under the hunting law with year-round closed hunting season. In Slovenia, protected species (bear, wolf, lynx) are regulated by nature protection legislation, game (chamois, ibex, roe deer, red deer, wild boar, mouflon) are regulated by hunting legislation.[9]

France, Switzerland, Germany and Austria have established large carnivore management boards with representatives of GOs, NGOs and scientists as discussion forums on regional and/or national level. The aim is an objective discussion about emerging problems and possible solutions to serve conflict management.[10]

In 2006, the Ministries of Environment of Italy, France and Switzerland signed an “italo-franco-suisse collaborative protocol for the management of wolf in the Alps” (Ministerio dell’Ambiente e della Tutela del Territorio et al. 2006). This protocol takes into account aspects of the Habitats Directive and Bern Convention as well as the existing national management plans with a common goal of re-establishing and protecting a viable wolf population in the Alpine arc.

Liechtenstein will in future be integrated in the management plans of Switzerland.

Wolf and lynx are strictly protected by international and national laws, but with regard to practical management, almost all countries having substantial populations of these carnivores are applying some regulations allowing for exceptional removals of problem animals. For the wolf, France is applying the principles of “tir de défense” and “tir de prélévemènt”, and Switzerland has set limits for how many livestock a wolf is allowed to kill before it can be lethally removed.

[9] WISO Platform. Results of fact finding in the frame of the Platform, “Large Carnivores and Wild Ungulates”. 2010

[10] WISO Platform. Results of fact finding in the frame of the Platform, “Large Carnivores and Wild Ungulates”. 2010

2.3 Human developments in the Alps

Since 1871, the resident human population in the Alps has almost doubled, from 7.8 million to15.2 million people (Bätzing 2015). However, the population development has varied hugely within the Alps and the population distribution became much more uneven: the majority of people live below 500 m. Areas along major transport routes have become urbanised and cities at the edges of the Alps have become “commuter towns” for the metropolises surrounding the Alps. Tourist destinations have grown, too. The population has increased especially in the western parts of the eastern Alps. The population in higher elevation areas has decreased, mostly because agriculture has become unprofitable due to limited mechanisation. The population decrease was most prominent in the Italian Alps (except South Tyrol), eastern Austrian Alps, and some regions in the French Alps. Young people and families moved away, and the population in these communities is considerably over-aged. A further population decrease is expected in areas with unfavourable economic conditions.

Tourism in the Alps has been stagnating on a high level since the early 1980s. About 60 million people visit the Alps every year for daytrips and an additional 60 million people stay for 370 million nights in the Alps every year (Siegrist 1998). However, tourism is spread unevenly across the seasons and across the Alps (37% of municipalities in the Alps offer no tourist beds at all; Price et al. 2011).

The influence of tourism on large carnivores and wildlife in general is twofold: Firstly, tourism requires infrastructures (e.g. transport infrastructure, ski slopes, or golf courses), which influences the landscape and the habitat of wildlife. Secondly, touristic activities (e.g. hiking, skiing, paragliding, but also added traffic from visitors) create disturbances for the local wildlife. Nonetheless, the populations of ungulates have increased throughout time. Large carnivores have a high capacity to adapt to human activities. Wildlife and especially large carnivores also represent a chance for tourism as visitors see them as the embodiment of pure nature and untamed wilderness. Wildlife tourism is however weakly developed in the Alps.

2.4 Ecological framework

Habitat loss and fragmentation are the leading human-caused deterministic factors affecting wildlife populations with effects being caused by e.g. altered connectivity or increased edge effects (Mills 2007).

The fragmentation of the landscape in Europe is increasing, which has various negative effects on wildlife (e.g. barrier effect, loss of habitat, increased numbers of traffic collisions). Nevertheless, the Alps still feature some of the largest unfragmented low-traffic areas in Central Europe but valley floors can be just as heavily settled and fragmented as the lowlands surrounding the Alps and present considerable barriers for animal movements.

The Alps are one of the best-known mountain ranges as well as being one of the richest in biodiversity, it is, however, also one of the most densely populated. The traditional tool used to conserve biodiversity and the natural environment has always been the creation of protected areas. However, it has become increasingly obvious that a majorly important aspect in the conservation process is to connect protected areas to one another to allow the migration of species across the entire Alpine range.

Besides the extent and quality of forests (which have improved over the past 100 years in the Alps), the connectivity between forest patches is decisive for far-roaming terrestrial species.

Forests in the Alps have been strongly overexploited in the 18th/19th century, but have recovered and forested areas have expanded again in in the 20th century. About 52% of the Alpine area is forested, and "forest creation and management" contributes the majority to recent changes in land cover (EEA 2010).

The realisation of an ecological continuum and the reduction of fragmentation lead to concrete spatial links (corridors) and measures in favour of the establishment of a pan-alpine ecological network (ECONNECT 2011).

Genetic flow across the whole Alpine range is important. Across the whole Alpine range a coordinated and transnational approach is needed in accordance with the legal framework provided by the Alpine Convention. Together with the "Ecological Continuum initiative" and the "Platform Ecological Network" of the Alpine Convention, Econnect created the Alpine ecological network to join efforts focussing on the Alpine massif as a whole in order to create a functioning ecological network in the Alps to contribute to conserve the extraordinary rich alpine diversity.[11]

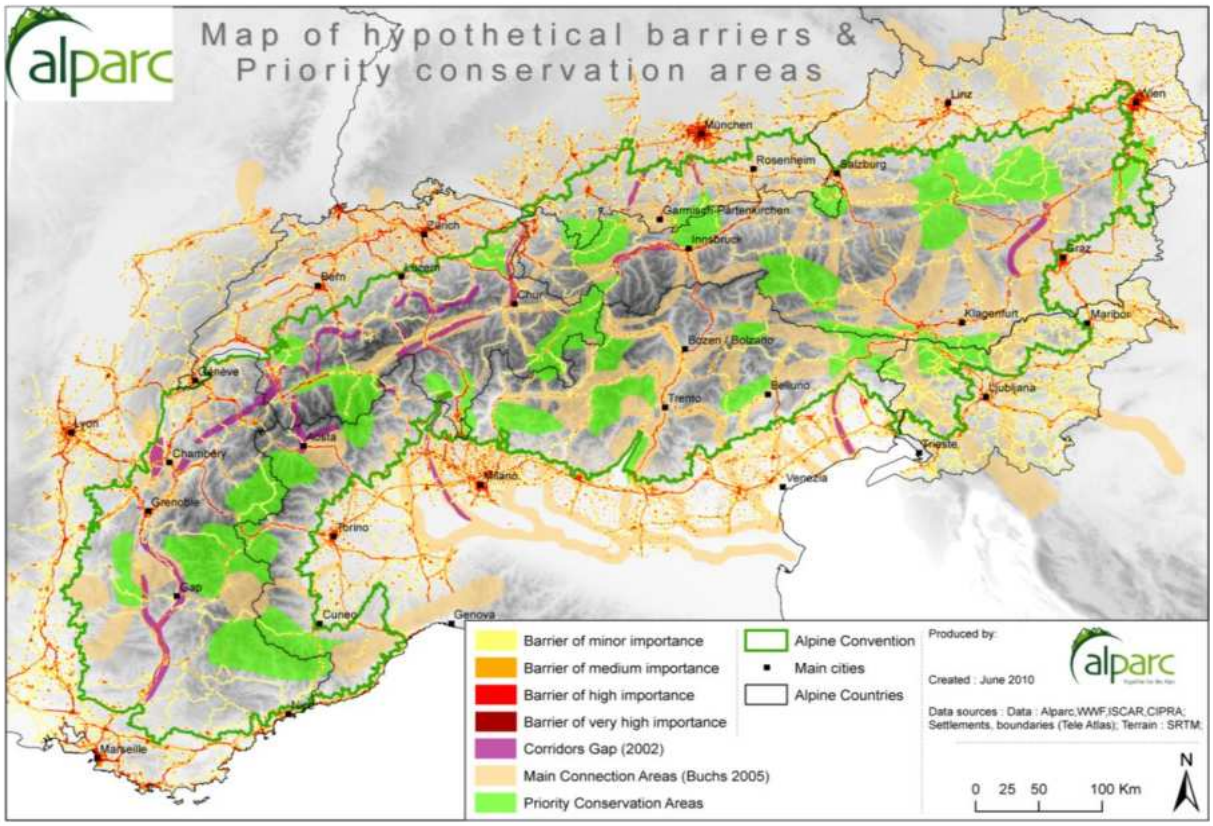

Fig. 1: Map of barriers and priority conservation areas. The map was based on expert opinion expressed during a workshop for the Ecological Continuum Initiative in 2010.

Marucco (2011) calculated habitat suitability models for the wolf in the Alps and studied the connectivity within the Alpine area. The main unit in the analysis were not individual wolves, but packs, because they represent the main reproductive unit in wolf social dynamics (Mech & Boitani 2003).

"Wolves can easily cross roads and highways, as documented by many studies (e.g. Boyd & Pletscher 1999, Ciucci et al. 2009); therefore, a single road is not usually identified as a barrier for wolf dis-

[11] http://www.alpine-ecological-network.org/the-alpine-ecological-network

persal. However, in Italy wolves are often killed by car accidents (Lovari et al. 2007), especially if they settle a territory in a region with a high road density (e.g. Avanzinelli et al. 2007). Therefore, road density is a major limitation to pack settlement more than to wolf dispersal. The report of ECONNECT documented that not just road density is a variable negatively related to wolf presence, but also human settlements, low forest cover and high rock elevation presence (Marucco 2009). Connectivity results need also to be interpreted within the strict regulations of wolf sociality and dispersal movement patters, very different than for the other solitary large carnivores" (Marucco 2011).

The lowest amounts of connectivity (i.e. barriers) were found mainly in the west-central Alps, and in Switzerland (Fig. 2). These findings coincide with the wolves' observed recolonization of the Alps from the Apennines, which has slowed down over the the indicated barriers in the recent decade (Marucco 2011).

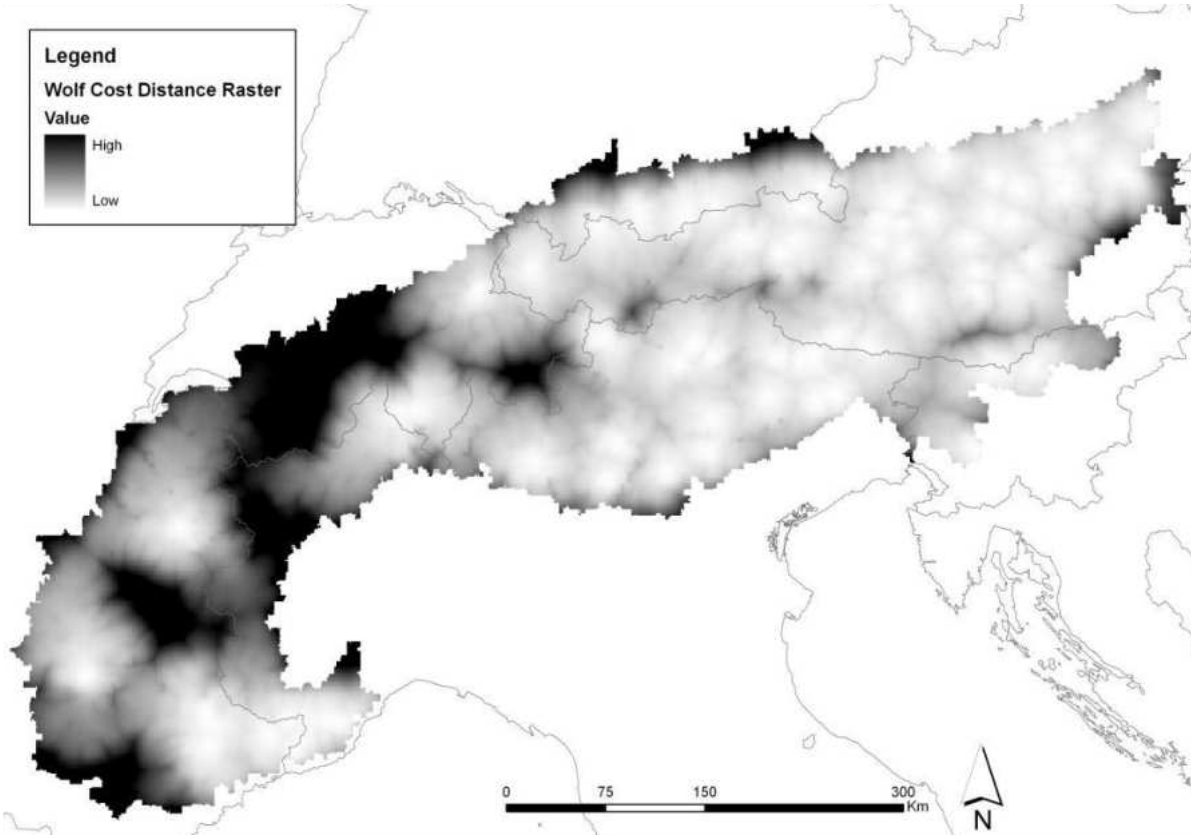

Fig. 2: The wolf cost distance raster. For every cell the least accumulative cost distance over a cost surface to the identified source locations was calculated. Light areas indicate higher connectivity, dark areas indicate barriers (Marucco 2011).

However, connectivity is also affected by management fragmentation, which is a type of fragmentation often overlooked (Linnell et al. 2007, cited in Marucco 2011), but crucial within the Alps with its many international and intranational borders. Switzerland was by then the only country, in which the possibility existed to remove "problem individuals". The identified barriers (Fig. 2) may therefore not only represent barriers in the landscape, but also management barriers for wolf expansion towards the Eastern Alps. The present recommendations aim at reducing such management fragmentation.

"*Finally, wolf connectivity over the Alps needs to be analysed in a wider context, taking into consideration that the alpine wolf population was naturally generated 20 years ago through natural dispersal from the south-western Apennines (Fabri et al. 2007). The connection with the Apennine population is constituted by an ecological corridor represented by the Ligurian Apennines Mountains, which is fundamental to be maintained in order to guarantee enough genetic diversity in the wolf Alpine population (Fabri et al. 2007). Moreover, an interesting slight connection has been documented with the Dinaric population from Slovenia, and the Carpatian wolf population (Rauer & Groff, pers.comm.). Spatial analysis of potential connectivity within these areas and the Alps, and characterisation of the barriers by their origin, size, shape and degree of permeability with an assessment of possibilities to diminish them, would be extremely important to allow a future wolf metapopulation over the different mountain chains in Western-Central Europe*" (Marucco 2011).

3. Current situation of the wolf population in the Alps

3.1 Return of the wolf to the Alps and population development

The historic decline and eventual eradication of the large carnivores in the Alps between 1800 and the early 1900 proceeded in parallel and was related to the expanding human population and the over-exploitation of natural habitats and resources, including forests and game. Increasing numbers of sheep, goats, cattle and horses affected the forests negatively due to browsing and out-competed the wild ungulates. The large predators were forced to kill livestock and were therefore persecuted, encouraged by governmental bounties. However, hunting alone did not lead to the eradication of the large carnivores. Only the massive intervention at the level of the landscape (forests) and the substantial reduction of wild ungulates led to the final eradication of lynx and wolf (Zimen 1978, Breitenmoser 1998a).

A radical change in forest management and the growing sensitivity of people for the protection of nature in the first half of the 20th century were the basis for the recovery of the forests (Breitenmoser 1998a). Wild ungulates started to recover and expand from remnant source populations after they were granted a certain legal protection (change of hunting legislation). Their renaissance was supported by numerous translocations and reintroductions. A swift increase in all wild ungulate populations – which is still continuing for roe deer, red deer and wild boar in many regions – was the result. The ecological recovery was facilitated by industrialisation, which drew people away from rural areas. As a consequence, the number of goats and sheep in the Alps declined drastically in the first half of the 20th century.

All these factors prepared the ground for the return of lynx and wolf to the Alps. The return of the wolf was a consequence of the improved protection of the remnant populations in the Apennine, in the Dinaric Range and in eastern Europe. The first wolves arrived in the early 1990s from the Italian population and settled the south-western Alps of France and Italy.

