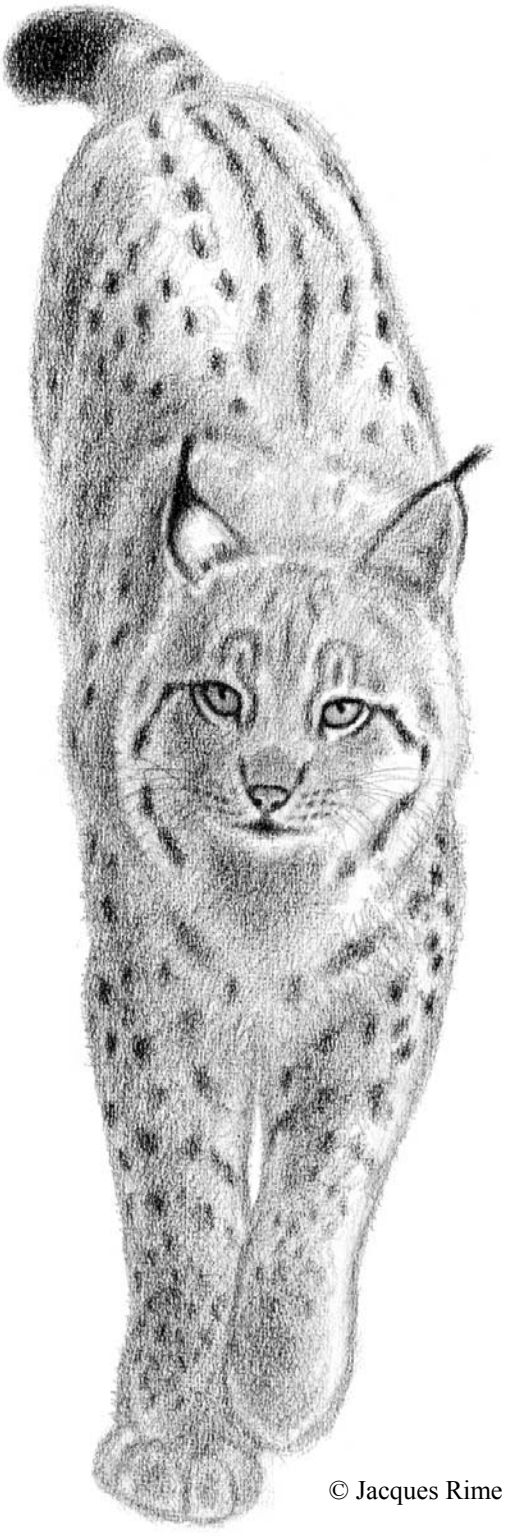
Status and Conservation of the Alpine Lynx Population

SCALP



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2nd conference on the
Status and **C**onservation
of the
Alpine **L**ynx **P**opulation

7th to 9th May 2003
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Proceedings

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Section 3. Conservation concepts and solutions

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2nd SCALP Conference, Amden 7-9 May 2003 – Introduction

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The lynx was re-introduced in the 1970s in the Alps of Switzerland, Italy and Austria, and south of the Julian Alps in Slovenia. Especially the Swiss and Slovenian projects lead to an important comeback during the first years of re-establishment. The swift expansion came to a halt in the late 1980s when the lynx occurrences in the Alps were still small and isolated. The re-introduction projects were neither co-ordinated nor were the lynx systematically monitored thereafter. The interpretation of the ambiguous data available proved to be difficult. Therefore, researchers from all Alpine countries have formed an expert group (SCALP – *Status and Conservation of the Alpine Lynx Population*) to set up a monitoring and surveillance system throughout the Alps, to come up with new conservation concepts and to co-ordinate further actions.

The first expert group meeting took place in 1994 in Villach (Austria). The following year the 1st SCALP conference took place in Engelberg (Switzerland) to celebrate the 25-year anniversary of the re-introduction in the Swiss Alps. The conference was not intended to be a forum of jubilation and triumph, but an occasion to critically review the reintroduction of the lynx into the Alps and to ask experts in the domain of reintroductions, monitoring, habitat evaluation, forestry, animal husbandry, and conceptual conservation to enhance our understanding of such a complex process as the recovery of a large carnivore population in a world dominated by humans. The proceedings of this 1st SCALP conference have been published by the Council of Europe (Breitenmoser-Würsten *et al.* 1998) while the status reports for the Alpine countries were compiled in a special issue of Hystrix (Breitenmoser *et al*. 1998, Cop and Frkovic 1998, Huber and Kaczensky 1998, Kaczensky 1998, Molinari 1998, Ragni *et al*. 1998, Stahl and Vandel 1998).

A 2nd expert group meeting was held in 2000 at the Alpe Devero (Italy) in order to agree on a common monitoring standard (Molinari-Jobin, this volume) and a second series of country-based status reports was again published in Hystrix (Fasel 2001, Huber *et al*. 2001, Molinari *et al*. 2001, Molinari-Jobin *et al*. 2001, Stahl and Vandel 2001, Stanisa *et al*. 2001, Wölfl and Kaczensky 2001).

In 2001 the SCALP drafted a Pan-Alpine Conservation Strategy (PACS) for the lynx that was adopted by the Standing Committee of the Bern Convention the same year (Molinari-Jobin *et al.* 2003). The PACS aims to secure the survival of the lynx in the Alps through the merging of the extant populations by means of a network of local populations. To achieve this goal, actions are needed on Alps-wide as well as on country level.

In order to improve future collaboration in lynx management on local, regional and international level, the 2nd SCALP conference was held in Amden, Eastern Switzerland, from 7 – 9 May 2003. Nearly 80 participants from 8 different countries and representing 15 GOs, 23 NGOs and 5 universities discussed the present status of lynx in each Alpine country, the main problems lynx face in the Alps and conservation concepts and possible solutions. In the fol-

lowing articles, short versions of the presentations at the Amden conference as well as the conclusions are presented.

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Monitoring of the Alpine lynx population

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Any sound implementation of management measures must be based on precise knowledge of the distribution, status and trend of each population. This is particularly important for conflict species such as the lynx. Yet, the monitoring of large carnivores in forest and mountain habitats still poses great methodological problems. The Alps are a heterogeneous region with different cultures and administrations, where GOs and NGOs as well as scientists are involved in the monitoring. This requires a high level of communication between organisations, regions and countries.

Even though all Alpine countries are obliged to monitor the lynx population through international treaties, there still exist great differences in the quality of the monitoring from one country to another. Due to financial constraints, habitat features and the size of the Alps it is impossible to work with the same intensity all-over. Therefore the monitoring system can differ regionally according to the local situation. Nevertheless, lynx experts of all Alpine countries recognised the need for a common strategy to monitor the Alpine lynx population in order to assure the same level of data quality: as the smallest common denominator the SCALP experts agreed to interpret the basic monitoring data with the same standard.

Three sources of information on the presence of lynx are available throughout the Alps: (1) reports of lynx killed or found dead or young orphaned lynx caught and put into captivity; (2) records of livestock killed by lynx; and (3) records of wild prey remains, tracks, scats, sightings, and vocalisations. All records are categorised by distinguishing three different levels of reliability (Molinari-Jobin *et al.* 2003):

Quality 1 represent the "hard facts", e.g. all reports of lynx killed or found dead, photographs of lynx as well as young orphaned lynx caught in the wild and put into captivity.

Quality 2 incorporate all records of livestock killed, wild prey remains, tracks and scats reported by people who attended special courses. These records are mostly an objective proof of lynx presence.

Quality 3 include all wild prey remains, scats and tracks reported by the general public as well as all sightings and vocalisations, e.g. signs that cannot be verified.

In the first country-based status reports the data from the reintroductions up to 1994 have been presented at the 1st SCALP conference in 1995 and subsequently published (Breitenmoser *et al*. 1998, Cop and Frkovic 1998, Huber and Kaczensky 1998, Kaczensky 1998, Molinari 1998, Ragni *et al*. 1998, Stahl and Vandel 1998). Five years later, the second status reports with the data from 1995 to 1999 were published where for the first time all lynx signs of presence have been categorised according to the common standard (Fasel 2001, Huber *et al*. 2001, Molinari *et al*. 2001, Molinari-Jobin *et al*. 2001, Stahl and Vandel 2001, Stanisa *et al*. 2001, Wölfl and Kaczensky 2001). The SCALP expert group will continue to

report about the lynx development in the Alps in five-year intervals. A mid-term update was produced for the 2nd SCALP conference in 2003. The summaries are presented in the following status reports.

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Status of the lynx in the Italian Alps: update 2000-2003

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To analyse the status and distribution of lynx in the Italian Alps, all signs of lynx presence found were pooled, evaluated and interpreted according to the SCALP guidelines (Molinari-Jobin *et al*. 2003, Molinari-Jobin, this volume). From 2000 to April 2003, a total of 235 signs of lynx presence were recorded, of which 115 were included in the Q2 (confirmed) and 118 in the Q3 (unconfirmed) reliability category. After a longer period of absence, it was possible to confirm the lynx presence also by 2 Q1 (hard fact) data. The data of the quality 1 and 2 were confined to four different regions, while the Q3 data spreads over all the Italian Alps. Apart from the north-eastern Italian Alps (Tarvisiano), the signs of presence collected showed a declining trend. During the past two years only in the Tarvisiano it was possible to collect confirmed records.

Distribution of signs of lynx presence of Q1 (hard facts, black triangles) and Q2 (confirmed records, grey dots) in the Italian Alps from 2000-2003. (Forest cover in gray, data base CORINE Landcover.)

The dynamics in the Italian Alps during this period was characterised by four main events (Fig. 1): (1) the positive trend observed in the north-east in Friuli V.G. up until 1995, declined during the next pentad, re-increased clearly to the highest level ever observed. For the first time it was possible to collect reliable information about reproduction. (2) The new occurrence from the Province of Belluno, documented during the previous pentad, has disappeared. The area occupied by lynx in the eastern Italian Alps seems again confined to the Carnic and Julian Alps. (3) The lynx occurrence of unknown origin in the Trentino still results extinct, but in the South Tyrol appeared 3 confirmed data one of which even Q1, a lynx photographed. But rumours confirm our hypothesis that this presence does not originate from natural spread. Instead, it is unclear whether the animal escaped from an enclosure or whether it was reintroduced clandestinely. (4) With the exception of 1 Q2 data, in the Val d'Aosta and Val d'Ossola only Q3 data were collected during the past 3 years.

In Italy the scattered lynx presence is still confined to border areas and subject to fluctuations, most probably due to single individuals. The exception being the Tarvisiano, which represents the only area with continuous confirmed data since 1986. Even though Italy is important for the future of the lynx in the Alps, as its territory connects the Swiss and Slovenian populations, responsible GOs disregard the necessity to support politically and financially the research and monitoring, the base of any kind of management and conservation. Up to date the monitoring is still based on volunteer work. The management of lynx in Italy remains illegal, with clandestine reintroductions on the one side, and illegal killings on the other.

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Lynx distribution in the French Alps: 2000-2002 update.

