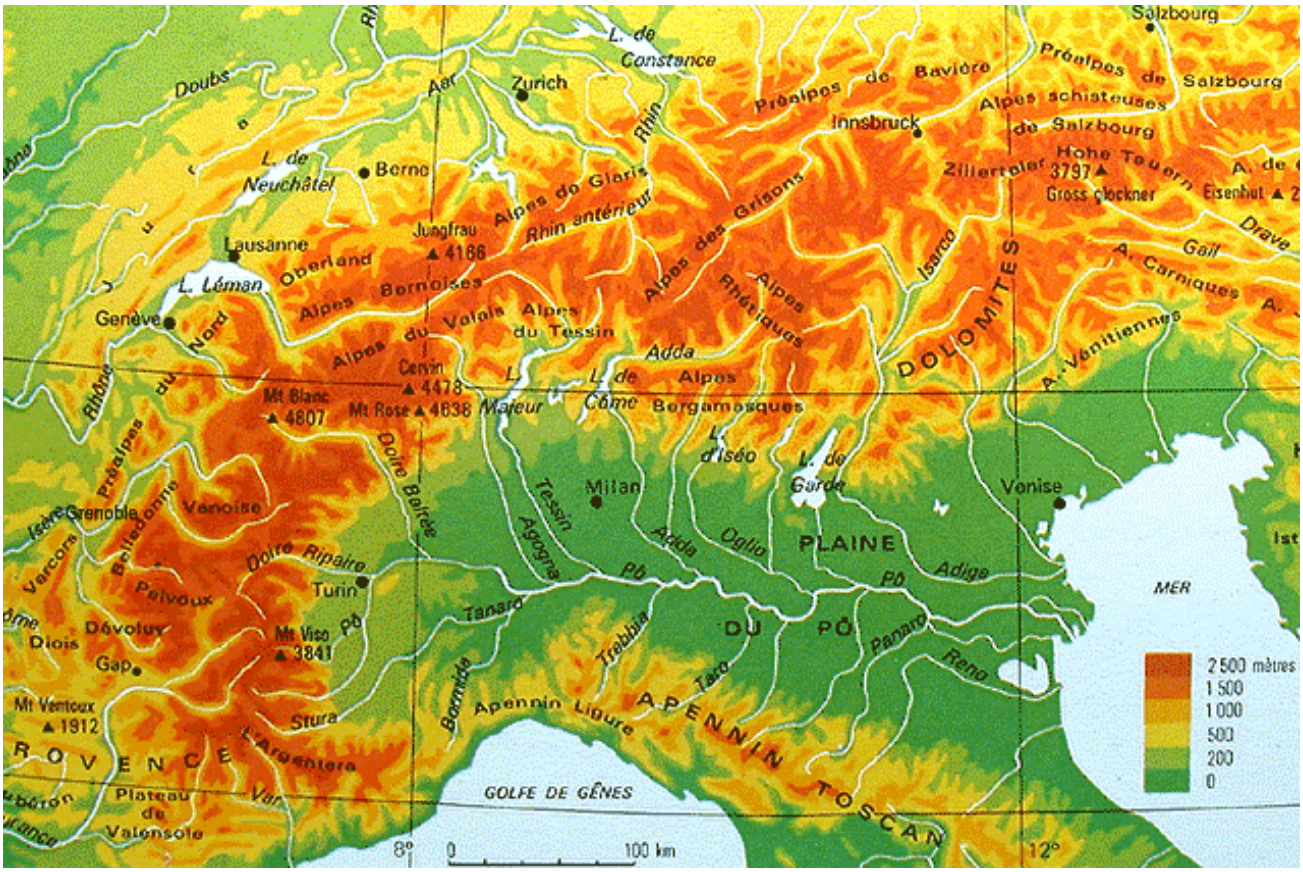
First report to the Permanent Committee:

Wolves in the western Alps:

Monitoring and Conservation Status



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1. Introduction

a) General context

Wolf presence in the Alps was recorded for the first time in the late 1980s in Italy, and the first evidence of reproduction was observed in the Mercantour National Park (France) in 1993. During the last twenty-five years, wolf numbers have increased steadily in the Alps as well as its range has expanded.