Wolf made a remarkable come-back to the Alps. Within only two decades the species settled the French Alps from the Italian Apennines and started to recolonise the Swiss Alps. Wolves are also arriving from the Dinaric, Carpathian and possibly also from the Central European Lowland populations. The Alps are situated in between of several wolf populations and could act as a cross-breeding area in the future. Thanks to non-invasive genetic monitoring, this process can be shown –

given the data are processed equally between the different countries. Monitoring of the recolonisation of the Alps by the wolf is requiring cross-border cooperation and the regular exchange of monitoring data.

3.2 Present status and distribution of the Alpine wolf population

The Alpine wolf population was assessed as „endangered“ according to the IUCN red list assessment, but with an increasing population trend. Low acceptance, habitat loss due to infrastructure development, persecution, hybridisation with dogs, poor management structures and accidental mortality were listed as the most relevant threats (Boitani et al. 2015).

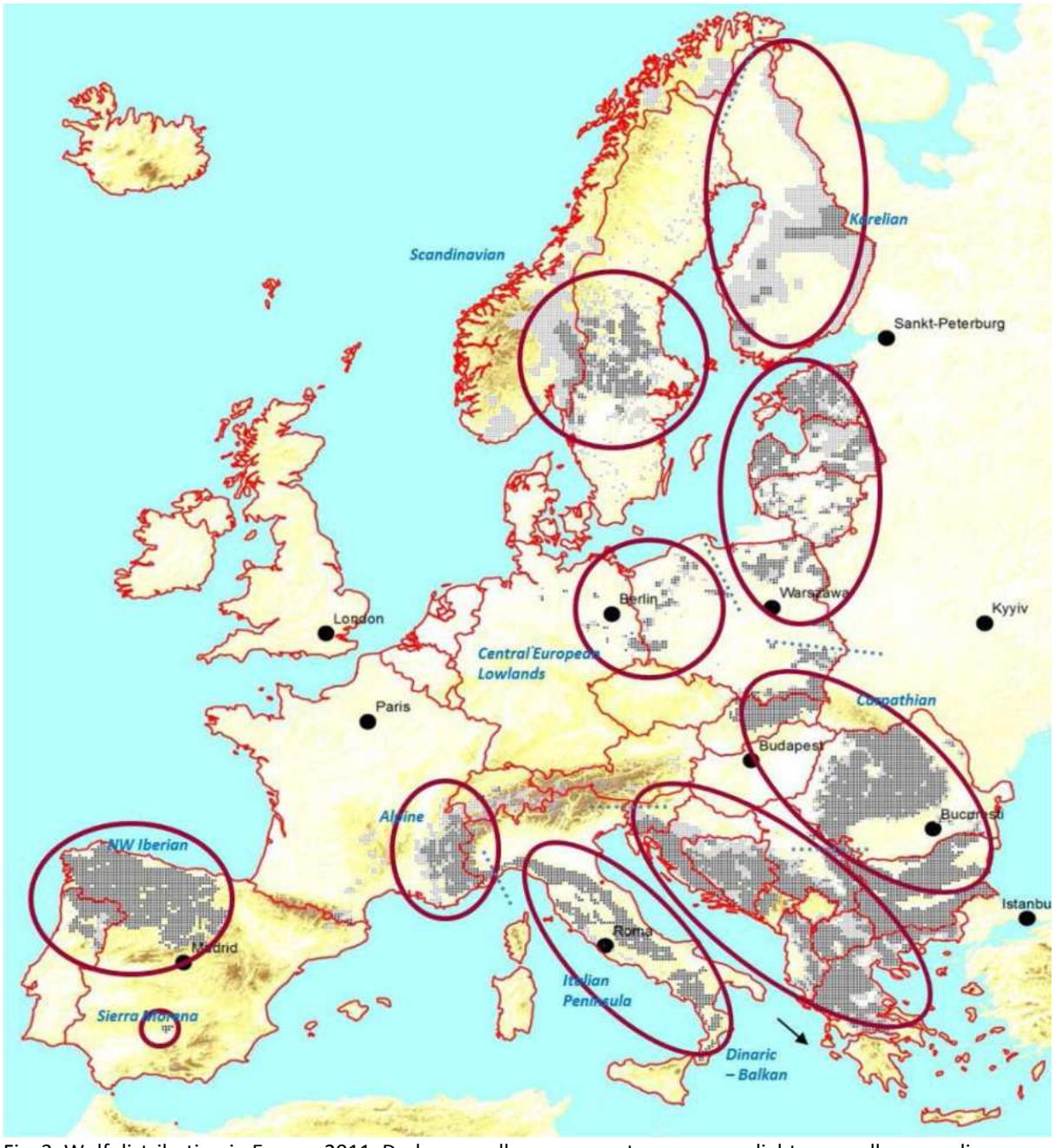

Fig. 3: Wolf distribution in Europe 2011. Dark grey cells: permanent occurrence, light grey cells: sporadic occurrence. Red borders mark countries for which information was available. Circled are the populations as defined by the IUCN/SSC Large Carnivore Initiative for Europe. Source: Kaczensky et al. 2013a.

The western Alps have been recolonised by wolves from the Italian population which had experienced a bottleneck and was reduced to about 100 individuals in the 1970s (Zimen & Boitani 1975). The recolonisation of the Eastern Alps is not as advanced as in the Western Alps. Pioneers in the Eastern Alps came from various source populations. The Alps will become a melting pot of various European wolf populations, enhancing the genetic diversity of the overall Alpine population. In 2009/2010, the Alpine wolf population was estimated to be at least 160 wolves or 32 packs (Kaczensky et al. 2013a). According to the Wolf Alpine Group (WAG), in 2014 the wolf population increased to at least 35 packs and six pairs were recorded.

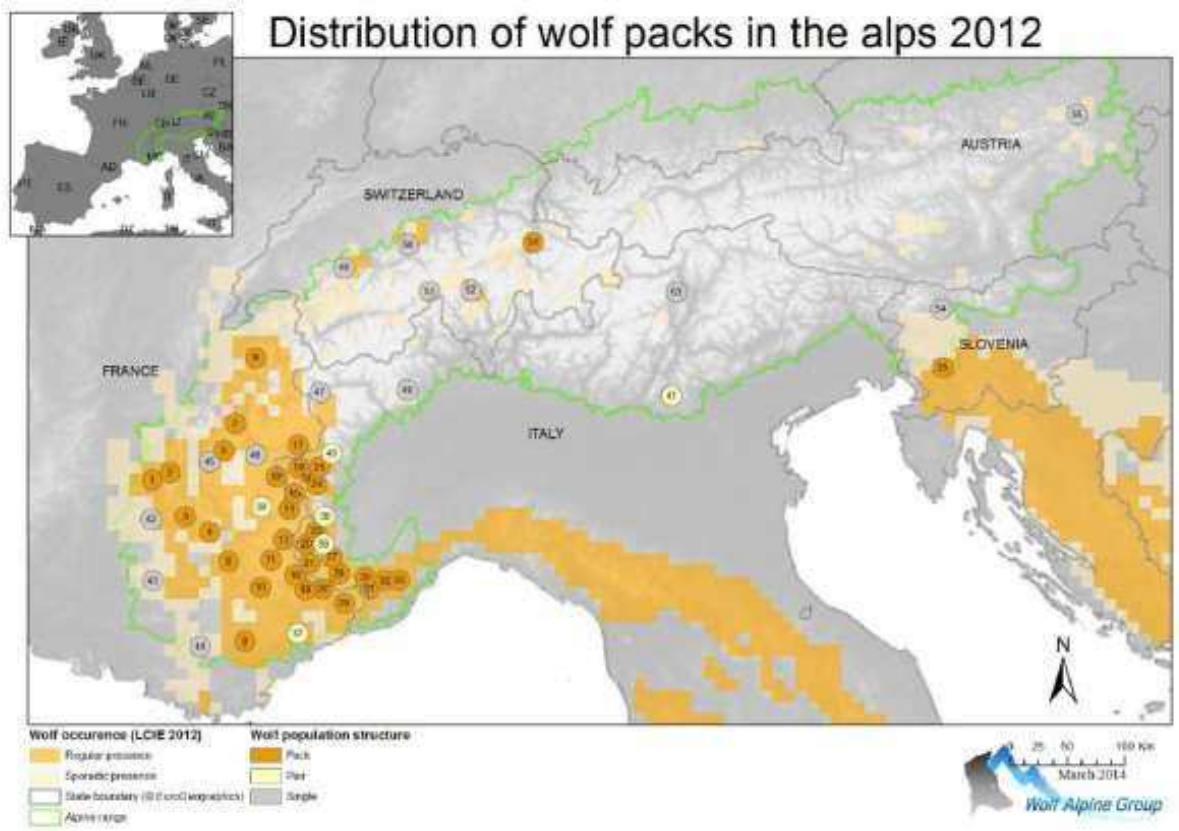

Fig. 4: Distribution of packs, pairs and single wolves in 2012 in the Alps that hold a territory for at least two years (WAG 2014).

Wolves in France are mostly found in the Alpine region (Marboutin 2013a). Census results in 2009 resulted in the identification of 13 wolf pack territories and 7 transboundary pack territories straddling France and Italy (Marboutin 2013a). By the 2010 season, the population estimated through snow tracking was around 68 wolves. Wolf presence study in 2014 showed an increase of wolf presence (ONCFS 2014).

The population in the Italian Alps was estimated at 60-70 wolves in 2010-2011 (Marucco & Avanzinelli 2012), distributed across at least 12 packs, in addition the to 7 transboundary packs shared with France. The Italian and Dinaric wolf population were separated for centuries, but in 2012 the first contact between these populations was documented (Boitani & Marucco 2013).

In Switzerland, a total of 60 wolves (14 females) were genetically identified from 2005-2014, but the first reproduction was only confirmed in 2012 (von Arx & Manz 2013). 24 wolves were genetically identified in Switzerland between October 2012 to September 2014.

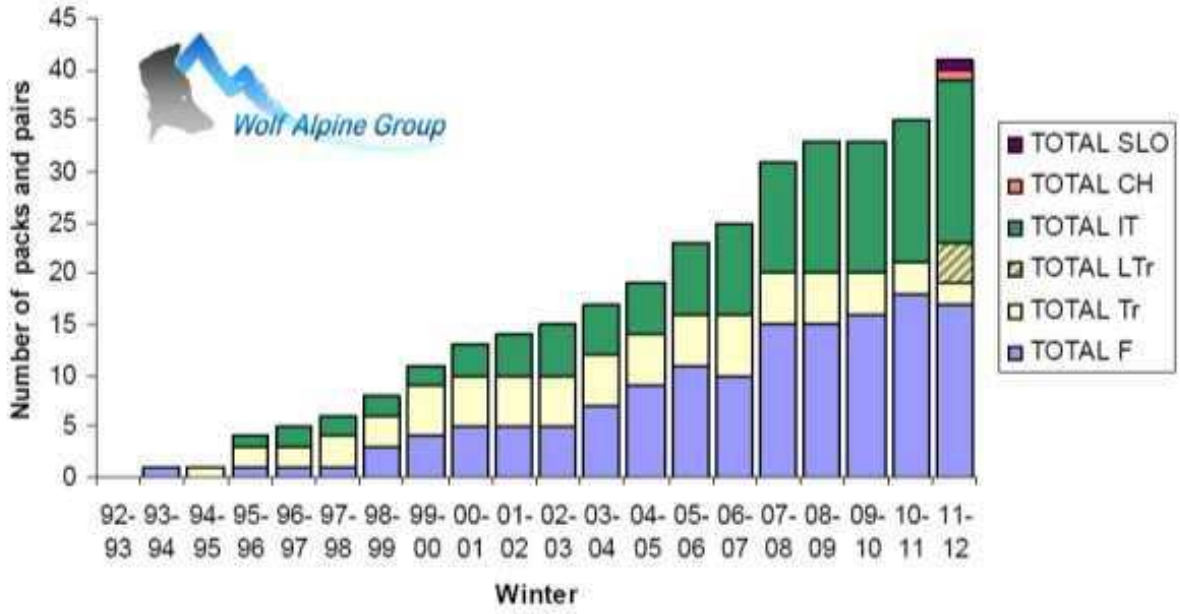

Fig. 5: Number of wolf packs and pairs across the Alpine countries (WAG 2014). NB: packs and pairs = at least 1M + 1F for two consecutive winters or breeding evidence next summer. F : France; IT : Italy, CH: Switzerland; SLO: Slovenia, Tr: transboundary, LTr: likely transboundary.

Wolves are mainly present in the northern part of Germany (Central-European Lowlands population). Recently, an expansion of the population towards the western parts of the present distribution range has been observed. Additionally, between 2006 and 2011, two lone wolves were recorded in Bavaria originating from the Alpine population (Bayerisches Landesamt für Umwelt 2014a). In spring 2014, two additional male wolves were identified in the Bavarian Alps (Press releases of the Bavarian State Office for Environment on 16 April 2014 and 11 July 2014).

Austria lies within the reach of several existing source populations. Dispersing individuals originating from the (Italian) Alpine, Eastern Europe and Dinaric-Balkan populations have been genetically identified in different parts of the Austrian Alps. The frequency of wolf visits to Austria increased slightly over the past 15 years, and both males and females were identified (Rauer et al. 2013). Most wolves were detected only once or a few times within a single year before disappearing again. From 2009–2014 at least 18 individuals were detected genetically. These wolves were found almost all over the country independent of the population they were originating from. Austria may therefore indeed develop into a cross-breeding area of wolves from different distinct populations (Rauer et al. 2013 and Rauer pers. comm.).

Wolf distribution in Slovenia represents the north-western part of the Dinaric-Balkan wolf population. They are distributed in south-western Slovenia (Dinaric Mountain chain), along the border with Croatia, towards the coast and in Trnovo forest in the North (Majić Skrbinšek 2013). There is only a sporadic occurrence in northern Slovenia, along the southern rim of the Alps. In Slovenia (whole country), in 2010, a genetic CMR method estimated the maximum number of wolves of 43 individuals. The minimum estimate in May 2011, after the cull and before reproduction was 32 wolves (Majić Skrbinšek 2013).

3.3 Diet and predation of wolf

The wolf is very adaptable in its diet, which is "*as broad as its geographic range*" (Peterson & Ciucci 2003). Wolves tend to live and hunt in packs. As they usually neither guard nor hide their kills, the optimum foraging strategy is to hunt prey that the hunting group can consume to the fullest extent possible in a single feeding session (Jędrzejewski et al. 2002). Numerous studies in Europe found that wolves in general preferred to prey on wild ungulates, especially cervids (Bassi et al. 2012). However, wolves quickly adapt to current conditions in regard to (seasonal) prey availability. A review of 20 studies performed in Italy between 1976 and 2004 found a general positive correlation on a national and regional level between the abundance of wild ungulates and their frequency of occurrence in the diet of wolves (Meriggi et al. 2011). A significant increase in the abundance of wild ungulates also led to a significant increase of wild ungulates in the wolves diet in the northern Apennines while livestock depredation decreased, despite an increase in the number of packs from two to four (Milanesi et al. 2012). Nonetheless, even fruit (Meriggi et al. 1991), carrion and garbage (Mech & Peterson 2003) can constitute a significant part of the diet when conventional prey is scarce. Such changes in diet occur seasonally, as the availability of prey species may change. For example, wild prey might move into more difficult and steeper terrain in summer, while at the same time domestic livestock is moved to the Alpine pastures, where it may be relatively easily accessible (Espuno 2004). Contrarily, snow conditions in winter may increase the vulnerability of wild ungulates (Nelson & Mech 1986b, Espuno 2004). The seasonal adaptation also includes preferences for different social categories within a species e.g. for juveniles (e.g. Gazzola et al. 2005), or during the rut for males as they are less attentive to their surroundings, and physically stressed (Mech & Peterson 2003, Palmegiani et al. 2013). Estimated consumption rates in Europe range from 2.8 – 5.6 kg per wolf per day (see Gazzola et al. 2007) but they may vary with pack size, season, prey availability etc. Comparing data from the western Italian Alps, the observed consumption rate is at the lower end of the range, which would translate to an annual consumption of 25 ± 8.1 red deer individuals/100 km², 39 ± 18.5 roe deer individuals / 100 km² and 11 ± 3.5 chamois individuals/100 km² (Gazzola et al. 2007).

