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Status of the Eurasian lynx (*Lynx lynx*) in the Italian Alps: an overview 2000–2004

Status risa (*Lynx lynx*) v Italijanskih Alpah: pregled za obdobje 2000–2004

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Abstract. To assess the status of lynx we analysed lynx signs of presence within the Italian Alps from 2000–2004. A total of 411 signs of lynx presence have been collected, compared to 261 signs during the previous pentad. Lynx tracks were the most frequent sign of presence, followed by prey remains and direct observations. Livestock depredation has so far not been a problem in Italy. Most of the presence signs (84%) are still concentrated in the Eastern Italian Alps in Friuli V.G. and the province of Belluno. A few confirmed lynx signs of presence indicate a recolonisation of the Trentino Alto Adige region. In the western Alps (Piemonte region), most signs of lynx presence are concentrated close to the French border. The number of lynx occurring in Italy is roughly estimated to less than 20 individuals. The population cannot be considered viable and is still depending on immigration from neighboring countries.

Keywords: *Lynx lynx*, Italy, monitoring, status, Alps

Introduction

Re-introduction programmes of lynx are not known to have been carried out successfully in Italy (Ragni & al. 1998). But as a consequence of re-introduction projects in Switzerland, Slovenia and Austria, the lynx returned to Italy at the beginning of the 1980s (Guidali & al. 1990, Ragni & al. 1998, Molinari 1998, Bologna & Mingozzi 2003). They spread from the Austrian and Slovenian re-introduction sites towards the north-east of the Friuli V.G. region where they established a regular occurrence (Molinari & al. 2001). A second, isolated occurrence of unknown origin was reported from the southern Dolomites in the Trentino region (Ragni & al. 1998). However, by the end of the 1990s, the trend in the Trentino occurrence was clearly negative, as only very few signs of lynx presence were collected (Molinari & al. 2001). Besides, some scattered observations were recorded also from the Val d'Aosta and the Piemonte close to the Swiss border (Molinari & al. 2001, Bologna & Mingozzi 2003).

In the frame of the SCALP (Status and Conservation of the Alpine Lynx Population), each Alpine country updates the status and distribution of lynx in the respective territory in a 5-year rhythm. Here we report on the development of lynx signs of presence within the Italian Alps from 2000–2004, outline trends per region and estimate the number of lynx present.

Methods

The collection of lynx signs of presence is effectuated by means of a network of people, mainly game wardens and foresters, who have attended special training courses. The number of trained people varied between regions as follows: 3 Ligura, 10 Piemonte, 25 Val d'Aosta, 5 Lombardia, 50 Trentino Alto Adige, 20 Veneto, 40 Friuli V.G. (on the whole, n = 153 people). 35% of these persons attended for the first time a training session, while for the others it was a repetition, as they had been already trained during the previous pentad. Whenever possible, these "lynx experts" verified the signs of presence reported to them by the general public. Within each region, one or two persons were responsible for the centralisation of the data. We distinguished three levels of data reliability in accordance with the SCALP guidelines (Molinari-Jobin & al. 2003) and the possibility to verify the collected data: Category 1 signs (C1) represent the hard facts, e.g. all reports of lynx killed, found dead, photographs or videos of lynx as well as scats that have been genetically analysed. Category 2 signs (C2) include all records of wild prey remains, livestock killed and tracks confirmed by people who attended special courses, e.g. mainly game wardens and foresters. As all these professionals were instructed in how to recognise lynx signs of presence, these records are mostly an objective proof of lynx presence, though both errors and even deception may occur. Category 3 signs (C3) represent all signs of lynx presence reported by the general public as well as all sightings and vocalisations, e.g. signs that cannot be verified. To estimate the extent of lynx occurrence area, we buffered the point data with a buffer of a radius of 5 km, resulting in an approximate area of 80 km^2, which corresponds to an average female home range size (Breitenmoser-Würsten & al. 2001).

To improve data quality and to get a minimum number of lynx present we installed camera traps at fresh kills whenever possible in the Friuli V.G. region from 2003 onwards. Due to the unique coat pattern, lynx can be identified individually by their photographs (Laass 1999). Besides, from 19. February to 8. April 2004, 12 camera traps have been installed systematically on game passages in the Julian Alps of Friuli V.G. The Minimum Convex Polygon covered with camera traps comprised an area of 50 km^2. All spatial analyses have been performed in the Geographic Information System (GIS) ArcView 3.3 (ESRI 1996 a,b,c).

Results

From 2000–2004, a total of 411 signs of lynx presence have been collected, compared to 261 signs during the previous pentad (Molinari & al. 2001). Overall, 56% of all signs recorded belong to the categories of C1 and C2, thus have been confirmed (Table 1). Although in 2003 no C1 data was reported, it was the year with the highest number of lynx signs of presence. Lynx tracks, of which 82% have been verified (C2), were the most frequent sign of presence. Livestock depredation has so far not been a problem in Italy. Only two cases of reproduction were reported: both were direct observations of two independent people (Italo Buzzi & Caterina Rinaldi) who saw a lynx with two kittens traversing a road in the Carnic Alps (Pontebba) in 2003 on two consecutive days in October (Fig. 1c).

Table 1: Number of lynx records collected per year per category.

	2000	2001	2002	2003	2004	Total
Category 1						
Photo		1	1		2	4
Scats[1]	1	1				2
Total	1	2	1	0	2	6
Category 2						
Livestock killed	1		1			2
Wild prey remains	7	10	8	24	15	64
Tracks	13	23	27	53	44	160
Total	21	33	36	77	59	226
Category 3						
Wild prey remains	4	4	7	11	13	39
Tracks	9	7	5	4	10	35
Sightings	23	11	23	24	16	97
Vocalisations				3		3
Scats	1			1	3	5
Total	37	22	35	43	42	179

[1] Genetically confirmed lynx scats.

Most of the presence signs (84%) are still concentrated in the Eastern Italian Alps in Friuli V.G. and the province of Belluno (Fig.1, Tab. 2). It is also in this area where most effort was made to verify lynx signs of presence, as 62% of signs of presence are C2 whereas in the Central Alps, 18% are verified and in the Western Alps 6%, respectively.

Table 2: Number of C2 data recorded per region and year.

Year	Val d'Aosta	Piemonte	Trentino Alto Adige	Veneto	Friuli	Total
1992	1			1	11	13
1993	3		1	1	6	11
1994			5	1	8	14
1995		1	1	5	14	21
1996				1	12	13
1997			1	1	12	14
1998		1		6	10	17
1999	5	3			9	17
2000	1		1	1	18	21
2001			4		29	33
2002		1		2	33	36
2003				1	76	77
2004			1		58	59
Total	10	6	14	20	296	346

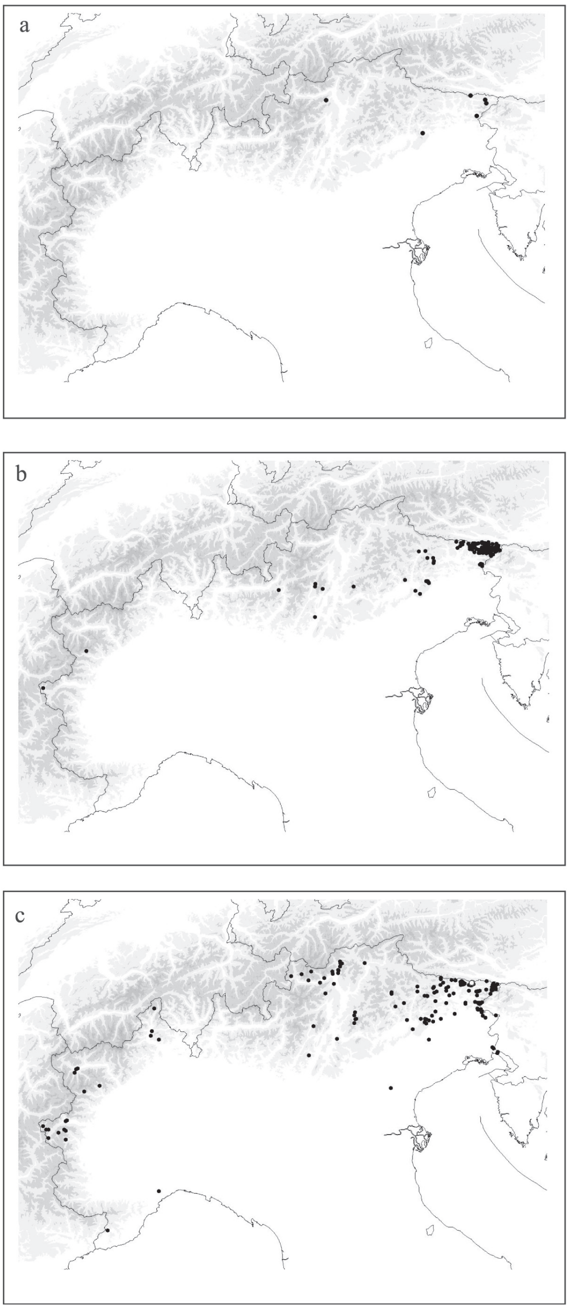

Fig. 1: Distribution of lynx signs of presence in the Italian Alps for the five-year period 2000-2004. (a) Category 1 data: photos, confirmed scats. (b) Category 2 data: killed livestock, confirmed wild prey remains and tracks. (c) Category 3 data: unconfirmed wild prey remains and tracks, sightings and vocalizations. The white dot indicates the area where reproduction was observed.

The area occupied by lynx estimated by means of a 5 km radius buffer ranged from 433 km^2 of the C1 data, 2491 km^2 of the C2 data to 6534 km^2 of the C3 data. Since some of the C3 data are very geographically isolated and lynx experts were not able to confirm lynx presence within the 5 years considered but on the other hand the C1 data is highly depending on monitoring effort, we consider the 2491 km^2 of the C2 data most realistic.

