



Overcoming barriers – management of large carnivores in the Alps

KEY FINDINGS

After centuries of intensive hunting large carnivores like brown bears, Eurasian lynx and wolves are now recovering in many areas of Europe. This work deals with large carnivore populations in the French Alps focusing on wolf and gives information on the recent population status, management, legal frameworks and recommendations for habitat protection and coexistence of humans and large carnivores.

The occurrence of **wolves** in France is limited to the Western Central Alps. In 2017 52 packs (360 individuals) were monitored. The Western Alpine population is of Italian origin, and migration moving from the Apennines to the Alpine population is still underway. Wolf populations are still far from being accepted by local farmers and livestock breeders, and conflicts with hunters are also reported. A French wolf plan exists. The actions listed in the wolf plan are based on livestock protection and compensations. The principles of “tir de défense” (removal of stock raiding individuals) and “tir de prélèvement” (a yearly defined number of individuals are removed) are applied. The goal is to reduce predation and keep or increase wolf populations and maintain them at favourable conservation status. **Lynx** is present in France in the Jura, the Vosges-Palatinian region and in the Alps. The alpine population originates from the Carpathians, where the nearest autochthonous population can be found. In 2016 100 individuals lived in France, and a small population of around 30 individuals has settled in the North of the French Alps (Savoie). For the lynx no management plan exists. In France the occurrence of **bears** is limited to the Pyrenees with an estimated population of 19 bears. There is no Alpine bear population in France. For the management of the brown bear a French bear plan exists.

Bears, wolves and lynx are strictly protected by international and national laws, but for their practical management, almost all countries with substantial populations of these carnivores have some regulations allowing for the targeted removal of problem animals. For large carnivores interregional wildlife habitat planning on the European level is important. It would clearly be desirable to have more transnational cooperation to develop more flexible management practices beyond national borders. The Habitat Directive with its focus on the favourable conservation status (FCS), combined with the Bonn and the Bern conventions, provides a good basis to achieve this.



Brief history and current situation of the presence of large carnivores (wolves, bears and lynx) in the Alps, including most recent monitoring data.

Lynx, bears, and wolves require expanded, non-fragmented habitats to establish their large home ranges and to allow long-distance movements. After centuries of intensive hunting, they are now recovering from a previous decline in many areas of Europe due to favourable legislation, although some small populations remain critically endangered. Despite their long-term protection in some countries and their functional role as ecosystem keystone species, these top predators are still considered to be 'conflict species', a view which has led to the reappearance and intensification of a wide range of conflicts, especially in view of the economically costly depredation on livestock and pets. Hunters perceive carnivores as competitors for shared prey species, and rural residents often express fear of both bears and wolves. These conflicts can escalate to very high political levels and dominate political discourse like in Austria and France (1, 2).

Wolf – current situation

The European wolf (*Canis lupus*) population has been increasing in the last few decades, both in number and in distribution range. The total number of wolves in Europe is larger than 10.000. The largest populations are the Carpathian population (5) and the Dinaric-Balkan population (6) (> 3.000 wolves), followed by the Baltic population (3) (>1.000 wolves). Other populations are an order of magnitude smaller (Italian Peninsula (7) ~800 wolves, Scandinavian (1) ~ 300 wolves, Central European Lowlands (4) ~ 200 wolves, Alpine (8)~ 160 wolves, Karelian (2) > 165 wolves) (1), see also numberings in Figure 1 and 2.