As some packs and lone individuals have established their home ranges along the state borders, and regularly move from one country to another, the situation clearly emphasized the need for collaboration in wolf monitoring, management and conservation between the alpine countries. In this context, a first step was made in 2001 when the ONCFS, in charge of wolf monitoring in France, took the initiative in inviting other people working on the same topic in the neighbouring alpine areas, i.e. in Italy and Switzerland. So came up the first Alpine Wolf Workshop. The main objective of the meeting was the implementation of an effective collaboration at the technical level between the three respective countries. Since, significant progress has been recorded, particularly regarding information exchanges. Moreover, the group (Wolf Alpine Group; WAG) meets every year or so to make a regular update of wolf monitoring and status in the different countries. However, some points (e.g. wolf genotyping, mapping of wolf distribution) still clearly need to be improved. The table below shows what has been done since the creation of the Wolf Alpine Group to improve wolf monitoring and share scientific protocols for the wolf monitoring over the Alps.

A second step was made at the institutional level in 2006. French, Italian and Swiss governmental authorities (i.e. Ministère de l'Ecologie et du Développement Durable, Ministerio dell'Ambiente e della Tutela del Territorio, Office fédéral de l'environnement) signed an agreement for a collaboration regarding wolf management in the Alps. In this frame, a permanent committee was created and a technical group was formed to give advice and scientific information on the wolf population status over the Alps. The permanent committee met for the first time in Lyon in February 2005. Following this meeting and others, of which the last one in Turin in December 2007, the technical group was asked to elaborate an analysis of the present situation of the wolf population status and distribution in the Alps, and of the methods used in wolf monitoring. In order to fulfil this task, a meeting of the technical group was organized in Turin in March 2008.

b) Objectives

After fruitful discussions, the following objectives were considered a priority:

i) Define the population (genetically, demographically or geographically?);

ii) Propose finite products in order to evaluate wolf population status (distribution, population dynamics and trends);

iii) Discuss possible improvement to achieve the evaluation process (techniques).

	Main Goals	Results
Briancon (FR) 2001:	- Common genetic approach	- Group formation and goal definition
Boudevillier (CH) 2002	- Non invasive sampling and CMR approach, InterregIII - Scale of monitoring - Communication	- PhD Fabbri genetic standardization presentation
Entracque (IT) 2004	- Standardization of sign validation with quality categories - Produce a common map	- Basic sampling unit = Pack - Definition of a Pack - 2 level monitoring necessary - LCIE Support for communication (web site)
St Martin Vésubie (FR) 2005	- Evaluation of the CMR appoach and problems - Map representation on yearly basis - Habitat suitability index	- Map production , available also on LCIE web site - CMR data - French presentation - CMR data - Italy presentation
La Fouly (CH) 2007	- Map sensitivity and form - Genetic common database	- Mapping results - Proposal of new calibration between genetic labs, and plan to organize a specific meeting for this aim

2.1. Wolf population status in the Italian Alps

The Piemonte Region carried out intensively wolf monitoring and research activities since 1999, to follow the natural wolf recolonization process over the Italian Alps started at the beginning of the 1990s. We determined that the wolf alpine recolonization process is a natural process due to dispersing wolves coming from the Appennines, Italy (Fabbri et al. 2007[1]). This process is dynamic and interests now the all western alpine range of Italy, France, and Switzerland. We set up a network of specialized operators from the Corpo Forestale dello Stato, the Polizia Provinciale, and the Natural and National Parks, to monitor the wolf population over the entire region, and in collaboration with the Valle d'Aosta and Liguria Regions. These operators are trained to collect wolves signs and help in the monitoring of the wolf population following a specific robust monitoring protocol. Monitoring techniques consist of a combination of three non-invasive techniques: snowtracking, genetic analysis on tissue, scat, or hair samples, and wolfhowling.

Since 1999, a total of 4850 km of wolf tracks were followed in winter during snow-tracking surveys and 2105 scats were analysed, in particular of these 54% successfully genotyped. Data were used to map the presence of the species, the minimum range of packs, to monitor the social dynamics, turn over of individuals within each pack, and to estimate survival rates and wolf population size over the years.

