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Status and distribution of the lynx in the Swiss Alps 2000–2004

Status in razširjenost risa v Švicarskih Alpah 2000–2004

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Abstract. To evaluate the 2000–2004 status of lynx in the Swiss Alps, we outlined the trend within the large carnivore management compartments and estimated the number of lynx present. Throughout Switzerland all reports of lynx signs of presence were collected and classified according to their reliability. From 2000–2004, more than 2000 signs of lynx presence were recorded from the Swiss Alps. The trend of the confirmed records collected over all of Switzerland showed that (1) the lynx population in the North-western Alps decreased compared to the previous pentad but nevertheless this compartment remained the area with the highest lynx density within Switzerland, (2) in the Valais and Central Switzerland West the trend is slightly positive, (3) due to the translocation project, the distribution of lynx in the Swiss Alps has considerably increased and (4) that there is still good lynx habitat yet to be colonised in the Swiss Alps.

To estimate the number of lynx, we used findings from systematic camera trap sessions and a radio-telemetry study as well as our expert guess. We estimated the number of lynx in 2004 at 60–90 individuals. Compared to the previous pentad, when the number of lynx in the Swiss Alps was estimated at 70, the number of lynx remained fairly stable. An expansion in the total distribution was compensated for by a decrease in the North-western Alps.

Keywords: *Lynx lynx*, Switzerland, status, distribution, Alps, monitoring

Introduction

Today, the Alpine lynx population consists of two main sub-populations that originated from re-introductions effectuated in the 1970s. Currently, the two core areas of lynx distribution lie in the western Alps (Switzerland and France), and one in the Slovenian Alps, expanding into Italy and Austria (Molinari-Jobin & al. 2003). The present lynx distribution does not reflect the potential range of the species in the Alpine countries as less than 10% of the 190'000 km² of the entire Alpine arc according to the Alpine Convention are permanently occupied (von Arx & al. 2004). According to IUCN Red List criteria, the Alpine lynx population still has to be considered endangered.

Nevertheless, local subpopulations can increase to a level that sheep owners and hunters find hard to cope with. Such an increase was observed in the late 1990s in the North-western Swiss Alps (Molinari-Jobin & al. 2001), when a high lynx number led to a harsh controversy and demonstrative illegal killings of lynx. This situation called for a new management approach, and in 2000, the Swiss

Lynx Concept (Blankenhorn 2005) was implemented. This management plan bases on the idea to trade lynx abundance for further distribution. For organisational purposes, Switzerland was divided into 8 large carnivore management compartments, taking into account natural and artificial barriers to natural spread of lynx as well as political borders (Fig. 1). The Swiss Lynx Concept foresees that lynx are translocated from high density areas to areas yet uncolonised by lynx in a first phase. In a second phase lynx may also be reduced through controlled hunting, if the impact of lynx predation on roe deer and chamois is considered too strong. Accordingly, 6 lynx were translocated in 2001 from the North-western Alps (VI) to North-eastern Switzerland (II). Another 3 lynx taken from the Jura population (I) followed in 2003. All translocated lynx were equipped with radio-collars and their movements registered on regular basis (Ryser & al. 2004).

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. The first Swiss status report was effectuated by Breitenmoser & al. (1998) and summarised the data from the reintroduction to 1995. In the second status report, data from 1995–99 were analysed (Molinari-Jobin & al. 2001). The purpose of this study is to evaluate the present status of lynx in the Swiss Alps in the early 2000s, to outline the trend within the compartments, and to estimate the number of lynx present. The status of the lynx in the Swiss Jura Mountains was analysed recently in a separate publication (Capt, in press).

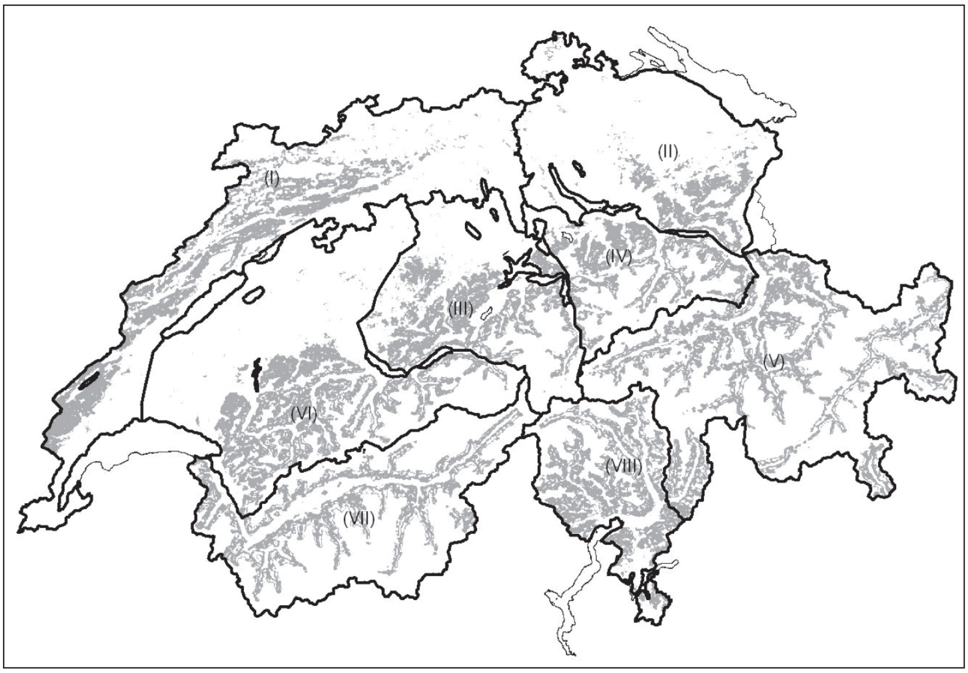

Fig. 1: Potential habitat (grey) and division of Switzerland into 8 large carnivore management compartments (I = Jura Mountains, II = North-eastern Switzerland, III = Central Switzerland West, IV = Central Switzerland East, V = Grisons, VI = North-western Alps, VII = Wallis, VIII = Ticino).

Methods

In Switzerland, we used a stratified approach to monitor the lynx population (Breitenmoser & al. 2006). (1) The information for the whole country was based on the collection of lynx signs of presence. (2) Within smaller study areas we estimated the number of lynx using capture-recapture models (KORA, unpubl. data).

The collection of lynx signs of presence was effectuated analogue to the previous pentad from 1995 to 1999 (Molinari-Jobin & al. 2001). On national level, three sources of information on the presence of lynx are available: (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) chance observations of wild prey remains, tracks, scats, sightings, and vocalisations. We distinguished three levels of reliability according to the possibility to verify an observation (Molinari-Jobin & al. 2003): Category 1 (C1) represent the hard facts (i.e. direct signs), e.g. all reports of lynx killed, found dead or captured, photographs of lynx as well as young orphaned lynx caught in the wild and put into captivity. We also include the scats that have been confirmed to be lynx scats by means of genetic analysis in this category, as this method is now well developed. Category 2 (C2) represent all records of livestock killed, wild prey remains, tracks and scats confirmed by trained people, e.g. mainly game wardens. As all game wardens were instructed 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 (C3) represent chance observations of all wild prey remains and tracks reported by the public as well as all sightings, scats and vocalisations, e.g. mainly indirect signs that can hardly be verified. To estimate the size of lynx distribution area, we first calculated the minimum convex polygon drawn around all C2 data for compatibility with previous works and second buffered the C2 point data with a buffer of a radius of 5 km. This results in an approximate area of 80 km^2, which corresponds to an average female home range size (Breitenmoser-Würsten & al. 2001).

