Best practices for management of large carnivores in Europe with respect to lethal and non-lethal management measures

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This document has been prepared by the Norwegian Institute for Nature Research for the Istituto di Ecologia Applicata and with the contributions of the IUCN/SSC Large Carnivore Initiative for Europe (chair: Luigi Boitani) and other experts as an additional contribution to contracts 1742024 and 1752024 from the COUNCIL OF EUROPE Directorate General Human Rights and Rule of Law(DGI), Bern Convention.

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Foreword

This report has been developed by the Norwegian Institute for Nature Research with the support of Istituto di Ecologia Applicata and with the contributions of the IUCN/SSC Large Carnivore Initiative for Europe (chair: Luigi Boitani) as well as other experts. We are grateful to the input of Aleksander Trajce, Valeria Salvatori, Aleksandra Majic, Janis Ozolins, Peep Mannil, Joachim Mergeay, Miha Krofel, Håkan Sand, Henrik Andren, Tomaz Skrbinsek, Elena Tsingarska, Marco Heurich, Mihai Pop, Robin Rigg, Jonas Kindberg and Urs Breitenmoser in the initial drafts and then for the inputs and discussions from various members of the Bern Convention's Group of Experts on Large Carnivores.

Introduction

Large carnivores (wolves, bears) have a diversity of statuses under the Bern Convention, with some countries variously having them on appendix II (affording **strict protection**), others having them on appendix III (affording **protection**) and others excluding them altogether from the appendices.

The major difference (articles 5 to 9) between strict protection and protection concerns the situations under which **lethal measures** (hunting and lethal control) can be applied. Under strict protection there are a series of strict conditions that must be satisfied (article 9) before an animal can be killed. Under a regime of protection, the restrictions on killing become less. In response to widespread recovery of wolves in many parts of Europe the Bern Convention has recently (March 2025) moved wolves from appendix II to appendix III which will increase the scope for the adoption of lethal measures. However, under both regimes the obligation for achieving conservation goals is the same.

In light of ongoing controversies surrounding large carnivore conservation there is a need to identify **best practices** associated with the conservation of the species in general, and identify any consequences of the different protection statuses that they can have on the different appendices. This brief report is intended to provide a quick overview of key issues based on accumulated experience that has been described in a vast literature on the topic as well as discussed in multiple forums and expert groups. It is intended to be a **framework to initiate discussions** and further development, rather than being a definitive set of guidance.

Context

Irrespective of the appendix they are on in a given country, the prerequisites for successful large carnivore conservation are similar because they are dictated by their **underlying biology** and the nature of their **interactions and relationships with humans**. Furthermore, the issues facing **bears** and **wolves** are very similar, with only a few species specific particularities. Many of the conclusions also apply to Eurasian lynx and wolverine as well. The appendix location of specific national populations merely restricts the range of management options within the lethal category of measures. We have therefore structured the report in sections dealing with the use of non-lethal and lethal measures rather than by appendix status.

Successful large carnivore conservation requires the coordinated implementation of a wide range of different measures that can be broadly clustered as follows;

A – **Planning** – both carnivore population management and habitat / landscape management.

B – **Economic measures**

C – **Monitoring and research**

D – **Information**, communication, dialogue, stakeholder participation

E – **Livestock** policy and **livestock protection**

F – **Lethal measures** – both hunting and targeted lethal control

Measures in the categories from A to E are always required, and are permissible under both appendix II and appendix III designations. Lethal control measures are already permissible to a limited extent under appendix II via derogation procedures. The main impact of a transition to appendix III is a liberalisation of lethal control and the possibility of opening for a normalised form of **hunting** aimed at the population rather than **lethal control** selectively aimed at targeting individuals. Both are subject to maintaining an appropriate conservation status.

This report contains a detailed **checklist** of conservation measures that are regarded as being best-practice for large carnivore conservation. The first section focuses on general requirements for **all large carnivore conservation**. The second focuses in greater detail on the **additional requirements** for situations where **hunting and / or more liberal lethal control** is implemented. While it is perfectly possible to conserve large carnivore populations under a hunting regime the checklist will make it clear that it also requires the introduction of a wide range of **additional measures** to ensure its sustainability and enhance its social acceptability. This is because there are far higher demands on the **frequency, precision and accuracy of population monitoring** when a more widespread use of lethal control is in use. The third section briefly provides an overview of some examples from carnivore conservation in Europe where specific elements of best practice have been applied.

Best practices for non-lethal measures in large carnivore conservation

There is a huge literature on non-lethal best-practices for large carnivore conservation. Some of the most readily available include;

LIFE: Technical report on "LIFE and human coexistence with large carnivores" (EC 2013).

EC: European Commission website on large carnivores (https://environment.ec.europa.eu/topics/nature-and-biodiversity/habitats-directive/large-carnivores/eu-large-carnivore-platform_en#the-eu-platform).