The main part of the wolf population in Piemonte Region lies in Torino and Cuneo Provinces. The population in the Piemonte Region consists of 14 packs, of which at least 5 have transboundary territories between the Italian and France Alps, and 2 interests an area of the Appennines. The minimum territory size goes from 50 to 300 km2. One newly formed pack, the pack in Valle Varaita, has likely a transboundary territory shared with Queyras, France, but we need to compare genetic results to confirm it. A newly formed pack is now present in Valle d'Aosta, near by the Piemonte Region border. We could document reproduction in all but two packs in summer 2007, of which one was recently on the French side of the border. In the Verbano Cusio Ossola Province (VCO), one lone female ("CN-F31") was present from 2002 to 2006. This wolf female dispersed from the Valle Pesio pack in the Ligurian Alps to this area in the VCO Province. Twenty-five dispersals were documented over the Alps area, 2 of which reached Switzerland, and one reached Germany. This last disperser was CN-M100, a male wolf coming from the Val Casotto pack of the Ligurian Alps, Italy, that was run over in Bavaria in May 2006.

These dispersal events are now common in the Alps, and are likely to continue in the future, considering the reproduction events documented during the summer. However the wolf growth rate is about 11.2 per year, which is lower compared to other similar recolonization situations. This is likely due to a high mortality rates. We documented 33 mortality events of which 76% were caused by anthropogenic factors, of which 32% of the wolves were poached and 68% were run over.

The minimum number of wolves in the Piemonte Region detected at the beginning of the winter was between 45 and 55 in the last two years. We estimated on average 36.2% (SD=13.6%) fewer wolves each season with snow-tracking data as we did by genetic capture-mark-recapture (CMR) modelling. CMR modelling emphasize the role of young dispersers with low recapture rates, which indirectly increase the overall population size estimate. Therefore these estimates should always be matched by pack number estimate and used carefully for management decisions.

[1] Fabbri et al (2007): From the Apennines to the Alps: colonization genetics of the naturally expanding Italian wolf (Canis lupus) population. ***Molecular Ecology*** 16(8), 1661-71.

2.2. Wolf population status in the French Alps

In France, the wolf monitoring is carried out since 1993 by a network of about 900 operators, dispatched all over the Alps (80% of them are wildlife- or related like- technicians) specifically trained to collect wolf presence signs according to a protocol that is standardized at the national level by ONCFS.

The monitoring surveys take place at two spatial scales:

1. a "landscape" and "coarse-grained" scale survey based on an extensive and opportunistic sampling of any kind of wolf presence signs and all depredation events on livestock in order to monitor changes in the species distribution range, and detect the settlement of new packs;
2. a "territory" and 'fine-grained" scale based on an intensive and controlled sampling designs within each detected wolf packs. These sampling are based on snow-tracking to estimate pack sizes, on wolf howling to detect reproduction, and on molecular tracking to evaluate demographic trends, pack structure and related demographic parameters.

In order to measure the status of the wolf population, we use 4 different population trend indexes:

i) to monitor the changes in spatial distribution of the species;

ii) to assess the trend of number of packs and the minimum wintering population size;

iii) to analyse spatial redundancy in presence data over consecutive years to document the regularity of the species occurrence.

In 2007, 23 wolf territories have been detected in the French Alps among witch 17 are packs (i.e. 1 male + 1 female over 2 consecutive years or detected reproduction). At least five of them are transboundary packs between France and Italy. From times to times, wolf presence signs are discovered close to the Swiss border. More than 200 howling sampling points covering each wolf territory in the Alps allow to document reproduction cases each year. The minimum wintering population size is estimated at 50-55 animals holding a territory witch is averaging a 9,6 % overall population rate of increase.

Several cases of mortality (n=32) have been recorded since 1992, most of them being human-related causes (poaching, traffic accidents). Five wolves have been legally shot between 2004 and 2007 according to the French wolf action plan.

Extensions of Capture-Recapture methods based on 1182 (among 2700 analysis) non invasive genetic analyses provides estimates of the population size accounting for detection probability and heterogeneity. The first tests indicate that the 'total' population size on the French side could be estimated around 2,3 times the minimum wintering population size (snow-tracking) but further developments are needed in this specific modelling approach.

Mechanisms of dispersal and following colonisation process are also evidenced using the non-invasive genotyping techniques with several cases documenting emigration from the southern Alps toward the north, as well as outside of the alpine range (Pyrenees, Massif Central).