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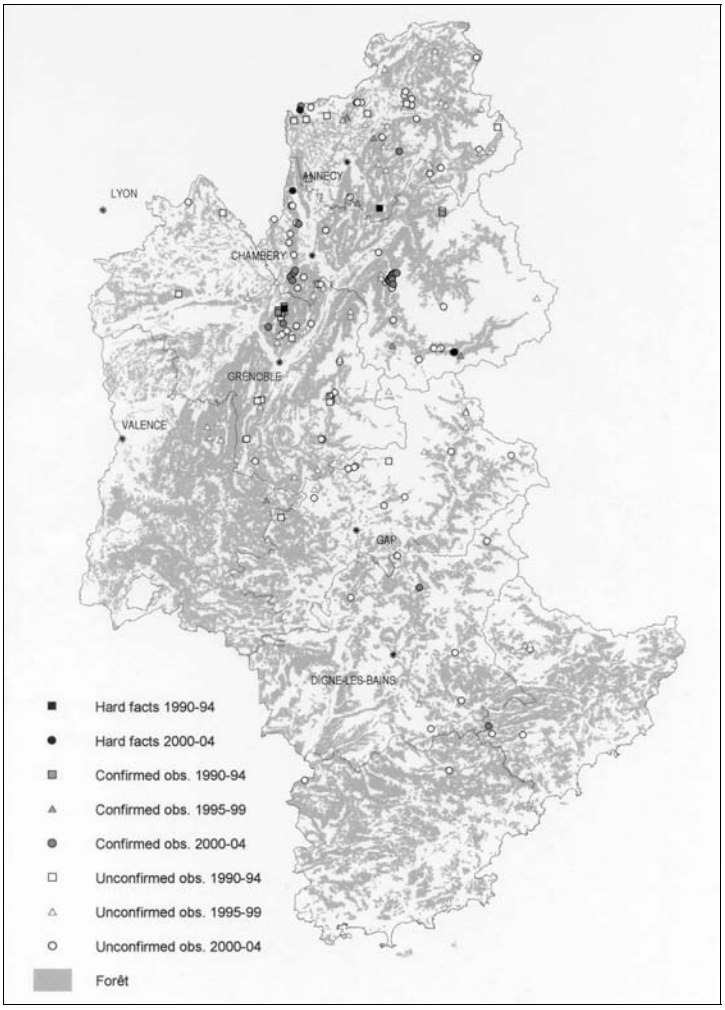
The French Carnivore Expert Group (LCEG sensu Stahl and Vandel 2001) is a network of ca. 900 people trained to identify lynx signs over the whole distribution area of the species in France (Vosges, Jura, Alps). During the previous studied period (1995-1999) in the Alps, 71 data (only Q1 + Q2) had been collected on lynx presence, mostly in the major forested regions of the northern part of the area. During 2000-2002, 107 data have been recorded, out of which 3 hard facts (Q1), 31 confirmed observations (Q2), and 73 unconfirmed observations (Q3) for which the lynx-experts considered they were "probable" lynx signs. Such an increase in the number of signs collected supports weakly the evidence for a stable settlement

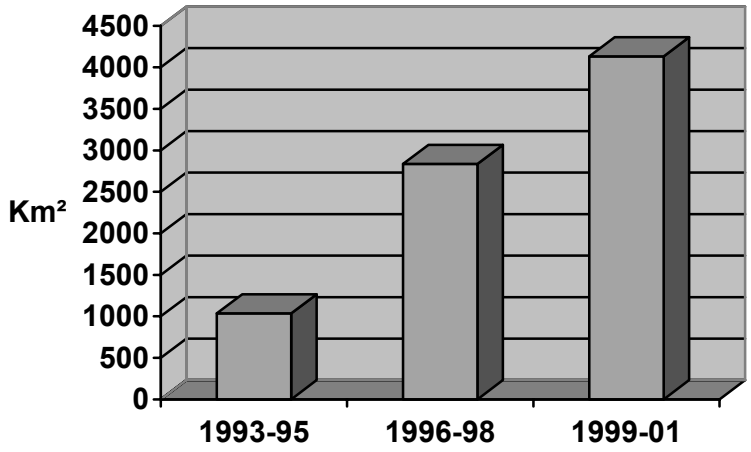


Distribution of lynx signs as collected from the French network since 1990. Each data is attributed a 9x9 km square of lynx presence which obviously yields an underestimated area occupied by the species (conservative approach).

Reference periods for data collection and pooling are 5 years long, and the last one will end in 2004. Only the northern part of the area gives strong support for some kind of established sub-population, possibly made of dispersing individuals from the Jura population.

of the species, with the exception of the northern part of this area: 80% of the estimated area occupied by lynx (each signs refers to a 9 x 9 km square) is located north to Grenoble, a sub-area where lynx signs have been regularly collected for the last 15 years. Other data are scattered over space, without any breeding evidence, whereas the colonization process should obviously rely on dispersing of sub adults from well-established core areas. Few lynx signs collected may come from various hypotheses. So far, one cannot distinguish between the effects of i) confounding factors (e.g. identifying lynx wild or domestic preys when scavengers and wolves are there too), ii) low detectability of lynx signs due to habitat characteristics, iii) few individuals being actually there, and iv) a mixture of i-iii) effects (most likely hypothesis). Other monitoring tools (camera traps, hair snares) will soon be evaluated to help assessing the actual range of the species more accurately.

Based on summing up all the 9x9 km squares allocated to each lynx sign detected during the consecutive 3-year periods, the area occupied by the species in the Alps steadily increased over the last years (see figure below). In the single 2002 year, the area already amounted to 1908 km², i.e. 46% of the total area occupied during the last period. During the same year (2002), the network gathered presence signs of lynx over 70% of the area already documented in the Vosges region, and 62% of that in the Jura one. Because the sampling design is not controlled (sampling effort, return rate) one cannot explain the differences observed between these proportions.



The area with lynx signs in the Alps (1999-2001) covered 27% of the overall French distribution of the species (Vosges: 2970 km²; Jura: 8217 km²; Alps: 4131 km².)

Regarding attacks to sheep in the Alps, less than 10 animals on average are killed by lynxes each year, i.e. less than 10% of the total amount of sheep killed by lynxes over France (out of which ¾ in the Jura region).

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Present status and distribution of the lynx in the Swiss Alps

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To evaluate the population and the distribution of lynx in the Swiss Alps, the spatial and numerical development of signs of presence found from 2000 to 2002 were analysed and compared to the previous investigation period (1995 to 1999). As in the former periods, three sources of information on presence of lynx were considered: (1) reports of lynx killed, captured or found dead; (2) records of livestock killed by lynx; (3) records of wild prey remains, tracks, scats, sightings and vocalisations. The observations were classified in accordance with the three levels of reliability as proposed by SCALP. From 2000 to 2002, 1039 signs of presence were recorded in the Swiss Alps (Table 1). 87 out of them could be classified as Q1 data (8.4%), compared to 49 (3.0%) out of 1633 for the former period. The increase of Q1 data is mainly due to the use of camera-traps for the extensive monitoring. The frequency of quality 3 data is relatively stable. Figure 1 shows the distribution of lynx for the three-year period 2000-2002 for the different data quality.

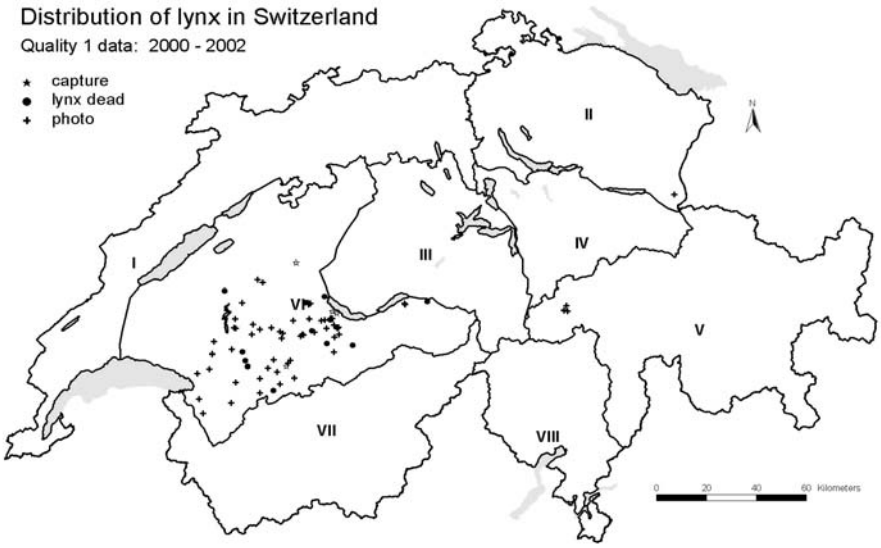
Table 1. Number of records collected in the two periods.

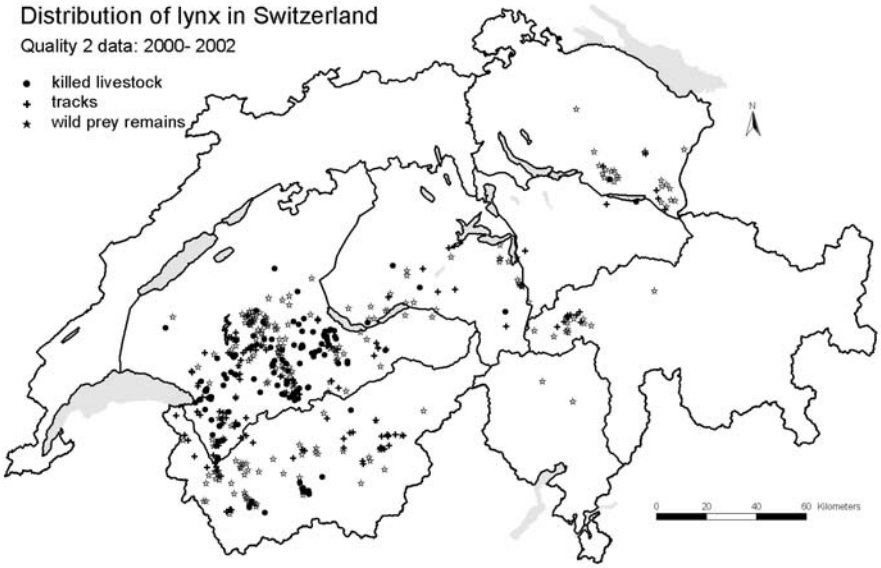
Quality 1	Total 1995-1999	Total 2000-2002
captures	6	4
dead lynx	41	17
photos	2	66
Total Q1	49 (3.0%)	87 (8.4%)
Quality 2		
killed livestock	519	270
wild prey remains	429	233
tracks	167	127
Total Q2	1115 (68.3%)	630 (60.6%)
Quality 3		
sightings	417	270
wild prey remains	18	15
tracks	22	35
vocalisations	12	2
Total Q3	469 (28.7%)	322 (31.0%)
Total	1633	1039

Regarding the distribution, lynx recently established in two new compartments, Graubünden (V) and Nordostschweiz (II), as revealed by the number of 5 per 5 km grid cells newly occupied by lynx in the different compartments of the Alps (Table 2). The presence in the compartment II is the consequence of the re-introduction project realised from 2001 to 2003. Lynx naturally arrived into the compartment V, probably originating from compartment III. Occupation range appears stable in the compartments VI and VII, but shows stagnation or even decrease or absence in number III, IV and VIII.

Table 2. Number of 5 per 5 km grid cells with lynx observations in the Alps. Only quality 1 and 2 data considered. Numbers: unique for period, total for period (parenthesis). 1995-2002: shared by both periods and total number (parenthesis).

Compartment	1995-1999	2000-2002	1995-2002
Graubünden V	1 (2)	8 (9)	1 (10)
Nordostschweiz II	1 (1)	14 (14)	0 (15)
Nordwestalpen VI	31 (121)	19 (109)	91 (141)
Ticino VIII	3 (3)	2 (2)	0 (5)
Valais VII	24 (47)	28 (51)	24 (76)
Zentralschweiz Ost IV	5 (8)	1 (4)	4 (10)
Zentralschweiz West III	22 (39)	8 (23)	18 (48)
Total	87 (221)	80 (212)	138 (305)





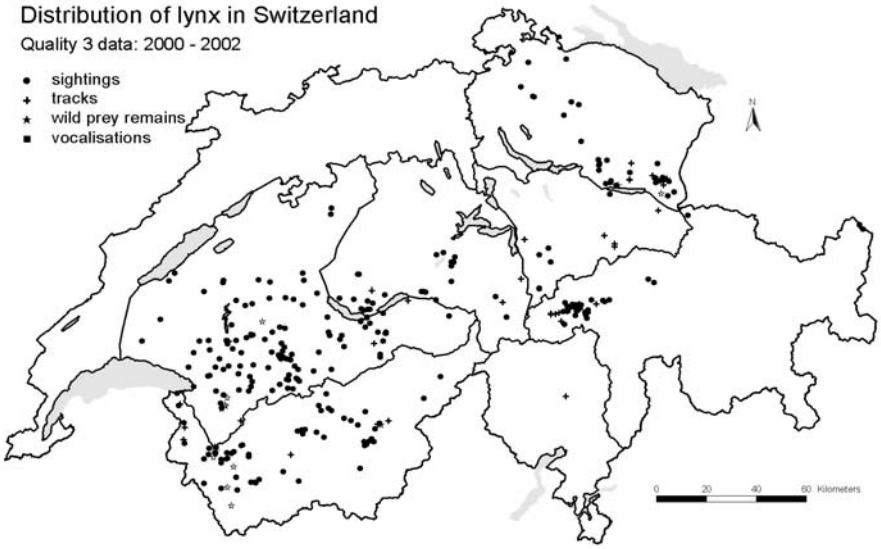


Figure 1. Distribution of the lynx in Switzerland and in the 8 management compartments for the three-year period 2000-2002.