A study on 9 packs in the French Alps between 1995 and 2009 showed a relative uniformity in their predation with 76% of wild ungulates and 8% of smaller prey (Fluhr 2011). The analysis showed that variations in the diet of the packs were based on environmental factors such as the type and abundance of wild prey and in particular the type of livestock protection programmes applied in the region (Fluhr 2011). Studies in different areas of the Piedmont Region of the Italian Alps showed that 69.5% (in summer, Regine 2008) and 90% of the total diet, respectively, consisted of wild ungulates, with the primary prey species changing almost every year between red deer, roe deer and wild boar (Marucco et al. 2010). Palmegiani et al. (2013) found that the wolf's diet in summer in Gran Paradiso National Park comprised mainly of chamois while in winter chamois and roe deer were taken in similar ratios. Outside the Alps, in eastern Germany, wild ungulates constituted over 95% of the wolf diet, with either a preference for red deer (Ansorge et al. 2006) or roe deer (Wagner et al. 2012). The degree of livestock in the diet varied considerably: almost none in eastern Germany (Ansorge et al. 2006, Wagner et al. 2012), 10% in southern Slovenia (Krofel & Kos 2010), 16% for nine packs in the French Alps (Fluhr 2011), and 31.9% in the Piedmont Region (Regine 2008). One pack in France seemed to show a preference for domestic livestock as 43% and 46% of the diet consisted of domestic livestock in summer and winter, respectively (Fluhr 2011). Among domestic livestock, sheep were the main victims, constituting 79.4% of the victims in the Piedmont Region between 1999 and 2009, followed by goats (16.8%), bovids (3.5%), equids (0.2%) and shepherd dogs (0.1%; Dalmasso et

al. 2012). In France, total numbers of domestic livestock victims have reached 8,226 for the year 2014 (DREAL 2015).

Predation impact of wolf on ungulates

A number of positive effects of wolf predation on their prey and ecosystem include the culling of unfit animals, control or limitation of prey numbers, stimulation of prey productivity and increase in food for scavengers (Mech & Peterson 2003, Peterson & Ciucci 2003). As wolves appear to take out individuals in lower physical condition, their effect on the prey population is reduced as they seem to cause mainly compensatory mortality. In central Europe, wolves selected in the winter the weakest deer with very low fat reserves (Jędrzejewski 2005 cited in Gazzola et al. 2007). Such selective culling could improve the average health of the prey population. In general, wolves have a high plasticity and use prey resources at their availability. Marucco et al. (2010) had observed almost every year a switch in the primary prey species (see above) and expected such behaviour to reduce the negative impact of predation on the prey population. Unlike lynx, wolves are also scavengers. During an intensive observation period in rather snowy winter, a pack of wolves was observed to almost exclusively scavenge on animals which have died e.g. from avalanches, without any additional hunting from the packs, showing that under conditions of high natural die-off of wild ungulates wolf may not be a source of additional mortality (Marucco et al. 2010).

Nevertheless, wolf predation on ungulate populations has led to challenges. A study on roe deer in Europe has shown that the effect of predation was higher in less productive environments (Melis et al. 2009). In the case of wolves, the annual net increase in a wild forest reindeer population of reindeer in Finland decreased from 13% to 7% due to wolf predation (Kojola et al. 2004), showing the capability of limiting at least some of its prey species populations. Human ungulate management and wolf predation can have additive effects. In Białowieża Primeval Forest, Poland, the combined effects of wolf predation and hunting have led to a decline in ungulate populations between 1991 and 1996 (Jędrzejewski et al. 2000). Modelling has shown that the profit of landowners in Scandinavia from moose hunting may be reduced by 10% or more as a result of wolf predation (Skonhoft 2006). Therefore, wolf predation should be taken into account for the management of game.

Red deer density in the eastern Alps is very high and requires special management measures to mitigate their browsing damage to forests. It can be assumed that the predation of wolves on red deer will influence this system. However, the recolonisation of wolves of the eastern Alps has just started, and there is no experience yet on the impact of wolves on abundance and distribution of red deer in such a situation.

3.4 Wild ungulates

3.4.1 Wild ungulate availability

The existence of a sufficient prey base is a key factor determining the successful return of large carnivores (Breitenmoser 1997). Populations of all wild ungulate species have been increasing over the past decades and continue to do so in many Alpine regions except for the chamois. Some countries make regular records of wild ungulate population sizes available (but often do not state census methods clearly), but others like Austria do not (Reimoser & Reimoser 2010). Hunting bag data were the only data sets almost consistently available across the Alpine Countries. Of course, data on hunting bags show clear weaknesses, e.g. not being linked with the real hunting effort invested. In Bavaria for example, hunting efforts to reduce ungulate numbers were raised

considerably over the last 20 years in order to decrease browsing impact on forest regrowth. Nevertheless, the existing data on population numbers and hunting bags were used to indicate the development of large herbivores and differences between the Alpine countries. More detailed population numbers and hunting bags are listed in the RowAlps report objective 1.[12]

Red deer have naturally recolonised the Alps, helped by reintroductions. Numbers are still increasing across the Alps according to censuses and hunting bags, with an especially strong increase of hunting bags in Austria. Hunting bags in the Alpine districts of Bavaria appear to be rising again as well, after experiencing an initial sharp drop by approx. 25% in the late 1980s followed by a slight further decrease for the next 15 years.

Roe deer are abundant and widespread across the Alps. Hunting bags appear to be still increasing in Austria and the Alpine districts of Bavaria. In the other countries they appear to be rather stable.

Wild boar hunting bag numbers are fluctuating strongly in some of the countries, with wild boar generally expanding their range and hunting bags increasing. In fact, the data compiled in the RowAlps report objective 1 show for all countries the highest hunting bags for wild boar for the most recent years.

Chamois are widespread across the Alps, but trends differ. Hunting bags in France continue to rise, while they stagnate in Bavaria and Slovenia. Meanwhile, in Switzerland and Austria, hunting bags have decreased by about a third since the early 1990s.

3.4.2. Wild ungulate management

Red deer and roe deer are the most widely distributed ungulates across Europe and the Alpine range; along with wild boar they compose the most important game species (Linnell & Zachos 2011). These populations recovered from a net decline in the 19th and 20th centuries due to widespread unregulated hunting (Putman 2011). Management practices such as regulated and selective hunting practices, increasing migratory corridors and habitat connectivity, reduction in habitat fragmentation and protection of habitat, but also reintroductions, reinforcements and artificial feeding have led to an increase and recently stabilisation of these populations. In many regions of Europe, wild ungulates are so abundant today that management practices include measures to reduce damage to crops and forests and prevention or mitigation of diseases. Hunting is the most important management practice and is used in many countries to control populations and hence limit damage to agriculture and forests (Putman 2011). Culling of wild ungulates is widespread across Europe and is largely linked to the claims of agriculture, forestry and transport sectors (Morellet et al. 2011).

In spite of these challenges, few countries have established robust long-term census system to monitor ungulate populations. Direct and indirect censuses are the most commonly used methods to monitor ungulate populations. Direct census methods may include capture-mark-recapture method (Switzerland), open hill counts (Switzerland), animal vocalisations (Italy), spot lighting (Italy, Switzerland) and drive counts (Italy, Switzerland) (Morellet et al. 2011). Estimates from indirect methods use faecal samples, animal vital rates (France), snow tracking (Switzerland) and habitat quality (France, Slovenia) among several other sampling methods (Morellet et al. 2011).

[12] Breitenmoser et al. 2015. The recovery of wolf Canis lupus and lynx Lynx lynx in the Alps: Biological and ecological parameters and wildlife management systems. RowAlps Report Objective 1. KORA, Muri bei Bern, Switzerland. 276 pp.

Wildlife in the Alpine countries is managed through legal and practical means such as protective laws and selective hunting. Legislation operates at different levels (national, regional, provincial, etc.) across Europe. One generality however, exists across European countries: game does generally not belong to the land owner (Putman 2011). Game belongs to everyone or no one – *res communis* or *res nullius*. In the case of *res communis*, the state can either sell hunting licenses or allocate the sale of hunting licenses to individuals or hunting groups and do not involve landowners in this aspect (e.g. Italy, Slovenia[13], Switzerland). In the case of *res nullius*, hunting rights belong to the landowner who allocates licenses while the state has the right to determine management goals (e.g. Austria, Germany, France; Putman 2011).

Although hunting seasons in European countries should ideally be determined based on the ecology and natural history of the species that are hunted, it is currently not the case in several countries (Apollonio et al. 2011). Factors that should ideally be taken into account when determining a hunting season include the period of rut, pre-parturition and post-parturition. These are important factors as hunting during these key moments can disrupt reproduction and have a negative impact on the population. Hunting during periods of late pregnancy can also be negatively perceived by the non-hunters with regard to ethical concerns. Culling adult females with young can result in the death or loss of fitness of young animals still dependant on their mothers. Many European countries allow the hunting of animals during these three critical periods during the breeding season for species such as red deer, roe deer, chamois and wild boar (Apollonio et al. 2011).

Table 3: Comparison of management systems across the Alpine countries (adapted from Putman 2011), showing strong state controlled management practices on the left and individual landowner management types on the right.

	Impose/determined by state (National or regional authorities)	**Proposed by land owners associations/ Hunters' associations, approved by State**	**Proposed by landowners associations/ Hunters' associations or equivalent voluntary (not approved by State?)**
Game management district/group	Switzerland, Slovenia, France, Austria	Germany, Italy	
Management objectives	Switzerland, Slovenia, France, Austria	Germany, Italy, Austria	
Management Plan	Switzerland, Slovenia, France	Germany, Italy, Austria	
Quota/Cull Targets	Switzerland, Slovenia, France Cull carried out by game wardens	Germany, Italy, Austria Individual licenses allo-cated (per animal)	Global quota allocated to leaseholders
	Cull carried out by State hunters	**Individual licenses allocated (per animal)**	**Global Quota allocated to leaseholders**
Global Quota/ Individual licenses	Switzerland (Canton of Geneva), France	Switzerland, France	Slovenia,Germany, Italy, Austria

[13] In Slovenia, the state is the legal owner of game according to the Environmental Protection Act of 2004.

3.5 Livestock husbandry

Sheep are the most important and most abundant domestic victims of predators in the Alps (Kaczensky 1996). Therefore the chapter focuses not exclusively but very much on summered sheep.

3.5.1 Development of livestock husbandry and pastoral systems in the Alps

Livestock husbandry has largely influenced Alpine societies and traditions. After a peak in the 19th century, the agricultural crisis as a consequence of industrialisation, led to the abandonment of many Alpine pastures. Contemporarily the first attempts were made to regulate forestry. Industrialisation drew people away from remote areas.

In the past 150 years, livestock populations have seen considerable changes. Cattle experienced an increase, but also a concentration; more cattle are in fewer hands than 150 years ago. Horses have been replaced by tractors and trucks. The importance of sheep, who are the main victims of large carnivore attacks, declined around 1830, when the domestic wool production lost its competitiveness to wool from abroad and cotton. Sheep husbandry is today promoted to prevent that remote pastures in the Alps are grown over by forest. Finally, goats have today totally lost their former economic significance in the mountains.

Since the middle of the 20th Century the tendency of woodland to expand and of wild ungulate populations to grow was true for the entire Alps, though with many regional differences. After the Second World War the rationalization of agriculture led again to the reduction of summered livestock and a decrease in farmers. Only the financial support in the frame of subsidies (since the 1980s) attenuated the trend and the variability of summered livestock. Nevertheless the species of livestock can still change (e.g. sheep instead of cattle or horses, sheep instead of goats and so on; Ringler 2009).

In the past 100 years numbers of summered sheep and goats have significantly decreased in the northern parts of the Alps (A: decrease to 1/7 of the numbers between 1927 to 2008; D: decrease to ½ of the numbers between 1950 to 2003; FL: decrease to 1/8 of the numbers between 1977 to 2003) whereas in Switzerland and in Italy summered sheep and goat numbers decreased only slightly (around 15%) and increased heavily in Slovenia (up to 4 times the number between 1923 to 2003) and France (additional 43%; Ringler 2009).

Important trends have influenced today's pastoral system (Ringler 2009):

- Whereas on the northern side of the Alps summered livestock clearly decreases since the 2000s, the summered livestock as well as the number and surface of used mountain pastures increases on the southern side of the Alps.
- Increasing availability of "external livestock", that is summered on mountain pastures. The share of "pension animals" increased in the 1980-1990s (e.g. in the National Park of the Pyrenees by 21%) whereas the share of "own sheep decreased (e.g. 34% in the National Park of the Pyrenees). The similar trend can be observed with cattle.
- The altitude of the "belt of alpine pastures" has been displaced significantly downwards on the northern side of the Alps since the 1970s.
- Forest surfaces increase all over the Alps since the middle of the 20th Century.
- The summered sheep number (compared with cattle) has increased in general (sheep are less time intensive as cattle), because personnel and time to take care of the mountain pastures and the summered livestock decreased.

- A further important change is the local public infrastructure (streets, a.s.o.), which allow to deliver livestock individually and leads to fluctuations of number of animals on the mountain pastures during each season. Roads allow also to be not constantly on the pasture, but to survey livestock on mountain pastures while being hosted in the valley.
- Education of personnel and main tasks on pastures has changed (more work hours for touristic services, more and more "enthusiasts" instead of full time farmers, less and less milk – processing, maintenance and care for the pastures as well as diminishing numbers of personnel on the pastures in general).
- In the absence of large predators, livestock protection measures have been largely abandoned over the past century and need to be reintroduced again. The most effective methods include livestock protection dogs, electric fences (depending on topography) and shepherds (Gehring et al. 2010).
- More and more rent agreements for the pastures.

3.5.2 Mountain pastures and pastoral systems today

Pastoral systems and practices vary depending on the country, traditions and type of terrain. There are three main types of mobile sheep herding: nomadic, transhumance (i.e. seasonal change of grazing areas) and the alp system.

Today, between 5 and 50% of the Alpine area are pastures, depending on regions. The entire surface of the Alps is around 190'000 km² (PSAC 2010). A large part of it is outside of pure pasture land, but rather in wood pastures and uncultivated areas high in the mountains. The pastures and pasturing system are important for agriculture in terms of "forage" for livestock, and at the same time for "Alpine" culture, landscape and against natural hazards. In absolute figures the surface of alpine pastures is the highest in France (more than 2 million ha), the number of pastures however is the highest in Austria (more than 13'000). Regions with an especially high share of mountain pastures related to the entire alpine area are the Oberallgäu/Bavaria/D, Provence-Cote d'Azur/F and Piedmont/I with nearly 70% as well as Grisons/CH (55%), Valais/CH (40%), Vorarlberg/A (49%), Tyrol/A (44%), Salzburg/A (42%) and South Tyrol/I (34%).[14]

On each alp other responsible bodies, managers and partners are engaged and make the mountain pasturing and pastoral system in the Alps a diversified and complex system. Where one alp adjoins directly the other the density of husbandries is high; especially in the western Oberallgäu and the Bregenzer Wald – around 0,7 alps/km² mountain area, but also in the Cantons of Schwyz, Fribourg, Waadtland and the Kitzbüheler Alps in Tyrol and some areas in the south-western Alps (Ringler 2009).

In Austria the contribution of alps for national economics, landscape and tourism is relevant. It is also the country with the highest numbers of „Bio-alps". The intensification of alps for milk cows has lead to more infrastructures whereas alps where no milkprocessing occurs are extensified more and more.

In Germany the touristic use of alps is comparably smaller, and the alps are used dominantly for young cattle. A large share of the alps is managed on the base of property rights. In Germany the summer pastures have been cleared from forest and are kept very clean from bushes.