Newsletter: Carnivore Damage Prevention News (https://cdpnews.net/).

LCIE: Website of the Large Carnivore Initiative for Europe Specialist Group with associated searchable database of thousands of diverse reports on large carnivore conservation (https://lcie.org/Publications).

EC: "Report on Key actions for large carnivore populations in Europe" developed for the EC by the Istituto di Ecologia Applicata (2015).

Bern Convention: Action plans for the conservation of brown bears and wolves in Europe (2000).

IUCN: Website of the Human-Wildlife Conflict and Coexistence Specialist Group (http://www.hwctf.org/) with associated guidelines on addressing human-wildlife conflict (https://www.hwctf.org/guidelines).

IUCN: Guidelines for reintroductions and other conservation translocations (2013) (https://iucn.org/resources/publication/guidelines-reintroductions-and-other-conservation-translocations).

WWF: Standard operating procedures for large carnivore management developed from the LIFE EuroLargeCarnivores project (https://www.eurolargecarnivores.eu/en/results/recommendations).

COST: Handbook on linear infrastructure and wildlife crossing structures (2003).

LIFE: Guidelines for responsible tourism involving wolves and bears (Karamanlidis et al. 2016, Kavcic et al. 2022).

From this diverse material and many other sources we have extracted the following checklist (Table 1) of key elements that represent essential components of a best practice management strategy. For each topic raised there are many examples of best practice from across Europe, but the main point we wish to focus on here is that **best practice for large carnivore management requires the consideration of all these aspects.** Failing on one component may jeopardise the whole. This holistic view is the added value of this framework as it tried to integrate the vast amount of specialised knowledge in the specific elements into a single framework. This need for holism at large spatial scales is probably the single feature that makes large carnivore conservation so challenging.

Table 1. Checklist of essential non-lethal elements of wolf and brown bear management systems that apply to all situations. Examples of many of these elements are presented in Table 3.

Topic	Issue	Species
Garbage management	Bears can easily become food conditioned if they have access to anthropogenic food sources. This leads to risky behaviours – for both bears and humans. Wolves are also at risk of developing strong habituation and potentially risky behaviour if they become accustomed to using anthropogenic foods. Prevent wolves and bears from accessing garbage and all other anthropogenic food sources is essential.	Bear / wolf
Emergency teams	There are many situations where there may be a need for specialised intervention teams for both bears and wolves. These situations include; - Rescue of individuals that become entangled, trapped or caught up in difficult situations. - Aversive conditioning using rubber bullets or fire-crackers to try and avoid individual wolves or bears further developing problematic behaviours. - Radio-collaring individuals that may need to be monitored extra closely, because of situations like problematic behaviour, or because they carry valuable genes	Bear / wolf
Diversionary / supplementary feeding	Although the effects of it are uncertain and controversial, the provisioning of supplementary feeding for bears is widespread in southeastern Europe. It is not recommended to extend the practice into new areas, but in areas where it is established any changes to the practices should only be done after very careful consideration.	Bear
Population monitoring	Monitoring the state of the population is essential, although challenging. For bears the use of non-invasive DNA from scats and hairs represents the state-of-the-art methodology. For wolves a combination of non-invasive DNA from scats, and mapping the number of packs using snow-tracking, camera-traps, and howling surveys represent the state-of-the-art. It is also essential to monitor the genetic status of populations. It is essential that countries sharing a population develop protocols that allow comparable data to be produced.	Bear / wolf
Research	There is a constant need to support large carnivore management with up-to-date research- This includes both ecological research on wolves and bears, and social science studies of the way stakeholders perceive them.	Bear / wolf
Law enforcement	Illegal killing of large carnivores is a widespread, but unpredictable, issue all across Europe. There is therefore a constant need to conduct law enforcement activities, and most importantly to ensure that reported cases are investigated and prosecuted. This is especially important in areas where poison is	Bear / wolf