Camera traps installed at fresh kills or on lynx passages were used since 1998 to photograph as many lynx as possible. Due to the unique coat pattern, lynx can be identified individually by their photographs (Laass 1999). Applying the method proposed by Nichols & Karanth (2002), we estimated the actual number of lynx in two winters 2001/02 and 2003/04 in a reference area of nearly 600 km^2 in the North-western Alps (VI) and in winter 2004/05 in a reference area of 340 km^2 in Central Switzerland West (III). Details of the sampling effort for each capture-recapture session are given in Table 1. We developed capture histories for each individual lynx older than 1 year identified in the camera trapping, i.e. photos of juvenile lynx were attributed to the capture history of the resident female (Zimmermann & al. 2006). To estimate abundance of independent lynx we used program CAPTURE to implement capture-recapture models for closed populations (Otis & al. 1978).

In a next step, we intersected the Minimum Convex Polygon of all C2 records within a specific compartment with the lynx habitat suitability map (Breitenmoser & al. 2001) to obtain the size of the suitable habitat per compartment that is occupied by lynx. The number of lynx estimated/100 km^2 was then extrapolated to the whole compartment, corrected with the habitat suitability map, assuming

Table 1: Trapping details for three different camera trap sessions in the Swiss Alps (KORA, unpubl. data).

Sampling period	27. 11. 2001– 03. 02. 2002	07. 12. 2003– 14. 02. 2004	05. 12. 2004– 08. 02. 2005
Study area	Compartment VI	Compartment VI	Compartment III
No. occasions (5 nights)	8	12	13
Trap-nights	1243	1920	690
Area covered by traps in km^2 (MCP)	575	558	340
Total no. of captures	34	32	19
Total no. adult individuals caught	9	10	5
Trap nights per lynx picture	37	60	36

that lynx density was the same throughout colonised area of the compartment. The spatial analyses have been performed in the Geographic Information System (GIS) ArcView 3.3 (ESRI 1996a,b,c). To estimate the number of lynx per compartment at the end of the 2000–2004 pentad, we either used the estimations obtained by capture-recapture method (compartments III and VI) or through radio-telemetry (compartment II), or our expert guess (other compartments).

Results

Development of lynx signs of presence

From 2000–2004, more than 2000 signs of presence were recorded in the Swiss Alps, compared to 1600 during the previous pentad (Molinari-Jobin & al. 2001). While the number of livestock killed decreased, the number of wild prey remains reported augmented from 2000 to 2004 (Table 2). Overall, 71% of all signs of presence belong to the C1 or C2 category, thus have been confirmed. Signs of presence are reported from all Alpine compartments, the fewest from Ticino (VIII), the most from the North-western Alps (VI, Fig. 2). The distribution of the C1 and C2 data reflect the colonisation of the new area in North-eastern Switzerland (II) due to the translocation project and confirm the expansion into the western part of Grisons (V) that was first noticed in the late 1990s. The minimum convex polygon drawn around the signs of lynx presence of C2 increased from 16'400 km^2 in 1995–99 to 20'166 km^2 in 2000–04. However, through the discontinuous distribution due to the translocation project, we also buffered the C2 data with a radius of 5 km, resulting in a range estimate of 11'736 km^2 compared to 8928 km^2 during the pentad from 1995–99. The only compartment completely occupied by lynx is the North-western Alps (VI). Lynx occur in about half of the Swiss Alps. Especially in Grisons (V) and Ticino (VIII) most of the potential habitat remained yet uncolonised.

Table 2: Number of records collected per year. Data from radio-tracking was not considered in this analysis.

Category 1	2000	2001	2002	2003	2004	Total
Lynx found dead	11	3	2	4	9	29
Lynx removed[1]	2		2		2	6
Photo	20	38	55	52	56	221
Total	33	41	59	56	67	256
Category 2						
Livestock killed	190	121	100	79	53	543
Wild prey remains	68	80	77	108	116	449
Tracks	36	54	56	46	43	235
Total	294	255	233	233	212	1227
Category 3						
Wild prey remains	11	6	3	9	32	61
Tracks	5	19	19	8	21	72
Sightings	120	94	81	77	72	444
Vocalisations	5	1	4	3	7	20
Scats		4	1	2	4	11
Total	141	124	108	99	136	608

[1] Mainly young orphaned lynx captured and put into captivity.

Trend per compartment

In North-eastern Switzerland (II) a few signs of lynx presence have been recorded before the translocation project in 2001 (Fig. 3). With the translocation of six lynx in 2001 three times as many signs of lynx presence were reported than in 2000. The restocking with three additional lynx in spring 2003 did not show in an increase in the number of lynx signs of presence reported. Until 2004 two lynx were reported dead and only one goat was killed by lynx in this compartment.

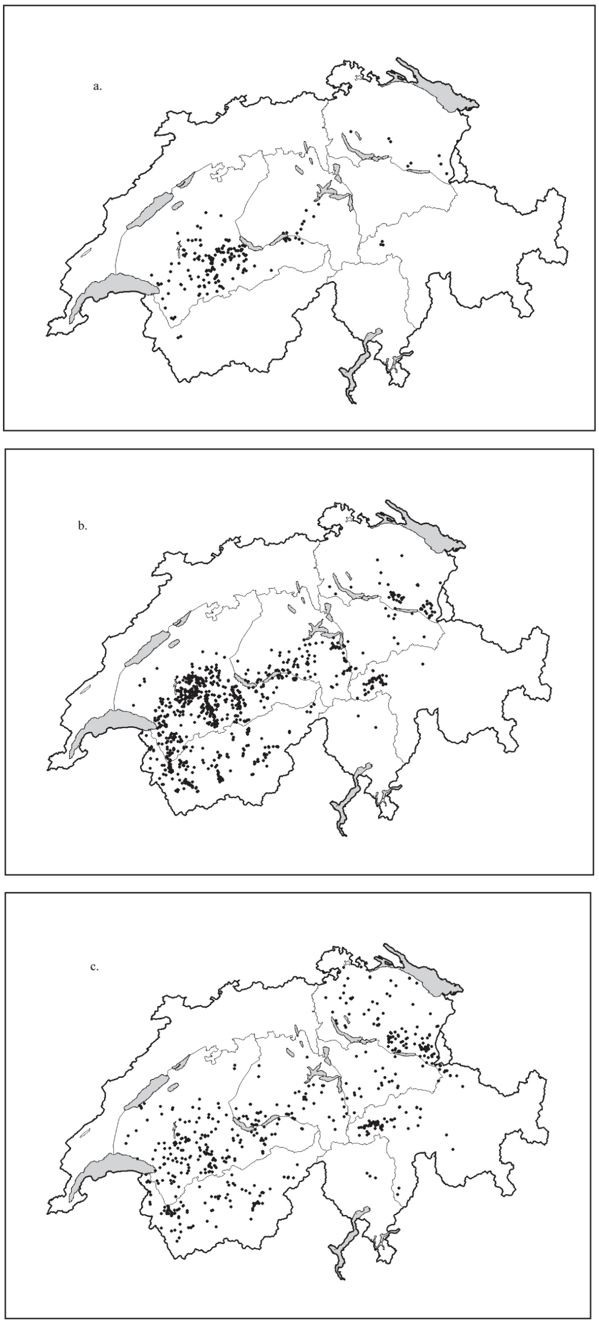

Fig. 2: Distribution of lynx signs of presence in Switzerland for the five-year period 2000-2004. (a) Category 1 data: dead lynx, lynx removed, photos. (b) Category 2 data: killed livestock, confirmed wild prey remains and tracks. (c) Category 3 data: unconfirmed wild prey remains and tracks, sightings and vocalizations.