In the Italian Alps, 5 different lynx were photographed until the end of 2004. The first photos were made as early as 1989, when a game warden (Carlo Vuerich) took photos of a lynx hunting a marmot in the Carnic Alps, Friuli V.G. (Molinari 1998). The second photo was taken by a forest warden (Paolo de Martin) in the Julian Alps, Friuli V.G. in 2001 and the third by a game warden (Eduard Gassebner) in the Alto Adige in 2002 (Fig. 1). In 2003 no lynx was pictured, although camera traps have been installed at 6 different kills in Friuli V.G. Unfortunately, either the lynx did not come back or the camera trap did not work. In 2004, camera traps were installed at 8 different kills in Friuli V.G. and at two occasions photos of two different individuals were taken, one in the Julian and one in the Carnic Alps (Walter Vuerich, Maria Festa). On game passages, camera traps were active in 2004 during 308 trap nights but no lynx was pictured.

Discussion

Lynx signs of presence have increased in the early 2000s compared to the previous pentad. This trend has to be at least partly explained by increased monitoring effort. The only area with newly detected presence of lynx is the western Friuli V.G. where a lack of monitoring effort has been reported previously (Molinari & al. 2001). The distribution of the 2000–2004 data indicates a contiguous population from north-eastern Friuli V.G. through to the province of Belluno (Fig. 1), although more effort is needed to confirm lynx signs of presence. In Friuli V.G., the number of C2 records increased considerably (Table 2). However, by means of camera traps only 2 different individuals were distinguished, one in the Julian and the other in the Carnic Alps. Unfortunately, on the photo of 2001 in the Julian Alps we were not able to identify the lynx. Camera trapping effort was reduced in 2004 to a small area of only 50 km^2 and a short period due to low budget. During this time no lynx was pictured nor during the checking of camera traps tracks have been found. We conclude that even in this area of Italy, where most signs of presence come from, only few individuals are present. But the use of camera traps to identify more different individuals will be extended in the future.

Except for north-eastern Italy, lynx occur only in areas bordering with Switzerland or France. While in the canton of Valais in Switzerland the trend of reported lynx signs of presence decreased since 2000 (Zimmermann & al. 2004), in France, the trend is positive in the northern French Alps (Marboutin & al. this volume). In Piemonte, most signs of lynx presence are concentrated in the Upper Susa Valley, close to the French border (Fig. 1c). A few confirmed lynx signs of presence indicate a recolonisation of the Trentino Alto Adige region. In 2002, a game warden (Eduard Gassebner) from the Province of Alto Adige presented a close-up photo of a lynx. Afterwards, some C3 data were collected from the same area. We suspect that the lynx most probably has been released from captivity, as it was the same year as Italian law changed the conditions for keeping "dangerous" animals.

The number of lynx occurring in Italy is roughly estimated to less than 20 individuals. The population cannot be considered viable and is still depending on immigration from neighboring countries.

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Survey of the Lynx distribution in the French Alps: 2000–2004 population status analysis

Pregled razširjenosti risa v Francoskih Alpah: analiza statusa populacije za obdobje 2000–2004

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Abstract. Within the SCALP framework, the status of the pan-alpine population of Eurasian Lynx is assessed every 5 years, based on the compilation of national reports and standardized classification of lynx presence signs according to data confidence levels (C1, C2, C3). From 2000 to 2004, the French national network of lynx experts collected N= 393 data, out of which 224 (compared to only 69 in 1995–1999) were considered as robust enough to evidence the presence of lynx (C1 = 1%; C2 = 42%; C3 = 57%) and were used for further analysis. A majority of the signs concerned the northern part of the Alps, however, in mostly two regions (Chartreuse/Epine : 34% of the signs; Maurienne: 21%). Other data were more scattered over space, from the Chablais region close to Switzerland down to the Haut-Verdon close to the Mercantour mountains. A negative trend was noticed from north to south in proportions of best quality signs (C1+C2), and a positive one in low quality ones – C3 – (χ^2 = 3.56, 1 df, p = 0.06), which could point at some methodological artefacts. Discarding C3 may however be too conservative a strategy to assess the species range and status. Using spatial recurrence and trend over time of all signs available (C1+C2+C3) could, therefore, provide the right balance between being *too much* versus *not enough* conservative. – When doing so, the area with lynx signs regularly detected sharply increased between 1996–1998 (100 km²), 1999–2001 (250 km²), and 2002–2004 (1195 km²). The latter area is still quite small regarding what is required for a viable large carnivore population. A simple demographic model suggested that even a quite moderate proportion of immigrants (e.g. dispersal inflow from neighbouring core areas – French Jura or Swiss Alps) could considerably decrease the theoretical demographic extinction risk of such a small population, but still depending upon adult survival rates, which also strongly influenced the extinction risk. The factors that may influence this sensitivity analysis (such as habitat connectivity and management of wooded corridors) should be evaluated within the Scalp framework.

Keywords: *Lynx lynx*, France, Alps, distribution, monitoring, population viability

Introduction

Standardized monitoring over countries that share large carnivore populations is obviously the first step towards a common management of these species. Over Europe, such an international collaboration for population monitoring is now properly implemented only for the Eurasian lynx over the Alps within the SCALP framework (Molinari-Jobin & al. 2003). The status reports about the national sub-units of this conceptual population build up a key-issue for assessing the overall status of the pan-alpine "meta-population" (see Hystrix, vol. 12(2), 2001 for the 1995–1999 period), and regular meetings held under the auspices of SCALP yield valuable contributions (e.g. Molinari-Jobin & al. 2005). The present paper provides the 2000–2004 French update, together with some simple demographic modelling to roughly enlighten the importance of dispersal and connectivity on the demographic viability of the 'French' alpine sub-population. Dispersal, indeed, is a key-parameter when considering fragmented and/or small populations (see e.g. Schadt 2002; Zimmermann 2004). Factors affecting the habitat continuity – e.g. roads and traffic volume, fencing – may, therefore, result in barrier effects to dispersal, and increased population extinction risk due to isolation (Klar & al. 2006).

Methods

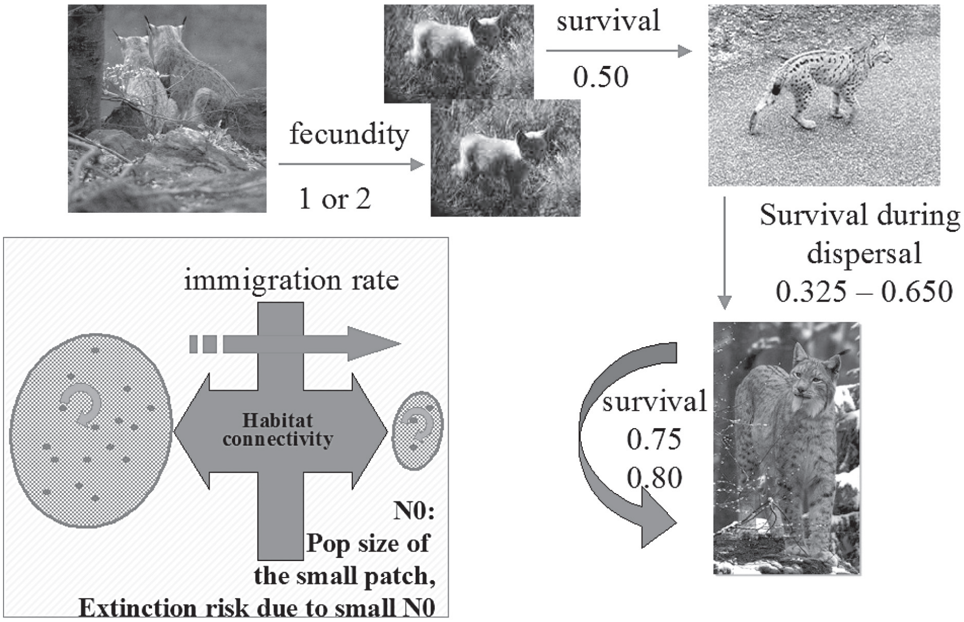
Lynx monitoring in France

The lynx monitoring in France is based on an extensive field work by a national network of about 850 lynx-experts who have been specially trained to collect possible presence signs (scats, tracks, visual observations, wild and domestic preys). All the data are validated by a single national expert (Office National de la Chasse & de la Faune Sauvage) using a standardized grid of criteria that basically relies on the degree of convergence between technical characteristics within each presence sign (see Vandel & Stahl 2005, for a detailed description). Such a centralized process ensures that any field data is analysed in the same way, wherever it comes from and whoever collected it. The presence signs, once validated, are converted into C1, C2, C3 categories to fit to the SCALP requirements: C1 are hard facts such as captures, dead lynx, photos; C2 are data directly collected by lynx-experts and further confirmed by the national expert; C3 are data indirectly collected by lynx-experts from the general public and confirmed by the national expert. Biologists in charge of evaluating the lynx status usually devote most consideration to direct data first (C1+C2).

Regarding range estimates, point data (i.e. defined by X, Y coordinates) were transformed following Vandel & Stahl (2005)'s method: each data was attributed a spatial buffer of 81 km² grid area of theoretical lynx presence, made of nine 3 x 3 km elementary squares, centred on the given X,Y coordinates. The sum of the squares was the estimated overall range. When overlapping maps from different yearly periods, the elementary squares that were regularly "lynx-positive" made up the regularly occupied area, a conservative estimate of lynx distribution (since areas newly or irregularly detected were discarded).

Demographic modelling

Because the French alpine population may be considered as small relative to other alpine ones (von Arx & al. 2004) and may be demographically connected to those from the Jura Mountains and Swiss Alps, its long term viability may depend on immigration from these areas. Using Monte Carlo runs within the ULM package (Legendre & Clobert 1995), a simple female-based model (with 3 age classes: kitten, sub-adult, adult; see the life cycle and structure of the model, Annex 1) with demographic stochasticity on vital rates was used to compute relative population viability analyses (PVA) according to the proportion of additional input from immigration. Mean survival and fecundity rates were from the literature (Schadt 2002), and the influence of dispersal on the population extinction risk was modelled, step-by-step, by adding a given proportion of immigrant sub-adults to the initial population size. Because the colonizing process within the French Alps is still active over a very large un-colonized area, dispersal of local sub-adults out of the Alps was set to zero – i.e. *immigration to* but no *emigration from* the French Alps. Because the dispersal success may depend on habitat fragmentation, an additional barrier mortality was incorporated into the model, simulating either strong connectivity (i.e. weak additional mortality of $^{1}/_{3}$) or weak connectivity (i.e. large additional mortality of ½). The extinction risk was estimated by the proportion of trajectories that went under a minimum of 1 individual within 1000 trajectories simulated over 100 years.