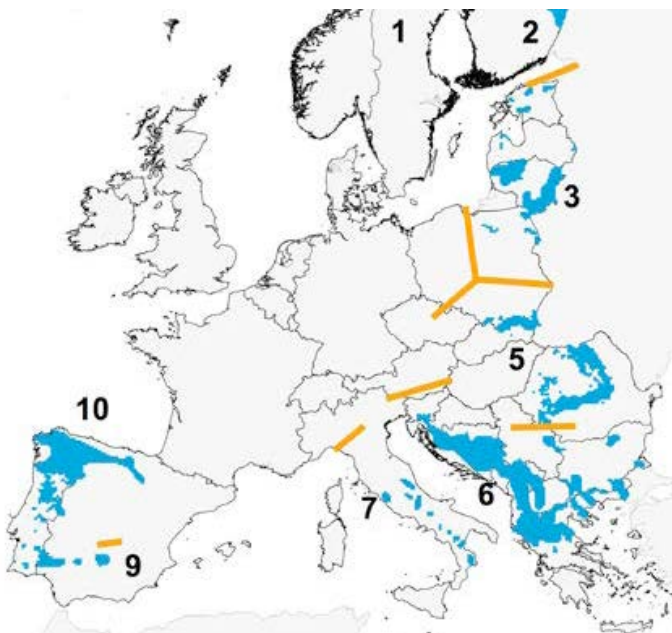


Figure 1: Distribution of wolves in Europe at their lowest extent during 1950 – 1970s (13). Numberings indicate the different population areas.

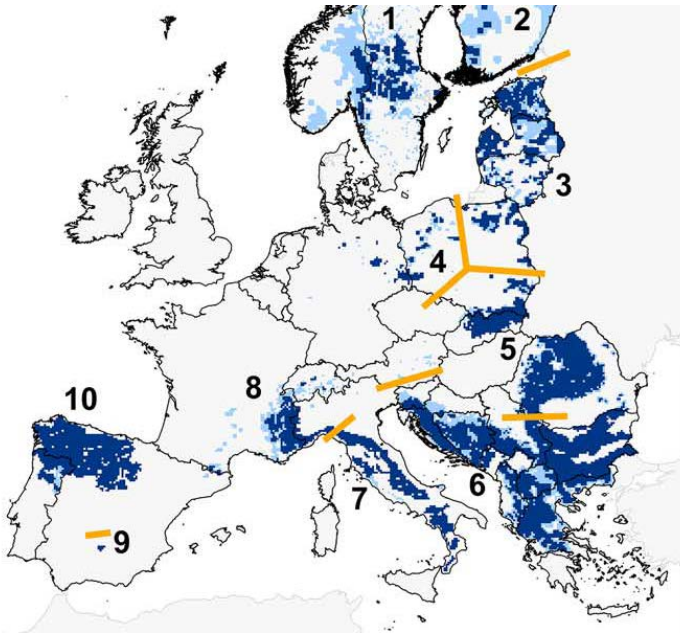


Figure 2: Wolf distribution in Europe around 2010. Dark blue cells indicate areas of permanent occurrence, light blue cells indicate areas of sporadic occurrence. Yellow lines indicate boundaries between today's population. Numbering shows different population areas, information on population size can be found in the section above (13).

In the Western Central Alps the wolf is considered to be “Endangered (D)” according to the IUCN- Red List of Threatened Species. According to the French Ministry of Environment the most recent estimations of wolf populations in the French Alpine area are from 2017: 52 packs (numbering 360 wolves) inhabit 63 permanent wolf presence zones and the population size is expected to be growing.

The Western Alpine population is of Italian origin and shares the same Italian genetic haplotype. Individual wolves dispersing from the Apennines first colonized the Alps in 1992 and succeeded in establishing a permanent and expanding population which shows a highly dynamic spatial pattern spreading towards the west and north. The genetic continuity with the Apennine population has been assessed at 2.5 individuals per generation, all of them moving from the Apennines to the Alpine population (1).

Several cases of illegal killings have been reported in France and Italy, and the presence of wolves is still far from being accepted by local farmers and livestock breeders. Conflicts with hunters are increasingly reported and remain unresolved. Both France and the regional government of Piemonte in Italy have carried out extensive and continuous research and monitoring of the wolf population and the damage to livestock caused by wolves (2, 6).

The most relevant threats to wolves in Europe are: low acceptance, habitat loss due to infrastructure development, persecution/illegal killing, hybridization with dogs, poor management structures and accidental mortality, livestock conflicts, wildlife management systems, lack of practical solutions when faced with EU demands and policies, lack of cooperation between countries and/or provinces, and a lack of knowledge. Most threats are expected to become slightly more important in the future (2,8).