In Central Switzerland West (III), where lynx have been first reintroduced in the 1970s, the number of signs of lynx presence increased in the 1990s, peaked in 1999, stabilized in the early 2000s at a lower level but increased again to peak height for 2003 and 2004 (Fig. 3), but with a much lower magnitude than in the North-western Alps (VI). With the exception of 2002 the number of livestock killed remained

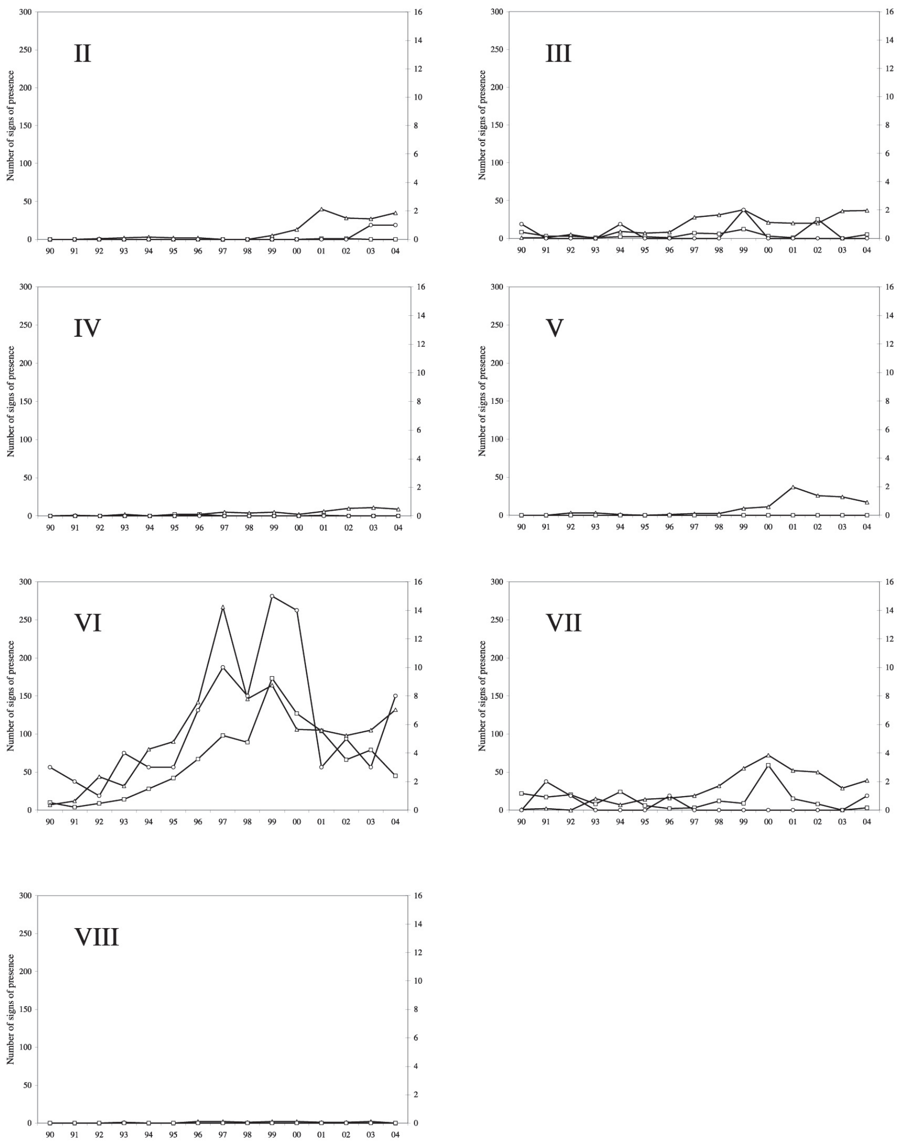

Fig. 3: Development of the number of lynx signs of presence per large carnivore management compartment (left x-axis: squares = livestock killed, triangles = occasional observations pooled; right x-axis: circles = dead lynx found and lynx removed from the population). The systematic monitoring in Switzerland started 1992. The roman numbers refer to the numbering of the management compartments of Fig. 1.

on a low level. Until 2004, a total of 21 lynx have been reported dead in this compartment since the beginning of the reintroduction. But no dead lynx were found during the past five years.

The compartment Central Switzerland East (IV) faces immigration from Central Switzerland West and North-eastern Switzerland (Fig. 2), but the reported signs of lynx presence remained on very low level (Fig. 3).

In Grisons (V), lynx immigration took place in the 1990s. The reported signs of presence peaked in 2001 (Fig. 3). At least two different lynx were pictured by means of camera traps set at paths or fresh lynx kills in 2002 in the western part of the Grisons. The C3 data in the North may result from emigrating lynx from North-eastern Switzerland (II).

More than half (53%) of the recorded signs of presence originate from the North-western Alps (VI), although this compartment covers only about 1/5 of the Swiss Alps. The development of the number of lynx signs of presence in the North-western Alps showed a positive trend in the late 1990s, with a peak at the turn of the century (Fig. 3). For the years 2003 and 2004 the trend of signs of lynx presence is again slightly positive. In 1999, the peak year, 173 livestock were compensated. Most livestock predation losses concerned sheep, followed by goats and farmed fallow deer (*Dama dama*). Until 2004, a total of 81 lynx have been reported dead in this compartment.

The compartment with the second highest number of lynx signs of presence reported is the Valais (VII). There, the number of signs of presence and livestock losses peaked in 2000 (Fig. 3). Until 2004, a total of 14 lynx have been reported dead from the Valais, but none since the past 8 years.

From the Ticino (VIII), only from 0 to 2 signs of lynx presence were reported per year (Fig. 3).

Estimation of number of lynx present

Three abundance estimates from camera trap sessions were used to estimate the number of independent lynx within the whole compartment (Table 3). After the translocation of 6 lynx from the North-western Alps (VI) to North-eastern Switzerland (II), the estimate from 2001/02 ranged from 27–40 individuals in the North-western Alps (VI), and increased to 36–51 individuals in winter 2003/04. Another 10–18 lynx were estimated in Central Switzerland West (III) in winter 2004/05. The number of lynx in North-eastern Switzerland (II) was estimated at 4–5 individuals in winter 2004/05 (Ryser & al. 2005). We estimate the number of lynx in the Valais (VII) at 5–10 individuals and in Central Switzerland East (IV), Grisons (V) and Ticino (VIII) all together at 4–6 individuals in 2004. Thus, the estimate for all of the Swiss Alps ranged from 60–90 individuals.