Knowledge on the distribution of lynx in the Austrian Alps 2000 – 2002

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To get an impression on the status and the distribution of lynx (*Lynx lynx*) in the Austrian Alps we analysed all available reports on the presence of lynx documented by hunters associations and the *Nationalpark O.ö. Kalkalpen*. All reports were analysed according to the SCALP-guidelines (Molinari-Jobin *et al*. 2003).

Between January 2000 and December 2002 we documented 102 plausible reports on lynx presence for the Austrian Alps (Fig.1). For the first time since 1995 we were able to confirm lynx presence by Quality 1 data ("hard-facts"). In 2000 and 2001 two pictures of one lynx each were taken by a camera-trap set in *Nationalpark O.ö. Kalkalpen*. In July 2002 remains of a lynx were found in Eastern Tyrol, the first known dead lynx in the Austrian Alps since 1995 (Huber and Kaczensky 1998). 39 reports of tracks or kills have been confirmed by experts and therefore classified as Quality 2 data. 60 unconfirmed reports of lynx presence were classified as Q3 data. Lynx presence was reported from a wide area in Styria and Carinthia but could not be confirmed by experts. There were no confirmed reports of lynx breeding in the Austrian Alps.

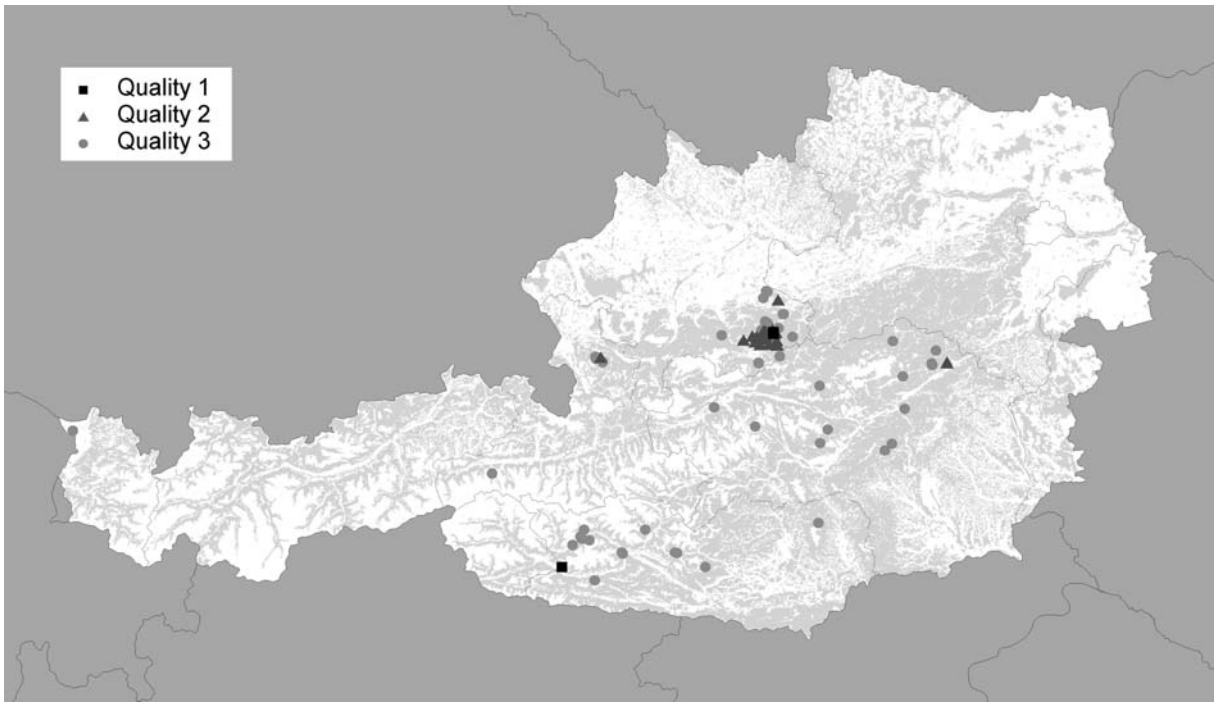

Fig.1: Distribution of reported records on the presence of lynx in the Austrian Alps (Quality 1-3) for the period 2000 to 2002. (Forest cover in gray, data base CORINE Landcover.)

For most of the Austrian Alps the number of reports of lynx presence remained stable on a low level, sporadic records continue to be reported from north-western Carinthia and the eastern part of the northern limestone Alps in Styria. For border areas towards Italy and Slovenia the number of lynx records decreased. In contrast the number of records from the border area of the districts of Styria, Upper and Lower Austria, centered around the *Nationalpark O.ö.Kalkalpen*, continued to increase from 26 records for 1995-1999 (Huber et al. 2001) to 56 records for 2000-2002. For the last period 2 of all Q1 data and 36 of the total of 39 Q2 records origin from a systematic monitoring established in this national park using snow tracking and camera-traps. As lynx presence is known though not confirmed from surrounding areas, there is increasing evidence of a developing population nucleus in the eastern part of the Northern Kalkalpen.

This now best known occurrence of the lynx in the Austrian Alps documents the shortcomings of the Austrian monitoring system for the lynx, which depends on unsolicited reports of lynx presence collected by the local hunters associations. Based on these reports only, it would not have been possible to identify the increase in lynx activity in the Kalkalpen. This raises the question whether the widely distributed signs of lynx presence document the actual distribution of a few scattered individuals. The low number of reports could as well be much influenced by low detectability of lynx signs, a low willingness to report observed signs and the flaws of the Austrian monitoring system: A system that is much constricted by a different hunting law in every district (Bundesland), all being based on landownership, and the lack of a federal hunting law. One of the major actions demanded at the first SCALP conference in Engelberg 1995 was to set up systematic schemes to monitor the existing lynx populations (Breitenmoser 1998). The Pan-Alpine-Conservation-Strategy for the Lynx (Molinari-Jobin *et al*. 2003) again lists as actions proposed the establishment of an efficient nationwide monitoring scheme. Austria needs to finally enact this proposed action to get information on the actual status and distribution of the lynx in the Austrian Alps.

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Present status and distribution of the lynx in the German Alps

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During the period of 1996 to 2002 no confirmed evidence of lynx presence is known in the German part of the Alpine Arc. From 1995 to 1999, some unconfirmed evidence has been reported from the Nationalpark of Berchtesgaden but since then no more data are available. In the western part of the German Alps, rumors about lynx presence has started as early as 1997. However, even with the education of some local people to verify lynx presence no evidence could be gathered so far.

During the last four years data indicate a negative trend for the Bohemian-Bavarian lynx population in eastern Bavaria. Pushed by this information a political discussion about the common future of lynx in Bavaria is on its way right now. A Bavarian-wide management approach for the species is proposed which should include the Alpine part of Germany as well.

On a larger scale a common management towards lynx conservation is still lacking in Germany. Efforts are on its way to show the needs of large carnivore conservation and management in Germany and to stress a national-wide approach.

The lynx in Liechtenstein

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Since the extinction of lynx neither direct observations, nor livestock killed, tracks or other signs of lynx presence have been recorded. Due to the translocations of lynx from western to eastern Switzerland (Ryser *et al.* this volume), a natural re-colonisation of Liechtenstein may be possible within a few years, although the Rhine valley may not easily be overcome by lynx.

Hunters and foresters as well as the public are actually informed about the situation of the lynx in Switzerland and about the possible re-colonisation of Liechtenstein. Signs of presence that may be found by hunters or foresters will be transmitted to the “Office of forests, nature and landscape”, which is the governments bureau responsible for game hunting and nature protection as well as forest-management.

Status of the lynx in Slovenia: update 2000-2001.

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In Slovenia the lynx occurrence is confined to the southern and north-western part of the country. Close to the freeway Ljubljana-Trst only a few signs of lynx presence were reported (Fig. 1). This might indicate that the Alpine occurrence is not as well connected to southern Slovenia as previously assumed (Stanisa *et al.* 2001).

Slovenia is still the only Alpine country that issues hunting quotas for lynx. While in 2000 the hunting was closed, in 2001 five lynx were issued but only three shot. No other known mortalities occured during the two years. In 2002, the quota was set at three lynx plus two if exceptional damage cases occur. The regular quota was fulfilled while no exceptional damages occurred.

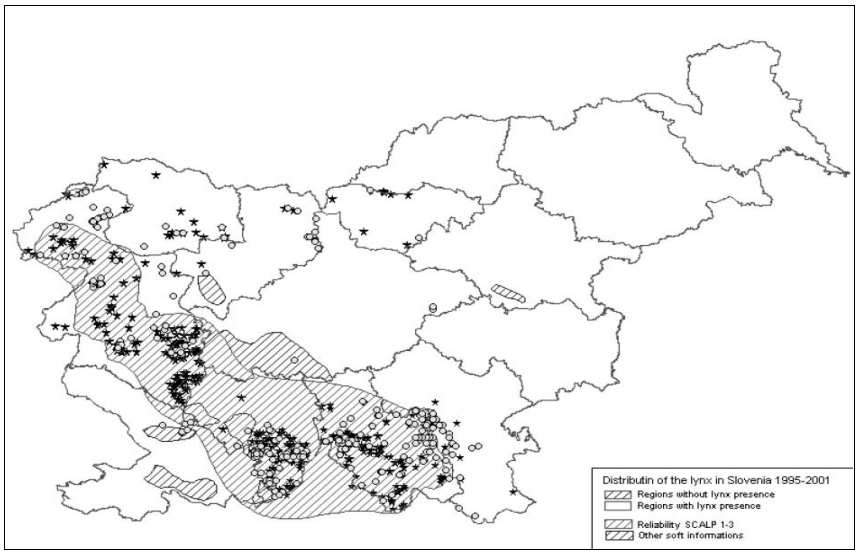

Fig. 1. Distribution of lynx signs of presence of quality 1, 2 and 3 in Slovenia (stars = data from 1995-1999, dots = data from 2000-2001).

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The human dimension: reasons for acceptance and resistance of lynxes and other predators in Switzerland

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Certain areas of Switzerland are currently experiencing an increase of the Lynx population and of other predator populations: species once eradicated have been actively reintroduced - such as the lynx - or have simply returned of their own accord - such as the wolf. This development is not well accepted among parts of the public (e.g. Mutter 1996), as in many regions throughout the world (e.g. Bath 1991; Boitani and Zimen 1979; Kellert 1991; Pate *et al*. 1996). Government agencies and NGOs are therefore conducting campaigns to rise public acceptance of predators. However, the success of such campaigns greatly depends on the following prerequisites (Bath 1994):

- knowledge about the frequency and spatial distribution of acceptance and rejection by the public.
- thorough knowledge of the dimensions of the relationship between humans and predators in general and, in particular, of the underlying reasons for acceptance or rejection.

Since these prerequisites were not available for the specific context of Switzerland, our project aimed at filling this gap. To achieve this aim, two research phases were conducted in the study, namely an inductive and a deductive phase.

- The purpose of the *inductive phase* was to explore the problem and to gain a deeper insight into the various factors causing acceptance or rejection (Caluori and Hunziker 2001a, b; Egli *et al*. 2001; Wallner and Hunziker 2001). Therefore we conducted qualitative interviews, i.e., a procedure similar to the 'focused interview' of Merton and Kendall (1956). After transcription, the interview contents were analysed according to the approach of the 'Grounded Theory' of Glaser and Strauss (1967). The interviewees were selected according to the 'theoretical-sampling' strategy (Glaser and Strauss 1967; Hunziker 1995), i.e., persons of widely differing positions and opinions were selected.
- In order to obtain information on frequencies and distributions of the different attitudes and to test the hypotheses derived from the inductive phase a *deductive research phase* was conducted consequently (Hunziker *et al*. 2001). I.e., randomly selected individuals throughout Switzerland were approached by a written survey in summer 1999. Out of the 4600 standardised questionnaires sent to the representative random sample of the Swiss population, 1442 were returned completed. After digitising these questionnaires, the data were analysed statistically.

The investigations showed that predators are principally well accepted by the majority of the Swiss public as a whole; even better than in the past (Hunziker *et al*. 2001). Nevertheless, there are considerable differences in acceptance between urban and rural, affected and non-affected regions.

Objection to the presence of predators can largely be explained by subjectively perceived (potential) or actually experienced direct and indirect affection by the predators' presence (Egli *et al*. 2001). And one of the most influential factors – in particular regarding short-term improvements of acceptance – is the communication between the parties involved. Here, not only information provided by the authorities and specialists but also the personal relationship between them and the local population play an important role.