[14] Almen und Alpen; Höhenkulturlandschaft der Alpen, Ökologie, Nutzung, Perspektiven" from Alfred Ringler, Verein zum Schutz der Bergwelt e.V. 2009, S. 460

In Italy agrotourism is fostered very much as well as the numbers of summered livestock. Pasturing in forests plays still a big role and the number of possible summered livestock is determined by the forest administration.

Liechtenstein's alps are used quite intensively and tourism plays a strong role in the entire alpine area.

In Slovenia a lot of summer pastures have been afforested during the past years. The surface of summer pastures has diminished and the remaining surfaces have been intensified. Slovenia has today the highest share of forests of all Alpine countries. On the alpine pastures large Alpine villages with many small huts exist, which are largely used also for tourism.

In northern Switzerland the alps are managed in a traditional way, but based on a maximum of rentability. Mainly on high-lying pastures sheep replace cattle more and more.

Extensive pastures[15] of the Alps are supported with more than 1 billion € annually. 800 million € of these are spent for alpine pastures[16]. The intensity of subsidies per ha for mountain pastures is different for each country and lied 2002 between 200 and 700 €/ha. Whereas the lowest amount is in Austria the highest is in Germany.

Subsidies are more and more justified by reasons of ecological and landscape ameliorations.

3.5.3 Present figures and distribution of livestock

Presently ca. 2 million cattle and 1.5 million sheep are distributed on Alpine pastures across the Alps. The trend in livestock husbandry varies, with intensification in some regions and decreasing in others, depending on local conditions. Cattle are still the most abundant livestock species summered in the Alps, but sheep are the most abundant in remote areas. Sheep are often an alternative to cattle for farmers with less time and personnel.

The decrease in milk price has led locally to abandonment of farming or switching from cattle to sheep, especially when the younger generation has to take over the farm. Many of the Alpine meadows are too remote, too steep or too small to hold cattle.

The differences between numbers of animals and the species in the Alpine regions are high.

Around ¾ of summered cattle are held in the Bavarian, Austrian and Swiss Alps, but more than 50% of the alpine sheep are in the French Alps. Sheep pastures are generally dominant in the southwestern Alps and are generally stronger in the western Alps, than in the eastern Alps. Mixed regions with sheep and cattle are widespread in the Isere, Alpes Maritimes, Piedmont, Valais, Slovenia, Werdenfelser Land and parts of Tyrol. The regions in Upper Austria and Bavaria are currently the regions with the fewest sheep in the Alps. Goats play still a role in Haute Savoie, Grisons, Ticino, in the Fribourgian Alps and finally around the Upper Italian lakes.

[15] Extensive pasture is understood as: little work and capital, cheap infrastructure, small amount or no fertilization, low density of animals, robust livestock species, structured pastures with shrubs, continuous grazing, maintenance of biodiversity, independent of altitude.

[16] Alpine pastures are defined as remote pastures far away from the main farm cultivated in order to be used for agriculture (extension of base for fodder, relieve of work burdon of farmers during summer time in the valleys and increase of animal health and agricultural products) as well as for tourism.

3.5.4 Livestock protection measures

With the disappearance of large carnivores from their historical range, the traditional livestock protection methods were also abandoned. It was a common practice in the past, when predators were rare, to leave large herds of livestock unattended in the mountain pastures, in countries like France, Switzerland and the Alpine region of Slovenia. However, the return of large carnivores, in particular wolves requires a return to traditional pastoral ways and guarding which can be an expensive option. In most Alpine countries, the greatest number of attacks occurred during the summer season when livestock graze on alpine pastures (Anonymous 2010). The most effective protective measures against predation include guardian dogs, electric fences and the presence of a shepherd.

In order to implement effective protection measures against large carnivores, the current livestock management system is of major importance. It is e.g. easier to implement protection measures if personnel is available on pastures, if the pastures are furnished with infrastructure for shepherds, if flocks or herds are rather large and held together on a specific surface area (facilitates the integration of livestock guardian dogs).

Current monetary measures

A compensation system to reimburse for losses of livestock to large carnivores has been adopted in France, Italy, Switzerland, Germany, Austria and Slovenia. The compensation techniques vary in the different countries depending on the socio-economic status of the country as well as culture and traditional practices (Boitani et al. 2010). In the Alpine countries, most of the compensations are monetary in nature. Except for the case of some provinces in Austria, this compensation is part of a pre-arranged government programme. These programmes include the examination of the dead domestic animal and determination of cause of death by an expert. The “typical” case of lynx depredation is rather easy to identify, whereas it is more difficult to distinguish between attacks of wolves or of stray dogs (Molinari et al. 2000, Fico et al. 2005). If confirmed that the animal was attacked and killed by a lynx or a wolf, the farmer or livestock owner is entitled to a predetermined sum of money which is generally based on the breed and age of the animal. In some countries, the amount of money reimbursed is also based on the proper implementation of anti-predator methods such as livestock guardian dogs, electric fences, night-time enclosures, presence of shepherds etc.

The rational for the compensation is that the legal protection and the recovery of the large carnivores are a societal desire, and that therefore society (hence the state) should pay for losses of those who economically suffer from the return of these animals. However, reimbursement of losses alone is an inadequate measure to solve the conflict. All countries, except Austria, support the implementation of protective measures.

Current management measures

Due to different situations in pastoral systems, livestock species as well as numbers are a result of different values of livestock summering, the kind and surface of alpine pastures in each country. Livestock protection against large carnivores has to be organized adapted to the correspondant situation. It may also mean that agricultural practices and subsidies have to be adjusted.

The intensity of care of livestock on summer pastures in the Alps is very different. France e.g. is the country with the highest numbers of summered sheep in the Alps (more than 50% of all the sheep in the Alps), however a high share of the flocks are not constantly cared for, but surveyed regularly

from the valleys. There are still a high number of personnel working on Italian alpine pastures, but only a moderate infrastructure exists.

In the German Alps, sheep predominantly are free-ranging, where they are controlled between 3 times a week to 3 times a month. Around 50% of the alps are still constantly taken care of mainly by young people from abroad and many women. The most laborious task on the Alps is still the maintenance of enclosures, whereas other chores such as taking care of infrastructure and pastures are minimized continuously. Nevertheless enclosures are mainly used in the valley. Since 2012, a special fund has been established in Bavaria for pilot projects concerning livestock protection measures, e.g. integration of guardian dogs. However, interest of livestock farmers is still low especially in the Alpine region.

In the Swiss Alps the flocks are rather small and managed extensively without permanent supervision. In the Swiss Alps only 9% of sheep breeders use a permanent shepherd. This corresponds to 30% of summered sheep that are guarded. In Switzerland, the Federal Office for the Environment (FOEN) has established and finances a national livestock protection programme, which is coordinated by the national agricultural consultancy Agridea. In collaboration with the cantons, the programme advises and financially supports farmers to implement measures to prevent livestock damages caused by large carnivores, e.g. integration of livestock guardian dogs, fences, pasture management. In addition, the programme provides advice and financial support to the husbandry, breeding and use of livestock guardian dogs.

In Austria around 600 sheep breeders own more than 100 sheep each. The median flock size is 26 sheep and 7 goats. In June, animals are summered on the Alpine pastures where they are checked once a week or two. Most of the alpine pastures are managed today from the homestead in the valley.

In Austria and Switzerland on average around 1-2 persons per Alp are still engaged continuously – mainly for Alps where milk-cows are summered. The personnel is to a large extent people from towns and abroad. Furthermore in Switzerland, occasionally nature protection projects, school classes and youth groups are involved in care for the summer pastures.

Current prevention and compensation of predation of wolf on livestock per country

The most intensive efforts for livestock protection have been undertaken in the French Alps, where the pressure of the wolf is high and the conflicts very tapered. The attacks began in 1993 and increased steadily until 2005. In 2006, the number of attacks reduced possibly due to the use of protection methods. However, the number of victims per year in 2010 was again higher than in 2005 and has approximately doubled until 2014 (Duriez et al. 2010, DREAL & DRAAF Rhône-Alpes 2011, ONCFS 2014a, DREAL 2015). On average 10 to 15% of flocks in the wolf range are attacked each year. Of those attacked, 70% of the flocks are attacked only once, while only less than 10% are repeatedly attacked more than five times (up to 20–30 times). After each attack, whether by lynx, wolf or dog/other, a damage assessment is carried out if possible within the first 48 hours of the attack (DREAL 2014b). The characteristics of the attack, state of the victim are recorded and the cause of attack are determined. In France, compensations are paid for three cases: direct losses, animals missing and indirect losses (DREAL 2014a). The compensations paid for wolf damage in all of France increased from 0.79 million € in 2008 to 2.3 million € in 2014 (DREAL 2014a, DREAL 2015).

Meanwhile, on national and regional level different wolf–groups are working („comité scientifique national du loup“, „comité national du loup“, „comités departementaux de concertation et de suivi du loup“).

The possible coexistence of sheep breeding and wolf packs has been supported by the „action pour la preservation du pastoralisme et du loup dans l'arc alpin». Main issues are the following points:

1. The state admits to support and preserve sheep breeding and summering of sheep on alpine pastures
2. The wolf shall be preserved in the alpine area, not beyond
3. Differentiation in zones where the wolf protection has first priority and zones of "management" ("gestion"). In the zones, where wolf protection has first priority, alternative livestock protection measures and pastoral systems, which allow for wolf existence are developed and tested (mainly in the Mercantour national park and Queyras nature parc). Here the investments in time and funds are high. In the "Territoires de gestion" the control and protection against wolf population is financed by LIFE projects.

In other mountain regions of Europe the coexistence of sheep and wolf is based on the following preconditions:

- Livestock is under control of shepherds and never without observation. The surveillance is partly supplemented with donkeys (make noise, bite and knock);
- the herds are accompanied by several experienced livestock guardian dogs (Dog of the mountain of the Pyrenees, Maremmen dog, Bernhardiner, Podhalansky or Curac);
- fencing during nights (the dogs sleep near but outside of the fence);
- the flocks have to be enough big in order to engage a shepherd and livestock guardian dogs;
- adequate and quick compensation of damages caused by wolf;
- culling of single wolfs that cause unacceptable damages (Ciucci & Boitani 1995, Carpathian Large Carnivore project of the WWF Munich/C. Promberger).

These measures allow minimizing attacks of wolf and bear, whereas the lynx has no chance to depredate livestock anymore.

Between 2009 and 2011, there were 15-70 cases of livestock damage in Austria. Compensations are only paid when livestock mortality is confirmed to have been caused by predators, however actual amounts paid are not available. These payments are "voluntary" as there is no legal right to compensation, and in most provinces they are covered by the hunting insurance of hunting associations.

Wolf-livestock conflict in Bavaria is currently low compared to other European countries presumably due to the low wolf presence in the region (Wölfl, pers. comm.). In 2010 when a single wolf was resident year round, 26 sheep were compensated with the amount of 3.670 €. Nowadays, within a special fund some pilot actions testing prevention measures are implemented across the country, e.g. adequate fencing and the proper use of guarding dogs.

In 2011 in Italy, there were 383 cases of livestock damage mostly on sheep and goat in Piedmont. Wolf attacks on domestic livestock were found to be significantly higher during the months of May to October (Fico et al. 1993, Gazzola et al. 2005). During these months, livestock can be found in Alpine meadows and may receive little or no protective measures to reduce the possibility of attacks by predators (Fico et al. 1993). Livestock owners are compensated for all injuries and damages to livestock by both wolf and dog unless in cases where the dog can be located and the attack positively

identified. In the Piedmont region, the total cost of direct losses was 68,000 € in 2010 and 72,953 € in 2011. An additional 19,703 € were spent for indirect losses (Dalmasso et al. 2012, Boitani & Marucco 2013).

Damages caused by wolf have started to occur in the Slovenian Alps in 2006 and are thought to be possibly caused by a single wolf. Up to 26 animals are killed per year and annual damage compensations amount up to 3,870 € (M. Jonozovič, pers. comm.).

The return of the large carnivores puts a lot of pressure on the sheep husbandry system as it has been established over the past 50 years. Although losses to large carnivores are financially compensated and preventive measures supported, the habit of letting sheep graze free on alpine and subalpine pastures is simply no longer possible with the presence of wolves. This requires a substantial change of the husbandry system with the respective personnel and leading to financial consequences.

In the Swiss Alps, 114,000 CHF for 280 animals killed by wolves was paid in 2011, and 48,500 CHF for 135 animals in 2012 (KORA 2014). Livestock kills have to be examined by an official person (state game warden in cantons with licence hunting, designated and trained person in cantons with renting hunting system) and losses are compensated to 100% if wolves are found to be the cause of death.

In conclusion, on the alpine pastures the protection of sheep and goats to avoid predation by large carnivores is of high priority. Experiences show that sheep and goats are more vulnerable to predation by large carnivores than cattle.

3.6 Perception of interest groups and individuals regarding large carnivores

The following chapter does not differ between the large carnivores. The chapter is based on the report for objective 2 of the RowAlps project, which was developed by working group 2.

Already when talking about the spirit of WISO at the very beginning of this report, the hypothesis was, that *sustainable wildlife management can't ever be a question of purely scientific knowledge – far away from it: Sustainable wildlife management has to be an expression of a will, how to deal with our wildlife species - by taking into account, by balancing and by harmonising ecological, economical and socio-cultural interests: A decision of all stakeholders involved is required - or let`s just say, a decision by society (Näscher 2009)*.

Therefore an analysis of the social framework and entry points for a successful management of conflicts has been required for these management recommendations. The objectives of working group 2 of the RowAlps project were to describe tolerance mechanisms for lynx and wolf among various land-user groups, and to identify factors that influence tolerance as well as potential measures to alter these factors. To reach these objectives,

- a meta-analysis of existing social science research on large carnivores across Europe was conducted by the Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL) and
- interviews and workshops with experts in the fields of hunting, alpine farming and social science research on LC were conducted by the Technische Universität München (TUM), Chair of Forest and Environmental Policy.

Due to limited resources the approach had some limitations which mainly are:

- Due to the qualitative methods used, the interpretation of the interviews and workshop outcomes are the results: a separation of the results and an interpretation of those results are not possible as in many other scientific investigations.
- Land users were interviewed only in Bavaria and then only those from the agricultural sector, as there were no resources available to working group 2 to conduct further interviews with hunters or land-users in other Alpine countries.
- Only one of the two originally planned hunting workshops was held because of a lack of participants from the western Alps section.
- All authors live and work in Germany. Although they interviewed experts from nearly all Alpine countries, their analysis is, by their account, undoubtedly influenced by the German situation in which they were socialized.

Every actor concerned with the (re)occurrence of large carnivores has his or her own view of both the central problems and the main goals of large carnivores management.

These largely implicit framings of the problem or the issues to be addressed influence the entire management process (IRGC 2005). Three different types of problem framings were identified: The population dynamics of large carnivores , the direct interactions between large carnivores and those affected; and the social and political conflicts. All three problem framings are influenced by the individual perception of large carnivores. In reality, a conjunction of these problem frames will be the basis of all large carnivores management.

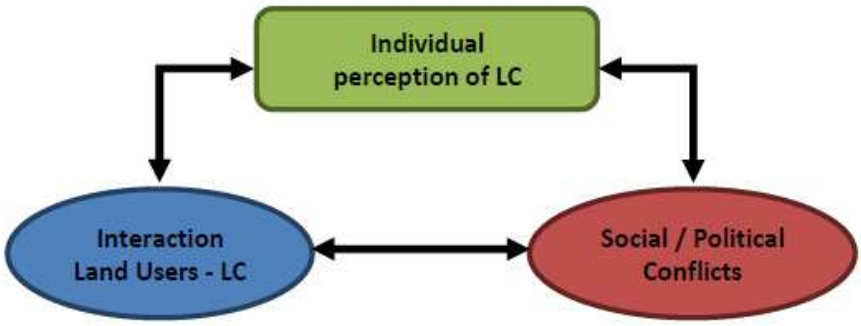

Fig. 6: Interdependencies among the various levels where factors influencing attitudes towards LC are settled.

3.6.1 Direct interaction of large carnivores and those affected

On the level of direct interaction, six main factors influencing the effect of the presence or imminent return of large carnivores on Alpine farming systems were found.