Table 3: Lynx abundance estimates (CR = Capture-recapture data, KORA, unpubl. data). The roman number in brackets refers to the large carnivore management unit (Fig. 1).

Data origin	CR 01/02 (VI)	CR 03/04 (VI)	CR 04/05 (III)
Estimated nr of lynx	12 ± 2.2	14 ± 2.4	7 ± 2
Size of reference area (A)	1150	1016	1004
Size of potential habitat within reference area	563	502	341
Nr of lynx/100 km^2 suitable habitat	1.7–2.5	2.3–3.3	1.5–2.6
Size of suitable habitat within MCP of C2 records per compartment	1573	1573	694
Extrapolated number of lynx for the whole compartment	27–40	36–51	10–18

Discussion

The trends of C1 and C2 records collected over all of Switzerland showed that (1) the lynx population in the North-western Alps (VI) decreased compared to the previous pentad but nevertheless this compartment remained the area with the highest lynx density within Switzerland, (2) in the Valais (VII) and Central Switzerland West (III) both neighbouring the North-western Alps (VI), the trend is slightly positive, (3) due to the translocation project, the distribution of lynx in the Swiss Alps has considerably increased and (4) that there is still good lynx habitat yet to be colonised in the Swiss Alps. The only area with a spontaneous immigration was the Bündner Oberland (canton of Grisons) in the west of compartment V (Fig. 2). In the Ticino (VIII) and Central Switzerland East (IV) only few records have been collected. These records might originate from single individuals who left the core population. Such individuals can produce signs of presence at low density and over huge areas, as they search for conspecifics. An illustration for this is given by a female lynx translocated from the Jura Mountains (I) to North-eastern Switzerland (II) who moved to Central Switzerland East (IV) in spring 2004. Even though 11 signs of presence were reported from this compartment in 2003 – before her arrival, no reproduction was observed neither in 2004 nor in 2005 (Ryser, pers. comm.), indicating a lack of a male lynx present.

The lynx in the Swiss Alps is highly depending on what is happening in the North-western Alps, as more than half of all lynx reside in this compartment. There, the lynx population peaked in 1998/99 with 55–59 lynx estimated (Breitenmoser-Würsten & al. 2001). Due to the translocation of 6 lynx from this compartment to North-eastern Switzerland (II) in 2001, the removal of 1 stock-raiding lynx in 2001, as well as at least 7 lynx that are known to have been illegally killed, the number of lynx in the North-western Alps (VI) was reduced to 27–40 in winter 2001/02 (Table 3). Nevertheless, even in 2001/02 the number of lynx in the North-western Alps was higher than in the other compartments. The capture-recapture lynx census of winter 2001/02 was repeated two years later and resulted in an estimate of 36–51 lynx within this compartment (Table 3). Thus, the lynx population in the North-western Alps (VI) was again increasing from winter 2001/02 to winter 2003/04.

Compared to the previous pentad, when the number of lynx in the Swiss Alps was estimated at 70 (Molinari-Jobin & al. 2001), the number of lynx remained fairly stable. A slight expansion in the total distribution was compensated for by a decrease in the North-western Alps (VI).

The harsh controversy that peaked in the late 1990s in the North-western Alps (Molinari-Jobin & al. 2001) mostly vanished with the translocation project, as the translocation of six lynx, the removal of a stock-raider plus several cases of illegal killings clearly reduced the lynx population in the North-western Alps (VI). If the density in the North-western Alps (VI) continues to increase, the Swiss Lynx Concept envisages some form of hunting to reduce the density if lynx cannot be translocated to other regions in the Alps or neighbouring ranges. On the other hand, the success of the translocation project is so far doubtful, as several losses have been reported and the number of lynx for North-eastern Switzerland (II) is only estimated at 4–5 individuals. For the winters 2006/07 and 2007/08 it is therefore planned to translocate another four lynx to North-eastern Switzerland.

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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

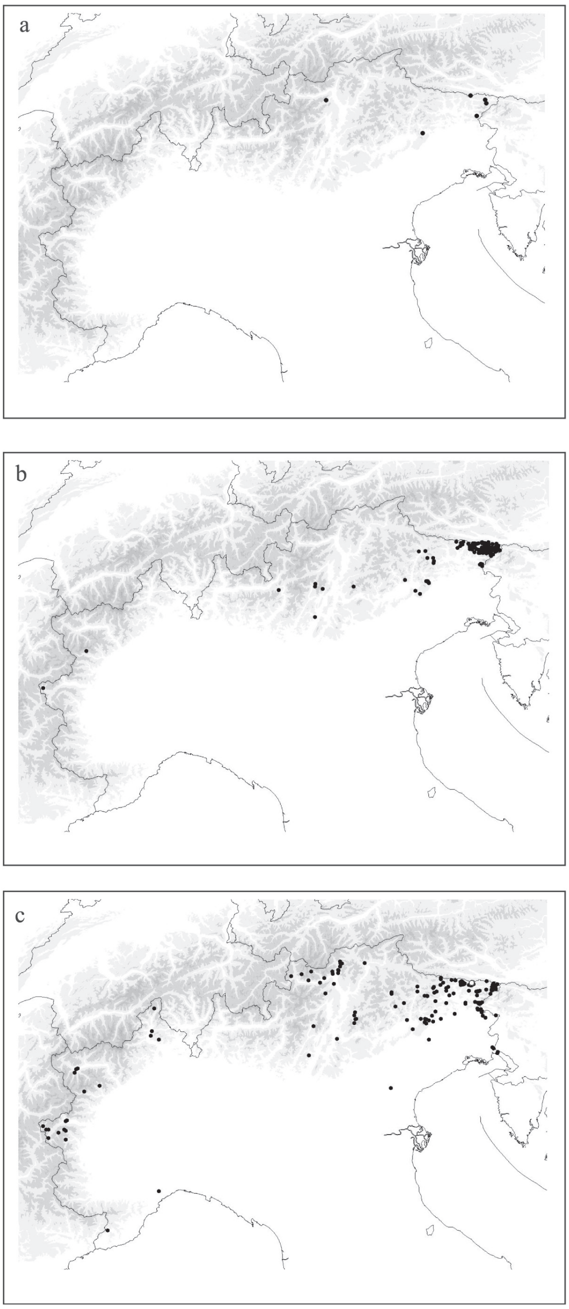

Fig. 1: Distribution of lynx signs of presence in the Italian Alps for the five-year period 2000-2004. (a) Category 1 data: photos, confirmed scats. (b) Category 2 data: killed livestock, confirmed wild prey remains and tracks. (c) Category 3 data: unconfirmed wild prey remains and tracks, sightings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