However, it became clear that other more deep-seated reasons also play an important role, in particular the people's general attitudes towards nature and wilderness – nature as a "partner" or as an "enemy" – and their general value orientation – traditional vs. post-modern – (Caluori and Hunziker 2001a). I.e., people who tend to be oriented towards traditional values are likely to oppose the presence of predators in Switzerland. By comparison, the age and educational background of the respondents were less important factors and whether respondents knew much or little about these animals seemed to have almost no influence on their views (Hunziker *et al*. 2001). Nevertheless, the findings showed that young people and those with more education were inclined to view predatory animals more positively.

The deep seated reasons of acceptance/resistance of predators, i.e., the general value-orientation and the attitudes towards nature and wilderness, were also responsible for the preferences regarding landscape developments such as cultural landscapes being abandoned and left to nature. Thus, at least the assessment of the "rewilding" type of landscape change seems to be driven by similar factors as the acceptance/resistance of predators. This further illustrates the high significance of value-orientations and attitudes towards nature as the basis of people's assessment of any natural development.

Due to the ongoing shift in values in Swiss society, acceptance of predators as well as of land abandonment will probably further increase without specific measures being applied. Taking the deep-seated origins of the attitudes into account, this development could be actively supported by, for example, encouraging people to understand nature as their partner and not as their enemy. Even in rural areas, where the short-term solution of concrete problems with predator damages has priority, such strategies could help to achieve a sustaining effect. And finally, public relations are crucial and should be paid as much attention as possible when furthering acceptance is the task.

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Lynx habitat fragmentation of the Alps – a preliminary model

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Habitat quality throughout the Alps has considerably improved since the eradication of the lynx in the early 20th century. But the mountain range is more fragmented than ever; high altitude ridges and valleys with human settlements and traffic lines hinder the movements of terrestrial animals. The lynx is a "conservative" disperser from its biology. An important step towards the convergence of the two existing Alpine populations is the evaluation of biological, ecological and geographic possibilities and constraints for the movements of individuals.

We evaluated the habitat suitability and connectivity for the lynx in the Alps in order to reveal (1) the suitable habitat patches (sub-populations), (2) the potential size of the sub-populations, and (3) connections between sub-populations.

Ecological Niche Factor Analysis (ENFA) (Hirzel *et al*. 2002) was used to predict the potential distribution of lynx in the Alps. After thorough analysis in biomapper 2.1 (Hirzel *et al*. 2001), seven environmental variables describing land use and human disturbance were used in the final model. The response variable is the presence of lynx in each square kilometre. Lynx was considered to be present in each square containing one or more telemetry fix/kill site. We divided the presence data into cross-validation groups following a k-fold partitioning design. Huberty's rule of thumb was used to determine the model training to testing ratio. A testing ratio of 29% was determined and a k-fold partition of four groups considered. Using cross-validation procedures, we trained our model iteratively on three of the four data sets using ENFA analysis. Validation was based on the remaining testing set. A Spearman-rank correlation between area-adjusted frequencies of cross-validation points within individual bins and the bin rank was calculated for each cross-validated model as described in Boyce *et al*. (2002). Predictions have been divided into 10 equal-interval bins, scaled between 0 and 100.

The four factors retained according to the Broken-stick rule (Hirzel *et al*. 2002) accounted for 100% of the marginality and 79.5% of the total specialisation. The marginality factor alone accounted for 29% of the total specialisation and showed that lynx were essentially linked to forest and shrubs and/or herbaceous vegetation. On the other hand, lynx tended to avoid areas of heterogeneous agriculture. The second (20.61% of the total variance explained), the third (19.46% of the total variance explained) and the fourth (10.47% of the total variance explained) factor accounted for more specialisation, mostly regarding distance to large and medium town, heterogeneous agriculture, forest and open space frequencies. Cross-validated Spearman-rank correlation (*rs*) between RSF bin ranks and area-adjusted frequencies for individual and average model displayed significant positive rank values (r_S: 0.891-0.939, $p<0.001$).

The cut off value of the habitat suitability map was fixed in a way that 80% of the presence cells were included in the boundaries of the potential distribution map. The resulting map has been smoothened in order to remove small isolated patches. To do this, we only used the pre-

defined cells of the potential distribution map and calculated the frequency of more cells of that type in a circular window of 5 kilometres radius, which corresponds approximately to the size of a female home range in the Alps (Breitenmoser-Würsten *et al*. 2001). We set the threshold in a way that 70% of the presence cells were included in the boundaries. This map was then overlaid with the barriers map (highways, main roads, and railways less than one kilometre apart from highways, elevation above 2,500 meters, settlements, and lakes) in order to identify sub-units of habitat.

The model divides the Alps in 37 suitable habitat patches (Fig. 1) ranging from 50 to 18,711 km^2 when all patches smaller than 50 km^2 are removed. Even within some patches, there were larger plots of suitable habitat connected through small bands of habitats only (e. g. patch no. 6 between the north-western Alps, the Valais north and the Valais south), which may act as bottle-necks and may impede movements of lynx.

The total area of suitable habitat in the Alps is about 93,579 km^2. Using the moderate density found in the Jura Mountains (Breitenmoser *et al*. 1993, Breitenmoser-Würsten *et al*. submitted) or the higher density found in the north-western Alps (Breitenmoser-Würsten *et al*. 2001), we estimate that the Alps could host a population of 961 to 1,827 resident lynx.

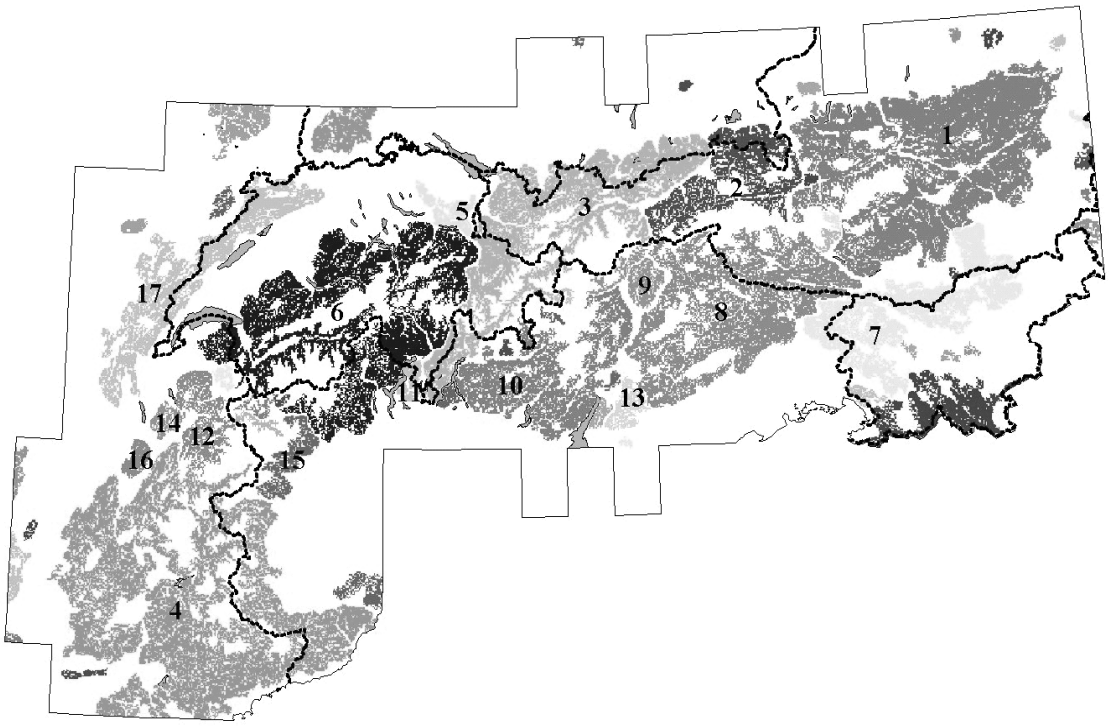

Figure 1. Suitable lynx habitat and fragmentation of the Alps. The different coloured areas represent distinct patches. Labelled are all patches >400 km^2.

Connectivity was calculated in the GIS using a friction grid and a cost distance function. The friction value attributed to each land use variable was assessed from our observations of the dispersal of radio-tagged subadult lynx.

The results of the cost distance analysis showed that all patches were within the range of dispersal cost of subadult lynx moving through unfavourable habitat. But experience suggests that only few dispersers will cross unsuitable areas and barriers such as (fenced) highways. During a peak of the lynx population in the north-western Swiss Alps from 1997-2000, only four out of fourteen radio-tagged subadult lynx, all males, went beyond the edge of suitable habitat, and only one reached a new compartment. This low migration rate may be enough to grant genetic exchange between established sub-populations, but seems not to allow the natural spread of the population into un-settled areas. As an alternative to spontaneous dispersal, artificial transfer of individuals across the barriers should be considered.

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Population and conservation genetics of two re-introduced lynx (*Lynx lynx*) populations in Switzerland – a molecular evaluation 30 years after translocation

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Lynx went extinct in most of Central and Western Europe at the end of the 19th century. In the 1970s, re-introduction programs started in the Alps and in adjacent mountain ranges of Swit-zerland, Slovenia, Italy, Austria and France. In all projects, only very few founder individuals were released. All came from the same founder population, the Carpathian Mountains of Slovakia, and some of them were even closely related (siblings, parent-offspring). The two populations in Switzerland - Jura and Alps - are still small and isolated. They consist today of not more than 40 - 50 and 60 - 80 reproducing individuals, respectively. From this situation, the following questions arise: Do the two populations and other re-introduced populations have a reduced genetic variability compared to the Slovakian source population and other autochthonous populations in Europe (Scandinavia, Finland, Baltics)? Do the two geographically separated populations of Switzerland differ genetically? Additionally, in the context of future re-introductions of lynx in Europe, the taxonomic status of the species in the various populations in Europe is of interest. To address these questions, genetic analyses are performed using microsatellites, which were developed in domestic cats (Menotti-Raymond & O'Brien 1995, Menotti-Raymond et al. 1997, Menotti-Raymond et al. 1999), Canada lynx (Carmicheal et al. 2000) and Sumatra tigers (Williamson 2002). For preliminary analyses results of 15 microsatellites and 350 samples from 11 populations were available. Additionally, we have analysed samples from Swiss zoos. The allele length was determined with an ABI 3100 sequencer with ABI Genescan and Genotyper software. Statistical analysis was performed using the programs GENEPOP (Raymond & Rousset 1995) and GENETIX (Belkhir et al. 1996-1997).

Genetic variability

Levels of heterozygosity varied in autochthonous populations between 0.54 (Sweden) and 0.68 (Latvia; Fig. 1). Striking is the small value for Sweden. The lynx population there experienced a bottleneck at the end of the 19th and early 20th century that left its genetic tracks (Hellborg *et al*. 2002).

In the re-introduced populations, we have observed a tendency for smaller values (0.42-0.61). The population in the Alps had with 0.42 by far the smallest level of heterozygosity. The allelic diversity in the lynx population in the Jura Mts and in the Alps was smaller than in the source population in the Carpathian Mts of Slovakia. For the other re-introduced populations, the samples size is still too small for a comparison.