Annex 1: Life cycle and structure of the demographic lynx model
The model is run in the framework of demographic stochasticity on survival rates, to simulate the chance extinctions due to small numbers of individuals. Both the immigration and survival of sub adults while dispersing between sub populations are modulated. Transition probabilities between age classes are fecundity and survival rates from the literature. Two level of habitat connectivity between populations are simulated: a weak connectivity associated to a large cost of dispersal (i.e. a strong additional mortality rate of 50%); a strong connectivity associated to a low cost of dispersal (i.e. a weak additional mortality rate.

Results

Lynx distribution

During the 2000–2004 period, N = 393 data have been collected, out of which 55% have been finally validated and used for further analysis. Despite this large number of data discarded, a sharp increase in the number of validated data is observed for the last pentad (Table 1). Although C3 are still in a majority, robust data about the lynx presence (i.e. C1+C2), are obviously increasing too. Most of the presence signs were, however, still concentrated over some very limited areas in the northern French Alps (Fig. 1), such as the Chartreuse / Epine massif, the Maurienne valley, and the Bauges massif (respectively n = 72, n = 45, and n = 20, i.e. 34%, 21%, and 9% of all signs of presence). North to Annecy and south to Grenoble, the data were more or less scattered over space, from the Chablais region down to the Haut-Verdon. Location of data (north to Grenoble *vs.* south to Grenoble) and data type (C1+C2 *vs.* C3) were not independent (Table 2, $\chi^2 = 3.56$, 1 df, $p = 0.06$): there was a negative trend from north to south in proportions of C1+C2, and, conversely, a positive one in C3.

Table 1: Numbers of lynx presence data, according to SCALP categories, validated over the French Alps.

Categories	1990–94	1995–99	2000–04	Total
C1	2	0	3	7
C2	5	7	92	103
C3	24	62	128	214
Total	31	69	224	324

Regarding range estimates, the area regularly occupied (using C1+C2+C3) increased from 100 km² in 1996–1998, to 250 km² in 1999–2001, and up to 1195 km² in 2002–2004. When adding areas newly detected, for which no one knows whether they will finally contribute to the regular area of the species, the total estimate amounted to 4444 km². Because the latter value is based on large numbers of C3 detected for the very first time in new areas, one would better consider the lower range estimate (1195 km²), computed only from those C1+C2+C3 that were recurrent over time.

Table 2: Unbalanced numbers of lynx presence data, according to SCALP categories (C1+C2 versus C3), and to geographical location.

Categories	North to Grenoble	South to Grenoble
C1+C2	80 (46%)	16 (31%)
C3	93 (54%)	35 (69%)
Total	173	51

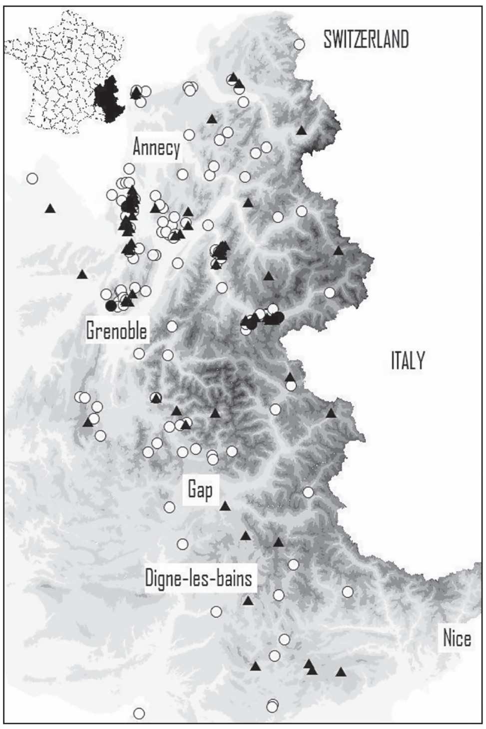


Fig. 1: Distribution of validated lynx signs (●= C1, ▲= C2, ○= C3) collected from 2000 to 2004 in the French Alps; shaded areas represent altitudinal patterns (the darker, the higher).

Population dynamics modelling

Demographic parameters were derived from Schadt (2002). Survival rates were set at 0.50 (kittens), 0.65 (sub-adults), 0.75–0.80 (adults); fecundity was 1 for the first attempt to breed, and 2 for older females. When using such values within a simple matrix-based deterministic model, the yearly population growth rate was λ= 1.02 – 1.07 (i.e. 2 to 7% increase/year); λ was more sensitive to changes in adult survival rates (elasticity: 0.66) than to changes in any other vital rate (e.g. overall fecundity : 0.17): a 10% increase in adult survival would yield a 10 x 0.66 = 6.6 % increase in λ, whereas a similar 10% increase in fecundity would yield only a 10 x 0.17 = 1.7% increase in λ. Within the stochastic framework (Monte Carlo runs), the extinction risks were, therefore, modelled according to changing adult survival rates (0.75 or 0.80); the dispersal success between source and target populations was modulated too, using additional mortality rates of $^1/_3$ or ½ as a simulation of differences in habitat connectivity due to e.g. fragmentation of wooded corridors [i.e. survival while dispersing within a patch: 0.65; survival while dispersing between patches: 0.65x(1–0.33) = 0.50 or 0.65x(1–0.50) = 0.325 according to high vs. low habitat connectivity].

A rough and conservative estimate of lynx numbers in the French Alps may be obtained using an average winter density of 1 adult/100 km² together with 0.5 young/100 km² (Haller & Breitenmoser 1986; Breitenmoser-Würsten & al. 2001) over the estimated range (1195 km²). Assuming a balanced sex-ratio, half of the resulting value was used as an initial population size (i.e. 9 females) in Monte Carlo runs to simulate extinction of population trajectories.

The extinction risk decreased sharply with increasing immigration rates, and reducing the level of theoretical mortality while dispersing from higher to lower values improved population persistence too (Figure 2A). This pattern was most pronounced when adult survival rate was lower: once this rate amounted 0.80, the extinction risk was moderate even with no input from immigration (Figure 2B). The influence of immigration on extinction risk logically depended on survival rates (of sub-adults and adults), but some kind of similar 'threshold effect' was observed with a 5–10% immigration rate.

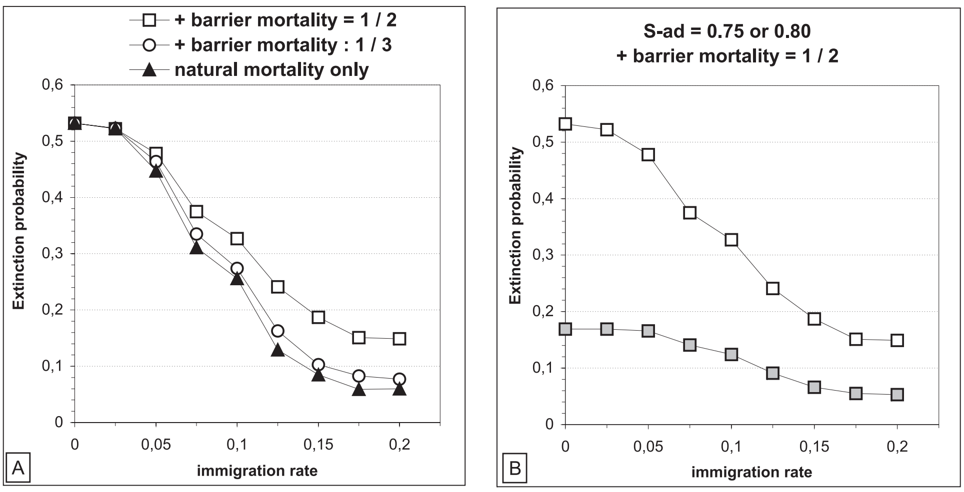


Fig. 2: Extinction risk (y-axis) as a function of increasing (0 to 20%) immigration rates (x-axis); survival of dispersing sub-adults is modulated (A- barrier effect) together with that of philopatric adults [B- □: S-ad = 0.80; ■: S-ad = 0.75].

Discussion

During the 2000–2004 period, the strong increase in numbers of lynx signs collected is likely to reflect both a higher sampling rate (quite a large number of new lynx-field experts have been additionally trained to collect possible lynx signs), and an actual north-to-south colonizing process of the lynx. In spite of this active colonizing process, the *detected* distribution area of the species is still composite: north to Grenoble, the range is more or less continuous and documented by quite robust data (C1+C2), whereas, southward to this latitude, only islets of presence that are mostly C3-based have been detected so far. Because the lynx expert network is implemented now in the whole possible distribution area of the species, the latter trend (more and more C3 south to the core area) could illustrate sampling artefacts (C3 being more likely in those newly- or even non-colonized areas). This might therefore suggest that the lynx status over the French Alps be first assessed in a conservative way, i.e. using preferably C1+C2 data only. However, within C3s collected at time *t*, those that were actual artefacts are unlikely to be spatially recurrent later on, whereas those that were not artefacts are likely to be next confirmed either as C3s, C2s, or even C1s. The spatial recurrence of all data available (C1+C2+C3) could, therefore, be used as a complementary approach to assess the lynx status.