Legal status and management:

The legal status of wolves in the European Union countries is defined in the Habitats Directive (92/43/EEC). Wolf populations are listed under Annexes II (requiring the establishment of Natura 2000 sites for species) and IV (requiring strict protection but with derogations still possible under Article 16). However, there are some exceptions: many EU countries list the wolf under Annex V which means that exploitation and taking in the wild is allowed (Bulgaria, Estonia, Latvia, Lithuania, Poland, Slovakia, parts of Finland, Greece and Spain). A growing number of countries have a management plan or are in the process of agreeing one. Wolf management can be centralized (e.g. France, Sweden) or decentralized (e.g. Spain, Germany) at the same time, leading to the same wolf population facing different management regimes in one country and in different countries.

Quite a few advances in population level management have been reported for many transboundary populations. Agreements between countries provide for some degree of coordinated management (Slovenia-Croatia, Slovakia-Poland), the sharing of information (e.g. Italy-France-Switzerland, Germany-Poland, Sweden-Norway-Finland) or, most commonly, for working groups between scientists or managers. For some populations however, little or no progress has been made, neither between countries (Karelian, Carpathian) nor within the same country (North Western Iberian). There are no formally binding population management plans that have been agreed between different countries.

The Western Alpine population is fully protected under French, Italian and Swiss law. In France and Switzerland the national action plans include provisions for the legal take of a few wolves under strict conditions in the event of depredation on livestock. The three countries have signed a formal agreement of cooperation for the management of the entire population (2).

The French wolf plan has been developed by the Ministry for Environment (Ministère de la Transition Ecologique et Solidaire), in collaboration with the Ministry for Agriculture (responsible for the sections on breeding and livestock protection). The wolf plan is managed at a regional level by the Direction Régionale de l'Aménagement, de l'Environnement et du logement (DREAL). Documentation about wolf attacks and compensation can also be found (in French) on the DREAL web site: <http://www.auvergne-rhone-alpes.developpement-durable.gouv.fr/mission-loup-r1323.html>

The actions of the wolf plan are based on livestock protection and compensations. For wolves only, there is a culling policy strictly regulated by Article 16.1 of the Habitats Directive. The maximum number of wolves which can be culled is determined by biological monitoring of the wolf population on the French territory. The goal is to reduce predation and keep or increase wolf populations and maintain them at favourable conservation status. Recent developments of the wolf plan should improve protection and enhance the effectiveness of measures. Therefore, it is planned to establish an observatory providing technical assistance and advice on choosing the adapted protection measures in order to reduce predation and avoid culling.

Scientific research has shown that culling and hunting of large carnivores is usually ineffective or even counterproductive in reducing depredations on livestock. These measures are also ineffective in improving the social acceptance of the presence of large carnivores. Preventive measures are the more rationale, effective, fair and least controversial ways to decrease and prevent depredations and other damage, and thus mitigate conflict. An alternative way of management that comprises scientific principles and creates a strategy of support, awareness and information for different stakeholders is recommendable (18).

Prevention measures are shepherds, guard dogs, movable and permanent safety fences. According to a recent study the combination of measure is most effective: it is important to have shepherds and dogs, dogs and fences. The best prevention is the combination of all three measures: shepherds, dogs and fences.

However there is no effective measure in seasonal move to summer pastures and in Mediterranean landscape as bushes don't allow an effective oversight (19). The financing of the prevention measures is shared in equal parts by the European Agricultural Fund for Rural development (EAFRD) and the French Ministry of Agriculture. According to the French Ministry of Environment there is no recent LIFE Programme for wolf in France. Two completed LIFE projects dealt with the situation of wolf in France: Loup en France (LIFE96 NAT/F/003202) and Loup dans les Alpes (LIFE99 NAT/F/006299). Both projects focused on monitoring of the populations, compensation of damages, protection measures as well as public awareness.

Wolves and livestock depredation are closely connected and thus conflict levels are high. Sheep account for the vast majority of livestock deaths. In 2017 the French wolf population (numbering 360 individuals) was responsible for 11.947 victims (mainly sheep). Compensation costs were up to € 3,620.192 and the wolf population is expected to grow.

Re-establishing former mitigation measures (e.g. shepherding, livestock guarding dogs) or establishing new measures (e.g. electric fences) can cost several times the amount spent on compensation. An increasing number of countries offer a compensation system although there are huge differences in who pays the compensation, and under what conditions (1).