In addition to the loss of alleles and the reduction of the level of heterozygosity, the re-

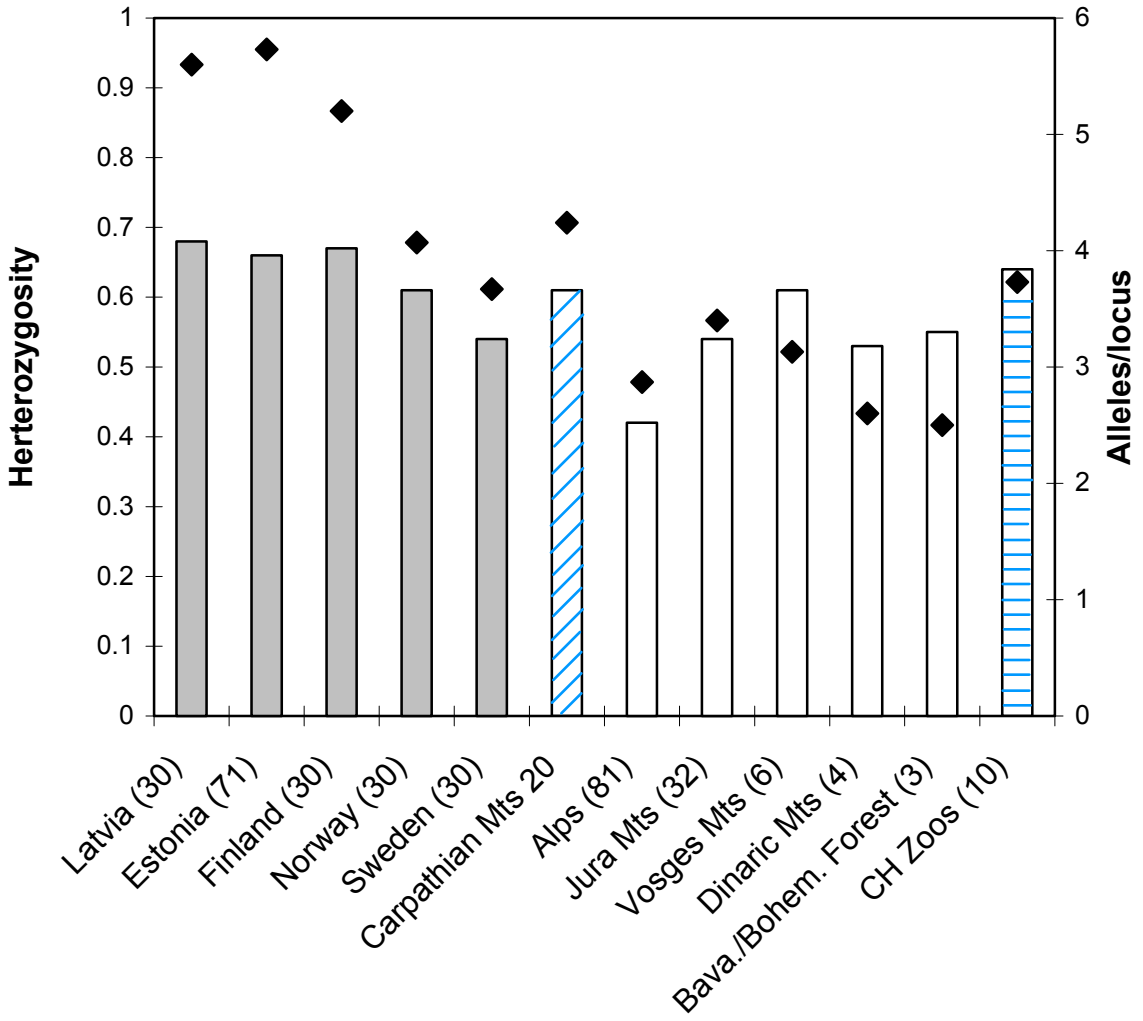

Fig. 1. Genetic variability of lynx populations in Europe. The columns present the level of heterozygosity (left y-axis), the symbols the mean number of alleles per locus (right y-axis). Grey columns = autochthonous populations, diagonal hatched column = source population (Carpathian Mts of Slovakia) for the re-introductions. White columns = re-introduced populations. Horizontal hatched column = Swiss zoo population. Number in parentheses refer to the sample size.

introduced populations in the Jura Mts and in the Alps have experienced a strong genetic drift. For example for microsatellite Fca 115, seven alleles went lost, and the frequencies of the remaining ones have changed drastically, from almost disappearing to becoming very frequent.

Genetic differentiation

The strong genetic drift has lead to a significant difference between the lynx population in the Alps and the Jura Mts, and between the two populations and the source population in the Carpathian Mts of Slovakia (Fig. 2). The re-introduced population in the Dinaric Mts (Slovenia, Croatia and Bosnia & Herzegovina) also drifted away from the source. The two populations in the Vosges Mts and the Bavarian (D)/Bohemian (CZ) forest on the other side are less distinct from the source population. They were founded with a larger number of individuals that were released over several years.

Lynx from the Nordic populations seem to be clearly distinct from those in the Carpathian Mts. To decide if they can be called subspecies as proposed from morphology further analyses are needed.

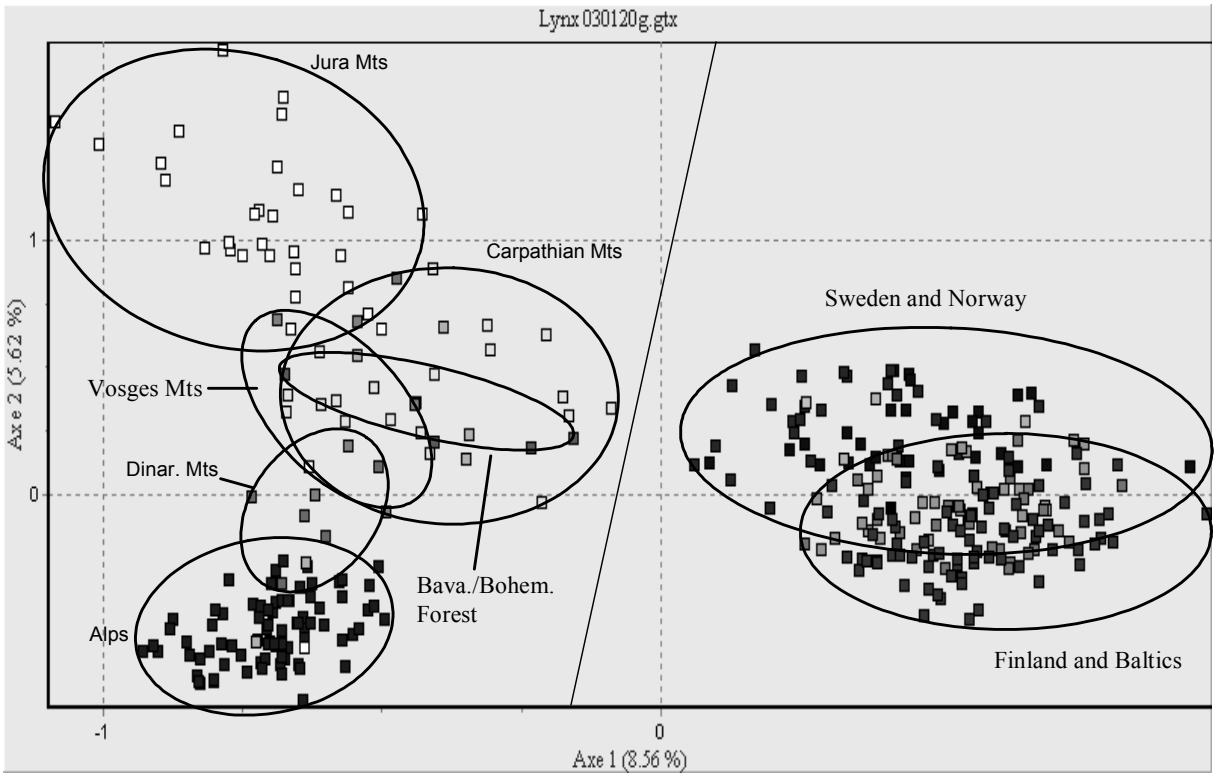

Fig. 2. Principle component analysis based on allele frequencies of 15 microsatellites for lynx populations in Europe.

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Impact on wild prey populations

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The impact of lynx on its prey populations can vary widely as it depends on factors that change in space and time. Roe deer is the main prey of lynx in the Alps, followed by chamois and red deer. All other prey is of minor significance. In the Alps, ibex has rarely been reported as lynx kills and wild boar never. Although not important in the overall diet, introduced species like mouflon or fallow deer have locally suffered from heavy predation and have been reduced drastically by lynx. For species like capercaillie the impact is negligible, because it occurs in low numbers only and it is therefore not profitable. The impact is also negligible for species like red fox, who by far outnumber the lynx.

The lynx' kill rate depends on the sex and reproductive status of lynx (Molinari-Jobin *et al.* 2002). Males kill more chamois than females, females who take care of kittens kill more frequently than males (approximately 70 ungulates / year *versus* 55 ungulates).

In the Alps, lynx densities have been reported to range from 1-2 lynx / 100 km^2 (Haller and Breitenmoser 1986, Breitenmoser-Würsten *et al.* 2001). If the preferred prey of lynx are roe deer and chamois, we can estimate that they kill on average 1 ungulate every 1-2 km^2.

For illustration of the impact we used a hypothetical example: the canton of Obwalden, where the first lynx have been reintroduced in the Alps in 1971. With its size of 490 km^2, Obwalden could host about 5-10 lynx, of which 2-4 males and 3-6 females. The potential predation rate would average 200-400 roe deer and 100-200 chamois, e.g. 1 roe deer every 1-3 km^2 and 1 chamois every 2-5 km^2. Lynx predation would be responsible for 40% of known roe deer and 20% of known chamois mortality. Considering the recruitment potential of roe deer and chamois, together with the information on the known mortality, the minimal density in Obwalden is estimated at 4-5 roe deer and 6 chamois/km^2. Lynx would therefore kill 13% of the roe deer and 5% of the chamois population. Obwalden today is far from such a "high" lynx density, as in the official statistics of perished game during the last year only 2 lynx kills were reported. If lynx would kill an average of 300 roe deer and 150 chamois per year this predation would not go unnoticed.

The example of Obwalden is relatively simple, as some variables were kept constant and others didn't have to be considered. The impact of lynx depends on prey density, itself fluctuating from year to year. An important aspect is also the recruitment potential of the prey: roe deer can recover faster than chamois from low density. If the alternative prey is red deer instead of chamois, the number of prey killed per year decreases as red deer are heavier than chamois allowing lynx to feed longer on the same kill. Habitat features have been shown to be important (Molinari-Jobin et al. submitted), and the presence of scavengers might force lynx to kill notable more frequently. Another aspect is the presence of competitors, such as wolves. The impact of lynx on prey depends on many variables and they change permanently in space and time. For some we have good estimates, some can only be guessed empirically.

We definitely need more predation studies from the Alps including both predator and prey.

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Eurasian lynx depredation on livestock in Switzerland – a lasting controversy 30 years after the reintroduction

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Almost a century after extinction, lynx was reintroduced in Switzerland 30 years ago. The ecological conditions for the lynx had considerably improved – there is more wild prey available than ever before. However, the Alps are the world's most intensively used mountain region. Today, 250'000 sheep are aestivated mainly unguarded in the Swiss Alps. They face about 70 lynx, which are however not evenly distributed. Depredation on livestock gives rise to a controversy, and may provoke retaliation killings which are a serious conservation problem.

Depredation on livestock occurs in fluctuations, depending on lynx and roe deer abundance: Years with few lynx kills are followed by periods of increased numbers of kills. When many predators face few wild prey, lynx tend to kill more sheep. However, even in peak years, the losses of sheep due to lynx predation never exceeded 0.2-0.4% of the local stock. Nevertheless, some flocks have been affected regularly by lynx attacks and suffered considerable losses. These flocks typically occupy scrubby parks or pastures, in the middle of the woodland and far from human settlements. The reappearance of attacks on these sites within a few years clearly indicate a *site effect*. Removing stock-raiding lynx from such pastures did not solve the problem – the succeeding lynx continued to kill livestock on the same pastures. Under such conditions, only the protection of the flocks can ameliorate the situation – e.g. with shepherds or guarding animals.

The problem is rather emotional than economical. To promote the coexistence of people and lynx, we need a pragmatic approach, considering also the socio-cultural aspects of the controversy. Conservation of the lynx population can only be achieved when the complaints of local people are considered. Therefore, a management plan implemented by the Swiss government in 2000, aims for a compromise: Lynx remain legally protected, but individuals specialising in livestock killing can be shot. Compensation is paid for depredation cases. In hot spots, where lynx attacks reappear again and again, the implementation of prevention measures can be ordered. Furthermore, local "over"abundance of lynx can be reduced by translocating lynx to not yet occupied areas.

From idealism to realism: How can action plans help to bridge the gap between theory and practice in lynx conservation?

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Large Carnivores (lynx, wolf and bear) are protected by a complex array of national and international legislation across Europe, but to all who work on management of these species appear obvious that current legislation is not sufficient to guarantee their optimal conservation. These species are loaded with high emotional values and cause a variety of conflicts with human interests. Predation on livestock affects farmers' economies, predation of wild prey affects hunters' activities and their potential predation on humans causes negative reactions across vast portions of the general public. Finding a smooth path to reconcile the needs to conserve viable populations of large carnivores with those of humans has been almost impossible throughout most of human histories.

The Large Carnivore Initiative for Europe (LCIE) was established in 1995 by WWF International together with partner organizations and experts in 19 European countries and its mission is "*to maintain and restore, in coexistence with people, viable populations of large carnivores as an integral part of ecosystems and landscapes across Europe*".

LCIE has focused on the continental scale of large carnivore conservation and on populations as management units. Its fundamental conservation approach is based on the meta-population concept and the need to include human dimensions issues in every management plan as the necessary step to ensure human-carnivores coexistence.