The spatial patchiness in the distribution of lynx signs may reflect a low efficiency of the expert network to record these data under the alpine environmental conditions. The relationship between the locations of lynx signs of presence and the surrounding eco-variables (altitude, steepness, percentage of wood, distance to roads or cities) have been modelled using the ENFA method (Hirzel & al. 2002; Basille 2004). The resulting map displayed a very patchy distribution of areas where lynx signs would likely be detected (Figure 3), and a methodological bias due to habitat accessibility was suspected (e.g. a negative relation was noted between signs of occurrence and increasing distance to roads). Contrary to the academic and biological findings in Zimmermann (2004), our map reflects only the sub-sample of the potential distribution area for which the expert network could detect lynx signs of presence. The next issue is to improve the detection rate of such signs, based on e.g. an extensive use of remote camera traps or hair snares (see Zimmermann & al. 2006, Marboutin & al. 2005). Despite the possible under estimation of the range occupied, lynx presence signs are however found over larger and larger areas; the species is now well established and regularly detected in several mountainous geographic entities (see Table 2 in Vandel & Stahl 2005 for a detailed review). Compared to the previous SCALP-update (1995–1999, Stahl & Vandel 2001), numbers of detected signs and corresponding areas are, from north to south: i) stable north to Annecy (Chablais, Chamonix, Glières-Aravis , Vuache-Salève); ii) stable (Belledone-Oisan-Taillefer) or increasing (Bauges, Maurienne, Chartreuse-Epine) between latitudes of Annecy and Grenoble; iii) stable but scarce and scattered (Dévoluy- Beauchêne, Valbonnais-Valgaudemard, Briançon-Queyras) between latitudes of Grenoble and Gap; iv) still to be confirmed (Monges, Embrunais-Ubaye, Haut-Var, Haut-Verdon-Canjuers) south to Gap (Fig. 1). Such a patchy distribution of lynx signs results in a small proportion of the total area being regularly occupied: in 2002–2004, the overall range detected was about 4500 km² out of which only 1200 km² with regular presence. The corresponding population size (roughly estimated to less than 20 animals) can obviously not be considered a long term viable unit, from the demographic or genetic point of view.

From a theoretical basic modelling, the influence of demographic stochasticity on extinction risk could be buffered first with increasing adult survival rates, and with moderate immigration rates (5–10 %). Immigration also means that the local dynamics *within* the source population are very important too. Population simulations are projections rather than exact predictions, because they rely on the quality of both model structure and demographic data. They should mostly be used, as a result, to evaluate relative outputs of different scenarios. In the present case, reducing for example the theoretical mortality induced by the barrier effect from ½ to $^1/_3$, when dispersal rate is 0.15, would induce a 50% relative decrease in extinction risk (from 0.2 to 0.1). Such results should only be regarded relative values, as they are partly conditional on the structure of the model and parameters' values. Increasingly powerful but complicated models are available (e.g. Schadt & al. 2002, Wiegand et al.

2004), so the trade-off is now between richness of model structure and availability of field estimates for their parameters. Above all, the present results should be analysed as an illustration that factors affecting dispersal patterns may be key-ones, but conditional on patterns in adult survival rates. When these vital rates are to fluctuate over time/space (e.g. due to diseases, or man-induced mortality) the buffering influence of immigration on extinction risks should not be neglected. Some emphasis should also be put on the study of dispersal patterns since recent results have shown this phenomenon is area-specific (Zimmermann & al. 2005). Factors that may improve the dispersal success, such as habitat connectivity and management, based on the conservation of e.g. wooded corridors, should therefore be evaluated as a possible key-issue for lynx conservation (Zimmermann 2004, Klar & al. 2006). The SCALP approach perfectly fits into that framework since it makes use of trans-boundary monitoring of populations and management of key-factors as a basis for defining what could be a robust conservation biology strategy.

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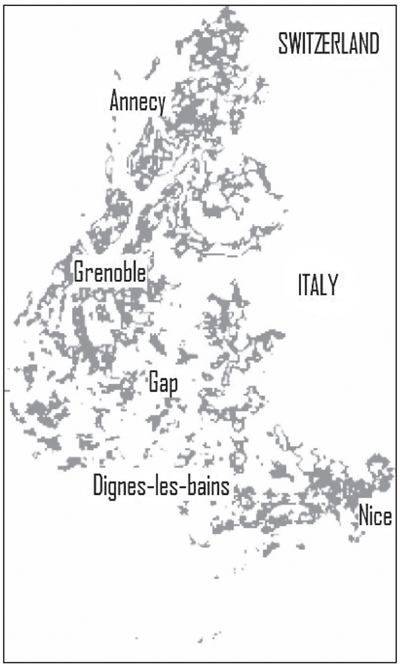

Fig. 3: ENFA-based modelling of the potential distribution of detected lynx presence signs. The grey areas are those with higher detection likelihood, i.e. those where the lynx-experts network would likely collect presence signs given the presence of the species AND the environmental conditions (slope, altitude, wooded area, distance to roads).

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Status and distribution of the Eurasian lynx (*Lynx lynx* L.) in Slovenia in 2000–2004 and comparison with the years 1995–1999

Status in razširjenost risa (*Lynx lynx* L.) v Sloveniji med leti 2000–2004 in primerjava z obdobjem 1995–1999

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Abstract. We have analysed recorded signs of lynx presence in Slovenia for the period 2000 – 2004 and compared them with the 1995 – 1999 period to determine population status, trends and range.

The analysis included 908 recorded signs of lynx presence, which is an 80% increase compared to the previous five-year period. The lynx monitoring has improved, both in the total number of acquired data, as well as in the share of the higher-reliability data. With regard to lynx presence, Slovenia can be divided into four areas: (1) the southern part, the area south of the Trieste–Ljubljana–Zagreb motorway (Kočevska and Notranjska regions), the area to which the lynx was first reintroduced and where the majority of the lynx in Slovenia are still present today, (2) the north-western part of the country with Julian Alps, the area that the lynx started to colonize in the mid eighties of the previous century, (3) Kamnik–Savinja Alps and some other, isolated areas with occasional lynx presence, (4) other areas (North-eastern and Eastern Slovenia), where lynx are not present. Based on the collected data we estimate there are 30 – 50 animals of this species present in Slovenia, 15 of which live in the western part of the country. The size of the lynx range has not decreased over the last five years, and the number of damage cases has increased. Compared to the previous period the status of the lynx population remained unchanged during the 2000 – 2004 period, and so the Slovenian population still remains one of the most vital populations in the Alps.

Keywords: Slovenia, *Lynx lynx*, SCALP, monitoring, distribution

Introduction

This report presents an analysis of recorded signs of lynx presence and spatial distribution of this species for the 2000 – 2004 period, as well as comparison with the 1995 – 1999 period. The lynx has been exterminated from most of Europe, including the area of Slovenia, around the year 1900. Kos (1928) reports that the last lynx in Slovenia was most probably killed in 1908. The attitudes of people towards this largest European cat have changed, and the results were the first reintroductions of the lynx to some European countries during the years 1970 – 1980. In 1973 the lynx was reintroduced to Slovenia, from where it soon spread to the neighbouring Croatia (Čop & Frković 1998). Started simultaneously with the reintroduction was a research project studying its success and following the spread of the newly established population. The study was done by the Institute for Forestry and Wood Science from Ljubljana, and led by Mr. Janez Čop. Today, the Slovenian lynx reintroduction is considered to be among the most successful reintroductions in Europe. Its chronology is described in the report about the reintroduction project (Čop 1994).

In 1978, five years after the reintroduction, the competent ministry issued the first decision allowing an exceptional cull of the first five lynx. Each culled lynx had to undergo a veterinary examination at the Department of Veterinary Medicine of the Biotechnical Faculty in Ljubljana. Until the present day, a total of 139 lynx were legally culled, killed by traffic or found dead. Including Croatia, this number exceeds 300 (Kos & al. 2005, Frković 2003). A radiotelemetry study of lynx behaviour took place in Slovenia during the years 1994 and 1995. The project provided the first data about habitat utilization and social structure of the lynx population in the Dinaric high karst area, but it also opened some new questions, especially regarding the food ecology (Huber & al. 1995). The first report on the status of the lynx population in Slovenia and Croatia was produced within the framework of the SCALP project (***S****tatus and* ***C****onservation of the* ***A****lpine* ***L****ynx* ***P****opulation*) in 1995 (Čop & Frković 1998). The second report was produced in 2000 (Staniša & al. 2001) for the 1995 – 1999 period. The present, third report presents the results of the monitoring effort, and analyses developments in the Slovenian population during the 2000–2004 period.

In Slovenia the lynx enjoys a year-round protection and is listed among the rare and threatened animal species. Based on the data about the lynx population size, recorded signs of lynx presence, realization of cull in the previous period and damages to livestock, the competent ministry can issue a decision permitting exceptional cull of a certain number of lynx. The cull is spatially distributed into individual regions, and is limited to the hunting season, usually from October until the end of February. A new decision is issued for every calendar year. Based on the collected data, the competent ministry decided not to issue this decision on three occasions since 1995 – in 1997, 1999 and 2000. The Rules on Taking of Lynx from the Wild for 2004 for the first time took into account the recommendation of the SCALP group not to hunt the lynx in the Alps and in the pre-Alpine regions north of the Maribor–Ljubljana–Nova Gorica line.

Methods

In Slovenia, the status of the lynx population wasn't analyzed exclusively for the Alpine part of the country as is the case in the other SCALP reports. Data from the entire country was taken into account, as the events taking place in the lynx core area to the south of the country carry great importance for its spatial expansion into the Alps. To ensure comparability of the data with the other Alpine countries, we divided the population into: (1) the north-western sub-population, located west of the Jesenice–Ljubljana–Trieste motorway, and (2) the southern sub-population, located south of the Trieste–Ljubljana–Zagreb motorway (Figure 1).

All the collected data have been evaluated according to the unified SCALP system, providing for comparability of the data between countries. The data is divided into three categories based on their reliability:

- The first category (C1) includes all undisputable facts of lynx presence (shot animals, traffic and other mortality).
- The second category (C2) includes all recorded signs of lynx presence that have been verified by SFS (Slovenian Forest Service) lynx experts. This includes the data about damages to livestock, tracks, scats, losses of game animals attributable to the lynx, as well as other verified signs of lynx presence. This category also includes all the data collected by professional hunters in the special-purpose hunting reserves.
- The third category (C3) includes all other collected data that haven't been verified.