Lynx – current situation

The Eurasian lynx (*Lynx lynx*) was driven to extinction in much of Western and Central Europe over the last few centuries. It survived in a small area in the Balkans (Greece, Macedonia, Albania, Kosovo and Montenegro). Larger populations persisted in Fennoscandia, the Baltic States, and European Russia. Lynx have been released in several countries of Europe, including Switzerland, Slovenia, Italy, Czech Republic, Austria, Germany and France (4). The total number of lynx in Europe is around 9.000- 10000 individuals.

Lynx populations in France can be found in the Jura, the Vosges-Palatinian region and in the Alps; according to the most recent monitoring data from the French Ministry of Environment, there were 100 lynx in France in 2016. A small population of around 30 individuals has settled in the north of the French Alps (Savoie).

The lynx brought back to the Alps after 1970 all came from the Carpathians, where the nearest autochthonous population can be found. Today, the Alpine population consists of several occurrences, all originating from re-introductions in the 1970s. Although lynx migrated into neighbouring countries (France, Italy) during the 30 years following the first releases they have not yet established a continuous population throughout the Alps. The capacity for expansion is limited as a result of the strong habitat fragmentation in the Alps. Nevertheless, there is a potential connection between the Western Alpine population and the Jura population, which in turn has potential connections with the Vosges population.

The most relevant threats to Eurasian lynx in Europe are low acceptance largely due to conflicts with hunters, persecution (i.e. illegal killings due to low acceptance) and habitat loss due to infrastructure development, poor management structures and accidental mortality. Small populations can suffer from inbreeding and need appropriate actions. A major conflict exists with ungulate (deer) hunting, and fruitful ways of conflict management with hunting have yet to be found (1).

Legal status and management:

Lynx are at present protected in all Alpine countries. In France and Switzerland individual lynx causing too much damage to livestock can be removed. National environment agencies are responsible for lynx

management. Except for Switzerland, national management plans are still lacking. This also applies to France, where there is no French lynx plan.

Livestock depredation is low, and thus conflict levels are also low. This is true of most of the populations. There is some damage in the Alpine and Jura populations. However, usually less than 100 domestic animals are killed per year in total. The only two populations with major depredation problems are the Nordic ones.

Bears – current situation

Brown bears (*Ursus arctos*) were originally found throughout Europe. They later disappeared from most areas as the human population grew. Suitable habitat was lost due to deforestation and agriculture, and the species was hunted by humans (3). In Europe, brown bears occur in 22 countries. The total number of brown bears in Europe has been estimated at about 18.000 individuals.

The occurrence of bears in France is limited to the Pyrenees with an estimated population of 19 bears (2015). The population is increasing but according to an IUCN Red List assessment seen as critically endangered. In the Alpine region the population is assumed to be stable but still critically endangered. There have been no bear sightings in the French Alps, but in surrounding Alpine areas. In Trentino (Italy) the population is estimated at 43 – 48 individuals, in Friuli (Italy) at around/below 12 individuals, in Switzerland there has been 1 sighting and in Slovenia 5 – 10. The overall Alpine population is estimated at around 45 – 50 individuals (1, 2).

Basic data on large carnivore populations in Europe are given in the following section, with a focus on the alpine bear populations (2):

The alpine bear population consists of a few bears over a large area. The bears are clustered in 3 population segments that are separated by large areas where there is no permanent bear presence, although individuals have shown that they are able to move freely between these segments. For future population developments, connectivity between these segments will be important.

Damage caused by bears has the potential to reduce public acceptance, especially where problem making individuals are concerned. The loss of more than 15 bears of the central Austrian bear population and 2 bears dispersing from Italy suggest an unnaturally high mortality rate among bears in the Alps. Illegal removals seem to be the most likely explanation (1).

Legal status and management:

Those parts of the populations that are found in EU countries are strictly protected under the Habitats Directive, where all populations are listed in Annex IV (species in need of strict protection). Sweden, Finland, Romania, Estonia, Bulgaria, Slovenia and Slovakia currently use derogations under Article 16 of the Directive to allow a limited cull of bears by hunters. Bosnia and Herzegovina and Norway manage bears as a game species with annual hunting quotas as only the Bern Convention binds them. In Croatia, regular bear hunting ended in 2013 when Croatia joined the EU and had to adapt to EU laws. Nearly all countries have some kind of bear management plan, action plan or bear management strategy (1).