Implementing this conservation approach required the preparation of European Action Plans to be endorsed at the highest possible institutional level in Europe. The endorsement of the Action Plans by the Bern Convention was achieved in 2001, but it is not sufficient to ensure effective management at continental scale. Although the Action Plans are the first and necessary tool to set the overall framework of a common European vision on large carnivores management, real actions are taken at national and local levels which are largely independent from international control. Livestock conflicts prevention and mitigation measures, anti-poaching activities, participative management and information campaigns are always carried out at national/local scale and they must be organized in national action plans. The Alps are a typical case where the obvious ecological unity of the region is fragmented by national and internal boundaries with a variety of administrative and legal regimes which must be reconciled to a common vision and action plan if large carnivores have to have a future.

LCIE role is also helping ensure the consistency of actions at national level with the continental approach and a set of general and issue-specific (hunting, forestry, livestock subsidies) guidelines were produced and made available on LCIE website.

Pan-Alpine Conservation Strategy for the Lynx

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To advance a new conservation concept and to co-ordinate future actions across the Alps, the SCALP expert group proposed a Pan-Alpine Conservation Strategy (PACS) for the Lynx in 2001 (Molinari-Jobin *et al*. 2003). In the same year the document was adopted by the Standing Committee of the Bern Convention.

The Conservation Strategy bases on two ideas: (1) no Alpine country can host a viable lynx population in isolation – all regional populations will be transboundary; and (2) international co-operation is essential for the conservation of shared populations, and even more to solve the mutual problems. While brown bear show a considerable and wolf a high migration capacity - they are about to re-colonise the Alps naturally - the expansion of the lynx populations is slow. Neither the Slovenian nor the Swiss lynx population have expanded markedly during the past 10 years, although more suitable habitat would be available in uncolonised parts of the Alps. The area of lynx presence remained stable (Switzerland and eastern Alps), fragmented (French Alps) or has decreased (Austria), some local occurrences even went extinct (Trentino, Italy) during the 1990s. Only in the Bellunese (Italy), lynx presence was confirmed for a new area, and in the north-western Swiss Alps, the lynx abundance increased. The number of lynx in the whole Alps was estimated conservatively to be about 90-120 individuals.

The goal is to re-establish and maintain, in co-existence with people, a vital lynx population covering the whole of the Alpine arc. This general goal can be split in four objectives:

1. The lynx populations in Slovenia and Switzerland maintain their vitality and must be helped to expand.
2. The populations in Slovenia and Switzerland are joined through colonisation of the area in between (Alps of Austria, Germany, Italy and Liechtenstein).
3. This unified population in the central Alps is allowed to expand to the north-east (Austria) and the south-west (France, Italy).
4. Gene flow is assured between the Alpine sub-populations and the population of Slovenia and Croatia, the population of the Jura Mountains and the population of the Bohemian/ Bavarian forest.

The SCALP experts propose conservation measures on the pan-Alpine as well as on national level. In all parts of the Alps, lynx have to live in a landscape of high human activities. Today, the Alps are a more suited living space for the lynx than in the 19th century, and the lynx has shown us that it can perfectly live in this human dominated landscape. We also present some background information about lynx life history in the Alps. However, the lynx needs support to regain the once lost territory and our tolerance to survive there. Therefore, the survival of the lynx in the Alps is less a question of the ecological conditions than of the co-existence with the people living in the same area. Any conservation or management strategy

must consider human dimension aspects as a priority. For the future of the lynx in the Alps it is important that, besides cross-border co-operation between the Alpine countries, a consensus with all interest groups on a regional level is found. With this document, experts from all Alpine countries propose standards for a common strategy and aim to boost local, regional, national and international activities and cooperation.

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Lynx (*Lynx lynx* L.) management in Slovenia
Historical review – Today's situation – Future perspectives

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In the article are presented short historical review of lynx on the ground of Slovenia (from archaeological excavations to his final extirpation in the beginning of 20th century), reintroduction in 1973, today's status, management and future perspectives. Archaeological excavations from 4000 B.C. give evidence, that lynx lived on the ground of today's Slovenia (Ljubljansko barje) as far back as the time of old Slavic tribes. It has been constantly present in Slovenia till the beginning of 18th century. In the year of 1821 rewards for dead lynxes were granted and the consequences were harmful – at the end of 19th century lynx vanished from most of his historical habitats – especially from northern and western parts of Slovenia. The last lynx was shot in 1908. Reintroductions of lynxes in Europe started after 1970 based on the completely changed attitudes of man towards nature, new knowledge of ecology and important roles of natural predators – mainly large carnivores. In 1973 lynx was also reintroduced in Slovenia, from where it was quickly spread to Croatia and even to Bosnia. The aim at the time was very clear - in the case of successful reintroduction, lynx will again became managed (hunted) species. It happened only five years after the release of three pairs of reintroduced lynxes. Since 1973, 142 lynxes have been eliminated from the population on the Slovenian territory, mostly for regular hunting reasons. Twenty years after the reintroduction in Slovenia telemetry methods were used to improve knowledge and monitoring of the Slovene population for the first time. Telemetry project was the second phase of the reintroduction process. Today, while Slovenia is about to join European Union, the third phase for long term survival of lynx on these territories is necessary – building up an effective management strategy according to the European and Slovenian legislation in cooperation with the neighbouring countries.

The Swiss Lynx Management Plan

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According to the Swiss federal law on hunting and the protection of wildlife and the ordinance to the federal law, enacted by the federal government in 1996, the *Swiss Agency for the Environment, Forests and Landscape* (SAEFL/BUWAL) shall develop concepts for the management of some protected species, among them the lynx. These concepts must contain principles on the protection, the culling or capture of the species, the prevention and determination of damage to livestock or plantations as well as the compensation of measures for the prevention of damage caused by these species.

The management plan was developed by the working group *Large Carnivores* consisting of members of the SAEFL, SWOA/BLW (Swiss Federal Office for Agriculture), cantons, interest groups and local as well as foreign experts. For organisational purposes Switzerland was divided into 8 large carnivore management units by taking into account natural and artificial barriers hindering the natural spread of the lynx population as well as political borders (Fig. 1). In each compartment, an inter-cantonal committee, consisting of a representative of the SAEFL and all cantons concerned, is responsible for the lynx management. The Swiss Lynx Project is mandated to monitor the lynx populations throughout Switzerland.

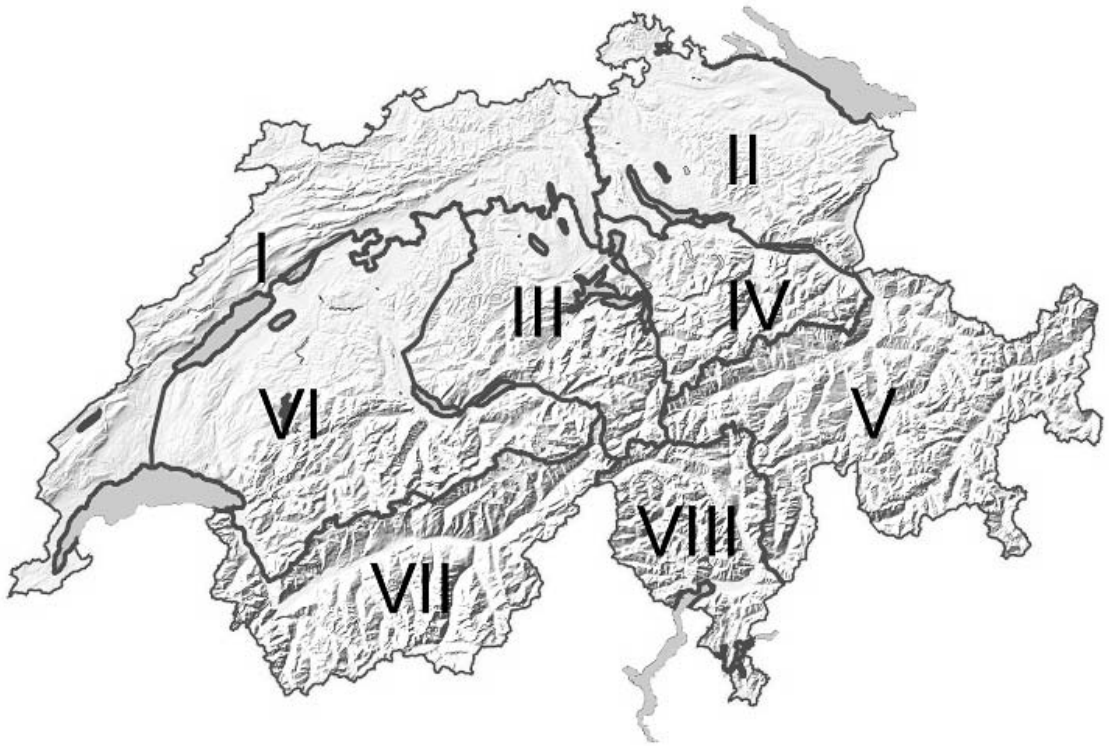

Fig. 1. Large carnivore management compartments in Switzerland.

The Lynx management plan aims to:

- Secure the long-term survival of the lynx population in the now settled areas by enhancing the acceptance of the lynx in the whole of the country.
- Establish the conditions for an expansion of the lynx into new living-space: in the long term by linking the compartments (e.g. green bridges) and in the short term by translocation of lynx from compartments with high lynx density into compartments without lynx (Robin and Ruhlé, this volume). Furthermore, if necessary and possible it supports re-introduction projects in other countries.
- Compensate and prevent losses in livestock caused by lynx. All damages assessed by cantonal authorities are compensated for, regardless of preventive measures. The compensations are paid by the cantons, but 80% are reimbursed by the confederation to them. Preventive measures are only mandatory in areas where damages occur repeatedly. It is not cost effective to implement preventive measures over the whole lynx distribution area due to generally low occurrence of damages (Angst and Breitenmoser, this volume).
- The removal of stock-raiding lynx is possible if (a) 15 sheep or goats are killed in a year within a circle of 5 km radius, (b) this number is reduced to 12 kills only if losses occurred in the same area the previous year, (c) kills in forests (which are generally closed for livestock) are not counted.
- To assure an appropriate harvest of ungulates in lynx areas, lynx may also be reduced if the impact of lynx predation on roe deer and chamois is considered too strong. The following criteria for interventions will be proposed in a revised version of the management plan: (a) decrease of the ungulate effective and decrease of harvest and a simultaneous (b) increase of the lynx population within a compartment, and (c) natural forest regeneration in the respective compartment has to be granted. Before any culling will be allowed by the government, an intensified monitoring of lynx, ungulates and forest is demanded to obtain reliable data. All criteria are reconsidered after each year.
- A third potential reason for removal of lynx may be given if lynx predation threatens endangered species (e.g. capercaillie). So far, no indications were found in this respect, therefore the criteria for interventions are not yet defined.

Translocation of lynx to northeastern Switzerland: the project LUNO – its history and structures

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LUNO (Luchsumsiedlung Nordostschweiz = Translocation of lynx to northeastern Switzerland) is on one side a first implementation of the Swiss Lynx Management Concept 2000 (Blankenhorn 2002, Roch 2000) and on the other side a governmental project based on an agreement between the Governments of the cantons Appenzell Innerrhoden, Appenzell Ausserrhoden, St. Gallen, Thurgau, and Zurich and the Swiss Agency for Environment, Forests and Landscape. The translocation from compartment VI to compartment II is more or less incidental since at the time of publication of the Swiss Lynx Management Concept but independently a deputee of the cantonal parliament of St. Gallen asked the government to check the possibilities to reintroduce this species in suitable habitats of the Canton.

The motivations for this requirement were:

- reasons to increase the biodiversity,
- the 100th anniversary of the successful reintroduction of ibex in Switzerland which also took place on the territory of the Canton St. Gallen,
- the 200th anniversary of the creation of the Canton St. Gallen by Napoleon Bonaparte for which several cultural activities were assigned.

Based upon a positive reaction of the government the parliament consented to the deputee's demand and by this created the base to cooperate within the above mentioned agreement (Ruhlé 2002). For the other four Cantons the decisions to participate to the agreement were taken by the governments or even by the ministers responsible for wildlife and hunting. In two cases the participation was a restricted one: the Cantons Appenzell Innerrhoden and Appenzell Ausserrhoden refused to be involved in releases to be made on their territories.

The main goals of project include:

- to set-up a regional lynx population,
- to develop and to assure the longterm survival of this population and, by that,
- to contribute to the restoration of the lynx population in the entire alpine arc.