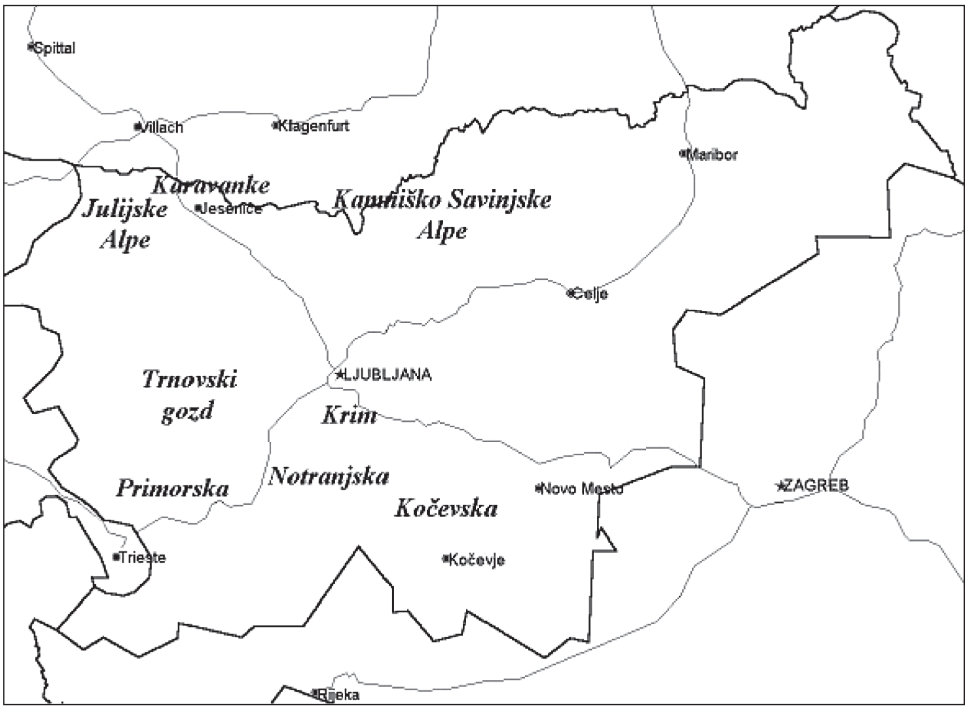


Fig. 1: Map of Slovenia showing some of the places mentioned in this report.

The data about the lynx in Slovenia is collected using different approaches:

(1) Ever since the reintroduction in 1973, the data about all verified mortality (traffic, found dead) and cull of the lynx is collected over the entire area of Slovenia.

(2) Since 1976, all losses of game animals are recorded in hunting statistics (required by the Hunting Laws of 1976 and 2004).

(3) Since 1986 in the Medved Kočevje Hunting Reserve, renamed Special Purpose Hunting Reserve Medved (LPN Medved) in 2004, and since 1991 in the Jelen Snežnik Hunting Reserve (today Special Purpose Hunting Reserve Jelen Snežnik or LPN Jelen Snežnik), all observed signs of lynx presence are recorded in a grid of squares. The size of the grid cell is 1×1 km. The total size of both areas is 73,000 hectares. A similar system is being used to record lynx presence in the Triglav National Park (Special Purpose Hunting Reserve Triglav or LPN Triglav) over the total area of 58,000 hectares.

(4) In 1996, monitoring was organized in North-western Slovenia where all observations in the area of 220,000 hectares are recorded with their geographic coordinates.

(5) In 1998 the Slovenian Forest Service started a monitoring based on a grid of forest sections in Notranjska, Kočevska and Primorska regions, where lynx presence is the strongest. The data are collected by district foresters and have a better than 1 km^2 spatial precision. In the areas where the lynx are not permanently present, the presence data are recorded through the SFS, Department of Forest Wildlife and Hunting. These data are usually categorized C3.

(6) Since 1996, SFS records all data about lynx damages to livestock using a unified methodology. The data are categorized C2.

Estimation of the lynx population size and its spatial distribution in Slovenia is based on data obtained from all six data sources. During the 2000 – 2004 period, geographic coordinates have also been recorded for all the collected data with a better than 1 km^2 spatial precision.

To describe temporal trends of lynx mortality, monitoring data from the special-purpose hunting reserves and damages to livestock, we used a fourth degree polynomial or the logarithmic curve, respectively. The population range of the lynx was described using the fixed Kernel method, using the areas that included 95%, 75% and 50% of the monitoring data points. This was done independently for the 1995 – 1999 and 2000 – 2004 periods. For determination of the population range, only the C1 and C2 data should be considered; however, we also used the C3 data. The reason is that the spatial locations of the C3 data are usually in the areas where the C2 data are also present, and the population range doesn't change significantly if the C3 data are excluded. The data that are spatially located into the 1×1 km grid have been randomly dispersed within the corresponding grid cell.

Results

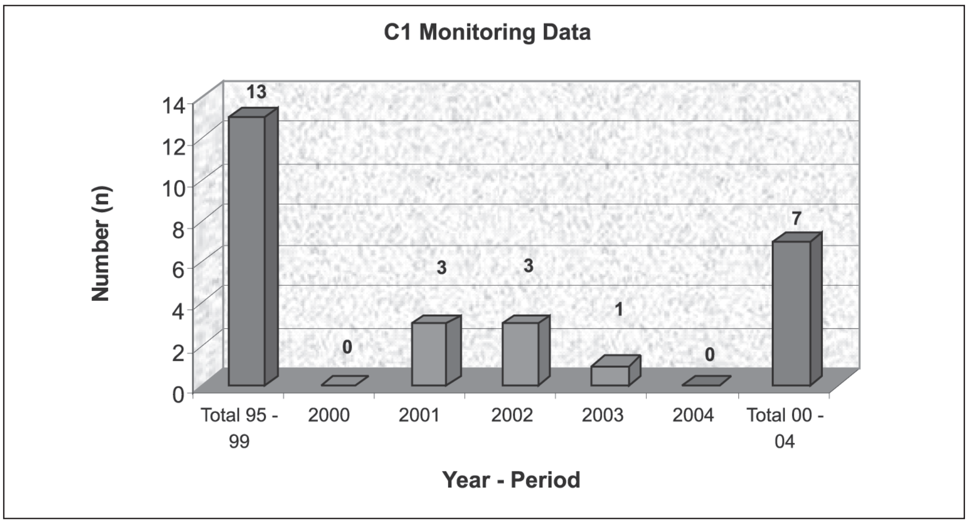
Monitoring and dynamics of the population size

In the 2000 – 2004 period, 908 data points were collected using the SCALP methodology, which is an 80% increase compared to the 1995 – 1999 period, when the number of collected data points was 505 (Table 1). The increase in the number of data points is mainly a product of better organization of the monitoring effort during the last five year period. Nonetheless, we can observe the majority of the increase in the southern subpopulation (factor 2.40), while the number of data points collected in the north-western subpopulation is, compared to the previous period, somewhat lower (factor 0.89). The largest part of the increase was in the last two years of the period. We can also see a statistically significant change in the data quality between both five-year periods (Table 1). This is observed for all the data ($p = 0.000$), as well as for the data from the southern ($p = 0.000$) and the northern subpopulation ($p = 0.009$).

Table 1: The number of the collected data about lynx presence by reliability.

Category	Southern Subpop.		North-western Subpop.		Total	
	1995–1999	2000–2004	1995–1999	2000–2004	1995–1999	2000–2004
C1	12	7	1	0	13	7
C2	230	674	77	93	307	767
C3	61	48	124	86	185	134
Total	303	729	202	179	505	908

There were 7 lynx taken from the population (reliability C1) in the last five-year period, which is almost a one-half decrease compared to the previous period (13 animals). The largest cull in the last period was in 2001 and 2002, with three animals removed each year (Table 2, Graph 1). The planned cull for the 1995 – 1999 period was 15 animals, of which 13, or 87%, were actually taken. During the 2000 – 2004 period the planned cull was 10 animals, of which 7 (70 %) were taken. The planned culls have been reduced from one period to the next, and even those were not realized (Table 2). The recorded lynx cull data shows a decreasing trend since 1990, and is approaching zero (Graph 2).

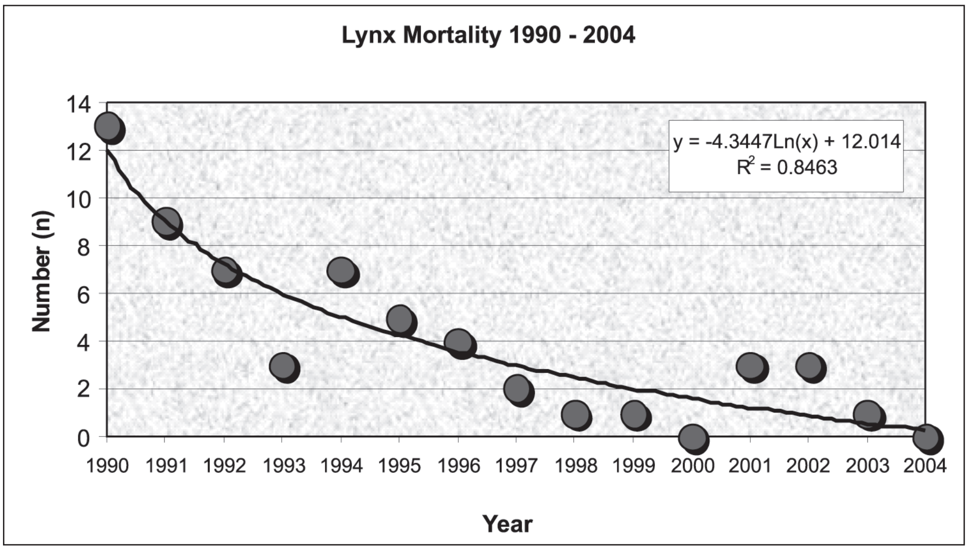


Graph 1: The dynamics of C1 monitoring data.