	still used because of its dramatic and non-selective impacts on multiple wildlife species.	
Livestock protection	Domestic livestock (especially sheep and goats, but also cattle and horses) are exposed to depredation from wolves and bears unless protected. There are a range of protection measures that help. These include; - Livestock guarding dogs - Shepherds - Nightime enclosures - Electric fences Semi-domestic reindeer in the Nordic area represent a special case because of their year-round exposure and the lack of practical protection measures.	Bear / wolf
Beehive protection	Beehives are vulnerable to bear attacks, but can be readily protected using log / stone structures or electric fences.	Bear
Economic tools for livestock protection	Economic assistance is necessary to facilitate the practical uptake of livestock protection, to maintain the viability of pastoralism, and to satisfy a need for social justice in management. The potential forms of assistance include; - Incentives paid to reward the presence of large carnivores - Assistance / support to purchase equipment or subsidise shepherds - Compensation paid for livestock lost.	Bear / wolf
Clear goals	A key starting point for conservation concerns the identification of clear goals that are compatible with obligations under national and international legislation. This is often non-trivial as it requires aligning generalised legal text with measurable and species specific concepts and is often the source of much controversy.	Bear / wolf
Management plans	Management plans are an essential tool to communicate objectives and coordinate the diversity of actions needed across multiple sectors to conserve large carnivores. Ideally management plans would coordinate across all three scales of transboundary, national, and sub-national levels, as well as inside and outside protected areas. Focusing on the biological populations, which often span borders, is viewed as essential for long term conservation.	Bear / wolf
Cross sectorial coordination	Because of their need for landscape level connectivity, large carnivore conservation can only be achieved with the cooperation of multiple sectors including environment, agriculture, transport, energy and defence (because of border fences).	Bear / wolf
Landscape connectivity	Because large carnivore conservation occurs on very large scales it is essential to maintain habitat connectivity and permeability for carnivore movements. This involves adopting landscape scale	Bear / wolf

	landuse planning and ensuring that suitable crossing structures are integrated into linear infrastructure.	
Ecosystem approach	Integrate management of large carnivores with wildlife and forest management structures to ensure that there is enough large herbivore prey for wolves and that forests support enough forage plants for bears.	Bear / wolf
Translocations	Some populations of bears are very small and will depend on artificial translocation of individuals from other populations to prevent inbreeding. This should be done according to existing IUCN guidelines.	Bear
Stakeholder dialogue platforms	It is essential to recognise the socio-cultural aspect of large carnivore conflicts. One mechanism to alleviate the social conflicts and address power imbalances is to create stakeholder dialogue platforms and explore ways to integrate stakeholder inputs into management planning processes.	Bear / wolf
Dog management	Free-ranging and feral dogs represent a major threat to wolf conservation and their numbers need to be controlled. By killing livestock and wildlife they often cause damage for which wolves are blamed. They also increase the risk of wolf-dog hybridisation.	Wolf
Information	There is a limitless need for trustworthy information related to carnivore ecology, monitoring results, conflicts, conflict reduction measures, management policies and safety measures.	Bear / wolf
Promoting positive vales	As well as objective information there is a need for authorities and civil society to balance the dominant conflict narratives with measures that promote the positive values that many people attach to large carnivores as well as the contributions of individuals to conservation and research.	Bear / wolf
Outreach and extension	Especially when it comes to livestock protection providing passive information is insufficient. There is a need for agricultural advisory services to be able to provide practical assistance to pastoralists in the field.	Bear / wolf
Institutional capacity building	Delivering on the multiple aspects needed for effective large carnivore conservation requires well-funded and high capacity institutions at multiple scales. There is therefore a need to invest in administrative, educational, management and research institutions.	Bear / wolf
Guiding ecotourism	Although ecotourism may offer some opportunities to offset some of the costs of large carnivore conservation it requires careful planning and regulation to prevent undesired side effects, as well as a dose of realism about the many limitations.	Bear / wolf

Additional best practices when large carnivores are subject to lethal control / hunting

Even with the best application of non-lethal conservation measures described in the previous section large carnivore conservation will inevitably require some application of lethal measures, although the extent will vary dramatically from occasional and carefully targeted individual removal to the annual removal of significant (up to 30-40%) proportions of the population each year in a normalised hunting system.

There is a massive literature from the field of wildlife management on how to best organise sustainable hunting practices for a wide range of species, including large carnivores. In addition to the primary literature there are also many reports and documents that try to distil this wide experience into sets of principles for diverse settings from trophy hunting to recreational hunting and conflict management.

Good examples include;

IUCN: Guiding principles on trophy hunting (2012).

IUCN: Guidelines on Sustainable Hunting in Europe (2006).

Bern Convention: European charter on hunting and biodiversity (2007).

Convention on Biological Diversity: Addis Ababa principles and guidelines for the sustainable use of biodiversity (https://www.cbd.int/sustainable/addis.shtml).

CITES: Checklist to assist in making non-detriment findings.

Alpine and Carpathian Conventions: Proceedings of the Joint conference of the Alpine and Carpathian Conventions for the exchange of practices on management of large carnivores (2024).

CIC: Best Practices in Sustainable Hunting (2008).

WWF: Standard Operating Procedures for making monitoring data and hunting quotas transparent from the EuroLargeCarnivore LIFE project (2022).

In addition, for the first version of this document we have scoped national management plans for large carnivores and spoken to national experts to gather the more practical experience from day-to-day management of hunting and lethal control which is not often reported in technical documents to develop this first draft of our best practice guidelines.