As a summary, the geographic recovery and the population size indexes used to evaluate wolf conservation status on the French side all show a general increase over years. Mainly because it's sensitivity to climatic condition and/or sampling pressure, the index of minimum wintering population size based on snow-tracking should mostly be used to evidence long term trends within areas where wintering climatic conditions are more or less constant. Despite the 'number of packs' can be regarded as a coarse grained indicator, it is however, methodologically and biologically, much more robust to variations of extrinsic factors. Associated with a geographic index, the number of packs could provide a good overview of the wolf population status.

2.3. Wolf population status in Switzerland

The wolf monitoring program in Switzerland has been officially initiated in 1999, i.e. three years after the first signs of wolf presence were recorded in the Val Ferret (canton Valais) and following the discovery of two dead wolves in Goms, 1998, and in Simplon (both regions in canton Valais), 1999, respectively. The monitoring is essentially based on genetic sampling, depredation survey and fortuitous observations collecting. Signs of presence are categorized according to their reliability, i.e. hard facts, confirmed signs such as depredation on livestock and unconfirmed ones.

From 1999 to 2006, 843 observations have been recorded throughout the country but only 98 of them belong to the "hard fact" category. More than a third of those (n = 35) have been gathered in 2006 only. Their distribution is restricted to the Alps, but for the first time some of them originated from the northern side of the mountain range. At least five individuals were present in the whole country end 2006, but no sign of reproduction or the presence of a wolf pack were recorded so far.

According to the Swiss Wolf Management Plan, individuals that kill more than 25 sheep and/or goats during 4 consecutive weeks, or more than 35 sheep and/or goats within 4 consecutive months can be removed. Two individuals, a male and a lone female, were eliminated for repeated depredations in 2006. In total, five wolves have been legally shot since 1999.

3.1. Objectives: How to define the wolf alpine population

Before producing any output about the population status (e.g. distribution maps of the population, parameter estimates such as population size, or survival rate at the population level), a specific definition of the "wolf alpine population" is needed. In other words, are we going to include wolves of the Liguria Apennines, of the Jura, of the Pyrenees? Where are the boundaries of the population? Which wolves should we take into account into the overall population size estimate?

Linnell et al. (2007)[2] gave an excellent overview of the definition of a population, depending on what is the process we are interested in and the scale we are considering. This so called "hierarchical population concept" interests a different scale of time and space if we consider a genetic process or a demographic process.

1. Therefore, from a **genetic point of view** the alpine wolf population should be considered the same from the Alps to the Apennines because the entire wolf population share the same unique haplotype and the occasional movements between the areas are still enough to prevent genetic differentiation (see Fabbri et al. 2007).
2. However, it is likely that from **a demographic point of view** these occasional movements of few individuals from the Apennines to the Alps and vice versa are not sufficient to have any significant influence on demographic processes.

Moreover, the ecological and management issues that interests the wolf population in the Alps are unique and different from the wolf population in the Apennines and other areas. Therefore, for these reasons and following the "guidelines for population level management plans for large carnivores" in Europe (Linnell et al. 2007), the wolf alpine population is considered to be a unique entity.

From a **geographical point of view**, the detailed definition of the boundaries of the population is arbitrary. Considering the terms "**wolf in the alps**" described in the collaboration protocol of the permanent committee, our technical group suggest the Colle di Cadibona as the reference area for the starting point of the wolf population distribution from the east, and the distinction from the Apennine population. The Colle di Cadibona is a pass at 435m of elevation in the Liguria Region which is considered by convention the point of junction between the Alps and the Apennines. Moreover it is an important area of communication between the Liguria and Piemonte Regions: there is a highway (A6 Torino-Savona) and a main road (SS29) which divide the two areas. This can be considered a natural barrier which likely do not prevent dispersal movements, but maybe stable wolf territory formations, and corresponds to the area of minimum presence of suitable habitat for wolves in the Apennines-Alps range as showed by the analysis made by Progetto Lupo Piemonte (Sinibaldi et al. 2001[3]). On the other side of the alpine range the Rhone river in France seems to be the best separation on a geographical point of view as it is a natural and structuring boundary to separate different ecosystems (differences in habitat structure, human activities …). It is also a main valley, that goes from the Mediterranean sea to Switzerland, where human activities and low suitable habitat can be a natural constraint for wolf packs formation and wolf dispersal process.