Due to the fact that the Confederation of Switzerland as well as five different Cantons located in Compartment II are involved in the LUNO project, its organisation is quite complex (Robin 2002):

- A steering committee is deciding on the strategical level and supervises the project. It

is composed of the ministers responsible for wildlife and hunting of the five Cantons involved and the head of the Swiss Agency for Environment, Forests and Landscape.

- An executive committee implements the strategical decisions and controls the operational ongoing of the project. It is composed of the heads of the wildlife agencies of the Confederation and the participating Cantons.
- The coordination is assured by two persons, a wildlife-biologist (Klaus Robin) and a forest engineer (Heinz Nigg).
- The operative work is done within a framework of modules with a lot of tasks as the following (Nigg 2002):
  - Module Lynx: translocation, mounting the radiotelemetry-equipment, telemetry and localisation, identification of prey found dead by local people particularly hunters, collaboration in information events (Head: Andreas Ryser)
  - Module Ungulates: standardisation of a method for roe deer and chamois population census and its application (Head: Patrick Durand).
  - Module "Rare species": estimation of a potential Lynx' impact on the regional capercaillie population (Head: Klaus Robin).
  - Module Forest: investigation on the impact of Lynx as a regulator of ungulates damaging forest plants (Head: Dani Rüegg).

The ongoing of the project is extensively communicated to diverse target groups as politicians, hunters, other NGO representatives, journalists and to the public. The means applied are oral presentations, broadcasting radio- and television emissions, diverse printproducts as well as a homepage www.luno.ch.

LUNO is running mainly at the cost of the Swiss Agency for Environment, Forests and Landscape.

The first phase of the projects'agreement runs for the three years' period 2001-2003. The agreement may be prolonged. Preliminary results of the "Module Lynx" of the LUNO project are presented by Ryser *et al*. (this volume).

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Translocation of lynx from western to eastern Switzerland – preliminary results

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The failure of lynx to spread into new areas, and the resulting local high population densities in the north-western Swiss Alps lead to conflicts with sheep breeders and hunters. Therefore, in 2000, the Swiss Agency of Environment, Forest and Landscape implemented the Swiss Lynx Concept, a management plan for the lynx in Switzerland. An important consequence of the concept was the agreement between the federal authorities and several cantons to translocate 8–12 lynx (6 in the first project year) from the north-western Alps to eastern Switzerland. The establishment of a new population nucleus in the eastern Swiss Alps should help to join the isolated lynx populations in the north-western Alps and in the triangle of Austria, Slovenia and Italy, as it is recommended in the Pan-Alpine Conservation Strategy for the Lynx.

The LUNO Project (Luchsumsiedlung Nordostschweiz: lynx translocation north-eastern Switzerland) was thoroughly planned, following e.g. the IUCN recommendations for reintroductions, and started in late winter 2001.

Between February and April 2001, 6 lynx (3 males, 3 females) were caught in the cantons of Berne, Vaud and Fribourg. Four of these animals were released in couples in the cantons of Zurich and St. Gallen in March 2001, and 2 were set free separately in surrounding areas one month later. According to the LUNO schedule, 3 more lynx (1 male, 2 females) were caught in the Jura Mountains in late winter 2003, and released in the cantons of Zurich and St. Gallen. All animals underwent extensive veterinary checkups after their capture and before release. Since they were released, we have been closely following the translocated lynx by means of radio-telemetry.

Five of the 6 animals released in 2001 have established their home ranges within 6 and 13 months (mean = 9 months), $\leq$ 40 km from the release site (arithmetic centre of home range). One male disappeared about 5 months after release, and we subsequently observed the shift of home range of the neighbouring male. Home range size for the 2 remaining males amounts to 228 km^2 and 155 km^2 (100-% MCP). Home range size for the females varies between 83 km^2 and 122 km^2. In 2002 one of the females was observed with 2 kittens. In 2003 the same female gave birth to another 2 kittens.

Of the 3 lynx translocated in 2003, one subadult female seems to stay in the release area, whereas both older animals (1 male, 1 female) show “homing behaviour”: Both lynx left the release area after 7 and 8 days, respectively, in the direction of the Jura mountains.

Between March 2001 and March 2003, we found 123 lynx kills by means of radio-tracking and reports of local people (80 roe deer, 38 chamois, 3 brown hares, 1 fox). Except one domestic goat killed by a female lynx, no depredation has been observed up to now.

Lynx and hunter – competitors forever?

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Man exterminated the lynx in the Alps. However, successful programmes for its repatriation have been going on for some 30 years now. Those in favour of such programmes are in the majority: political institutions, the majority of the people living in the alpine countries, environmental organisations, wildlife biologists. Also, most of the active hunters accept the lynx as a part of wildlife. But a lot of them wishes the lynx staying in neighbours garden.

Whenever it comes to the lynx, there is also a defiant anti-movement based on a spirit that prevailed in past centuries. This negative attitude is most pronounced amongst people whose own exploitation interests compete with the lynx. In the Alpine countries the lynx feeds mostly on roe deer, chamois and other game species and occasionally on sheep. Consequently, the people most concerned by its repatriation are hunters and farmers.

The ecological argument for the lynx's right to exist is very weak. One might even say that we do not need the lynx for ecological reasons. The same might apply to the wolf and the bear. But we **want** the lynx because it is part of our local fauna and because man has no right whatsoever to exterminate species. This brings us to an ethical-moral aspect of the matter where purely scientific reasons are simply not as powerful as emotional arguments.

The hunter asks himself similar questions as the farmer. He notices in his hunting area that lynxes are killing some of the roe deer or chamois he has hoped to hunt and kill himself. The "lynx" as a hunter turns into a direct competitor of the hunter "man". In this context, it needs to be made clear that the hunter cannot be against the lynx on grounds of economic subsistence, because as a rule, hunting, normally, is a pastime. I do not know a single hunter whose existence is threatened because the lynx has eaten some of his roe deer. A minority amongst the hunters I know, however, still carefully preserves traditional hostile images. Thus, the fight for the acceptance of the lynx is not over yet and the hunters are a key-group for the longtime-survival of the lynxes in the Alps. Let us have a look at some arguments frequently brought forward by those hunters who are against the lynx:

1. Today's Alpine landscape is not suitable for the lynx. The natural habitats where no people live are said to be too small to allow the lynx to survive.
2. In areas where the lynx exists the deer almost become extinct, so that hunting is no longer possible.
3. Lynxes only eat fresh prey and therefore kill a different animal for every meal. They do not return to the dead body of the animal they killed. Or: Lynxes bite off the head of a deer and leave the rest of the animal unused.
4. Lynxes do not only eat weak animals but also so-called "future-preserving animals", i.e. animals the hunter wishes to stay alive for procreation purposes.
5. The lynx is said to be a major threat to rare and endangered animal species

such as the capercaillie, the hazel and the black grouse.

6. Most hunters are “for” the lynxes but against the release.

Thanks to telemetric studies on the lynx, we know today that these animals do not generally avoid areas inhabited or intensively used by man. Therefore, civilisation or cultural landscape need not to be a hindrance to the existence of the lynx. We know that there is enough living space for the lynx in the Alps.

We know for sure that in areas where the lynx exists, roe deer and chamois do not run any risk of becoming extinct. But we also know that the roe deer and chamois change their behaviour. The animals become shier, more cautious, they become less visible and are getting more mobile. The roe deer is an expert when it comes to hiding, and therefore it knows very well how to hide - also from the hunter. This is the real reason why some hunters reject the lynx: because of the lynx, they must spend more time and show more skills in order to continue to succeed as hunters. And in practice many hunters lack both: time and skills.

Numerous scientific findings clearly indicate that the lynx often returns to the prey it has killed in order to eat from it over a period of several days. Why should the lynx not do that? Only archaic, mystic imagination, which is not untypical of some hunters, can question such behaviour of the lynx, and it is the same imagination that leads to the assertion that lynxes are especially after the heads of deer. The lynx is not a head-freak, but the red fox is!

In the Carpathians and in Scandinavia tetraonids may account for a certain amount of the lynx’s diet. Tetraonids, however, are present there in larger numbers. In Switzerland telemetry studies on 24 lynxes have shown that they had eaten only one capercaillie and one black grouse over a period of several years. Nevertheless, in the Swiss Jura decent stocks of lynxes can be found along with reasonable numbers of capercaillies.

Which are the hunting rules hunters impose on themselves? In the textbooks for young hunters you will find a definition for the concept of “gamekeeping” (german: Hege). For all hunters I know, gamekeeping is the highest self-imposed goal. The “Hunting Encyclopedia”, which is considered standard literature amongst practicing hunters, describes “gamekeeping” as follows (in short):

- hunting-related care measures of a legal, administrative and private nature;
- preserving a stock of wild animals that is appropriate for the conditions prevailing in the specific country; protecting the biodiversity and health of the species;
- maintaining and safeguarding habitats and the basis for survival of game;
- avoiding damages to the forest caused by game.

As we can see, the above definition addresses hunting-related care, preservation, a large number of species (biodiversity), habitat-quality, the basis for survival and certain other things. It does not say anything about shooting, trophies, excessive game stocks or the elimination of predators. None of the hunters I know does not claim proudly that he is a keeper. But I also know a lot of hunters who in practice have their individual, secret understanding of game-keeping.

By way of summarising we may say that the arguments presented by hunters opposing the lynx are based on personal fears that the lynx might take something away from them for which they

invest money, time and a lot of passion. They reveal some aspects of a hunter's psychological pattern and the attitude of hunters towards wild animals. This attitude might remind us of those farmers who have an emotional tie to their domestic animals. Often the care provided by hunters for wild animals only differs slightly from the care farmers show for their livestock. Scientific arguments contradicting their views are simply brushed aside. The views held by hunters opposing the lynx are based on slogans of ancient writers and not on modern knowledge. Resorting to emotional arguments, they manage to compete with science. Many hunters talk about the lynx, but only very few of them have actually ever seen one or hunted in an area where the lynx lives. The public at large knows too little about hunting and wild game in order to be able to differentiate between "good and bad" arguments. Political decision-makers often find themselves in a similar situation. Many hunters do not dare to decide clearly for or against the lynx which includes always the "yes or no" to the release of lynxes which is necessary for a pan-alpine repatriation.

Nevertheless I want to stress, that it is important and vital not to exclude the hunters from any field. After all, they represent a group of people providing extremely valuable services for the wildlife research. A big part of the hunters spend a lot of time in the forest and on fields. They observe a lot, see a lot and often look back on many years of experience. For the vast majority of wildlife research the hunters' experience was and still is indispensable. This is why we must maintain or even improve the basis for talks and co-operations between hunters and researchers. Both sides are invited to show their tolerance and understanding for the concerns of the other.

The Situation of the Alpine Lynx Population – Conclusions from the 2nd SCALP Conference, Amden 7-9 May 2003

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There is no Alpine lynx population – yet. What we observe, thirty years after the reintroductions in Switzerland, Italy, Austria, and Slovenia, are two local populations with a limited expansion, and some individuals scattered across the Alpine arc. Local occurrences fluctuate, sometimes causing trouble because there are – according to the judgment of local people – too many, sometimes because there are too few and the species locally disappears again. From the first country-based status reports, which delineated the situation in 1995 (Breitenmoser *et al*. 1998, Cop and Frkovic 1998, Huber and Kaczensky 1998, Kaczensky 1998, Molinari 1998, Ragni *et al*. 1998, Stahl and Vandel 1998) to the second series of status reports five years later (Fasel 2001, Huber *et al*. 2001, Molinari *et al*. 2001, Molinari-Jobin *et al*. 2001, Stahl and Vandel 2001, Stanisa *et al*. 2001, Wölfl and Kaczensky 2001) and the trends in recent years (see updates presented at the SCALP conference in this document), the development of the lynx across the Alps is ambivalent (Fig. 1). Some areas with new or increasing presence of lynx cannot counter-balance the fact that local occurrences went extinct. Lynx presence has particularly decreased in the area between the only two reproducing populations in the north-western and in the eastern Alps, thus reducing the chance that the two populations may merge in the foreseeable future.

When, three decades ago, lynx reintroduction programmes where initiated in several Alpine countries, all projects where small-scale and not co-ordinated. This may be explained through the lack of understanding of lynx ecology and reintroduction processes at that time. Since then, however, we have developed both the legal framework and the science and methods for the conservation of large carnivore populations. Examples of our advanced understanding and the pan-Alpine approach on the technical level have been presented at the conference in Amden and are summarised in this volume. Above all, we have understood that viable large carnivore populations need huge spaces, especially in a human-dominated world, where, for reason of conflicting interests, we do not allow the populations to reach the carrying capacity of the living space. This urges the Alpine countries for a close co-operation, as eventually they will all share one large population. The prime aim of the project "Status and Conservation of the Alpine Lynx Population" (SCALP), started ten years ago by experts from France, Italy, Switzerland, Liechtenstein, Austria, Germany, and Slovenia, was to develop a common concept and monitoring, and to advance the co-operation across the Alps (Molinari-Jobin, this volume).