In this section of the report we have extracted some key messages that are relevant for the use of lethal control and / or hunting for two large carnivore species in Europe, the wolf and the brown bear, although they are also broadly applicable to Eurasian lynx and wolverines too. The report is organised as a check-list of issues (Table 2) that need to be put into place (1) if hunting is to be **sustainable**, (2) if it is to be **acceptable** to the widest possible public, and (3) if it is to achieve its potential as a **conflict management** tool. The checklist is complimented by brief explanatory notes for issues that require further elaboration.

It is important to consider that there are two different situations. Firstly, is the situation where carnivores are killed as part of a regular **hunting** activity. This serves to provide recreational or trophy hunting opportunities and can be used to stabilise or adjust population density and make broad adjustments to geographic distribution. Secondly, is the situation where individual carnivores (or social groups) are killed as part of a **lethal control** activity (or culing) typically in response to a conflict episode. In hunting situations all the normal ethics of hunting, including fair chase and humaneness, are important, whereas in lethal control actions efficiency and humaneness are the main considerations. These are fundamentally different forms of reaction that should not be confused. Hunting may, or may not, be associated with conflict reduction, and is likely to be associated with less direct pathways. Lethal control is by definition a conflict reaction / reduction tool with a rather direct pathway. Evidence for their utility is currently limited and often contested. It is important to note that many countries currently practice a *de facto* form of hunting even though it is administrated and legally justified as lethal control (with respect to protection status under the Bern Convention / Habitats Directive). This guidance (with respect to hunting vs lethal control) primarily refers to the way killing is actually organised and conducted, rather than the way it is legally justified.

Context and **trade-offs**. The choice of methods and seasons will vary depending on conditions like vegetation, topography human density, snow conditions, the need to consider other hunting activities, and the different sensibilities of different national or regional publics. There is therefore likely to be much variation in the decisions about best practices for hunting methods and seasons. Furthermore, no hunting form will be able to maximise all of the key elements of **humaneness**, **safety, sustainability**, acceptability (in terms of **fair-chase**), **efficiency** (in terms of being able to kill animals within a practical amount of time and effort), and **effectivity** (to achieve the desired goals). Instead, there will always be a need to make trade-offs between these dimensions, and different countries or regions may make these trade-offs in different ways. The important aspect is that all welfare, safety and sustainability issues are considered, discussed openly and that choices can be justified based on **informed discussion**.

All the issues mentioned are important for both wolves and bears. Most issues raised in the following checklist apply equally to wolves and bears, although species specific issues are identified. It must be underlined that again that under a system of lethal control the following topics are **additional** to the non-lethal topics mentioned in the previous table that are always required.

Table 2. Checklist of additional elements of a wolf and brown bear management system where lethal control and / or hunting of the species becomes more common. Explanatory footnotes are provided further down in the text to explain some issues in more detail.

Topic	Issues	Footnotes
Safety	Human safety, of both hunters and non-hunters, is of paramount importance in all activities with respect to injury from weapons and potentially from the wild animal (mainly bears). Safety is relevant for both the way that hunting and lethal control are practiced and having procedures in place to use lethal removal of bears or wolves that demonstrate behaviour that is dangerous for humans.	
Animal welfare	Humaneness is an essential aspect of all hunting and lethal control activities, and involves consideration of;	1,2,3,4

	- Choice of hunting season - Choice of weapons and ammunition - Choice of methods, lights, sights, baits, dogs - Hunter training is essential - Access to teams with dogs to follow-up wounded animals	
Fair chase	Fair chase is an important element in hunting, which needs to be weighted against allowing a practical level of efficiency. It is much less important in lethal control actions.	
Wolf hybrid removal	A special case for wolves concerns hybridisation. Current best practice is to remove hybrids where practically possible, and lethal measures are the most efficient.	
Motivations and mechanisms	It is essential to be explicit and open about the motivations and desired outcomes behind hunting / lethal control. This involves a clear explanation of the proposed pathway linking the killing of the animal to the desired effect. In cases where the activity is multi-functional, then all motivations need to be identified. These motivations and associated mechanisms will likely differ dramatically between hunting and lethal control.	5
Who does the killing	The issue of who hunts or engages in lethal control will be highly contextual. As a general rule, lethal control operations need a higher threshold of skill that may be best done by government rangers or contracted hunters, whereas many hunting benefits can be increased via a broad participation.	
Integrated management	Hunting and lethal control will never be able to address all issues and conflicts associated with large carnivores. Rather they are just two tools in a wider toolkit that also includes information, damage prevention methods and economic tools. All tools need to be deployed in an integrated manner.	
Setting clear objectives	Clear objectives for population size and distribution of the large carnivore populations and for levels of conflict are essential to monitor whether they are being achieved or not and to understand if the hunting / lethal control is contributing to these objectives.	
Decision-making processes	It is essential to involve a broad range of stakeholders in decision making structures, with the view of building consensus, or at least a broadly accepted compromise, on overall aspects of the management regime. Being transparent about decisions and processes is also essential. There should be a clear link between quotas, or specific decisions, and the stated management objectives.	
Arbitration / court proofing	Decisions around hunting quotas and lethal control are almost inevitably going to be appealed and / or challenged in court. It is therefore beneficial if an independent appeals process is	3