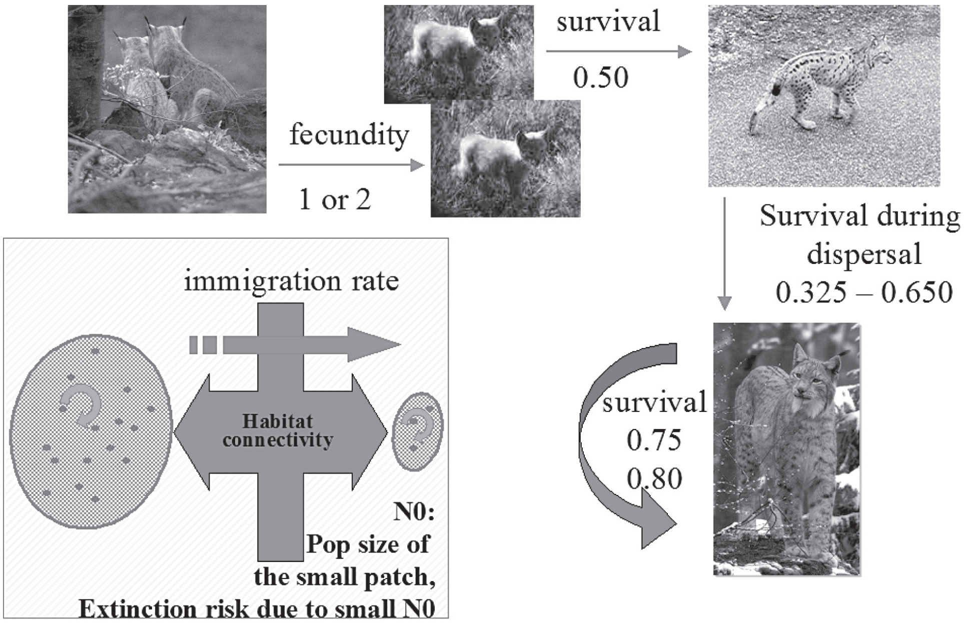
Lynx monitoring in France

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

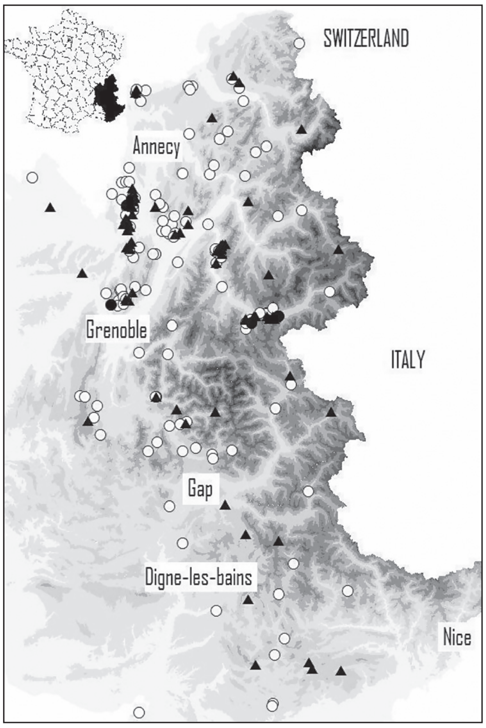


Fig. 1: Distribution of validated lynx signs (●= C1, ▲= C2, ○= C3) collected from 2000 to 2004 in the French Alps; shaded areas represent altitudinal patterns (the darker, the higher).

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 $\lambda = 1.02 – 1.07$ (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.

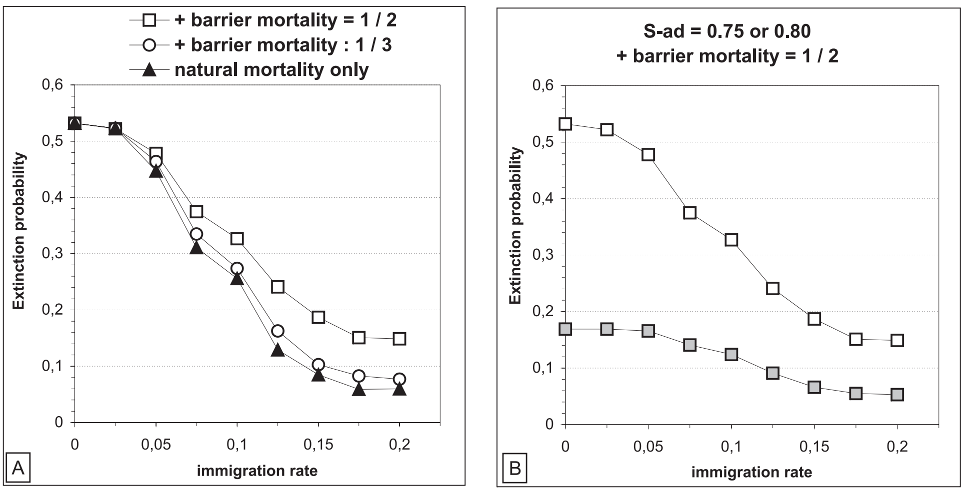


Fig. 2: Extinction risk (*y*-axis) as a function of increasing (0 to 20%) immigration rates (*x*-axis); survival of dispersing sub-adults is modulated (A- barrier effect) together with that of philopatric adults [B- □: S-ad = 0.80; ■: S-ad = 0.75].

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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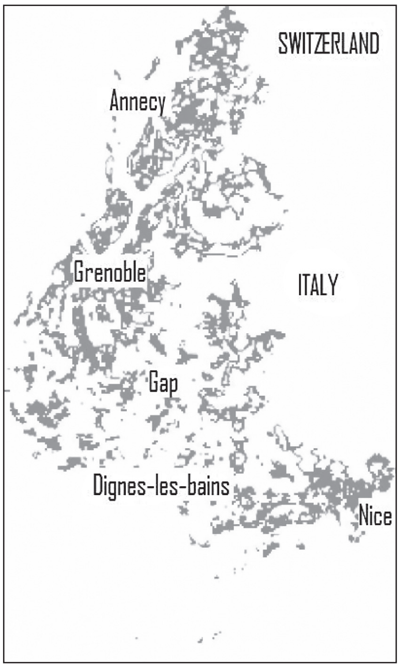

Fig. 3: ENFA-based modelling of the potential distribution of detected lynx presence signs. The grey areas are those with higher detection likelihood, i.e. those where the lynx-experts network would likely collect presence signs given the presence of the species AND the environmental conditions (slope,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