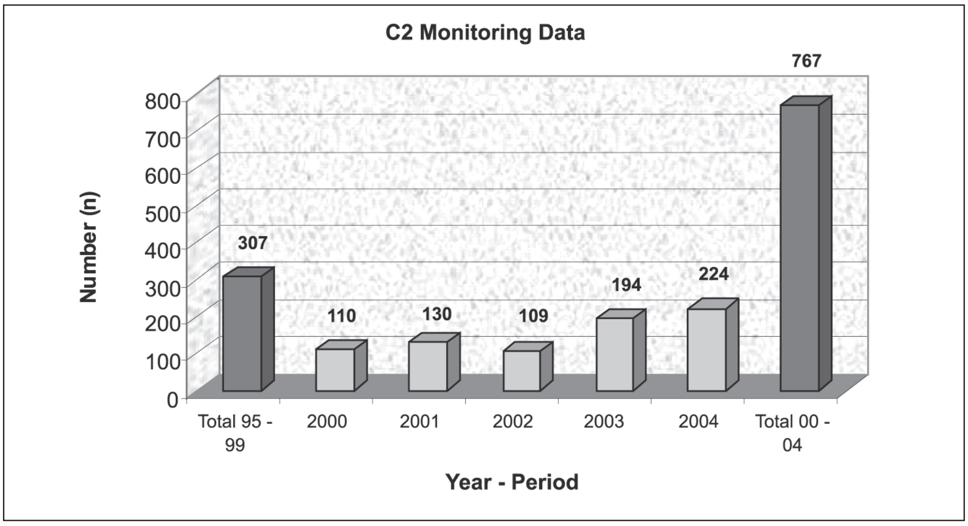
Table 2: Planned cull, realized cull, and other verified mortality of lynx in Slovenia.

Year	Plan	Cull	Losses	Total Mortality
1995/96	5	4	1	5
1996/97	5	3	1	4
1997/98	0	0	2	2
1998/99	5	0	1	1
1999/00	0	0	1	1
Total 1995–1999	15	7	6	13
2000/01	0	0	0	0
2001/02	5	3	0	3
2002	3	3	0	3
2003	2	1	0	1
2004	2	0	0	0
Total 2000–2004	10	7	0	7

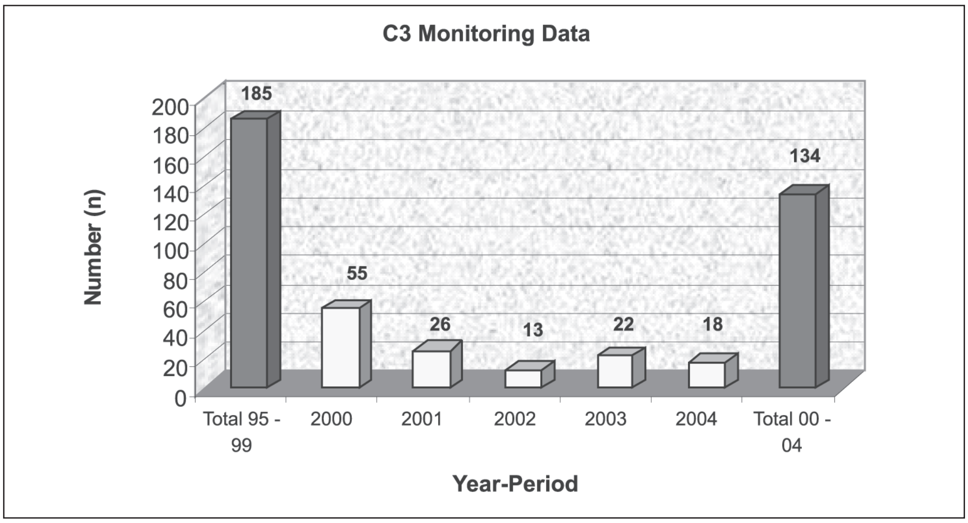
There is a large number of reliable C2 data about lynx presence. There are 767 such data points for the last period or 85% of all data points, while this number in the previous period was 307 or 60%. The number of C2 data has increased 2.5 times from one five-year period to the next. During the last five-year period, the number of these data grew (Graph 3). The trend with the C3 data is exactly the opposite. The numbers of these data are declining, both from one five-year period to the next, when the decrease was 30%, as well as from year to year (Graph 4). Besides the number of the data points itself the analysis of the categories of the collected data also shows an improvement in the lynx monitoring method during the 2000 – 2004 period.



Graph 2: The trend of lynx mortality in Slovenia from 1990 until 2004.

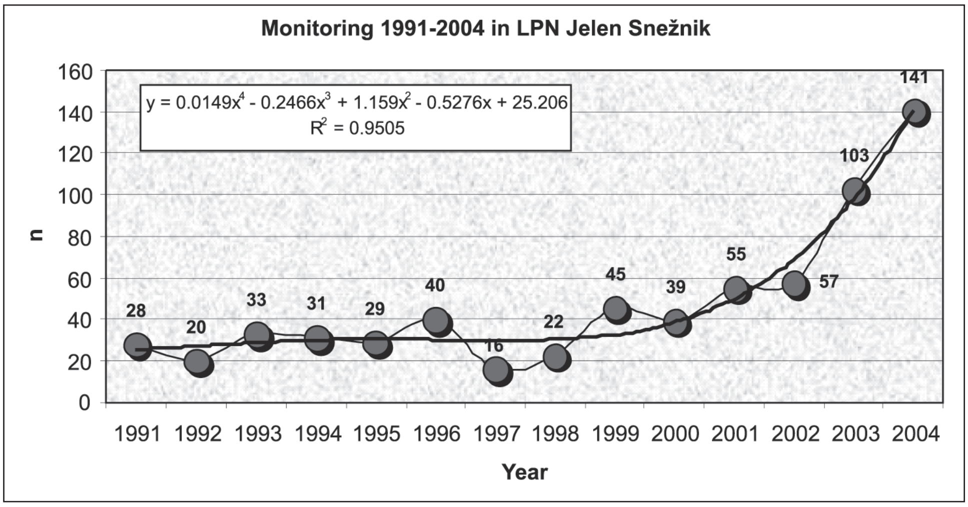


Graph 3: The dynamics of the C2 monitoring data.

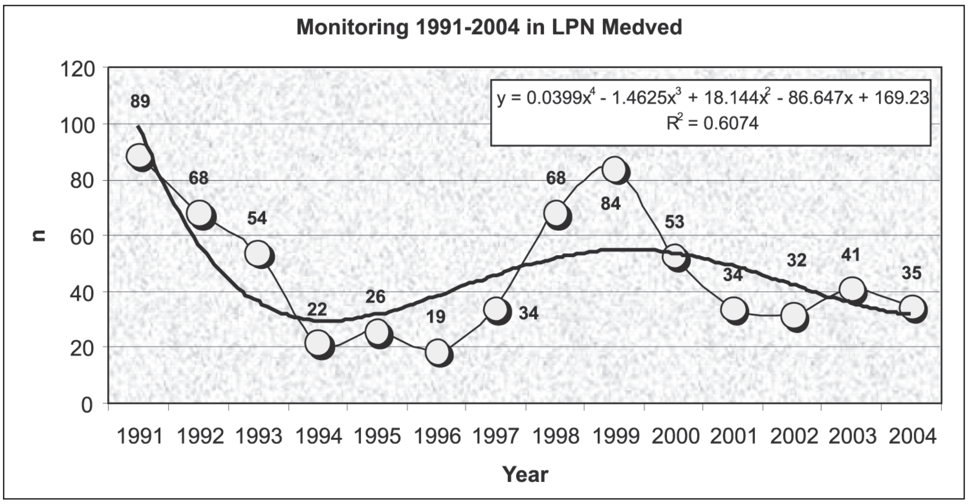


Graph 4: The dynamics of the C3 monitoring data.

The dynamics of the collected monitoring data of all three categories is also shown separately for the two areas covered by both special-purpose hunting reserves (Graphs 5 and 6). In LPN Jelen Snežnik, the dynamics of both monitoring and the number of lynx was steady until the year 2000. After 2000, we can observe a sharp increase in the number of the recorded signs of lynx presence. In LPN Medved, the number of observations cyclically fluctuates with a ten-year period. The dynamics of the recorded data of lynx presence is currently decreasing. In both cases we're dealing with C2 quality data, recorded by professional hunters. The status of the lynx in LPN Medved is unchanged over the last five years, or even slightly declining. In LPN Jelen Snežnik the status is better, and is improving over the last few years.



Graph 5: Dynamics of the data collected within the framework of the monitoring in LPN Jelen Snežnik.



Graph 6: Dynamics of the data collected within the framework of the monitoring in LPN Medved.

Population range

Slovenia can be divided into four areas with regard to lynx presence (Figures 2 and 3). The first is the *southern area*, which mainly includes Notranjska and Kočevska regions. The other area is the *north-western area*, spreading west and north of the Jesenice-Ljubljana–Trieste line. These two areas represent more than 95% of the lynx range in Slovenia, and are treated as two subpopulations. The third area is the area of Kamnik–Savinja Alps (Kam.–Sav.). We're assuming occasional lynx presence in this area. The fourth area is Eastern and North–Eastern Slovenia, where the lynx are assumed absent. Although lynx presence has been recorded in this area, all the data are of C3 category. The described rough division of the population range in Slovenia into two subpopulations is valid both for the 2000–2004 period, as well as for the previous 1995 – 1999 period.

Table 3: The size of different areas of the lynx population range, in hectares.

Period	Area			Total
	S. Subpop	NW Subpop.	Kam. – Sav.	
1995–1999	266.200	298.800	17.000	582.000
2000–2004	351.200	255.900	19.900	627.000
Factor	1,32	0,86	1,17	1,08

The lynx population range spans over approximately 627,000 ha, which represents 31% of the total area of Slovenia. At around 582,000 hectares, the size of the population range was slightly smaller during the previous period. The total increase of the population range was approximately 8%.

The size of the area from which the southern subpopulation data have been detected (Table 3) has increased for 30%. There are once again data about lynx presence in the western part, the Vreščica and Slavnik areas. There were no data from these areas during the previous period. There has also been an increase in the number of lynx presence observations in the eastern part of the subpopulation, the Kočevski Rog area. During the 2000 – 2004 period, we have three locations where the density of the monitoring data was the highest (50% fixed Kernel): LPN Jelen, LPN Medved and in the vicinity of Ribnica. In the southern subpopulation the lynx is also present along the border with Croatia.