	created and if all decisions are pre-tested for their ability to withstand a challenge in court.	
Ecosystem planning	Large carnivores need to be managed within a holistic framework together with their wild ungulate prey and other landuses such as forestry, agriculture and pastoralism.	
Information	There is an almost infinite need for clear, trusted and reliable information in large carnivore management, especially if hunting and lethal control are being used.	6
Quotas	The potential for over-harvest is ever present with large carnivores so that it is obvious that any hunting or lethal control needs to be limited by quotas.	
Adaptive management	Hunting and lethal control can only be used in a sustainable way if they are embedded in an adaptive management framework that links quota setting, killing with risk assessment and monitoring and where quotas are adjusted in light of new monitoring data.	
Monitoring	Monitoring the size and distribution of the large carnivore population is essential. The more intensive the management, the more intensive and robust the monitoring which is needed. Best practice includes; - Monitor population size and genetics / health - Involve hunters in monitoring of species they harvest - Coordinate methods across borders in shared populations - The need conversion factors between units monitored and numbers of individuals / reproductions - Conflicts also need to be monitored - It can increase trust if those that conduct monitoring are not the same as those that set quotas	
Modelling / risk assessment	Any quotas set for hunting / lethal management need to be based on a detailed risk assessment process that models the potential impact of different quotas on population development. This will almost always involve some form of population model, which should also ideally consider genetic effects too.	7
Management units	Because of the scale of their movements, large carnivores require very large management units for quota setting. Most hunting grounds will be too small to have their own quota.	8
Quota management	Quotas will typically be small, such that they risk being over-filled without appropriate mechanisms.	9
Enforcement / inspection	Shot carnivores should be submitted for inspection to collect biological data and to inspect the killing method for welfare considerations.	

Periodic review	Management plans and results should be periodically reviewed, so that experience can be incorporated.	
Avoiding side-effects	Hunting and lethal control can potentially introduce unintended side-effects that need to be considered.	10
Precautionary principle	The precautionary principle should be followed throughout, especially in systems with low levels of scientific data and monitoring uncertainty.	11

Explanatory footnotes to checklist for measures associated with hunting and lethal control

1. Hunting season. **Wolf**: On one hand are issues related to practicality. In Nordic countries access to good tracking snow is essential for wolf hunting. In others there is a need to combine wolf hunting with other hunting forms – so that wolf hunting can be an opportunistic activity. On the other hand are welfare issues surrounding the ability of cubs-of-the-year to survive if adults are shot. Traditions vary in Europe, many countries allow autumn and winter harvest, while others only allow winter harvest. **Bear**: Most bear hunting occurs in autumn due to fact that they hibernate during winter.

2. Choice of methods. **Wolf**: Methods vary widely from sit-and-wait, to drive hunts with or without dogs, to hunting at bait, or snow-tracking and the use of flag-lines (fladry). The use of various types of hunting dogs (especially hounds) is also emerging in the Nordic countries as a new form of wolf hunting. **Bear**: Are variously hunted at bait (common in southeast Europe) or with dogs (northern Europe). The use of bait for both species is especially controversial and if allowed needs to be carefully regulated.

The use of artificial light and night-vision equipment is also controversial and needs to be considered in the context of public safety. Camera-traps with real-time MMS transmission of images are also emerging as a new technology. The use of dogs in hunting large carnivores is emerging as a particularly important issue where local perspectives are likely to be highly diverse. The choice of methods will involve issues related to objective animal welfare (disturbance and humane killing), subjective ethics (related to fair chase) and local traditions, practices and other landusers.

3. Self-defence rules. There are multiple situations (in normal hunting situations or when hunting bears) where hunters may encounter a bear in a situation that can be perceived as threatening for their own safety. In such situations it is not uncommon that hunters shoot at the bear. Many countries provide legal openings for these situations, although they are often contested and may be abused. It is therefore essential to provide clarity about these rules in hunter training.

4. Hunter training. Hunting or conducting lethal control on large carnivores is a very special situation compared to other forms of hunting. They move over large areas, they are very shy, often moving fast, the opportunities to kill one are few during a person's lifetime, the optimal target area on the animal is different than for other game, and especially for bears there is often an element of fear involved on the part of the hunter. As a result, there are often higher rates of wounding of large carnivores than other game species (Stokke et al. 2012). This can be potentially minimised through hunter training, including shooting practice on specific wolf / bear targets, and preparing them for the situations that may arise. Hunters will also need training in the specific regulations likely to govern large carnivore hunting / control, as well as preparation for how to navigate the inevitable controversies that will arise from these forms of hunting.