France has a new bear plan (2018). It is available (in French) on the DREAL Occitanie web site : <http://www.occitanie.developpement-durable.gouv.fr/ours-brun-r6949.html>

Legal frameworks relevant for the protection of large carnivores

Large carnivores often have large individual home ranges of more than 100 km². Legal instruments for species protection need to be implemented at an international level through international treaties to address transboundary conservation. There are several legal regulations on the conservation of large carnivores: The most prominent and often cited instrument is the Habitats Directive (Council Directive 92/43/EEC) with its Annexes II, IV and V for EU countries. The Bern Convention is also relevant for non-EU countries. The Bonn Convention aims to conserve terrestrial, aquatic and avian migratory species and the Convention on Biological Diversity is aimed at promoting sustainable development. Furthermore, most European countries have adopted the IUCN's red listing procedures, the Alpine States are members of the Alpine Convention and the EU countries have implemented the Convention on the International Trade in Endangered Species (CITES).

The following section gives a short insight into the relevant frameworks:

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 which was adopted in 1992. The Natura 2000 network was established under the Habitats Directive and comprises a series of protected areas within the European Union (Emerald Network for Switzerland and Liechtenstein). All the large carnivore species as well as their habitats are strictly protected under the Habitats Directive (Annex II, under which Natura 2000 sites are required, and Annex IV). Wolves and brown bears, but not lynx, are additionally designated as priority species. The current focus of the Commission is on "coordinating management across national boundaries as a possible 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". Formal requirements towards EU Member States are more than "just avoiding extinctions".

On behalf of the European Commission, the Large Carnivore Initiative for Europe developed the "Guidelines for Population Level Management Plans for Large Carnivores" in 2008 (2).

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 "Favourable Conservation Status" for correct and concrete use and 3.) to recommend "best management practices" for large carnivores.

Bern Convention: All EU countries are also signatories to the Bern Convention. The Bern Convention places an emphasis on the need to improve transboundary approaches in the preamble and in articles 1, 10 and 11. Recommendation 115 (2005) also calls on countries to work towards transboundary action plans for large carnivores. Wolves and bears are listed in Appendix II (strictly protected) and Eurasian lynx are in Appendix III (protected) of the Bern Convention.

Bonn Convention: Most EU countries are signatories to the Bonn Convention which is aimed at migratory species that cross international borders. The Bonn Convention allows states sharing migratory populations to sign legally binding treaties to govern the management of these species (7).

The combination of the Habitats Directive and these two conservation conventions should give EU countries a good basis to develop population level management plans. Under these regulations, Member States will be able to adopt management practices that are more flexible than those adopted on the basis of a strictly national perspective.

Additionally, the Bern and Bonn Conventions can be useful frameworks to induce non-EU countries to take part in these plans. Many Bern Convention signatories have taken part only with strong reservations about

wolves and bears and their placement on the list of Appendix II. Three key countries have not signed any of these conventions: Bosnia & Herzegovina, Montenegro and Russia. They have only signed the Convention on Biological Diversity as the only relevant international conservation legislation.

Convention on Biological Diversity (CBD): entered into force on 29 December 1993. It has 3 main objectives: 1.The conservation of biological diversity, 2.The sustainable use of the components of biological diversity, 3.The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

Alpine Convention: is an international treaty (convention) for the protection of the Alps. It was signed at the beginning of 1991 by the eight countries of the Alpine Arc: Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland and the European Community. The Convention works with integrated policies and approaches for the sustainable development of the Alpine Space. The Permanent Committee and the competent administrations are the main institutions primarily responsible for the Convention's implementation. Working groups, platforms, committees etc. support and supervise the implementation of the Convention. One Platform of the Convention is WISO (Wildlife and Society) which deals with large carnivores and wild ungulates.

Convention on International Trade in Endangered Species (CITES) 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. Bears, lynx and wolves are listed in Appendix 2 (www.cites.org). In the EU countries CITES is implemented by EC Regulation 338/97 (7, 8).