1. Financial burden / opportunity costs
Farmers evaluate the state subsidies for flock protection on two different levels. On the one hand, they want all direct expenses for flock protection covered by the state. On the other hand, the working capacity of the farmer is a restricting factor for flock protection. The farmers expect that also the opportunity costs are covered by the state.

2. Farming practices
Different types of farming practices (e.g. free ranging vs. directed grazing with the help of shepherds or fences; grazing only during summer or also in winter; herd size) require different types of flock

protection. Especially in the case of the more extensive forms of grazing, protecting flocks in the presence of large carnivores is extremely difficult in the view of many farmers.

3. Type of animals
It is well known that sheep and goats are much more vulnerable to predation from large carnivores than cattle. A special focus should be put on ancient breeds which are highly subsidized within the Common Agricultural Policy of the European Union (CAP) and also often have a high non-monetary value for the farmer.

4. Legal framework / grazing rights
Legal regulations and old grazing rights sometimes complicate both the implementation of flock protection measures and the reorganization of grazing systems.

5. Natural conditions
Natural conditions, such as the extent and density of forest, local weather conditions and topography, influence the likelihood of damage to livestock due to large carnivores.

6. Tourism
Flock protection measures using livestock guardian dogs (LGDs) might lead to conflicts with hikers and bikers, especially in regions where tourism is important.

These six influencing factors can be summarized by the concept of vulnerability. The concept of vulnerability is not meant to be a concept of zoning, but rather it is a strategy to set priorities for efforts to mitigate conflicts.

Influencing factors for the vulnerability of Alpine farming regions are the historical development, on the basis of natural and cultural conditions, current land use policies (subsidies for shepherds, subsidies for rare breeds (often sheep and goat), less subsidies for free ranging grazing (example Switzerland)) and large carnivores management (feasibility of flock protection).

Additionally, some currently practiced methods of hunting and ungulate management will be challenged by the return of large carnivores. The impact of large carnivores on both the size and the behaviour of ungulate populations must be considered in hunting and forest management planning. For example, various methods of feeding ungulates (such as efforts to influence their spatial distribution to reduce browsing effects on silvicultural crops) will be more problematic if large carnivores adapt their hunting habits to take advantage of accumulations of ungulates caused by feeding stations and winter enclosures. Adaption to the return of large carnivores may be more demanding in countries where such types of winter feeding are more common than in other countries.

3.6.2 Factors in social and political conflicts with large carnivores as a trigger for conflicts

On the social and political levels, the conflicts detected could be described as mainly power struggles and value conflicts. Here, large carnivores are often only one issue within an already existing larger conflict. The distribution of power among the various actors in such conflicts has changed in the course of the reoccurrence of large carnivores. The following conflict constellations were found:

1. Urban – rural (Power struggle and value conflict)
This conflict constellation has no clear actor structure, and is displayed within public and political discourses. Land-use actors criticize the higher degree of influence that urban actors have on political decisions. On the discourse level, a clear difference in values is constructed, in which land-use actors

are seen as having a use-orientated, anthropocentric image of nature, while the urban population are portrayed as viewing it more from an aesthetic oriented, ecocentric point of view. Also, the self-image of Alpine farmers differs from the image they have among the general public. Generally, both the general public and urban actors often criticize the negative impact of farming on the environment and the high level of subsidies. In return, farmers base the legitimacy of their practices and the subsidies they receive on their role as food suppliers.

2. Land-use actors – state (Power struggle)
The common conflicts here revolve around the subsidy system and legal regulations. Regulations that reduce the level of autonomy of land-use actors and increase the amount of control state agencies have are opposed by land-use actors.

3. Land-use actors – environmental NGOs (Power struggles and value conflicts)
The basis for the power struggle is the question of which group should have the power to make decisions about what occurs in the Alps, while the basis for the value conflict is the question of which value is more important: High levels of biodiversity and / or wilderness (environmental NGOs) or tradition and culture (land-use actors).

4. Horizontal / vertical conflicts between or within state agencies (Power struggles)
In most Alpine countries, the central conflict is a horizontal conflict between the ministries for agriculture and environment.

3.6.3 Interaction of both levels – social/political and direct interaction

The two levels of analysis are interconnected. Negative perceptions of large carnivores might result in a reduced willingness to adopt flock protection measures. An unsuccessful implementation of flock protection might increase political conflict. Political conflict influences individuals' perceptions of large carnivores and large carnivores' management. Nevertheless, we formulate the hypothesis that there is a correlation between the reason a particular actor is practicing animal husbandry and the level on which large carnivores management is or can be most successful. If the main reason for practicing animal husbandry is economical, work at the level of direct interaction between land users and large carnivores is most important. In regions where other reasons, such as tradition or cultural identity are more important, the resolution of social conflicts is crucial.

3.6.4 Management implications

The following chapter is focused on a land use perspective and mainly on agriculture. The results do not analyse nor focus on differences for single countries.

Preconditions for all paths of actions are that the social norms and values of farmers are obviously generally opposed to large carnivores:

- The extinction of large carnivores is perceived as a cultural achievement.
- Animals that are being bred are perceived as the "nature to be protected".
- Conservation of the cultural landscape is a central justification for their position. Farmers disagree with the target of establishing wilderness in the Alps, for which large carnivores are perceived as a symbol (Caluori & Hunziker 2001).

A slightly different situation concerning social norms and values of farmers can be observed in parts of Slovenia and Italy, where farmers are more familiar with large carnivores because of the relatively long tradition there of living alongside them.

Management implications in hunting

Hunters have a more ambiguous view:

- On the one hand, there is a tradition of purposeful extermination or hunting of predators. Thus, some hunters still perceive the extinction of large carnivores in the Alps that occurred in the 19th century as a good and necessary end. On the other hand, the idea of game keeping is common and could be applied to large carnivores. For example, in Slovenia hunters actively reintroduced the lynx.
- Norms that guide hunting practices are very important (Schraml 1998, Stengeli 2014). These norms can be influenced by in-group communication.
- Large carnivores have a relevance as potential trophy animals.
- Especially in Germany, the perception is common that large carnivores, particularly wolves, will not have suitable habitat in such a densely populated country (Kaczensky 2006, Stengeli 2014).

Given that the main threat to LC populations is illegal killing, in general two aspects of this problem have to be addressed:

1. Accidental killing and the
2. encounter rate between hunters and LC (and thus, the concomitant potential that an illegal killing of a LC will occur).

Furthermore, stronger control on hunters by official bodies would be necessary in order to be able to enforce protection of LC. Game wardens like the “guardacaccia” in Italy or the “Wildhüter” in Switzerland are examples of ways to implement better on-site control of hunters.

Legal regulations and financial aid (e.g in Switzerland hunters get a reduced hunting licence fee if they can prove that large carnivores are present in their hunting area) to the hunting sector will also need to be evaluated to determine if the outcome of these steering instruments hinders the goals of large carnivores protection. Hunting regulations should be analysed if the influence of the presence of large carnivores is considered. For example, hunting quotas are often not adapted to the special challenges of large carnivores presence.

Management implications in power distribution between political actors

Managing social conflicts requires an understanding of the relationships and the distribution of power between different actors in different countries. Comparing the position and power of interest groups and actors in the Alpine countries, it seems obvious that every country has its own tradition affected by its own unique institutional setting. The return of LC and the accompanying societal discussion might cause a change in the distribution of power among the institutions involved which will also either shift the existing lines of conflict or generate new ones. The following paragraphs summarize the political actors involved, likely changes in the distribution of power between them and the main drivers of the discussion about LC are described for each Alpine country.

Austria

In Austria, private land owners, state and public forest owners and hunting associations are considered to be the most powerful players. With the return of LC, especially wolf, land owners and

hunting associations are expected to lose power, and the pressure other actors will be able to exert on them will increase. The eNGOs, the environmental authority and hunters whose main purpose in hunting is to stem the threat ungulates pose to forests will gain more influence in the field. The agricultural sector was judged as the main driver.

France

Due to the centralized political system in France, the agricultural, hunting and environmental authorities have the most power of the institutions participants identified as being involved in LC issues but also receive the most pressure from interest groups. Sheep farmers are land users, but often do not own the land they use, unlike most of their counterparts in other countries. This fact makes them a less powerful interest group in France than in other countries. With the return of the wolf to France, sheep farmers are gaining power and putting pressure on the authorities responsible for LC management. Environmental NGOs (eNGOs) have also become politically more important through their efforts to restrict traditional land-use practices (drive hunts) due to the danger they pose to the bears that are now present in the Pyrenees and hence exciting conflicts with the hunting association. The agricultural sector is perceived to be the main driver of the discussion regarding LC in France.

Germany – Bavaria

In Bavaria, private land owners and the organizations that represent them, such as the farmers' association, currently have the most power with regard to LC. Forest authorities (the forest ministry and the state forest administration) and the hunting association are struggling to influence land owners within an ongoing conflict about forest regeneration. With the return of LC, especially the wolf, both the farmers' association and the hunting association are expected to receive more pressure from eNGOs and environmental authorities. The agricultural sector was judged as the main driver of the discussion about LC.

Italy - South Tyrol

In contrast to France, land owners here are rather powerful. The "Landeshauptmann" (governor of the province) plays an equally important role as that played by the state government (Rome). Here, the hunting sector was listed as the main driver.

Slovenia

The Slovenian Forest Service (SFS) is in charge of hunting management, forest management and LC management. The fact that all of these tasks are undertaken by a single public body makes the influence of the SFS stronger than the forest agencies in the other countries investigated here. This could possibly help mitigate conflict. As a technical body that serves as a consulting entity to the Ministry for Environment and Farming, the University of Ljubljana is also perceived as a quite powerful actor that is for the most part not greatly influenced by other actors. Thus, the university has a greater influence on LC management than universities in other countries. With the return of LC, the pressure on the SFS is expected to rise, because the conflicts between land users (land owners, hunting association) and between land users and the SFS will intensify. The hunting sector was judged as the main driver of the discussion about LC, especially wolves.

Land-use practices like ungulate (game) and forest management are largely directed towards meeting economic goals. As ungulates are herbivores and browse on trees, forest regeneration is dependent on both ungulate density and forest structure (management). This implies that there are competing interests between the hunting sector (which is interested in high ungulate densities) and the forestry sector (which is interested in high levels of forest regeneration). In each of the different

Alpine countries, one or the other interest prevails depending on the relative economic importance of the respective sectors.

Management implications in farming

In the view of the experts interviewed, prerequisites for livestock breeders tolerating large carnivores are:

- functioning flock protection measures and
- sufficient funds for financial aid and compensations.

Effective flock protection demands experience with different measures under different conditions to be able to recommend the most promising method to farmers given their particular situation. Numerous open questions about the effectiveness of flock protection methods still need to be addressed.

In terms of sufficient financial aid - for example, in cases where it is not clear if damage was caused by large carnivores or other predators - solutions that involve little bureaucracy and favor land users should be established. Central here is that compensation will continue to be paid, even if compensation costs rise tremendously. Furthermore, late or reduced payments must be avoided. These are preconditions for establishing trust in and credibility for the state (agencies). In this context, processing of compensation payments through agricultural administrations is crucial. The distribution of compensation and financial aid via the established network is more promising than attempts to establish relationships between farmers and other government entities with which they have no existing relationships (e.g. environmental authorities). Farmers already have a relatively trusting relationship with agricultural authorities.

Agricultural funding must be adapted in the long term to eliminate contradictions, especially concerning the promotion of vulnerable livestock species (sheep) and inconsistencies between subsidies for extensive pasture management and flock protection measures (Meschnig 2014). In the Alps, rare breeds are often sheep or goat breeds. Thus, two biodiversity conservations goals – conservation of rare breeds vs. large carnivores protection – will have to be balanced.

Diverse synergies exist among farming methods on the one hand, whicht are adapted to be more suitable for a coexistence with large carnivores and pasture- and herd management methods on the other hand, that are adapted to promote biodiversity and animal welfare and are more ecologically sound.

To be able to effectively promote tolerance towards large carnivores and to find suitable solutions, the level on which conflict emerges (direct interaction or social / political) must be considered. And therefore it is crucial to be clear about the actual phase of large carnivores colonization that is taking place (as, for example, is used in Bavarian management plans; Phase 1: before return; Phase 2: occurrence of single animals; Phase 3: small population established; Phase 4: expanding population). Different phases demand different management measures, and every phase (appearance of an animal, establishment of pack etc.) must be immediately communicated to the land users.

Social conflicts are often the dominant ones, even where technical arguments are being used. A central entry point here is negotiating with the actors involved (Primm & Clark 1996; Majić et al. 2011). Preferably, this should be done before large carnivores enter a region, or at least before the first conflict occurs. Though it is tempting to adopt a “wait and see” attitude as long as there are no

conflicts, or only relatively few, management of a conflict which has already escalated is much more difficult (Glasl 2002).

Especially in countries like Slovenia and Italy that have been forced to take cost-cutting measures due to the economic crisis, the risk exists that spending little or no money early on will mean either having to spend more money later or having to deal with a major conflict.

To what extent money should be spent on managing conflicts has to be decided, and the consequences of this decision have to be borne. In France, a discussion about the amount of money spent directly or indirectly on wolves popped up.

Such questions have to be worked out among the actors involved and communicated appropriately.

Nevertheless, even early intervention and commendable handling of conflicts (financial, communicative etc.) cannot guarantee peaceful coexistence everywhere. There could be situations where it will not be possible - particularly where extensive pasture management and large carnivores (esp. wolf) must exist side by side. In those cases, appropriate courses of action will have to be defined and communicated. (See Primm & Clark (1996) for the importance of understanding and working with the policy process.)

As it is unlikely that public communication will reach land users, it is suggested developing and establishing a communication concept with land user associations as the central communicator. Affected actors should be the first to obtain new information and have the opportunity to communicate this information to their own group. An effective manner of communication will have to be worked out with the actors themselves. Role models (collection of best practice examples, farms etc. with charismatic personalities where coexistence with large carnivores works) are needed that will be perceived as in-group and, therefore, accepted in the field. These role models will have to be well-financed and scientifically assisted. For a project to be seen as in-group supported action, comprehensive involvement of actors is necessary. Examples of projects that have involved agricultural actors are the Swiss “AlpFUTUR” project[17] and the Austrian shepherding and flock protection projects. In our opinion, the best mode of operation is one in which the group charged with developing measures includes the actors that must implement these measures later.

Management implications for participation and communication

It is proposed to have an increased focus on management of social and political conflicts by:

- Implementation of participatory approaches of high quality.
- Minimize goal conflicts with land use regulations (e.g. high importance of the EU Common Agricultural Policy, hunting regulations have to consider LC presence)

Finally participation is very important when dealing with management of Large Carnivores. The participatory approaches have to be of high quality (whereas the criteria of this quality have still to be identified, e.g. fitting discussions to the level of decision making, Inclusion of all relevant interest groups and state agencies). And finally a further management implication is an increased focus on in-group communication (e.g. projects in collaboration with land use actors).

[17] http://www.alpfutur.ch/index.php

The following entry points for the social acceptance of wolf and lynx can be summarized:

1. Consideration of conflict level;

2. Negotiation with actors - for example, in participatory processes or model projects - with the goal of optimizing both flock protection and conflict management;

3. Development of a communication process with actors.

4 Discussion, interpretation and assessment of a future Alpine wolf population and main threats

4.1. Minimum viable population (MVP), ecological carrying capacity (ECC), and favourable conservation status (FCS) for the Alpine wolf population

Concepts of population viability

Per definition, a viable population size lies somewhere between the ecological carrying capacity (ECC) and the minimum viable population (MVP). The ECC is the point in an unmanaged population where the birth rate and the mortality are at equilibrium. It may be temporarily exceeded, but then the mortality will surpass the birth rate and the population will steer towards ECC again (Mills 2007). The ECC is not static but may change over time due to changes in environmental conditions and/or resource management, which influence birth rate and mortality.