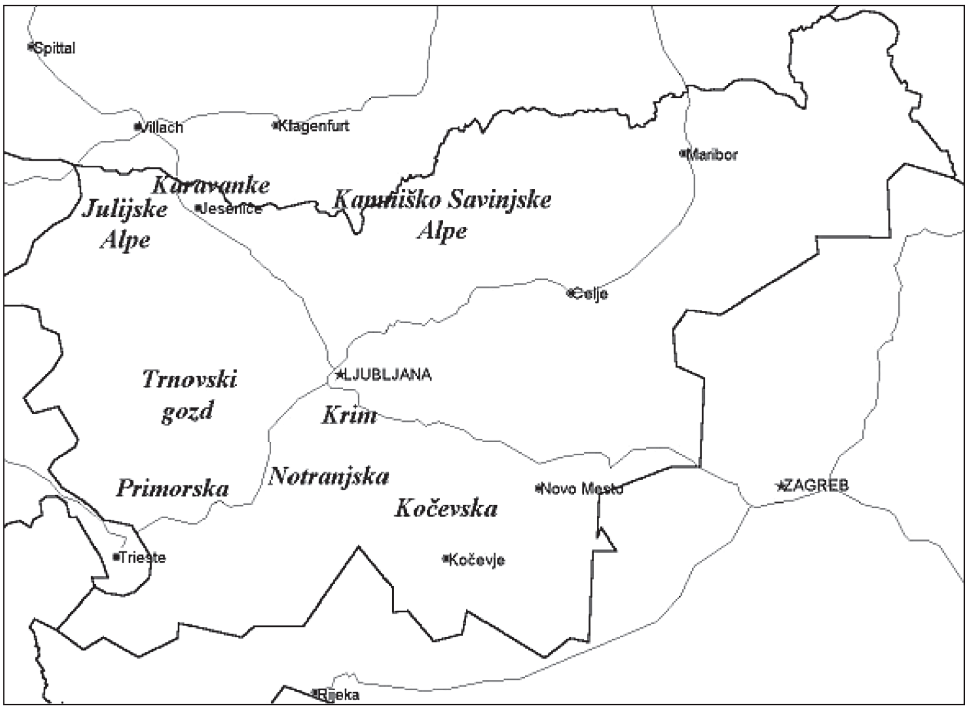


Fig. 1: Map of Slovenia showing some of the places mentioned in this report.

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

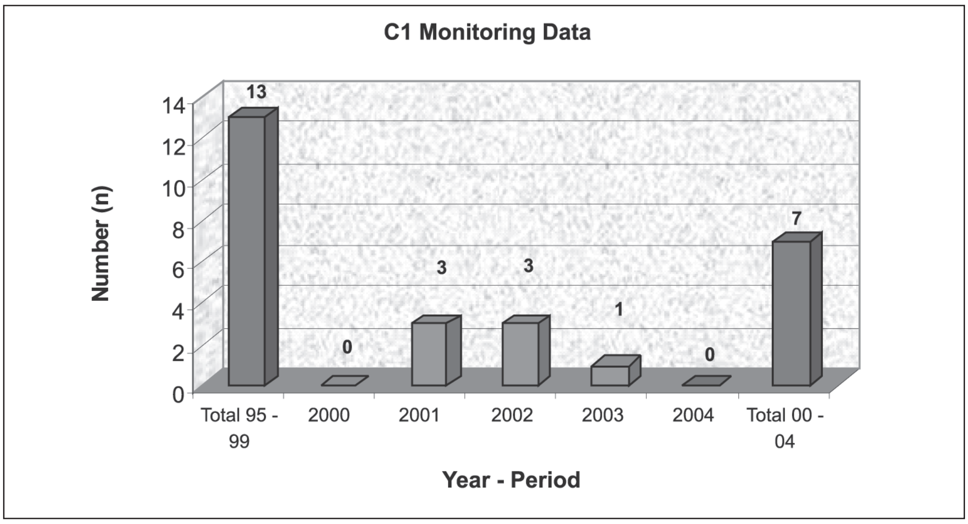
Monitoring and dynamics of the population size

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).

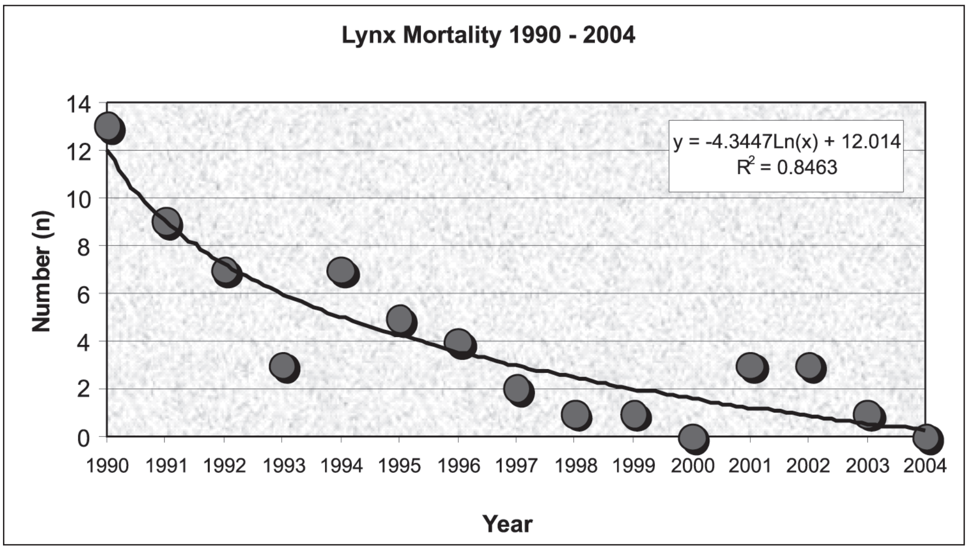


Graph 1: The dynamics of C1 monitoring data.

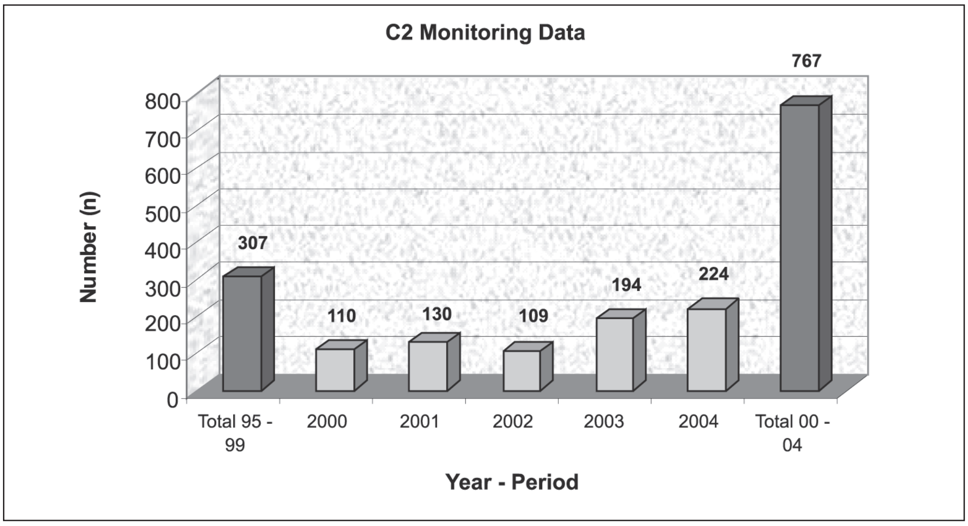
Table 2: Planned cull, realized cull, and other verified mortality of lynx in Slovenia.