National instruments for the management of large carnivores

Alpine countries manage their wildlife through protective laws and selective hunting. France, Switzerland, Germany and Austria have established large carnivore management boards of representatives of GOs, NGOs and scientists as discussion forums on regional and/or national level. The aim is to conduct objective discussions about emerging problems and to find possible solutions to conflict management (7).

In France, wildlife and environmental monitoring is carried out by the Office National de la Chasse et de la Faune Sauvage (ONCFS). The authority in charge is the state (Ministère de l'écologie, du développement durable et de l'énergie). In France, wolf and bear management is 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. Lynx conservation is managed at regional and departmental levels, except for derogations from its protected status which imply a decision at national level (7).

Bears, wolves and lynx are strictly protected by international and national laws, but with regard to practical management, almost all countries with 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" (removal of stock raiding individuals) and "tir de prélèvement" (a yearly defined number of individuals are removed). This approach is managed by the French wolf plan.

The most intensive efforts for livestock protection have been undertaken in the French Alps, where the pressure exerted by the wolf is high and the conflicts are serious. The attacks began in 1993 and increased steadily until 2005. In 2006, the number of attacks declined possibly due to the use of protection methods. However, the number of victims per year in 2010 was again higher than in 2005 and nearly doubled until 2014 (10). On average 10 to 15% of the flocks in the wolves' ranges are attacked each year. 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, wolves or dogs/other, a damage assessment is carried out where possible within the first 48 hours of the attack. The characteristics of the attack and the state of the victim

are recorded and the cause of attack determined. In France, compensations are paid in three cases: direct losses, animals missing and indirect losses (9). Compensation payments for wolf damage in the whole of France increased from € 0.79 million in 2008 to € 3.6 million in 2017 (9, 10).

Meanwhile, on the national and regional level, different wolf working groups have been established ("comité scientifique national du loup", "comité national du loup", "comités départementaux de concertation et de suivi du loup"). The possible coexistence of sheep breeding and wolf packs has been supported by the "action pour la préservation du pastoralisme et du loup dans l'arc alpin».

The main issues are:

1. The state commits to supporting and preserving sheep breeding and summering of sheep on Alpine pastures,
2. The wolf shall be preserved in the alpine area, not beyond
3. Differentiation into zones where wolf protection is given first priority and zones of "management" ("gestion"). In the zones where wolf protection is given first priority alternative livestock protection measures and pastoral systems are developed and tested to allow for the wolf's existence (mainly in the Mercantour national park and the Queyras nature park). Here investment in terms of time and funds is high.

Key actions for habitat protection and coexistence between large carnivores and human activities

Europe is a very diverse continent from a geographical, environmental and socio-economic perspective and there are no solutions that work in all contexts. It is therefore necessary to identify a range of potential solutions and then pick a combination of measures which work best in different local contexts (1).

The key actions for large carnivore populations in Europe are as follows (12):

- Reduction of habitat fragmentation (due to infrastructure and climate change) and reduction of disturbances associated with infrastructure development
- Improving the development and implementation of ecological networks for large carnivores, enhancing ecological connectivity, creation of movement corridors
- Improving transboundary cooperation on the conservation and management of large carnivores
- Harmonization of monitoring procedures
- Development of national and transnational management plans
- Popularize preventive measures to minimise conflicts
- Evaluation of conflicts
- Law enforcement in case of illegal killing of large carnivores
- Capacity building and information exchange, including public involvement, awareness and education

Relevant policy options for the coexistence with and management of large carnivores

1) Connectivity – trans-sectoral spatial planning: Large carnivores often have large individual home ranges. Therefore the existence of ecological corridors for species migration and genetic exchange is important for vital populations. The issue of habitat connectivity is a major concern for large carnivore management. Successful integration of habitat connectivity into spatial planning needs to consider diverse social, cultural, legislative, economic and ecological demands, while assigning sufficient resources and capacities to large carnivore conservation and the maintenance of ecosystem functions (14).