5. Multi-functionality of hunting. Hunting is an activity to which multiple functions are attached. These can be broadly grouped into ecological, economic and social-cultural functions (Fischer et al. 2013). Furthermore, within each of these categories are a wide diversity of other functions that vary with context. Recognising these multiple dimensions is essential when evaluating the motivations and utility, and designing the practices, of hunting and lethal control. It is also important, however, to be aware of the diversity of objections among certain publics to hunting and the killing of large carnivores.

6. Information. Although information by itself will have little impact on changing the public's values towards large carnivores, it is often cited as being an essential missing element by stakeholders and may well influence their trust in institutions and processes. In any large carnivore management situation it is best practice that all documents, decisions and outcomes are made available in the name of transparency. Data on population monitoring and conflicts should also be made available in as close to real time as possible. Information on large carnivore kills should also be made available in real time to ensure that quotas are not over-filled.

7. Modelling for risk assessment. There are multiple modelling frameworks available for estimating the demographic and genetic effects of different levels of mortality. Within an adaptive management framework the focus is on very short time scales (typically 1 - 3 years) for demographic issues allowing robust predictions. One inevitable issue is that monitoring data is only available with a lag that can be from 6 months to 1-2 years (especially if it needs DNA processing). In which cases it is possible to use a prediction model to extrapolate the likely impact of the previous year's mortality to estimate the most likely population size at the start of the year's harvest. Lags will introduce a certain degree of fluctuation in population trajectories, but can be minimised through rapid reaction to detected changes in population size and through experience (Andren et al. 2020, Cussack et al. 2022). It is also good practice to set a quota for total "human-induced mortality" such that hunting and lethal control quotas also take into account vehicle collisions, for example.

8. Management units. Large carnivores require very large management units for quota setting, typically on the scales of thousands, or tens of thousands, of km^2. The quota can then be distributed to finer levels within this overall region based on a predefined statement of objectives (i.e. a desire to address conflicts associated with specific areas). Because most hunting grounds will be too small to have their own quota cooperation between neighbouring hunting grounds / landowners should be encouraged. Depending on the way hunting is organised with respect to landownership / lease holding it is important to discuss and develop procedures concerning the ability of hunters to follow highly mobile animals. In situations where wounded animals are being tracked, or where lethal control is practiced, there should be procedures in place to permit the hunters to cross between management units in pursuit of the animal.

9. Quota management. Good practices to prevent overfilling of quotas involve providing a hotline that must be called (or an online system that is checked) before a hunt is initiated to see if the local quota is open, and after a successful hunt there should be an obligation to rapidly report the kill. Quotas can also be subdivided into an initial quota and a follow-up quota. It is also normal to operate with female sub-quotas which will end the hunt once a certain number are killed because of the disproportionate effect of killing an adult female on the population's demographics.

10. Avoiding unintended side-effects. Killing large carnivores can potentially have indirect effects beyond the numbers killed. These include;

- **Infanticide** is an issue for bears and needs to be considered in population models if a large number of adult males are killed because high mortality rates of adult male bears is associated with the additional mortality of young cubs by new males.

- The issue of **social group disruption** is controversial for wolves because of a fear of increased risk of hybridisation, increased dispersal, reduced welfare and changes to reproduction. There is much discussion about if the best strategy is to remove whole packs of wolves, or just individuals within the

pack, with logical arguments presented for both cases. The topic needs more consideration and more data analysis, but the answer may depend on local context.

- **Baiting sites** run the risk of habituating bears or wolves to anthropogenic food sources. Their use needs to be carefully regulated and best practice is currently suggesting that they should be minimised. The widespread use of feeding sites for bears in southeast Europe is a special case with many complex considerations.

11. Precautionary approach. Although large carnivores are relatively well-studied species and there is a large knowledge base on which to build management, there are at least three reasons why there is a need for a degree of precaution in management systems that involve hunting or lethal control.

- **Monitoring uncertainty**: Monitoring large carnivores over large (national) areas on a regular (annual) basis is a logistically and scientifically challenging task. Estimates will either be counts (without statistical measures of uncertainty) or be associated with wide confidence intervals. There is therefore a need to incorporate this uncertainty into any quota setting process.

- **Implementation uncertainty**: Illegal killing and mortality from anthropogenic sources such as vehicle collisions are widespread, but very unpredictable, additional sources of mortality that need to be taken into account in harvest models.

- **Ecological uncertainty**: There are many demographic and genetic issues that are still not well documented, especially associated with disruption of social groups in wolves or age structure modification in both bears and wolves.