The lower end of the spectrum of a viable population size is given by the MVP. However, there is more than one concept of population viability:

- *Demographic viability* calculates the probability of extinction for a population of a given size within a specified number of years as a function of natality and mortality.
- *Genetic viability* concerns the long term persistence of genetic variation and evolutionary potential, and the avoidance of genetic impoverishment through inbreeding and genetic drift.
- *Ecological viability* refers to the interaction between a species and its environment. This encompasses both the needs, but also the effects of a species regarding its environment (Linnell et al. 2008). It is more a function of the ecosystem than of the species.

Despite many uncertainties about the exact ratio between the concepts, it is agreed that it usually takes a far larger population (e.g. by a factor 10) to maintain genetic viability and/or ecological viability than for demographic viability. In general, demographic and ecological viability are assessed at the population level, and genetic viability at the metapopulation or ecosystem level (Linnell et al. 2008). However, the concept of MVP is difficult to apply: scientifically, it is not possible to correctly determine a single minimum number of individuals that will secure long term survival of the population because of the inherent uncertainty and stochasticity in nature and management; and ethically, it is questionable to manage for a minimum number of individuals (Mills 2007). Consequently, the EU Habitats Directive does not demand MVP as a target for species, but to achieve Favourable Conservation Status (FCS). The definition in Article 1 of the Habitats Directive says:

"The conservation status will be taken as 'favourable' when:

- *population dynamics data on the species concerned indicate that it is maintaining itself on a long term basis as a viable component of its natural habitat, and*
- *the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis" (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)."*

The guidance document "Assessment, monitoring and reporting under article 17 of the Habitats Directive" indirectly states that a population must be at least bigger than a MVP to be able to reach FCS. The upper limit is defined by what the potential habitat can support at an "optimum density" (i.e. ECC).

FCS is based on two major Favourable Reference Values (FRV) – the Favourable Reference Range (FRR) and the Favourable Reference Population (FRP) – according to the DocHab-04-003/03 rev 3 and the guidance documents. It is stated in the guidance documents that FCS is a positive goal, where the goal should be to make species status as favourable as possible, and not just to have passed a minimum benchmark.

Like any legal text, the directive text is not based on scientific definitions. This poses major challenges in its operationalisation per se, and especially for species as diverse as lichen and lynx. An interpretation for large carnivores was made by Linnell et al. (2008) in the "Guidelines for Population Level Management Plans for Large Carnivores in Europe".

Operational proposal to define Favourable Reference Population

"[W]e suggest that favourable reference population be defined as the sum of the following criteria:

(1) The population must be at least as large as when the Habitats Directive came into effect, and,
(2) The population must be at least as large (and preferably much larger) as a MVP, as defined by the IUCN criterion E (extinction risk based on a quantitative [Population Viability Analysis] with <10% extinction risk in 100 years), or criterion D (number of mature individuals).
(3) *The population's status is constantly monitored using robust methodology"* (Linnell et al. 2008).

A population can be considered as viable (i.e. at least MVP) according to the IUCN Red List if it reaches at least the category "Near Threatened NT", which is not formally a threatened category[18]. This category is reached under criterion D with a population of 1,000 or more mature individuals in the population. However, if the considered regional population is connected to a neighbouring population to such an extent that immigration can have a significant positive effect on the demographic viability of the population and the sum of the populations (hence the metapopulation) reaches the benchmark, then the threat category for the regional population (hence the subpopulation) can be downgraded by one level; i.e. if two connected neighbouring populations exceed the benchmark of 1,000 mature individuals, the regional subpopulation is still considered as not threatened if it exceeds the next lower benchmark of 250 mature individuals (which would classify as "Vulnerable VU" in an un-connected population; Linnell et al. 2008).

[18] The ICUN Red List threatened categories are Vulnerable VU, Endangered EN, and Critically Endangered CR.

Operational proposal to define Favourable Reference Range

Put simply, the Favourable Reference Range (FRR) is the area needed to contain the Favourable Reference Population. However, the issues of habitat quality, density (e.g. societal carrying capacity) and connectivity warrant consideration.

"As a result we generally recommend that Favourable Reference Range be considered larger than the area strictly necessary to support the Favourable Reference Population, and that it attempts to ensure (1) the continuity of distribution within a given population, and (2) the possibility for connectivity between populations" (Linnell et al. 2008).

Operational definition for favourable conservation status for large carnivores

"We […] suggest that a population can be regarded as having reached FCS if it satisfies all of the following criteria;

(1) 'Population dynamics data on the species concerned indicate that it is maintaining itself on a long term basis as a viable component of its natural habitat' *(Article 1 (i)). We interpret this as implying that monitoring data indicate the population has a stable or increasing trend. We believe that a slight reduction in population size may be permitted if it is a result of response to changes in prey density or habitat quality that are not the cause of direct human action, unless conditions for derogations apply […]. All segments of a population should have stable or positive trends, and not just the population as a whole. And,*

(2) 'The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future' *(Article 1 (i)). We interpret this as implying that the overall distribution of the population is stable or increasing. And,*

(3) 'There is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis' *(Article 1 (i)).We interpret this to imply that the quality and continuity of habitat should be sufficient, and have a stable or increasing trend. And,*

(4) The population size and range are equal to or greater than when the Directive came into force. And,

(5) The Favourable Reference Population size has been reached. According to our proposal this will be set at levels greater than those regarded as being viable using the IUCN Red List criteria E or D. And,

(6) *The Favourable Reference Range has been occupied. And*,

(7) *Connectivity within and between populations (at least one genetically effective migrant per generation) is being maintained or enhanced. And,*

(8) 'Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2 with particular regard to priority natural habitat types and priority species' *(Article 11) and* 'Member States shall establish a system to monitor the incidental capture and killing of the animals species listed in Annex IV (a)' *(Article 12.4). These statements combine to indicate that the population should be subject to a robust monitoring program.*

Criteria 1-3 and 8 are taken from the text of the Directive, criteria 4 and 6 are taken from the guidance documents, while criteria 5 and 7 are based on our own recommendations" (Linnell et al. 2008).

"[T]he absolute minimum requirements that Member States must meet are:

(1) Countries sharing one population, or segments of a population, contribute to ensuring between them that the population reaches and maintains FCS, and
(2) They allow for connectivity between neighbouring populations and segments within the same population, and
(3) Management activities do not create a sink that can influence the FCS of a population of any of its segments, and
(4) *Populations should in general not be allowed to go below the level they had when the Directive came into force on their territory"* (Linnell et al. 2008).

Assessment of the current Alpine wolf population

In 2009/10 there were 32 packs and a minimum of 160 wolves (not only mature individuals) counted or estimated, respectively, in the Alps (Kaczensky et al. 2013a; cf. Chapter 3.2). There is no straightforward way to estimate the number of mature individuals (MI) from either the number of packs or the number of wolves. Obviously, the minimum number of MI in this example would be 64, that is twice the number of packs (i.e. the actually reproducing wolves[19]). There are more mature individuals – hence potentially reproducing wolves – living in the Alps, but a qualified estimation would need further discussion and compilation of data.

The Alpine population is connected with the Italian population (the study performed by Fabbri et al. (2007) identified a continuing, moderate gene flow from the population in the Apennines to the population in the Alps, corresponding to 1.25–2.50 wolves per generation) and to the Dinaric population (as mixed couple reproduction has demonstrated) as well as to the Eastern European population (Rauer et al. 2013). The Alpine wolf population is hence not isolated, and will likely not be so in the future. Nevertheless, the Alpine population has at the moment not yet reached FCS under any of the criteria as both the population and its distribution are still very limited.

4.2 Potential distribution of the wolf in the Alps and hypothetical expansion of the population

The recolonisation of previously occupied habitat and the expansion of a recovering species of population are determined by factors such as the habitat and landscape features, land-tenure system, dispersal characteristics, resource availability and distribution, as well as human attitudes and activities (Zimmermann 2004).

Potential distribution

Four distinct wolf habitat suitability models for the entire Alpine range are so far available: the ones by Herrmann (2011) and Falcucci et al. (2013), and two distinct models by Marucco (2011). All models predict still a high amount of suitable habitat available for (re)colonisation. The model by Herrmann (2011) predicted approximately 50% of the area of the Alpine Convention as suitable habitat for wolves. Falcucci et al. (2013) predicted 5.2% of suitable area in the Alps, but we believe

[19] This is clearly underestimating the number of mature individuals in a wolf population. Besides the reproducing pair, packs may include several other adult wolves or adult wolves may live independently from packs. The IUCN Red List Guidelines state that "*in many taxa there is a pool of non-reproductive (e.g. suppressed) individuals that will quickly become reproductive if a mature individual dies. These individuals can be considered to be capable of reproduction"* (IUCN Standards and Petitions Committee 2014).

that this is an error in the paper. Marucco (2011) adapted the spatially explicit, individual-based model (SE-IBM) developed by Marucco & McIntire (2010) and applied it to the entire Alpine range (Fig. 7). The SE-IBM includes the needs of wolf packs and the characteristics of wolf territories to predict habitat suitability of packs (Marucco 2011). Marucco (2011) presented the maps without numerical values on the amount of suitable habitat in her results.

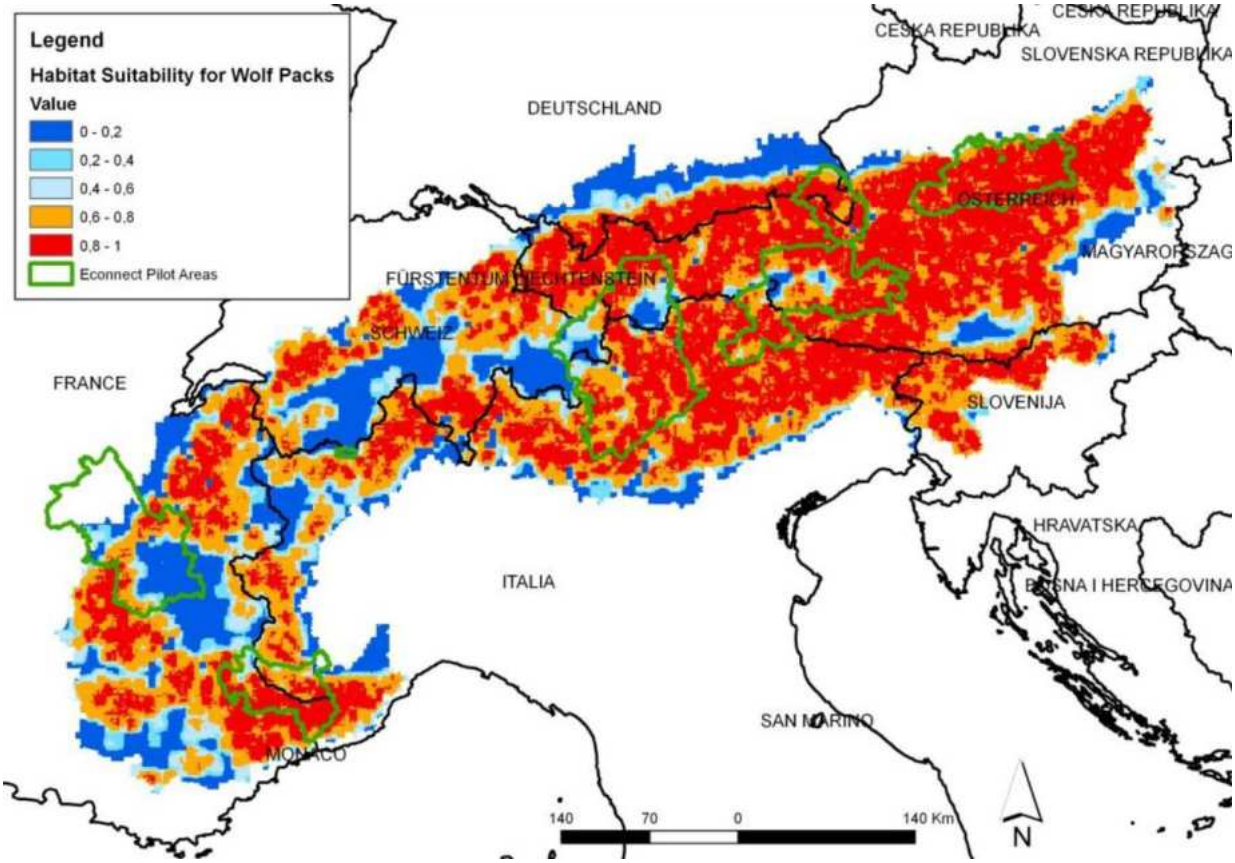

Fig. 7: Wolf pack habitat suitability map based on the spatially explicit individual-based model (SE-IBM) developed by Marucco (2011). Blue = low suitability, red = high suitability.

The results of the various (incl. regional) wolf habitat models are mainly in agreement with each other with regard to the main factors influencing wolf presence and distribution. Higher suitability is indicated in the eastern and north-eastern Alps than in the western and central-western Alps. Regions with very high elevations are generally indicated as very lowly suitable (Glenz et al. 2001, Herrmann 2011, Marucco 2011). High human density and “disturbance” (roads, settlements) were indicated to negatively impact wolf presence whereas prey abundance and diversity, and forest cover were predicted to have a positive effect (Massolo & Meriggi 1998, Herrmann 2011, Marucco 2011, Falcucci et al. 2013).

Another common conclusion of the different studies is that human-caused mortality (traffic accidents, culling, poaching) seems to be the most limiting factor for wolf occurrence and that wolf presence will likely be defined by human pressure and tolerance (Landry 1996, Massolo & Merrigi 1998, Corsi et al. 1999, Glenz et al. 2001, Fechter & Storch 2014). It was suggested that wolves can live even in areas with high road density (indicating high human presence) if they are tolerated and the population can sustain the traffic-based mortality (Landry 1997b, Fechter & Storch 2014). More

than “wilderness” it seems that wolves need sufficient prey and reduced human pressure to survive in a certain region on the long-term (Fechter & Storch 2014).

Fragmentation within the Alps (subpopulations)

No subpopulation of wolves is identified in the Alps but the wolf population in the Alps was considered to be a distinct population unit for practical reasons. High connectivity is expected for wolf habitat in the Alps. Nonetheless, high road density can result in significant mortality and reduced habitat quality through fragmentation or by providing easy access to wildlife areas to people and thus limit pack settlements. Natural and anthropogenic factors such as settlements, lakes and high rock areas can decrease connectivity (Marucco 2011).