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

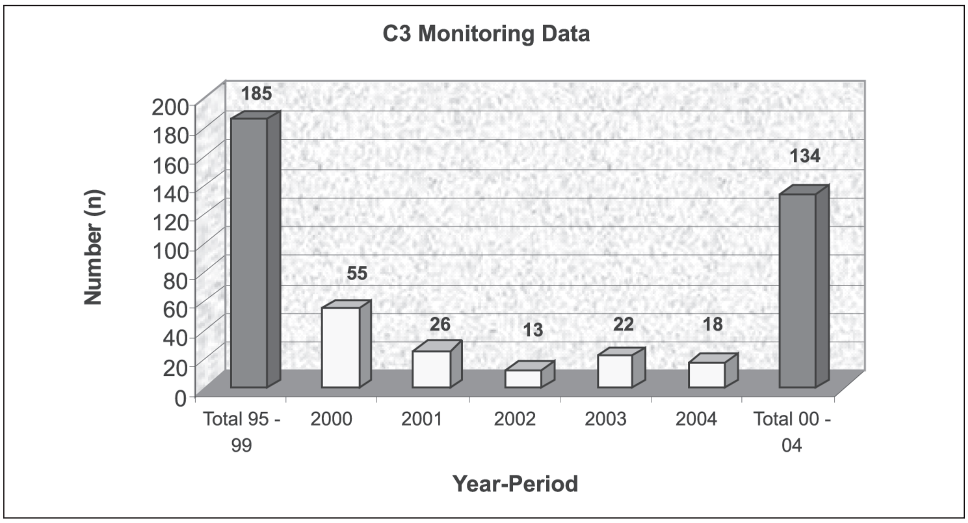
There is a large number of reliable C2 data about lynx presence. There are 767 such data points for the last period or 85% of all data points, while this number in the previous period was 307 or 60%. The number of C2 data has increased 2.5 times from one five-year period to the next. During the last 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.

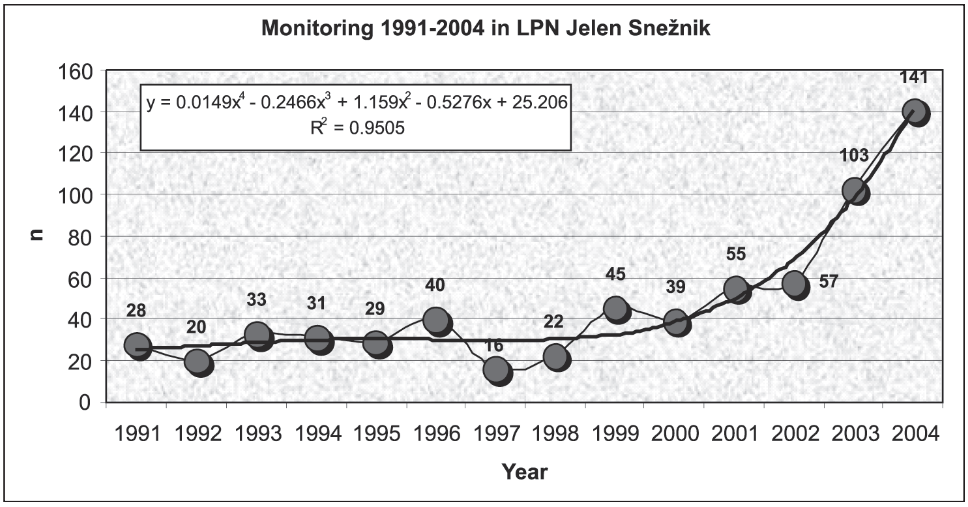


Graph 3: The dynamics of the C2 monitoring data.

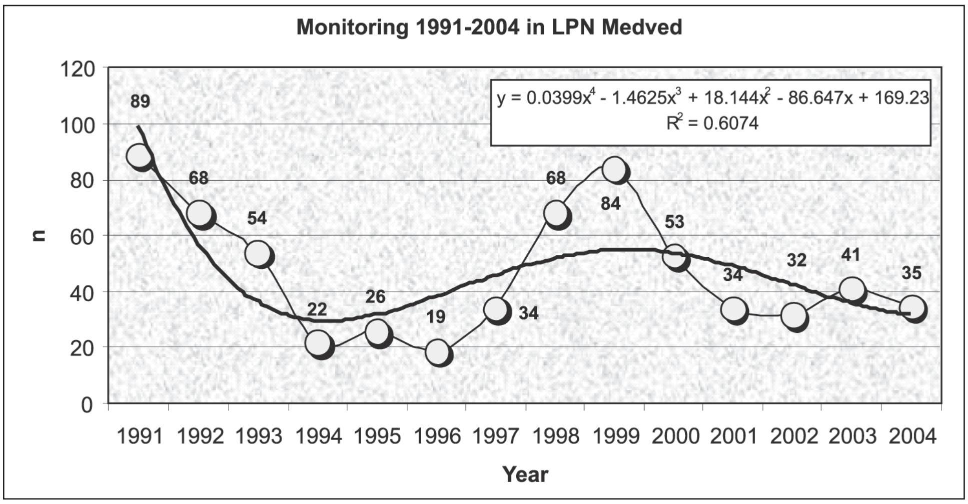


Graph 4: The dynamics of the C3 monitoring data.

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.

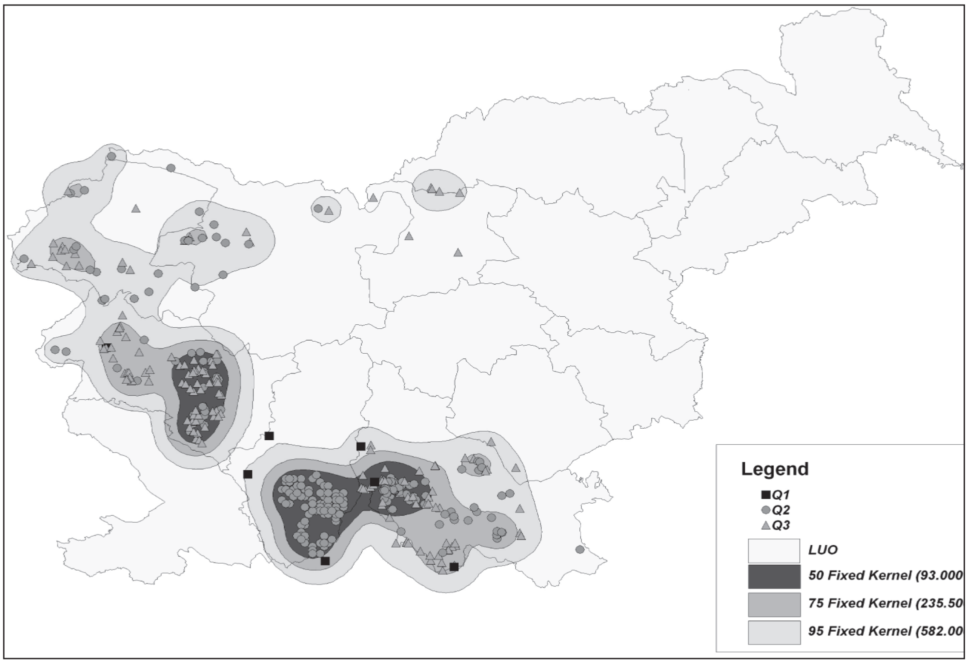


Figure 2: Lynx population range in Slovenia 1995 – 1999.