The goal must be to create a viable, self-sustaining and manageable lynx population covering the whole of the Alps. The justification for this goal is idealistic and ecological, but also formal: International treaties and agreements and national laws oblige us to maintain or to recreate viable populations of our indigenous species and their habitat. The Pan-Alpine Conservation Strategy for the Lynx (PACS; Molinari-Jobin et al. 2003), drafted by the SCALP expert

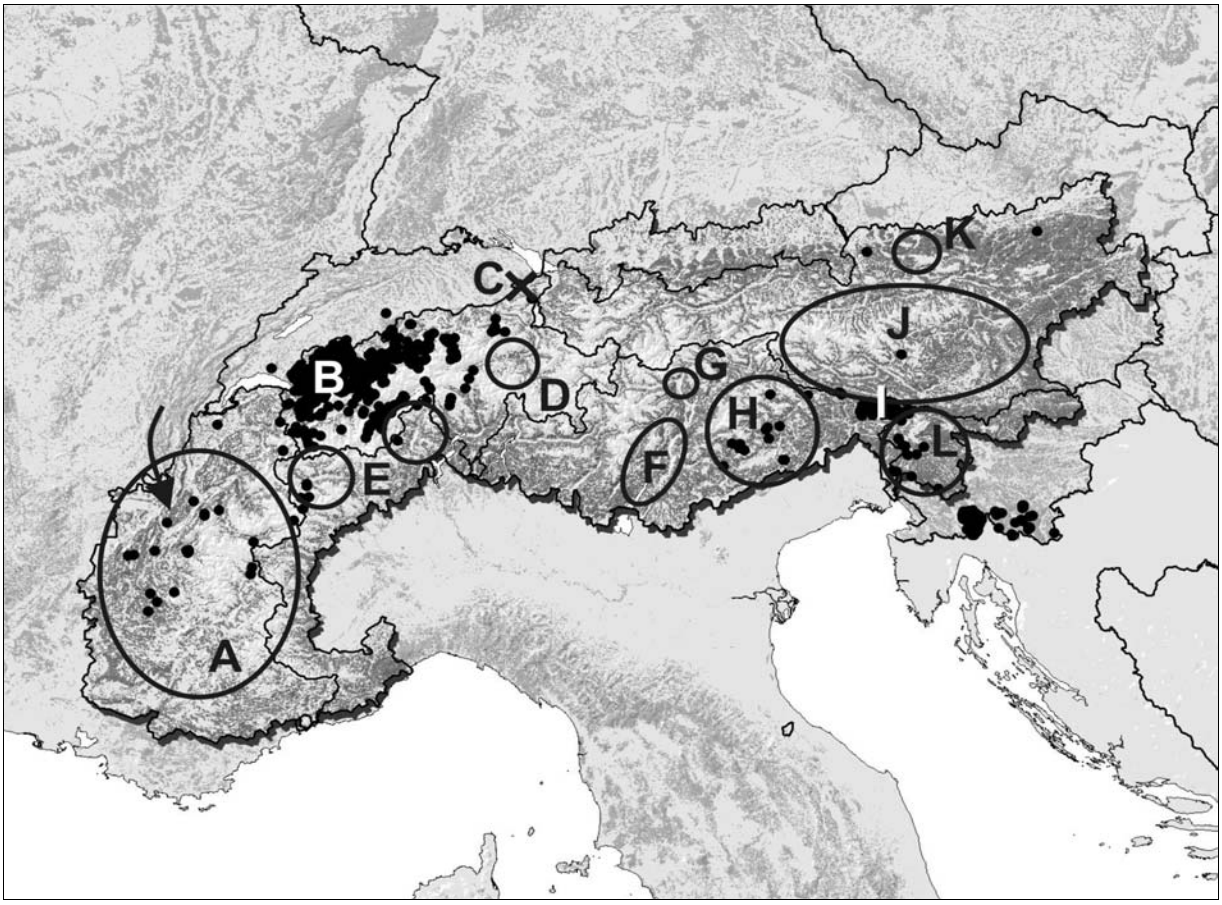

Figure 1. Recent development in lynx distribution in the Alps. The map presents the quality 2 observations (black dots) from the 1999 status report updates (references in text) as compiled in the pan-Alpine conservation strategy for the lynx (Molinari-Jobin et al. 2003). Circles and letters indicate areas of recent development or significant changes compared to the 1995 status reports (references in text): A – French Alps: Recent increase of observations also in the southern French Alps, where, however, the monitoring system is not yet as well established as in the northern part. Immigration from the Jura population probable (arrow). B – north-western Swiss Alps: High population density from 1995-1999, but no corresponding expansion of the population. C – eastern Swiss Alps: Release of nine lynx translocated from the north-western Alps (6 animals in 2001) and the Jura population (3 animals in 2003). D – Vorderrhein, Grisons: New local observations since 1998. E – Val d'Aosta and Valle d'Ossola, western Italian Alps: Increasing frequency of observations after 1995, but no confirmation since 1999. F – Trentino, Italian Alps: Occurrence extinct after 1995. G – Südtirol, Italian Alps: Lynx photo taken in 2001. H – Bellunese, Italian Alps: Observations after 1995, but no confirmation in recent years. I – Tarvisiano, Italian Alps: Increasing number of records in the past two years. J – Kärnten and Steiermark, Austrian Alps: No more reports in recent years. K – Kalkalpen, Austrian Alps: Observations (including photo) of maybe a single individual in the past two years. L – Slovenian Alps: Decreasing frequency of records since the 1999 status report.

group and endorsed by the Standing Committee to the Bern Convention in 2001, provides a framework for the conservation of the lynx in this largest European mountain range. The PACS reviewed the status of the species, assessed the Alps as a living space for the lynx, and listed actions recommended for each Alpine country. The PACS is an expert document, based on the principles of the Action Plan for the Conservation of the Eurasian Lynx in Europe (Breitenmoser *et al*. 2000). These strategies need to be implemented by the single countries, among others through the development of specific conservation action plans (Boitani, this volume). So far, Switzerland is the only Alpine country, which has implemented a management plan (Blankenhorn, this volume). Undoubtedly, lynx conservation problems were more pressing in Switzerland than elsewhere.

Why, given all the new insights and instruments we have developed over the past years, did the recovery of the Alpine lynx population not further advance since the first SCALP conference in 1995 (see Fig. 1)? There are several biological, organisational and political constraints hampering the spontaneous or human-supported spread of the lynx:

- The lynx is, by its life history, a relatively bad coloniser. The Alps are naturally and artificially fragmented (Zimmermann *et al*., this volume). For the species to spread across a barrier and to found a new (sub)population, a relatively high input is needed, requiring a strong demographic pressure (emigration) from the source population. However, a high local lynx abundance results generally in a hefty controversy, as local people do not accept peak lynx densities.
- The administrative level of the legal protection (European Union Habitat Directives, Council of Europe's Bern Convention, national laws) and of wildlife management is not the same. Although international conventions and national legislation is binding for the entire country, wildlife management is often within the competencies of the regions. Regional authorities fear the conflict between harvest (hunting of ungulates) and ecosystem conservation (recovery of carnivore populations).
- Lynx is removed from the influence of local institutions and people. Local interest groups, mainly hunters and sheep breeders, do however not welcome the return of the lynx. This restrains local and regional authorities to actively promote the return of the species.
- Regional authorities often claim to welcome the "natural" return of the lynx, but reject "artificial" reintroductions. This is of course semantic, as all lynx in the Alps were eradicated and spontaneous recolonisation is practically impossible. But most authorities are afraid to take the responsibility for a reintroduction, as the return of a large carnivore generally leads to a controversy between different NGOs and interest groups and often gets into local politics.
- Across the Alps, national and local authorities – as good as NGOs and scientists – have different priorities regarding large carnivore management. Wherever the return of the wolf or the brown bear dominates the public discussion, lynx conservation has a low importance.

Some important scientific questions remain to be solved – we do, for instance, not yet under-

stand the long-term effect of fragmentation (Zimmermann *et al*., this volume) or genetic isolation (Breitenmoser-Würsten and Obexer-Ruff, this volume) – we have the theoretical knowledge to do good conservation. Furthermore, the SCALP expert group has established common monitoring principles, and, though the monitoring must be improved in several parts of the Alps, we have a continuous surveillance of the Alpine lynx population. What we lack, however, is the favourable political milieu to advance lynx conservation across the Alps. National and regional GOs must play a significant role in lynx conservation, but in order to get active, they must be assured that the local population agrees. In our democratic civil societies, a formal legal obligation is often not enough for local authorities to act; there must be a strong commitment from the interest groups and the public. On the other hand, recreating a continuous population within reasonable time requires active management of the species across the Alps according to a general plan, so co-ordination on an international level. Clearly, it is a difficult endeavour to co-ordinate actions on an international, national and regional level. In order to advance the Alps-wide co-operation in and co-ordination of the lynx conservation, we need both, a top-down and a bottom-up process, and we have to address several tasks at the same time:

- To continue monitoring: A consistent monitoring is important to produce baseline data for any decision regarding conservation or management measures. The monitoring system can differ between the countries, but the interpretation must be compatible in order to allow for an Alps-wide assessment of the population status.
- To establish a lasting co-operation and co-ordination among national and regional GOs in charge of wildlife conservation and management. It is not enough to just accept a general goal as formulated above; the agencies should closely co-operate not only in lynx conservation, but also in regard to the spreading wolf and bear populations, and they must agree on common management principles (because all will eventually have to manage these populations). A multi-species approach, also including the ungulate populations, allows balancing between regional priorities and the shared goals for the whole of the Alps.
- To create a foundation of trust between conservation NGOs, interest groups and local people. The key to the long-term survival of the lynx in the Alps is not the enforcement of its legal protection (repressive measures are not only an illusion in the practical context of the hunting in the Alps, but also against the principles of public involvement), but a fundamental agreement about principles of coexistence with large carnivores in a cultivated landscape. In regard to the lynx, which causes only minor damage in livestock, but can have a considerable impact on local roe deer populations (Molinari and Molinari-Jobin, this volume), the most important partners in this discussion are the nature conservation organisations and the hunters. If they can work out a compromise regarding lynx conservation and management (including hunting of lynx), they could create the socio-political atmosphere for the national and regional wildlife management agencies to become active.

The SCALP conference in Amden was one more time a meeting of insiders. There were the experts, the GOs and the NGOs already present at the first conference in 1995. Three hunter's associations and two nature conservation organisations attended the conference, but no other interest groups did come. At the moment, the discussion about the conservation and

management of the Alpine lynx population seems to idle, leaving us with three groups: those who agree and know, those who do not agree, and those who do not want to know. The translocation of lynx from the western to the eastern Swiss Alps (Robin and Ruhlé, this volume, and Ryser *et al*., this volume) was a good example of a combined conservation and management project, but has already become a controversy in local politics. What can we do to overcome this deadlock? I see the need for action from all partner groups involved, the governmental agencies, the private organisations, and the scientists.

The GOs, both on national and regional level, need to organise their co-operation. They must agree on common goals and management and conservation principles and they need to implement those. This cannot be achieved in one meeting, but only in an ongoing, established process, through regular exchange of information and meetings to discuss actual problems. This discussion must include all large carnivore species, as a fact all wildlife populations requiring cross-border management and conservation, and must base on the principle that the whole of the Alps, and not only a part or a region, is the living space for these species.

The private organisations, NGOs and interest groups, must start to directly communicate and to work towards a practical compromise regarding the coexistence with large carnivores. As long as a theme such as lynx conservation is directly linked to fundamental views and is used to defend the own position, it will be hard to find a common solution. The organisations and the associations have a high responsibility to work towards a co-operation, in order to avoid that their groups become more and more polarised.

The experts, finally, must continue to produce baseline data and to assess the situation of the lynx in the Alps (and to do so, they need the support from the GOs and NGOs). Furthermore, the experts need to support the regional GOs and the private institutions to build partnerships and to incorporate their region or local situation into a more general concept and into a pan-Alpine picture. If the mountain does not come to the prophet (as we have partly experienced at the Amden meeting), the prophet must go to the mountain.

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