Before producing any specific maps or population trend estimates, the technical group will need the agreement of the permanent committee about the geographical boundary proposal, in order to specifically define what **should be considered in the term "Alpine wolf population**".

[2] Linnell et al (2007): guidelines for population level management plans for large carnivores in Europe. LCIE report 2007 May 7th

[3] Sinibaldi, I., L. Boitani, F. Corsi. 2001. Analisi dell'habitat e modello di idoneità, in Regione Piemonte ed. Relazione finale - Progetto Interreg Italia-Francia 1994-99: Il lupo in Piemonte. Torino.

3.2. Objectives: How to evaluate wolf conservation status

The evaluation of the conservation status must take into account the biological characteristics of the target species in order to provide a robust estimation of the geographic and demographic trend. Hence, it should take into account that the wolf species is territorial, socially structured, with a high capacity of movement during dispersal, and that we have to document the status at a very large geographic scale (alpine range). Based on the previous works of the Wolf Alpine Group since 2001, the best output that we can propose to the permanent committee on a yearly basis (each May as the biological year) as a robust evaluation for the wolf conservation status in the Alps can include:

- a map of wolf packs and other wolf occurrence that can be produced each May (biological year) to document the geographical pattern (see figure 1);
- a graph showing the temporal trend of the wolf pack numbers with specification on the transboundary state (or not) to document the demographic pattern (see figure 2);
- a table describing each wolf territory characteristics (pack, lone wolf, transboundary or not…) for the given year (see table 1).

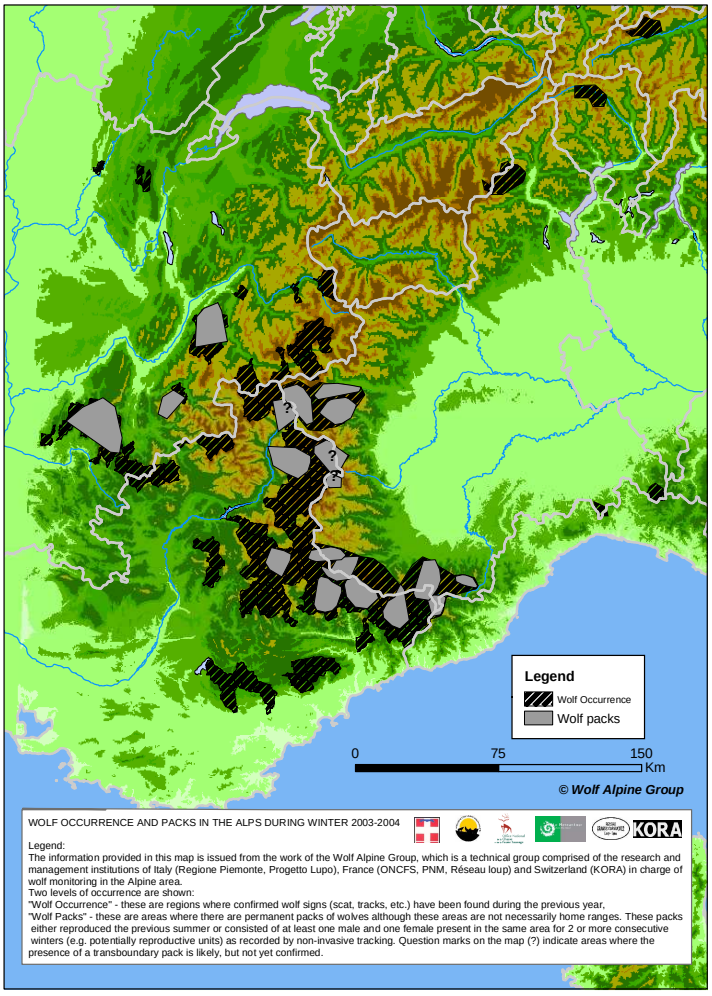

Figure 1: example of a map covering all the alpine range (query submitted to the Permanent Committee agreement on the definition of the target population) including wolf packs and other wolf presence areas. This map will be drawn using all validated data gathered through the combination of different tools (such as snowtracking, genetic sampling or telemetry if available).