2) Zoning/ zonal structure of habitats: Protected areas are core zones and they are a fundamental element of the ecological network of a region. Wolf management in France includes the zonal structuring of habitats where the wolf has to be preserved in the Alpine area where it has been given first priority and where there are zones of “management” where the focus is on control and protection against wolf populations. This approach is also recommended by experts for other large carnivore species: definition of graded zones of protection, pasture management and hunting, as well as protective measures to allow Alpine pasture management and other uses (8, 14, 16,17).

3) Local, regional and transnational approaches: For large carnivores interregional wildlife habitat planning on the European level is important. This international process should be conducted in parallel with internal national processes, closely linked with and based upon national planning processes, promoting cross-border cooperation and harmonization. (14).In addition to regional solutions, transregional and transnational coordination is also important. The Large Carnivore Initiative for Europe (ICIE), along with the EU platform on coexistence between people and large carnivores and the WISO platform (wildlife and society) of the Alpine Convention are important examples (15).

4) Improving legal frameworks: Legal frameworks, especially the “favourable conservation status (FCS)” of the Habitat Directive need to be considered. The implementation of the relevant regulations should be evaluated and improved where necessary (e. g. concerning the Annex II status of the wolf in different countries). Applying the principles of the Habitat Directive and Bern and Bonn Convention combined appears to be a good basis for the further development of population level management plans. Under these regulations, more flexible management practices can be developed by EU Member States on a transnational level (7,8,15).

5) Exchange of information - working together: An exchange of information and experiences is important, as well as networking between the different interest groups, and it is also important to find a common basis for working together and developing approaches. The management and protection of large carnivores requires cooperation among different sectors. In this process, representatives from the environment, agriculture, forestry, tourism, infrastructure/transport and spatial planning sectors should be involved (14,15).

5) Higher value added farm product: Support needs to be given to the preservation and appreciation of pasture farming for the production of dairy and meat products. In the Alpine area this kind of species-appropriate animal husbandry has a long tradition that adds value to sustainable food production. Grazing preserves mountain pastures and is thus an important contribution for the conservation of biological diversity. Therefore, pasture management needs support and protection to ensure its continued existence (15).

Literature:

- 1 Boitiani, L. et al. (2015): Key actions for large carnivore populations in Europe. Institute of Applied Ecology (Rome, Italy). Report to DG Environment, European Commissions, Bruxelles. Contract no. 07.0307/2013/6544446/SER/B3.
- 2 Linell J., V. Salvatori & L. Boitiani (2008): Guidelines for Population Level Management Plans for Large Carnivores in Europe 2008. A Large Carnivore Initiative for Europe report prepared for the European Commission (contract (070501/2005/424162/MAR/B2)
- 3 McLellan, B.N., Proctor, M.F., Huber, D. & Michel, S. (2016): *Ursus arctos*. The IUCN Red List of Threatened Species 2016: e.T41688A45034772. <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T41688A45034772.en>
- 4 Breitenmoser, U., Breitenmoser-Würsten, C., Lanz, T., von Arx, M., Antonevich, A., Bao, W. & Avgan, B. (2015): *Lynx lynx*. The IUCN Red List of Threatened Species 2015: e.T12519A121707666.
- 5 Arx, M. (2007): *Lynx lynx*. The IUCN Red List of Threatened Species 2007: e.T12519A3351478.
- 6 Large Carnivore Initiative for Europe. 2007. *Canis lupus*. The IUCN Red List of Threatened Species 2007: e.T3746A10048689.
- 7 Schnidrig R., Nienhuis C., Imhof R., Bürki R. & Breitenmoser U. (2016) *Lynx* in the Alps: Recommendations for an internationally coordinated management. RowAlps Report Objective 3. KORA Bericht Nr. 71. KORA, Muri bei Bern, Switzerland, and BAFU, Ittigen, Switzerland, 70 pp.
- 8 Schnidrig R., Nienhuis C., Imhof R., Bürki R. & Breitenmoser U. (Eds) 2016. *Wolf* in the Alps: Recommendations for an internationally coordinated management. RowAlps Report Objective 3. KORA Bericht Nr. 72. KORA, Muri bei Bern, Switzerland, and BAFU, Ittigen, Switzerland, 70 pp.
- 9 DREAL (Directions régionales de l'environnement, de l'aménagement et du logement) 2014a. Plan d'action national loup 2013-2017. 52 pp. <http://www.developpementdurable.gouv.fr/IMG/pdf/Planloup2013-2.pdf>
- 10 DREAL (Directions régionales de l'environnement, de l'aménagement et du logement). 2015. <http://www.rhone-alpes.developpement-durable.gouv.fr/bilans-dommages-et-protocolea3854.html>
- 11 Skrbincek, A. M. & M. Krofel (2014): Final report for the pilot action: defining, preventing and reacting to problem bear behaviour in Europe. Institute of Applied Ecology (Rome, Italy). Report to DG Environment, European Commission, Bruxelles. Contract no. 07.0307/2013/6544446/SER/B3.
- 12 Carpathian Convention Working Group on Conservation and Sustainable Use of Biological and Landscape Diversity (2016): Proceedings of the Conference on Large Carnivores' Protection in the Carpathians, Rožnov pod Radhoštěm, Czech Republic, October 2016, <http://www.ochranaprirody.cz/conference-on-large-carnivores-protection-in-the-carpathians/>
- 13 Chapron G. (2014): Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science* 19, Vol 346. Issue 6216, pp. 1517 – 1519.
- 14 Angelini P.; Füreder L.; Plassmann G.; Renner K.; Sedy K. & A. Ullrich (2011): Alpine biodiversity needs ecological connectivity. Results from the ECONNECT-Project. <http://www.econnectproject.eu/cms/>
- 15 Netzwerkland (2017): Der Wolf im Alpenraum. Tagungsunterlagen: <https://www.zukunftsraumland.at/aktuell/140>