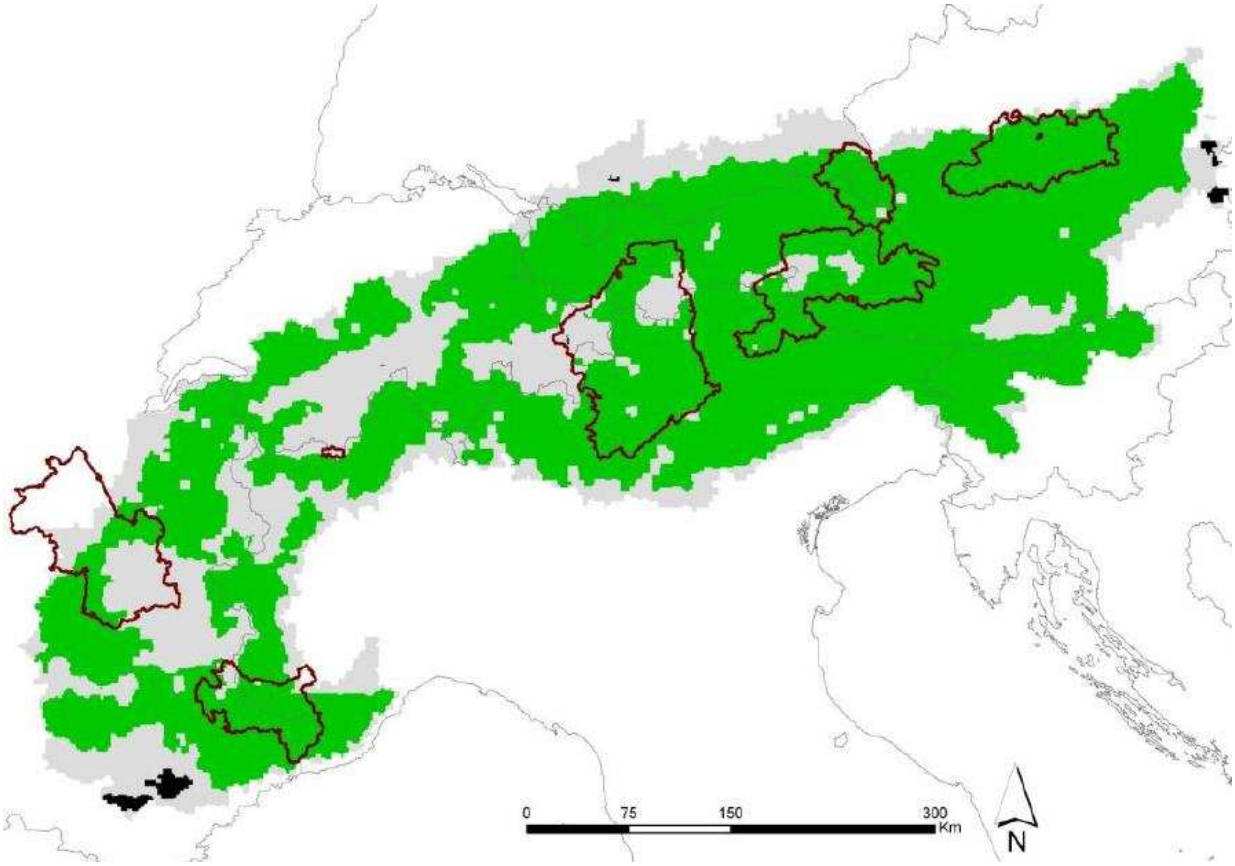

Fig. 8: Network analysis with a threshold of 0.5. Individual components of the network are illustrated with different colours against the grey background of the Alpine convention area. The sum of the coloured patches is the suitable habitat. Within a patch of a certain colour, all parts are connected. Only towards the very edges of the Alps, the network is broken, as indicated by the change in colour. Brown polygons = Econnect pilot regions (Marucco 2011).

Connectivity to neighbouring populations

The wolf population in the south-western Alps is connected to its source population in the Apennine through the Ligurian Apennine Mountains, acting as an ecological corridor also important to assure genetic exchange (Marucco 2009, Marucco & McIntire 2010, Marucco 2011). The Alpine wolf population is furthermore connected to the Dinaric population via Slovenia, as demonstrated by the genetic identification of Dinaric wolfs in Austria and Italy (Marucco 2011). Wolves can also immigrate to the Alps from the Carpathian and from the Central European Lowland or north-eastern European

wolf populations, respectively, as revealed by the genetic origin of wolves found in Austria (Rauer et al. 2013), making the future Alpine population a melting pot for nowadays several genetically distinct populations.

Hypothetical expansion of the population

The wolf population in the Alps so far expanded mainly from the West to the East, with the population in the south-western Alps as the main source. Erratic colonisation is however always possible (see below). Wolf (re-) colonisation takes place in two steps: first young single individuals, mostly young males, sporadically disperse to find new suitable territories and mates. In a second step territories are established and stable reproductive packs are formed if enough suitable habitat is available (Valière et al. 2003, Fabbri et al. 2014). Several years (4–6) can pass between the first arrival of a disperser and the building of a pack (Valière et al. 2003). In the south-western Alps for example, individual wolves were first recorded in the beginning of the 1990s, and the first record of pack establishment was recorded in Italy and France after 1995 (Herrmann 2011). In Switzerland, the first wolves from the south-western Alps arrived in 1995 (Landry 1997a), but the first successful reproduction took place only in 2012 (von Arx & Manz 2013).

From 1999 to 2008 the main source for wolves, which were recolonising the Alpine range, was in the Ligurian-Maritime Alps (Marucco 2009). In the future, the main source will likely shift to the north towards the Cozie Alps region, from where the recolonisation of the eastern Alps was expected (Marucco 2009). The high dispersal capability of wolves allows for long distance dispersal and solitary wolves were already recorded in the eastern part of the Alps (Fabbri et al. 2014). However, Marucco (2009) suggested that for a recolonisation of the entire Alpine range, several wolf packs must be created in the Central Alps acting as a new source for wolf repopulation in the Eastern Alps. The establishment of a pack in eastern Switzerland (von Arx & Manz 2013), another one with parents from different source populations in the central Italian Alps (SloWolf 2012) and the first confirmed wolf reproduction in the Slovenian part of the Alps (WAG 2014) may mark the beginning of the colonisation of the Central and Eastern Alps. These events also demonstrate how erratic the establishment of new packs can be and how unpredictable the colonisation process is, especially when considering that wolves can immigrate to the Alps from several source populations.

4.3 Assessment of a future Alpine wolf population

We base the assessment of a future Alpine wolf population on the situation where the whole of the Alpine Arc is settled, i.e. the Favourable Reference Range is occupied according to Criterion 6 of the operational definition of FCS by Linnell et al. (2008; Chapter 4.1). Obviously, the crucial points in the operational definition for the future wolf population in the Alps are Criteria 5 (number of mature individuals) and 7 (connectivity within and between populations).

Potential abundance

The Alpine-wide habitat model by Herrmann (2011) predicted 92,870 km² of suitable habitat for wolf[20]. Assuming a density of 1.3–1.7/100 km², a potential 1,200–1,580 wolves were calculated (Herrmann 2011). However, these are not only mature individuals (MI), as used for the IUCN Red List assessment. An empiric or generic formula to calculate the number of MI from the population size is

[20] Other publications did not quantify the extent of suitable habitat, but the maps presented seem to confirm that roughly half of the total area of the Alps can be considered wolf habitat.

not known. Another simple method to estimate the potential population is based on the current distribution. There are 15.5 packs (12 packs plus 7 transboundary ones) in the Italian Alps, covering 5,500 km² (Kaczensky et al. 2013a). This equals about 1 pack per 355 km². An extrapolation over the area of the Alpine Convention results in 538 packs in the Alps. This is, of course, an extremely crude estimate, but demonstrates that even when considering only the reproducing pairs, the MI under Criterion D of the Red List for a population to be Near Threatened (NT) could be reached. However, the population in the south-western Alps is connected to the Apennine population. Consequently, Criterion D could be applied for a not isolated population, according to which it must exceed the benchmark of 125 packs with a minimum of 250 mature individuals (when considering only the reproducing pairs as MI) to reach the FRP as defined by Linell et al. 2008; see chapter 4.1).

Connectivity within the Alps

So far, no major barriers have been identified within the Alps that would split the Alpine population into different subpopulations. Furthermore, the recolonisation of the Alps may have started in the south-west, but the packs at the Calanda, Switzerland, and the Lessinia Regional Park, Italy, have demonstrated that new packs and hence potential population nuclei can establish basically anywhere within the Alpine Arc.

Connectivity to neighbouring populations

The Alps are within the reach of wolves dispersing from the Italian, Dinaric, north-eastern European, Central European Lowlands and probably Carpathian populations. The genetic monitoring in Austria has found single dispersers from at least five different regions (incl. the western Alpine population; WAG 2014). The number of genetically effective migrants per generation is so far only known for immigrants from the Apennine population, where it exceeds the benchmark set in the Guidelines of one genetically effective migrant per generation (see above). The future will reveal the connectivity to the eastern populations. The best connectivity exists to the Dinaric population, whereas the barriers to the Carpathians and the north-eastern European populations are more prominent. However, wolves have recently demonstrated that they can disperse through human-made landscapes and overcome almost any anthropogenic barrier.

Conclusions

As the Alpine wolf population is considered to be a not isolated one a population size exceeding the minimum number of 125 packs or 250 mature individuals would be required to reach the benchmark of a FRP and thus the FCS provided that the reproductive units are more or less evenly distributed in the Alpine range.

4.4. Challenges for the recovery and conservation of the Alpine wolf population

4.4.1. Management challenges

Some challenges regarding large carnivores are specific to the management level, but may have to be adapted depending on the population development. Several management plans for wolves have suggested diversified management responses depending on the phases during the re-colonisation process.

Multitude of administrative units

While the measures may change over time with the development of the population, they should still follow the same goals and respect the same management principles in different administrative units to allow a consistent management of the entire population. The “administrative fragmentation” is a two-level challenge in the Alps. On the one hand, the suitable wolf habitat in the Alpine Arc is distributed over seven countries; on the other hand, in some of these countries (Italy, Switzerland, Austria and Germany), hunting and wildlife management is a competence of the federal states (provinces). Although all large carnivores are legally protected by national, hence higher-ranking laws, the implementation of conservation or management measures generally leads to discussions over competences, and the implementation of international agreements is hence a challenge at national level. The current lack of cooperation between nations and provinces was identified as crucial shortcomings regarding the conservation of the Alpine wolf population (Chapter 4.4.1). Improved cooperation and communication between all levels of (inter-) national administrative units is required besides the Wolf Alpine Group, which consists mostly of experts and not administrators or managers.

Guiding strategic document

With regard to wolf management, the whole area of the Alpine Convention is covered by National or Provincial Management Plans, with the exception of Liechtenstein. Nevertheless, an overarching strategic management or conservation plan for the whole of the Alpine wolf population is not yet available.

Wildlife and forest management systems

Wolves and hunters are using the same resources, wild ungulates, and some of these species like red deer are heavily managed (e.g. winter enclosures in Austria and Bavaria). Consequently, the presence and impact of the wolf needs to be integrated into the wildlife management system. As wild ungulate management is also strongly influenced by goals of and decisions regarding the forest management, foresters need to be integrated into this discussion. Considering the yet low level of experience with regard to the impact of the wolves on their wild prey species, an adaptive approach will be needed, along with intensified monitoring of wildlife populations and improved communication.

Conclusions

All major challenges of the recovery of the Alpine wolf population are anthropogenic. Tackling the socio-economic and management challenges will require both, top-down and bottom-up approaches, and will heavily rely on good communication. For example, necessary changes to long-lasting, possibly even traditional, wildlife management or livestock husbandry systems might be perceived negatively by those affected. The involvement of stakeholders in all processes should aid in preventing, or at least limiting, such a negative effect. Treves & Bruskotter (2014) emphasised to the importance of always pointing out actual benefits of carnivore presence. If only the avoidance and reduction of problems and risks are addressed, social acceptance might decrease, possibly by increasing the perception of problems and risks (Treves & Bruskotter 2014).

On the positive side, financial requirements for managing conflicts with livestock owners are relatively low for national economies, although higher for wolves than for lynx. Nevertheless, even a comparatively low financial provision demands a commitment from society and political bodies. The offering of financial aids (e.g. as damage compensation) may simply be ignored in protest, if no consensus about the basic commitment can be found.

4.4.2. Most important threats and/or shortcomings

The four assessments that have been published since 2000 (Boitani 2000, Kaczensky et al. 2013a, Boitani et al. 2015, KORA 2015; compiled in Breitenmoser et al. 2015) all list human caused mortalities as one of the main threats, be it shooting, hunting, poaching, persecution, poisoning, accidental mortality, or vehicle and train collision. No other element is listed as a threat to the whole Alpine population in KORA (2015), but some further elements are listed as threats in either France, Italy or Switzerland. Boitani (2000), Kaczensky et al. (2013a), and Boitani et al. (2015) all list low acceptance and poor management structures as main threats. Additionally, Kaczensky et al. (2013a), and Boitani et al. (2015) list the deterioration of habitat due to infrastructure development as a main threat to the European population.

At the workshop from 12–13 March 2015 of the RowAlps working group 3, the major threats to the wolf and/or shortcomings were identified based on a presentation of the reports mentioned above. The low acceptance, and reasons and effects thereof (e.g. the fear of people), were evaluated to be the main threats, followed by illegal killing and various forms of conflicts with livestock management (e.g. conflicts of guardian dogs with tourism). Poor management in general was listed as a shortcoming, but more specific parts of the management were nominated as well, namely issues related to wildlife management systems/hunting systems (e.g. that the presence of LC is not taken into account for the management of wild ungulates). Too complex and sharp EU demands and policies, and a lack of cooperation between international and national administrative units were regarded to be among the main shortcomings, too. Also listed were the dangers of not taking into account people with the expanding population (i.e. information and involvement of the public), and that the consultation of interest groups is not equal to a participatory approach. These two elements are related to both categories low acceptance and poor management. Accidental mortality and the lack of knowledge were nominated, as well.

Major threats to the Alpine wolf population and shortcomings:

1. Low acceptance
2. Illegal killing
3. Livestock conflicts
4. Management issues
    a. Poor management in general
    b. Wildlife management systems/hunting system
    c. Lack of practical solutions regarding EU demands and policies
    d. Lack of cooperation between countries and/or provinces
5. Accidental mortality
6. Lack of knowledge

Hybridisation with (stray) dogs is generally considered a risk for recovering and spreading wolf populations (Boitani 2003), but as there are less stray dogs in the Alps than in other regions of Europe, the risk of hybridisation is currently not a priority issue. Nevertheless, the subject should not be neglected.

5 Practical goal

The overall practical goal is to achieve a favourable conservation status (FCS) of wolf in the Alps of at least 125 packs widely distributed across the Alps and connected to neighbouring populations. This implies especially strengthening transboundary cooperation and dialogue with local people and interest groups.

To reach FCS, a more or less even distribution of the 125 wolf packs is required across the Alpine countries according to suitable habitat.

Table 4. Minimum number of wolf packs per country to reach FCS, distributed according to suitable habitat[21].

Country	Number of packs according to suitable habitat
France	26
Italy	39
Switzerland	17
Liechtenstein	1
Austria	39
Slovenia	3
Germany	4

The main threats to the present and future wolf population in the Alps are human caused mortalities, be it illegal killing or accidental mortality, and livestock depredation. Moreover, low acceptance and poor management structures have to be dealt with, in order to reach FCS for the wolf in the following decades.

For this purpose, the most important management issues are to secure damage prevention and compensation systems, to foster dialogue among authorities, with wildlife managers, hunters and foresters, to integrate local people in monitoring systems, to prevent and persecute illegal action through law enforcement and to control wolf-dog hybrids and stray dogs.

6 Management options and implications

Wolf conservation in the Alps needs to be actively managed. Important issues are in particular the implementation of sustainable damage prevention measures and compensation systems, addressing social and political conflicts and also the prevention of illegal action. As most of the threats and challenges are related, conservation measures must be considered jointly where appropriate.

[21] The minimum number of packs per country were calculated from to the proportion of suitable habitat per country according to Herrmann (2011). As the calculated numbers of packs per country were a minimum, all numbers were rounded up, resulting in a sum that is slightly higher than 125.

6.1 Secure sustainable damage prevention and compensation systems for livestock damages

Damages to livestock caused by wolves can be extensive. To mitigate the negative impact of livestock depredation by wolf, the development of a sustainable damage prevention and compensation system is recommended. “Sustainable” in this case means that the measures must be longlasting and reliable even if compensation costs are rising, i.e. farmers must not fear every year whether the compensation payments are continued or not.
In most Alpine countries, the predation of wild ungulates by wolves is not considered to be a damage on which people, such as hunters, can make a claim for compensation.

Option 6.1.1: Authorities secure mechanisms for the compensation of livestock damages caused by wolf

Currently, the compensation systems vary among the Alpine countries depending on their socio-economic status as well as culture and cultural practices. In order for these already established systems to function appropriately and in the long term, authorities should secure certain implementation instruments, including the integration of compensation systems into national regulations, sufficient and sustainable funding, an impartial investigation mechanism, a network of people trained to identify wolf kills, and/or professional referees in case of doubt or disorder.

Option 6.1.1a: Authorities compensate livestock damages according to current official “lists” based on a legal obligation

Authorities that are legally obliged to compensate livestock damages should, wherever possible, adhere to official “lists” when determining the value of damaged livestock. These lists provide estimates on the market price of livestock according to species, breed, age etc., and are usually published and updated by national livestock breeding associations.

Option 6.1.1b: Authorities compensate livestock damages according to current official “lists” without any legal obligation

Even if authorities are not legally obliged to compensate livestock damages, they should, wherever possible, adhere to official “lists” when determining the value of damaged livestock. These lists provide estimates on the market price of livestock according to species, breed, age etc., and are usually published and updated by national livestock breeding associations. This option is probably less sustainable than Option 6.1.1a where authorities have a legal obligation to compensate livestock damages.