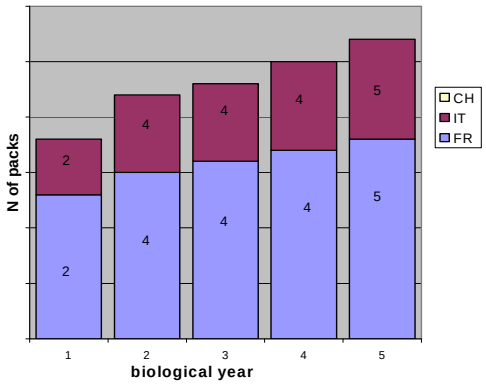

Figure 2 : fictive example of a graph showing the trends of the number of packs detected for each countries with number of transboundarie's ones written inside each bar.

	Status	*Pack size estimation*	*Documented reproduction*	*Remarques*
Name Pack 1	Trans Fr-It	N1	Yes	
Name Pack 2	Fr	N2	Yes	
Name Pack i	It	N3	Yes	
...	...	...	…	
Name lone wolf territory i	Trans Ch-It	1	No	
...	...	...	…	

Table 1: example of a description of wolf pack or lone wolf territories identified within the alpine range of the species. A wolf territory is defined as a permanent wolf area that at least one animal hold since at least 2 consecutive winters

4.1. Further development of the coordination

The coordination on the management of the wolf population over the Alps interests different levels. In particular, after the "Protocol of collaboration between Italy, France and Switzerland for the management of wolves in the Alps" 3 groups have been identified:

- a Permanent committee for the management of the wolf in the Alps
- a technical group for wolf monitoring and research over the Alps
- a technical group for livestock depredations issues

Moreover, in the past an informal technical group (Wolf alpine group) of researchers responsible for the wolf monitoring in each of the 3 countries, met regularly to improve the wolf monitoring over the Alps and develop other scientific issues.

For the development of a robust transboundary coordination it is important that:

- The WAG will continue to meet regularly and discuss about specific topics through technical workshops that will allow to improve scientific reflexions and implement pilot studies;
- The Permanent committee can ask the Technical group to produce any summary document about the wolf population status or related biological topics.

We think that 4 topics need to be improved as a priority through a transboundary approach in order to evaluate better the wolf conservation status in the Alps:

- *Mapping wolf occurrence and packs:*
    - define data collection standards, like the SCALP quality criteria ones, adapted for wolf data;
    - explore different possibilities in mapping a species occurrence, and particularly explore the sensitivity of grid-cell sizes (i.e. 5x5 km vs. 10x10 km);

- *Genotyping individuals:*

There is a need for a common genotype database. However, owing to methodological constraints, direct comparisons of genotypes analyzed in different labs by different people is technically not feasible straightforward (e.g. different weights of microsatellites between labs). It is neither practically and financially unfeasible to regroup all the samples in a single lab and proceed to the data analysis there. The most practical options are:

- in the short term, exchange raw material (i.e. scats) to make redundant analyses when needed to answer questions such as the identification of a transboundary pack
- in the long term, calibrate a genetic procedure between the different labs, to possibly use the data for population size estimate and population dynamics analyses (genetic CMR approach). Some protocol modifications could also be brought to enhance the success rate of the genetic analyses.

- *Write a memorandum of understanding* for the common use of the pooled data (both for monitoring and genetic data).

- *About wolf captures*:

Wolf population status can be determined and monitored using non invasive techniques (a combination of genetic analysis on scat/tissue samples, snowtracking, and wolf howling techniques). Interesting predator-prey dynamics, and the evaluation of the impact of wolves on prey, need other techniques to be quantified. The application of radiocollars on wolves to estimate kill rates and other parameters are fundamental to study predator-prey dynamics, as well as a variety of other topics. In this context wolf captures are required. This tool, however, is best applied on a specific area, and can not be applied on a large scale. Specific protocols have been developed in Italy for trapping wolves. However, in the future common protocols for wolf captures, handling, monitoring and management of the wolves once collared to acquire specific information, should be developed and shared. A specific meeting should be planned only to define specific common objectives and techniques, if this topic will be considered of particular importance.

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