There was a 15% decrease in the size of the western subpopulation area (Table 3), mostly because of the lower number of observations from Nanos and the area around Idrija, while the number of data points from Trnovski Gozd remained the same as in the previous period. Both time periods compared, we can observe lynx presence more frequently in the areas around Cerkno and Bovec. The area where lynx presence is observed in Bohinj and Jelovica remains approximately the same. In the north-western subpopulation we find two higher data density areas (75% fixed Kernel) in the vicinity of Tolmin and Bovec. This is where the attacks of lynx on livestock were most frequent in this subpopulation. The north-western subpopulation reaches across the state border with Italy, from Kambersko all the way to the tri-border between Austria, Slovenia and Italy, and then across the Austrian border toward Kepa and Mojstrana.

The area of lynx presence in Kamnik–Savinja Alps is smaller, but has also increased slightly over the recent years. The largest numbers of observations are around Kamniška Bistrica and Solčava. C2 category of some of these data confirms permanent presence of lynx in this area as well, although these are probably just single animals.

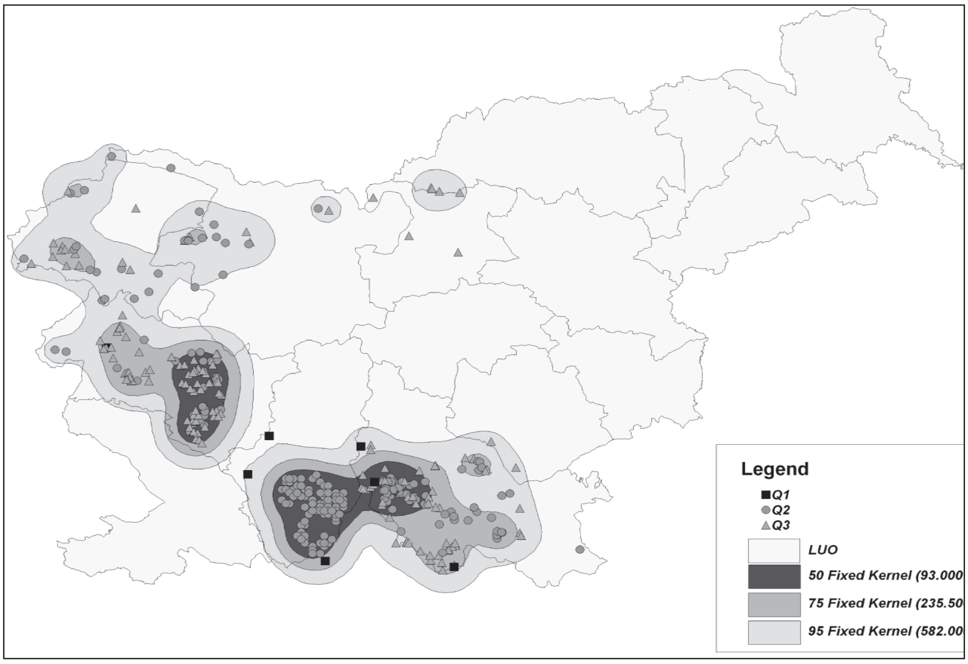


Figure 2: Lynx population range in Slovenia 1995 – 1999.

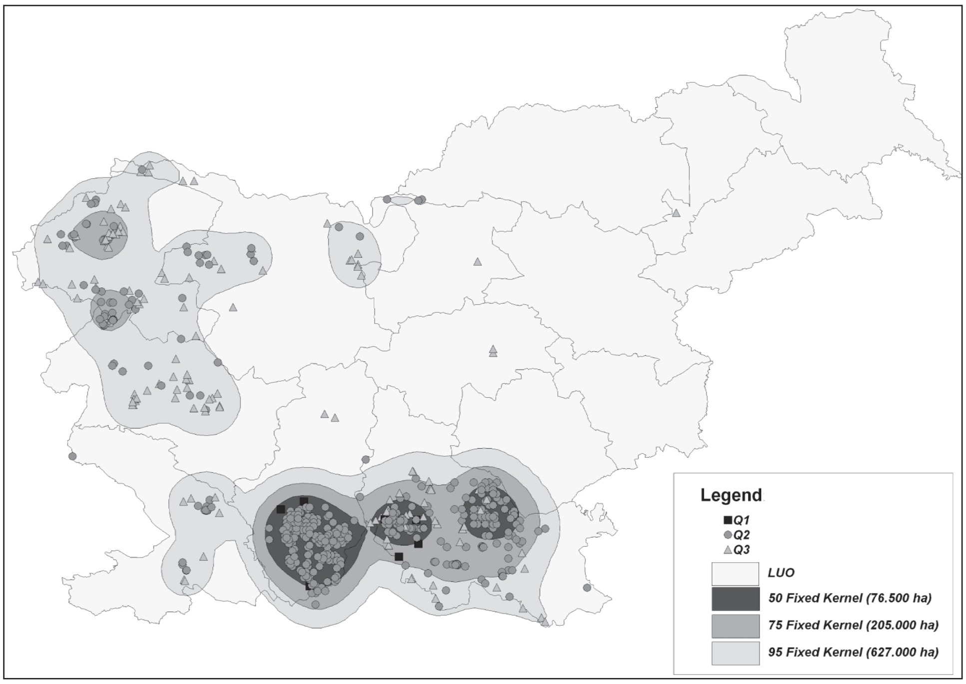


Fig. 3: Lynx population range in Slovenia 2000 – 2004.

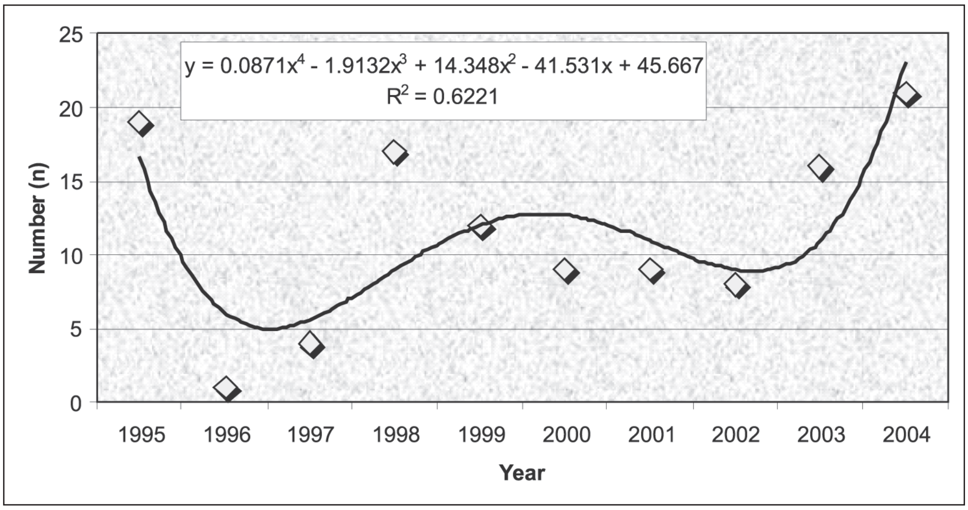
Damages to livestock

The damages caused by lynx to livestock represent a relatively small share of the large carnivore damages in Slovenia (which are also caused by wolves and bears). This share has been 10% in the 2000 – 2004 period, and 8% in the previous period. From one period to the next, the lynx damages have increased from 51,500 € to 71,500 €, an increase of 1.4 (Table 4). There is a very weak correlation ($R^2 = 0.4620$) with low statistical significance between the amount of damage and the number of damage cases, so we used the number of damage cases and not the monetary value of the damages for further analyses. A single damage case represents a single case of lynx appearance, while the monetary value of the damage depends on the number of killed animals, which varies from 1 and up to 10 or more. The total number of damage cases over the last five-year period was 122, which is a 1.7 factor increase compared to the previous five-year period, when there were 71 cases recorded. The number of damage cases in the southern subpopulation in the later period was 63, which is a 1.2 factor increase compared to the previous period (53 cases). In the north-western subpopulation the number of damage cases in the later period was 59, which is a 3.3 factor increase compared to the previous period when there were only 18 cases recorded. The increase in the number of attacks can also be attributed to an increase in the number of small livestock.

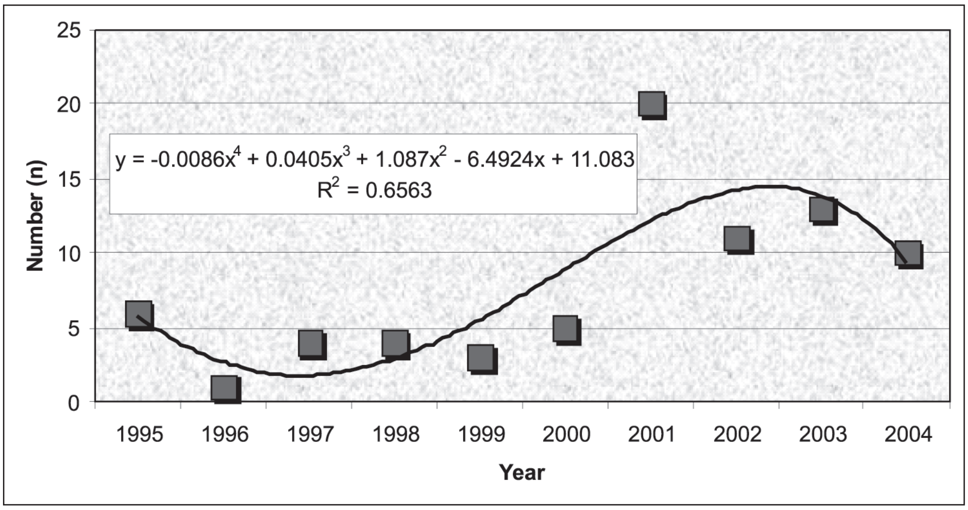
Table 4: Damages to livestock caused by the lynx.