Option 6.1.2: Private institutions compensate livestock damages according to current official “lists” without legal obligation

Private institutions that have agreed or are mandated to compensate livestock damages without legal obligation, should, wherever possible, adhere to official “lists” when determining the value of damaged livestock. These lists provide estimates on the market price of livestock according to species, breed, age etc., and are usually published and updated by national livestock breeding associations. This option is probably less sustainable than Option 6.1.1b where authorities are involved in the process.

Option 6.1.3: Establish adequate damage prevention measures where livestock damages have been repeatedly confirmed

Across the Alps, livestock guardian dogs, electric fences and the presence of shepherds are considered to be adequate damage prevention measures. Such measures should be immediately implemented in areas where packs have established and damages have been repeatedly confirmed, in order to prevent habituation to livestock as an easy prey.

Option 6.1.3a: Link compensation payments to application of damage prevention measures

Authorities or private institutions that compensate livestock damages caused by wolves (with or without legal obligation; Options 6.1.1a-c) should link the payment of compensation to the prior implementation of damage prevention measures. If such requirements are put in place, they should be communicated clearly i.e. which prevention measures are regarded as adequate.

Option 6.1.4: Adapt summering systems in order to establish effective damage prevention measures

The ability to implement and also the efficiency of prevention measures greatly depends on the herding and/or pastoral systems in place. In some cases, the type of system e.g. rather small flocks (<50 animals) without permanent supervision, may even make the implementation of prevention measures virtually impossible or at least ineffective. This implies that certain systems may require adaptation. Therefore, not only agricultural practices but also subsidies that promote such systems should probably be adapted in the long term.

Option 6.1.5: Secure mechanisms for the advice on and assistance in implementing damage prevention measures by institutions in charge

To assist the farmers affected by the presence of wolf, the institutions in charge should provide advice on implementing damage prevention measures.

6.2 Foster dialogue among authorities, with wildlife managers, hunters and foresters by establishing information and consultation mechanisms for the wolf

Law enforcement, but also the implementation of conservation and management options listed above, require the support by the public and especially by interest groups concerned (e.g. land owners and land users). Several decades after the return of the wolf to the Alps have revealed that a strong legal framework alone does not guarantee the survival of the populations. Participatory processes are required. Participation, by definition, means more than just the provision of information. It is the aim to turn persons affected into persons involved, which means that compromises and common decisions must be possible. This means also that, for some issues, participatory processes are not possible. Political and legal preconditions are required which enable the possibility of reaching such compromises and common decisions. Otherwise, the process will cause frustration. However, even if a participatory process is not possible in the decision-making for a certain issue, it may e.g. still be possible for the when, where and how of the implementation. For a review of key elements of stakeholder engagement and public participation we refer to Linnell (2013). In general, the inclusion of all affected actors in decision making but specifically in the process of developing management plans is absolutely essential.

Option 6.2.1: Establish round tables and workshops to encourage dialogue among authorities and interest groups

There are conflicting goals between and within the fields of agriculture, forestry, hunting and nature protection. While the legitimacy of each of these conflicting goals cannot be discussed, the extent of the disagreement should be identified. Possible solutions are either a prioritization of the goals or a geographical identification of areas where these conflicting goals hinder large carnivore's management. An earnest dialogue addressing all critical and controversial points between the different interest groups should be started with the aim to develop common ground and find compromises with regard to wolf management and conservation. This dialogue should be facilitated by an independent and broadly accepted institution or mandated key person.

Option 6.2.1a: Establish different forms of participation in pilot regions and evaluate outcome in terms of best practice projects

There are different forms of participation processes. These vary in terms of organisation of the group, e.g. who moderates the group, the requirements of work investment for the participants of the group, the influence that the results of the group can have (participation of GO representatives from different administrative levels and agencies). For example, the analysis of one participatory process can be found in Boutros & Baumgartner (2004). The effectiveness of such variations should be tested in order to establish best practice guidelines.

Option 6.2.1b: Based on consultations with interest groups, authorities develop and implement guidelines on how to integrate wolf presence into ungulate and forest management

The experience with previous round tables and involvement of interest groups reveal that for wolf management the ungulate hunting management is crucial. Wildlife management as it has developed in the Alpine countries in the 20th century tries mainly to balance between hunting and forest harvest, hence to maintain relatively high ungulate densities while mitigating browsing damage. The impact of an efficient predator such as the wolf on the ungulate populations is a "new" and maybe considerable factor in this system and should now be taken into account in order to avoid conflicts of goals. In the field of hunting, potential ways to adapt ungulate (game) management to the presence of wolf should be discussed, for example with regard to harvest quotas and feeding practices (feeding stations, baiting, fruit trees, waste management in villages) as well as hunting practices and regulations. Furthermore, adaptation of forest management practices to reflect the carrying capacity for ungulates, and compensation schemes to address the impacts of browsing damage by ungulates due to verifiable impacts of wolf should be considered. This would require a dialogue between wildlife managers, hunters, foresters, and conservationists with the aim to adapt given wildlife management practices, especially ungulate and forest management. In addition, measures to improve ongoing internal communication and exchange between hunters regarding wolf should be integrated into wolf management plans.

Option 6.2.1c: Create suitable units for wolf, ungulate and forest management within the national borders and cross-border

As wolves need a lot of space, their management entails a different spatial scale than traditional ungulate or hunting management. Inadequate management units (e.g. for monitoring or assessment of status) often result in wrong conclusions. The Alpine countries should therefore identify and establish adequate management units for the monitoring and conservation of wolf.

Such units should consider habitat and subpopulation models, but can also be based on existing units (e.g. hunting units or national subunits).

Management units could also incorporate areas that are especially important for the return of wolf (cross-border regions, regions that adjoin core areas of wolf etc.) and areas, where the implementation of livestock protection might be more complex and/or land use practices require fundamental changes.

Option 6.2.2: Enable and foster fact-based in-group communication

Norms that guide, for example, hunting practices are very important and can be influenced by in-group communication. Therefore such in-group communication should be encouraged and also supported by providing relevant facts. The information used should come from a source which is generally accepted to be objective. A structure for the communication of such objective information should be established, too. It is even more effective, if in-group actors were involved in the gathering of the information.

Option 6.2.3: Undertake regular systematic public surveys to evaluate and refine work with interest groups and broad public ("social monitoring")

The management of any animal population should include a monitoring in order to assess the effectiveness of the management, enabling the managers to adapt the management in case of adverse results. Similarly, the effectiveness of measures to increase the social acceptance requires its own monitoring. This should be established by regular public surveys in the interest groups and the broad public.

Social-scientific aspects should be included in the monitoring process:

1. Systematic evaluation of reporting about large carnivores should be done in order to be able to reliably interpret changes in attitudes. For example, in Slovenia it was found that the behaviour of individual problem bears was responsible for a large part of negative reporting.
2. Focus groups should be created with participants from different sectors (hunting, agriculture, tourism, nature conservation) in regions with large carnivores presence in order to identify emerging problems immediately.
3. Regular systematic public surveys should be conducted, with special focus on the most relevant interest groups (hunting, agriculture, tourism, nature conservation) in order to detect changes in attitudes at early stages and to evaluate the quality of large carnivores management.

6.3 Integrate local people in the wolf monitoring

The involvement of local people increases amongst other things the feeling of involvement of more than just the person actually involved, but also of their peers. Furthermore, it may empower stakeholders through the co-generation of knowledge and make the research more robust by providing higher quality information input. It also contributes to the dialogue between the local stakeholders/interest groups and the managers/administration and can help to increase the information flow in both directions. For a review of key elements of stakeholder engagement and public participation we refer to Linnell (2013).

Options 6.3.1: Involve interested people at local level, e.g. hunters, foresters and nature enthusiasts in the monitoring of wolf

A scientific robust monitoring is the basis of all meaningful conservation and management actions. However, monitoring results should also be communicated, understood, and accepted by the local population concerned. The performance and the acceptance of monitoring, but also the general dialogue could be improved by integrating individuals from (different) interest groups into the field work, by e.g. providing specific web portals designed for the collection and assessment of observations/records of wolf individuals.

Options 6.3.2: Authorities develop an incentive system for the documented presence of wolf at regional or communal level

The presence of wolf can hamper the fulfilment of the required hunting quota or reduce the harvest of ungulate game. State institutions or land users should therefore also consider mitigating conflicts between hunters and wolf through e.g. offering (financial) incentives to hunters' associations who have wolf in their hunting grounds, if in accordance with national legislation. Such a system also offers the opportunity to integrate hunters into the wolf monitoring, e.g. by giving them the burden of onus of wolf presence.

6.4 Prevent and persecute illegal action through law enforcement

Illegal killing poses a threat wolf in Europe and can have a severe effect on the local population. However, environmental crimes are usually not a priority in law enforcement and only special cases are even noted publicly (e.g. Stadt Bern 2000[22], Bayerischer Rundfunk 2015[23], ORF 2015[24]). The following options intend to increase the awareness of the problem and of its severeness, and to improve its persecution/abatement.

Option 6.4.1: Establish or strenghten corps of independent state employed rangers and game wardens

In some Alpine countries (e.g. France, Slovenia) or in parts of these countries (e.g. Switzerland, Italy), state wildlife rangers with official status are overseeing the implementation of hunting and wildlife protection laws. Such institutions are generally better positioned to investigate or persecute wildlife crime than privately employed game wardens. An official wildlife crime corps should be established.

Option 6.4.2: Raise awareness within police, state attorneys and judges regarding illegal mortality of protected species

The law enforcement corps may not be aware of the severeness of crimes against strictly protected species, e.g. large carnivores or are generally not familiar with nature conservation regulations. Awareness of the issue should to be raised for all levels of legal intervention, from the game warden to the judge by e.g. inviting enforcement authorities to round tables (see Option 6.2.1) and offering training courses.

[22] http://www.bern.ch/mediencenter/aktuell_pol_feu/2000-02-926
[23] http://www.br.de/nachrichten/oberpfalz/inhalt/tote-luchse-bayerischer-wald-100.html
[24] http://ooe.orf.at/news/stories/2715954/

Option 6.4.3: Secure and guarantee professional investigation methods

Investigations on illegal wildlife killing require specific professional skills. In the past, CITES and Interpol have collaborated in the organisation of courses, specific to the issue of wildlife crime. Contact with these two organisations should be made regarding the education of investigators and prosecutors.

Option 6.4.4: Enable and encourage interest groups address illegal actions

Law enforcement – especially with regard to wildlife crime – is generally only successful if it has a broad societal acceptance and is supported by specific interest groups, such as the hunters. Stakeholder groups should be informed about the severeness of the problem of illegal killing of wolf and should be invited to rigorously employ the existing legal framework and address the issue in the broad public.

6.5 Control of wolf-dog hybrids and domestic dogs

As there are fewer stray dogs in the Alps compared to other regions of Europe, the risk of hybridisation is regarded as low for the Alpine wolf population. Nevertheless, as hybridisation has been detected in neighbouring wolf populations (e.g. Apennines) this issue needs to be addressed.

In December 2014, the Standing Committee of the Berne Convention adopted a recommendation on how to address the problem of hybridisation between wolves and domestic dogs.[25] The following options reflect the content of this recommendation.

Option 6.5.1: Authorities control, prohibit or restrict the keeping of wolves and wolf-dog hybrids as pets

In order to prevent wolves from hybridising with domestic dogs in the first place, effective measures to minimise the numbers of free-ranging dogs, and to prohibit or restrict the keeping of wolves and wolf-dog hybrids as pets need to be put in place. National authorities should enforce any measures that control, prohibit or restrict the keeping of such animals by adapting current national laws accordingly. Furthermore, authorities need to put incentives in place that encourage the public to report any illegally kept wolves and wolf-dog hybrids.

Option 6.5.2: Authorities promote the detection of free-ranging wolf-dog hybrids by establishing effective monitoring systems

National authorities are in charge of establishing and promoting effective monitoring systems within their countries. The monitoring should focus on areas where wolf packs are more likely to be in close proximity to settlements with free-ranging dogs and/or where wolf-dog hybrids are kept as pets. Once hybridisation is suspected, experts should monitor the wolf packs more closely using genetic and/or morphological features.

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[25] Recommendation No. 173 (2014) on hybridisation between wild grey wolves (*Canis lupus*) and domestic dogs (*Canis lupus familiaris*). Convention on the Conservation of European Wildlife and Natural Habitats. Standing Committee. 34th Meeting, Strasbourg, 2-5 December 2015. https://wcd.coe.int/com.instranet.InstraServlet?command=com.instranet.CmdBlobGet&InstranetImage=2654095&SecMode=1&DocId=2196762&Usage=2

Option 6.5.3: Authorities entrust state bodies with the removal of wolf-dog hybrids

Once wolf-dog hybrids have been detected and correctly identified, individuals need to be removed immediately. The removal of wolf-dog hybrids needs to be conducted based on an official mandate, hence exclusively by state-designated bodies (at regional or national level) that have been officially entrusted by the authorities in charge. Although hybrids are included in the protection of wolves from the Berne Convention, derogations from article 9 apply to the removal of hybrids.

Option 6.5.4: Authorities establish measures to prevent wolves from being intentionally or mistakenly killed as wolf-dog hybrids (wolf-dog hybrids have the same protection status in the Bern Convention as the wolf)

In general, wolf-dog hybrids are not easily distinguished from wolves. As a consequence, wolves can be intentionally or mistakenly killed as wolf-dog hybrids. It is the task of the national authorities to establish measures in order to prevent such intentional or mistaken killings. Measures include the government-controlled removal of wolf-dog hybrids (Option 3) and granting them with the same legal status as the wolf (strictly protected according to Appendix II of the Bern Convention). Although hybrids are included in the protection of wolves from the Berne Convention, derogations from article 9 apply to the removal of hybrids.

7 Suggestions for priorities in time and space

Despite the diversity of situations that wolf management is faced with across the Alpine countries, the RowAlps project has identified a set of general management options for the entire Alpine wolf population. Although there may be some regional and national variation in the priority of implementing these management options, suggestions for pan-Alpine priorities in time and space are needed. Therefore, working group 3 of the RowAlps project identified the level and timing of priority for each of the five management options (Table 5). The report of the European Commission "Key actions for Large Carnivore populations in Europe[26]" provided a basis for defining the level of priority and the timing of implementation for most of the options (marked with an asterisk in Table 5). The remaining ones have been assigned to a level of urgency according to the rating of working group 3. The timing of implementation was defined separately for areas with and without established wolf packs.

[26] Boitani, L. et al. (2015): Key actions for Large Carnivore populations in Europe. Institute of Applied Ecology (Rome, Italy). Report to DG Environment, European Commission, Bruxelles.

Table 5. Suggested level of priority and timing of implementation for management options for the Alpine wolf population.

Management option	Level of priority	Timing of implementation
Secure sustainable damage prevention and compensation systems for livestock damages (Option 6.1)	High	> Establish measures: - as soon as possible in areas with established wolf packs - upon first appearance of individual wolves in areas without established wolf packs > Continuous implementation
Foster dialogue among authorities, with wildlife managers, hunters and foresters by establishing information and consultation mechanisms regarding the wolf (Option 6.2)	High/Medium	> Establish measures: - as soon as possible in areas with established wolf packs - upon first appearance of individual wolves in areas without established wolf packs > Continuous implementation
Integrate local people into wolf monitoring (Option 6.3)	Medium	> Establish measures: - as soon as possible in areas with established wolf monitoring systems - from the onset of developing new monitoring systems > Continuous implementation
Prevent and persecute illegal action through law enforcement (Option 6.4)	High/Medium	> Establishing measures: - as soon as possible in areas with established wolf packs - upon first appearance of individual wolves in areas without established wolf packs > Continuous implementation
Control of wolf-dog hybrids and domestic dogs (Option 6.5)	Low	> Establishing measures: - as soon as possible in areas where hybridisation has been detected - where necessary in all other areas > Continuous implementation

Annex 1: Literature

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