- 16 Breitenmoser U. (2000): Action plan for the conservation of the Eurasian lynx (*Lynx lynx*) in Europe. https://www.researchgate.net/publication/228776242_Action_Plan_for_the_Conservation_of_the_Eurasian_Lynx_in_Europe_Lynx_lynx
- 17 Boitani L. (2000): Action plan for the conservation of the wolf (*Canis lupus*) in Europe. http://www.cap-loup.fr/wp-content/uploads/loup_plan_action_Europe_Boitani-2000.pdf
- 18 Gil A. F., Pereira D., Pinto S. M. & I. Silvestre (2018): Large carnivore management plans of protection: Best practices in EU Member states. Directorate General for Internal Policies of the Union. PE 596.844. <http://www.europarl.europa.eu/supporting-analyses>
- 19 Roincé C (2016): Évaluation de l'efficacité des moyens de protection des troupeaux domestiques contre la prédation exercée par le loup. Terroïko. http://www.auvergne-rhone-alpes.developpement-durable.gouv.fr/IMG/pdf/Evaluation_moyens_protection_2008-14.pdf

Links to legal frameworks:

CITES (1975): Convention on International Trade in Endangered Species of Wild Fauna and Flora; implemented by EC Regulation 38/97. <https://www.cites.org/eng/disc/text.php>

Council of Europe (1982): Convention on the Conservation of European Wildlife and Natural Habitats_(Bern Convention). <https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/104>

European Commission (1992): Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043>

IUCN (2017): Red List of Threatened Species. <http://www.iucnredlist.org/about/overview>

Secretariat of the Convention on Biological Diversity (1993): Convention on Biological Diversity (CBD). <https://www.cbd.int/convention/>

UNEP (1979): Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). <https://www.cms.int/en/convention-text>

Disclaimer and copyright. The opinions expressed in this document are the sole responsibility of the authors and do not necessarily represent the official position of the European Parliament. Reproduction and translation for non-commercial purposes are authorised, provided the source is acknowledged and the European Parliament is given prior notice and sent a copy. © European Union, 2018.

Administrator responsible: Tina OHLIGER Editorial assistant: Eva ASPLUND
Contact: Poldep-Economy-Science@ep.europa.eu

This document is available on the internet at: www.europarl.europa.eu/supporting-analyses
IP/A/ENVI/2018-12

Print ISBN 978-92-846-3166-7 | doi:10.2861/904779| QA-01-18-669-EN-C
PDF ISBN 978-92-846-3165-0 | doi:10.2861/463305| QA-01-18-669-EN-N