Year	Number of damage cases			Damage	
	Total	S Subpop	NW Subpop.	SIT	€
1995	25	19	6	1,254,954	5,750
1996	2	1	1	93,000	400
1997	8	4	4	308,850	1,450
1998	21	17	4	2,449,400	35,800
1999	15	12	3	1,731,000	8,000
1995–1999	71	53	18	5,837,204	51,400
2000	14	9	5	2,159,000	9,600
2001	29	9	20	5,388,000	29,100
2002	19	8	11	2,975,000	13,400
2003	29	16	13	2,637,000	10,987
2004	31	21	10	2,024,500	8,435
2000–2004	122	63	59	15,183,500	71,522

The trends of the number of attacks (4th level polynomial) are fluctuating for both populations, which is especially true for the southern subpopulation. The number of attacks in the north-western subpopulation area is increasing over the years, with a slight decrease in 2004.



Graph 7: The dynamics of the number of attacks in the southern subpopulation.



Graph 8: The dynamics of the number of attacks in the north-western subpopulation.

Discussion

By continuation of the monitoring of signs of lynx presence, the number of the animals taken from the population and the number of lynx attacks on livestock during the last five-year period we have obtained data that enables a rough understanding of the development of the Slovenian lynx population.

(1) *The total number of monitoring data points* has increased significantly (Table 1). The number of reliable data C2 has also increased. This is certainly a result of better organization of the monitoring effort during the last five year period. The increase in the number of lynx presence data in the southern subpopulation can also be partly attributed to the presence of lynx in new areas over the last five years, as can be seen from the data showing lynx presence on Vremščica, Slavnik, and in the eastern part of Kočevski Rog. There is also a pronounced increase in the number of signs of lynx presence in the LPN Snežnik area. In the north-western subpopulation, the number of data collected over the last five-year period is lower compared to the previous period. However, this decrease is on account of a lower number of data from just a certain part of the area – Nanos and the Idrija region. Similarly to other areas, the numbers of data collected in the other parts of this area grew. The number of lynx on Nanos and the area around Idrija is probably not significantly lower than it was during the previous period. The decrease can be attributed to the monitoring effort, which will require a better organization in this area. In light of these facts, we cannot maintain that the number of lynx present in the western subpopulation during the last period was lower.

(2) *The data of recorded lynx mortality* show a negative trend, which approaches the asymptote of zero (Graph 2). We can see a similar trend in the number of animals planned for culling, however the cull plans were usually not reached (Table 2). Illegal killing, which is supposed to be quite significant, is often mentioned in this context. The cull is supposed to be additionally hindered by territoriality and low population density. However, interpretation of these facts warrants caution. For example, in the western subpopulation there were no lynx culled regardless of the issued cull permit, constant lynx presence, and numerous damages caused over a relatively small area. The fact that there was a cull permit makes poaching quite unlikely. The current lower lynx density as previosly period (1990–95) makes hunting of this species difficult as well.

(3) *Monitoring of lynx presence in the special-purpose hunting reserves* has been one of the main parameters showing the lynx population size trends. Reliable (C2) data, collected in an organized manner, and the trends calculated from them are assumed to be showing the actual status in the wild. The results were also verified with the managers of both hunting reserves. For LPN Medved they confirmed the trend (Graph 6) that the status of lynx in the hunting reserve over the last five years is generally unchanged, or recently even on a slight decrease. The status shown by the trend (Graph 5), a substantial increase in lynx presence in the hunting reserve, has similarly been confirmed for LPN Jelen Snežnik.

(4) *The size of lynx population range* has increased according to comparative analyses. There was an increase in the area of the southern subpopulation, while that of the north-western subpopulation has slightly decreased. For the north-western subpopulation, we should apply the reasoning used in the discussion of the number of observations from paragraph one. The number of observations and the size of the population range calculated from them are, of course, related. Had the monitoring in Nanos and Idrija areas been done more thoroughly, the calculated range wouldn't decrease. We should also exercise caution in interpretation of the increase of the population range of the southern subpopulation. The report for the 1995—1999 period (Staniša & al. 2001) showed the population range also in the areas where it was known that lynx were present, but monitoring data were missing. If those areas are compared, we can see that the range of the southern subpopulation also didn't change as drastically as we could conclude from our analysis. In any case, there is a significant shift of the range westward. Possible reasons for the shift are a somewhat lower number of roe deer and red deer, an increased number of wolves in the Kočevje area, diseases and problems in the population. If we take into consideration the findings of the 1995– 1999 report, there hasn't been a significant change of the lynx population range for the last 10 years.

(5) *Damage cases* of attacks on livestock and their dynamics are a fairly reliable indirect sign of lynx presence, although the number of attacks can be also caused by an increase in the number of attacks of a single lynx. The increase in the number of attacks shows an increase in the number of lynx over the last period. However, we must not neglect the fact that the higher number of the attacks depends also on an increased number of small livestock available, and on the inadequate protective measures used. The number of attacks in the north-western subpopulation is almost the same as in the southern, which also hints at the relative relation between the numbers of lynx in both subpopulations (Table 4). The increased numbers of attacks in the Tolmin and Bovec areas correlates also with the increased number of other signs of lynx presence in this area. On basis of this criterion we can assume that there are more lynx in the western subpopulation than five years ago.

We can summarize the findings from the paragraphs above into a table and use "–" to show deterioration, "+" for improvement and "0" for no change in the lynx population status. Deterioration is demonstrated only by the recorded lynx mortality. All other parameters show either no change or an improvement of population status. If we take into account the considerations from (2) about the difficulties of hunting for lynx, we can state with a certainty that the status of the lynx population in Slovenia didn't get any worse during the 2000 – 2004 period, and has probably remained unchanged.

Table 5: Status of the Slovenian lynx population (marked +, 0, –).

analysis category	S. subpop	W. subpop	total
(1) Total number of monitoring data.	+	0	+
(2) Lynx taken from the population.	–	–	–
(3) Lynx monitoring in the special purpose hunting reserves.	0 , +		
(4) Size of the population range.	0	0	0
(5) Number of damage cases.	+	+	+

How many lynx are there in Slovenia? The report for the 1995 – 1999 period (Staniša & al. 2001) estimates 40 to 50 lynx for the entire country, 30 to 40 in the southern subpopulation and about 10 in the western subpopulation. Using the population range of approximately 650,000 ha and overlap of the lynx home ranges from different sources (Kos & al. 2004, Ragni 1998), we get to a similar number.

- western subpopulation 10 – 15 lynx
- southern subpopulation 20 – 35 lynx
- Slovenia – total 30 – 50 lynx

However, connectivity of an individual habitat patch should also be taken into consideration when estimating lynx spatial distribution. In this manner lynx territoriality also has a significant effect on evaluation of the available habitat. Using this additional valuation of habitat in Slovenia, we can assume existence of 9 to 15 suitable territories in the areas currently occupied by reproductive animals. In these territories, reproduction occurred over the last five years (Kos & al. 2004, Kos, unpublished data). Taking into account the structure inside individual territories, we can assume presence of 30 to 50 lynx in Slovenia.

In Slovenia, the numbers and spatial distribution of the collected data (Figure 3) allow differentiation of four different areas: (1) the southern part of the country – the southern subpopulation, spreading over the area south of the Trieste–Ljubljana–Zagreb motorway (Kočevska, Notranjska), is the area to which the lynx was first reintroduced and where its numbers are still the highest today, (2) the north-western part of the country with Julian Alps – north-western subpopulation, the area that lynx started to colonize in the mid eighties of the previous century, (3) Kamnik–Savinja Alps to the north and some other isolated areas where only a small number of lynx presence data were collected, and (4) the rest of Slovenia – North-Eastern and Eastern Slovenia, where the lynx is not present.

A potential migration obstacle separating the presence of lynx in Western and Southern Slovenia is the Jesenice–Ljubljana–Trieste motorway. However, considering that this motorway is crossed by bears without serious problems (KACZENSKY 2000), we can assume the same for the lynx (Adamič & al. 2000). To the west and to the north of these motorways there are no significant spatial obstacles that would obstruct the spatial expansion of the lynx into Italy and Austria. Expansion of the lynx population into these two countries, and consequent repopulation of the Alps through natural migration, depends mainly on management decisions implemented in the border regions.

The available data by themselves are a good enough basis for evaluation of the possibility of expansion of the lynx population into the Alps. The presence of lynx in the border area with Italy and Austria, especially around Tolmin and Bovec, is getting stronger and stronger. The population range has already expanded over the national border. We estimate that the outlooks for population expansion across the borders are currently good. The data from our monitoring should be additionally augmented by monitoring data from both neighbouring countries. However, better answers regarding capability of the lynx to expand from Southern to North-Western Slovenia and further into the Alps can be provided only by radiotelemetric studies. In the years 2004 to 2007, there is a plan to capture and radiotrack two lynx in the border area with Italy within the scope of an international Interreg project.

At the first conference of the SCALP group, in 1995, the Slovenian lynx population was evaluated as the most vital in the Alps, which was indicated by its fast spreading to the neighbouring Croatia and towards Italy and Austria (Čop & Frković 1998). Slovenia was always considered to be the core of the lynx population in the Eastern Alps. It is evident from this report that this role is currently still preserved.

Conclusions

(1) Lynx monitoring has intensified in the 2000 – 2004 period and has more high-quality data compared to the previous five-year period.

(2) The trend of removal of lynx from nature is falling and is approaching zero.

(3) The lynx range in Slovenia is separated into four areas, of which two are separate subpopulations (western and southern), one area represents isolated areas with occasional lynx presence (Kamnik–Savinja Alps), and the last is the area without lynx presence.

(4) The population range of the lynx remained in the 2000 – 2004 period of approximately the same size as in the previous five-year period.
(5) Compared to the previous five-year period, there was an increase in the number of attacks of lynx on small livestock in certain areas during the 2000 – 2004 period.
(6) The estimated number of lynx during 2000 – 2004 remains the same as in the previous period, from 30 to 50 animals. A slight increase is detected in the north-western subpopulation.
(7) The status of the lynx population in Slovenia remains stable.

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