Examples of best practice in action

This section very briefly covers some few examples of where best practices have been applied in real life in the context of large carnivore conservation and management in Europe. No example (Table 3) offers a perfect situation as there are always challenges remaining and no example can be directly transferred to different contexts, but despite these caveats we feel that the cases we highlight can offer constructive inspiration. They mainly focus on wolves and bears, but a few lynx examples are also added because of the similarity of issues. There are many other good examples from across the continent.

Table 3. Examples of best practices in large carnivore management from Europe, including non-lethal and lethal practices.

Topic	Example
Livestock protection	The 4 year (2010-2013) LIFE project SloWolf introduced livestock protection measures in Slovenia which led to a 74% decrease in livestock depredation, despite an increase in the wolf population. https://volkovi.si/ and https://www.gov.si/teme/velike-zveri/
Livestock protection	Over the last 30 years there have many projects, often funded by the EU's LIFE program, which have tested and implemented livestock protection measures. These projects have been successful at the local level in assisting livestock producers to adopt practices that protect their livestock and have served as model projects to inspire upscaling of the efforts. https://environment.ec.europa.eu/publications/life-and-human-coexistence-large-carnivores_en and https://www.sciencedirect.com/science/article/pii/S2351989424001690 An independently funded newsletter – Carnivore Damage Prevention News – has communicated best practices for and inspirational case studies for livestock protection for 25 years https://cdpnews.net/ It is also essential to recognise and maintain the ongoing use of traditional herding practices in areas where they have remained intact.
Research	Since the early 1990's the Scandinavian countries have coordinated their research efforts under transnational species-specific projects – Skandulv (https://www.slu.se/institutioner/ekologi/forskning2/forskning/teman1/rovdjur-och-vilt/skandulv/) for wolves, Scandlynx (https://www.nina.no/Naturmangfold/Rovvilt/SCANDLYNX/) for lynx and the Scandinavian Bear Project (https://www.brownbearproject.com/) for bears – using funding from both countries to allow larger projects to operate.
Monitoring	Created in 2010, the Norwegian Large Predator Monitoring Program (Rovdata www.rovdata.no) coordinates the annual census of bears, wolves, Eurasian lynx and wolverines using standardised methods that are harmonised with Sweden. The program analyses data, produces reports and communicates results as part of a structured system where the roles of data collectors (the public, hunters and state rangers), data interpreters (Rovdata) and decision makers (administration and politicians) are kept separated to ensure objectivity. The raw data collected by the Environment Agency is stored on

	an open database (www.rovbase.no) and an App (Skandobs) is used to collect observations from the public.
Monitoring	Although Germany is a federal country where responsibility for nature management is largely decentralised to the 16 states, the Federal Documentation and Consultation Centre on Wolves (the DBBW) compiles data on wolf numbers, distribution and mortality and presents it to the public for the whole country. They have also been involved in setting monitoring standards that are applied across the federal states. https://www.dbb-wolf.de/the-dbbw
Monitoring	Genetical analysis of DNA in scats has become the state-of-the-art method for monitoring brown bear populations in Europe, but requires the collection of hundreds or thousands of samples. This is very often achieved through the participation of hunters. Good examples of these cooperations include Slovenia (www.dinalpbear.eu) and Sweden (https://www.naturvardsverket.se/4ac26f/globalassets/media/publikationer-pdf/ovriga-pub/978-91-620-8710-4.pdf)
Monitoring	The Wolf Alpine Group consists of a group of scientists from seven countries in the Alpine Arc that cooperate to map the changing distributions and densities of wolves as they recolonize the Alps. Working for 23 years they produce periodic reports https://pmc.ncbi.nlm.nih.gov/articles/PMC10668717/
Transboundary cooperation	The Alpine and Carpathian conventions represent transboundary cooperative initiatives spanning EU and non-EU countries. Both have taken a long interest in using the platform to foster the cooperation necessary for transboundary coordination of large carnivore management http://www.carpathianconvention.org/wp-content/uploads/2024/10/Report-on-JOINT-CONFERENCE-of-Alpine-and-Carpathian-Conventions_final_revised-version-29052024.pdf . These organisations have also inspired a Dinaric-Balkan-Pindos Large Carnivore Initiative https://dinaric-carnivores.org/en/
Sustainable hunting	Estonia manages its wolf population through hunting. This is organised in 10 year management plans, currently entering its third period (2002-11, 2012-21, 2022-31). Through a system of adaptive management where quotas are annually adjusted (between 38 and 156) to monitoring of the population's status they have been able to keep the wolf population at a desired level between 19 and 32 breeding packs since 2008. The desired level is based on stakeholder negotiations and is set at a level that keeps conflicts with levels that are viewed as being acceptable. https://keskkonnaamet.ee/sites/default/files/documents/2024-04/Large%20Carnivore%20action%20plan_EE_2022-2031.pdf
Public awareness	Through an active media campaign the wolf was elected as the national animal of Estonia in 2018. This novel activity has helped reinforce the status of the wolf as a valued member of the Estonia fauna and national identity. https://estonianworld.com/life/estonia-picks-the-wolf-as-the-national-animal/

National recognition	In recent years several prominent wolf researchers have been recognised for their contributions to science / conservation through being awarded medals by their governments. These includes Peep Männil in Estonia (2018) and Petter Wabakken in Norway (2025). https://www.lcie.org/News/recognition-for-wildlife-conservation and https://www.statsforvalteren.no/innlandet/folk-og-samfunn/medaljer-og-ordener/kongens-fortjenstmedalje-til-petter-wabakken-elverum/
Activating civil society	In Belgium a volunteer Wolf Fencing Group have been helping sheep farmers install electric fencing according to strict quality standards and as a result wolf attacks on livestock have declined. https://www.wolffencing.be/
Stakeholder engagement	The "EU Platform on Coexistence between people and large carnivores" has operated since 2014, bringing together key stakeholders (hunting, landowners, reindeer herding, nature conservation). The European level model has been replicated into regional platforms since 2018. It provides a unique forum for stakeholders to engage in open dialogue with each other and with the European Commission. https://environment.ec.europa.eu/topics/nature-and-biodiversity/habitats-directive/large-carnivores/eu-large-carnivore-platform_en#the-eu-platform
Connectivity	Several countries have been very successful at using large carnivores as focal species to motivate the construction of green bridges across linear transport infrastructure. These actions also benefit many other species of wildlife. Good examples involve Croatia and Greece, where brown bears were the focal species (https://environment.ec.europa.eu/news/practical-support-minimising-vehicle-bear-collisions-greece-italy-romania-spain-2024-10-31_en) and Poland where wolves have been in focus https://ibs.bialowieza.pl/en/product/animals-and-roads-methods-of-mitigating-the-negative-impact-of-roads-on-wildlife/
Recovery	Through the use of a wide range of measures including livestock protection, enforcement, information, restoring connectivity, monitoring and research a combination of NGOs and public authorities have nurtured the expansion and reconnection of the two sub-populations of the Cantabrian bear population in northern Spain. https://fundacionosopardo.org/ and https://fundacionosopardo.org/life-bear-defragmentation-project-2/
Recovery	The Balkan Lynx Recovery Programme has been ongoing since 2006, with international partners financing and providing technical assistance to build the capacity of NGOs in Northern Macedonia, Albania, Kosovo and Montenegro. Through a series of projects the programme has engaged in research, monitoring, and information campaigns, as well as using advocacy to create protected areas, block harmful development and raise international awareness to have the Balkan lynx subspecies recognised as critically endangered by the IUCN and uplisted to Appendix 1 of the Convention on the Conservation of Migratory Species. https://www.kora.ch/en/projects/lynx/balkan-lynx-recovery-programme and https://mes.org.mk/en/programa-za-zakrepnuvane-na-balkanskiot-ris-iv/

Population supplementation and stakeholder engagement	The LIFE Lynx project in Slovenia and Croatia successfully reduced the degree of inbreeding in its Eurasian lynx population by introducing additional wild caught animals from Slovakia and Romania while maintaining high degrees of interaction and support from hunters and other stakeholders. https://www.lifelynx.eu/ and https://www.biorxiv.org/content/10.1101/2024.10.15.617164v1 The project built on previous projects that also invested heavily in stakeholder engagement. https://www.dinapivka.si/
Reintroduction	The province of Trentino in northern Italy reintroduced 10 bears from Slovenia in the period 1999 – 2001. Since then the bear population has grown and firmly established itself. Despite high social conflict levels in recent years the project represents an example of a well planned and well managed activity, with a major investment in monitoring, information, conflict mitigation and conflict management. https://grandicarnivori.provincia.tn.it/
Developing a common understanding of issues	Many conflicts are made worse through a lack of common understandings of terminology and issues. A range of pan-European projects have worked to build these common understandings of difficult issues, including problem bears https://circabc.europa.eu/ui/group/3f466d71-92a7-49eb-9c63-6cb0fadf29dc/library/18784a6a-91c0-48ad-b06d-8a2474248c74/details , problem wolves https://lciepub.nina.no/pdf/638742571606602771_Technical_report_T2.1_WW_LCIE.pdf and https://lciepub.nina.no/pdf/637423653359535374_Reinhardt_REP_bold_wolves.pdf
Garbage management	There have been conflict episodes associated with brown bears being attracted to garbage on both the Polish and Slovakian side of the Tatras mountains for many years. However, recent efforts to install bear proof bins and use electric fencing dramatically reduced the incidence of these episodes https://zasahovytim.sopsr.sk/en/securing-of-waste-in-the-high-tatra-mountains-brings-results/ and https://www.interreg-central.eu/projects/leca/