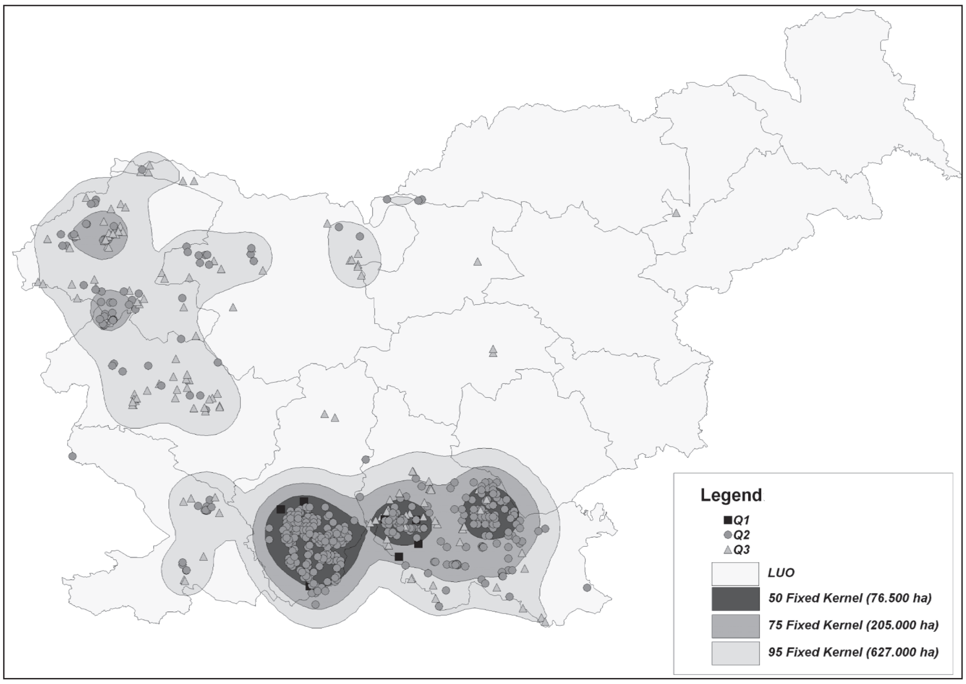


Fig. 3: Lynx population range in Slovenia 2000 – 2004.

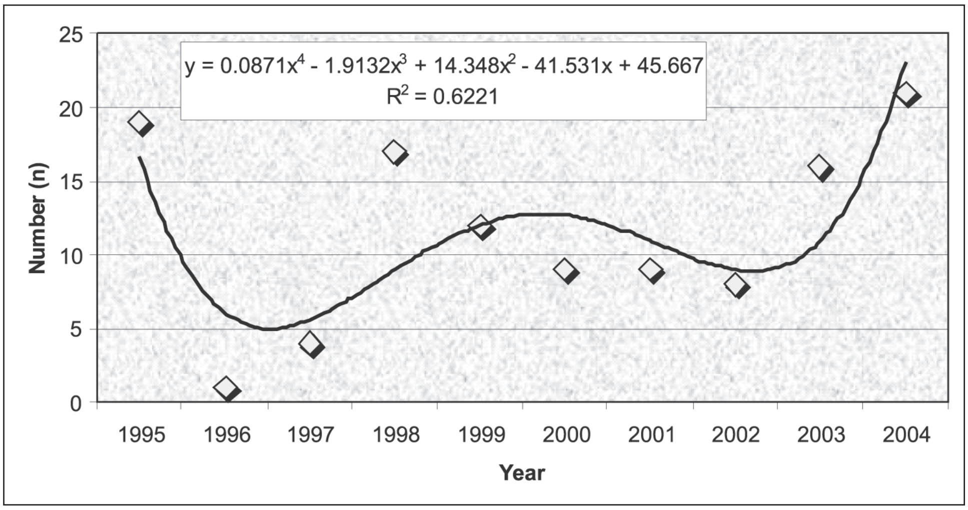
Damages to livestock

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.

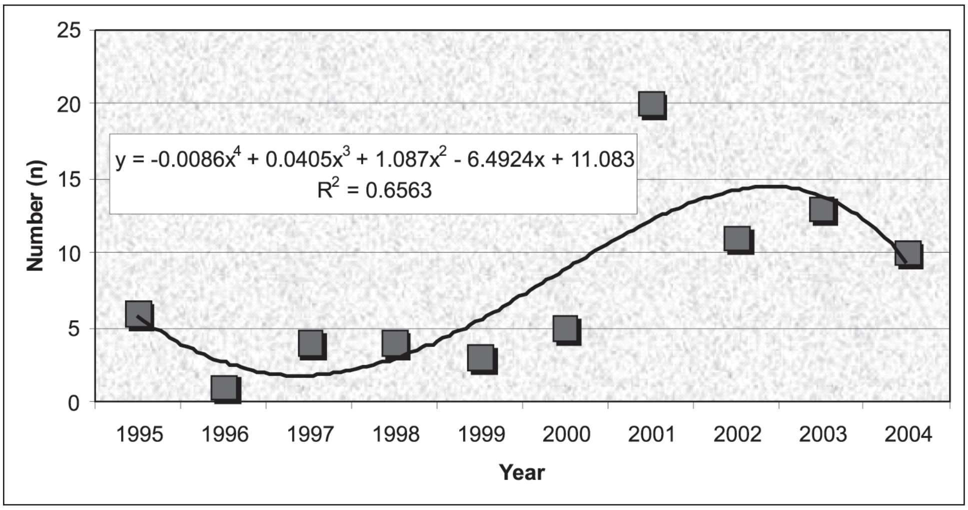
Table 4: Damages to livestock caused by the lynx.

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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Lynx in the Austrian Alps 2000 to 2004

Ris v Avstrijskih Alpah v obdobju 2000– 2004

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Abstract. Based on reports submitted mostly by hunters and from monitoring activities in the national park Kalkalpen we tried to evaluate the status and the distribution of the lynx in the Austrian Alps for the period 2000 to 2004. Reports on lynx presence have been collected by the hunters associations of Styria, Carinthia, Upper Austria and Vorarlberg, by the national park Kalkalpen and by the department of wildlife biology and game management at the University of natural resources and applied life sciences. For the period 2000 to 2004 225 reports on lynx have been documented for the Austrian Alps. 116 of these were classified as category 3 data, 103 reports on prey-remains and tracks have been confirmed by trained people and classified as category 2 data and six reports concerned hard-facts (C1). All hard facts and all verified records originate from two distinct areas – national park Kalkalpen and the Niedere Tauern mountain range. Other areas with lynx reports are the Northeastern Limestone Alps, northwesterm Carinthia and Vorarlberg. Based on the available data we can not determine the actual distribution of the lynx in Austrian Alps or the status of the species in the region. Monitoring efforts by hunters and foresters in the Niedere Tauern mountain range has yielded good data on the local situation of lynx. This has to serve as a model for the future development of the monitoring system in Austria.
Keywords: *Lynx lynx*, Alps, Austria, monitoring, distribution

Introduction

Although Austria features an intensively used landscape, the country is densely forested. Currently about 47 percent of Austria is covered by forests (Schadauer 2004). Forest cover is even higher in the Alpine regions. Austria also features high densities of the most important prey species for the lynx: in 2003/2004 hunters in Austria shot 285.114 roe deer, 46.949 red deer and 26.185 chamois (Statistik Austria 2004, Molinari-Jobin & al. 2000). Considering this, Austria should provide good habitat for the lynx. After being extirpated during the second half of the 19th century (Eiberle 1972), lynx were re-introduced into the Austrian Alps in 1976–1979 (Festetics & al. 1980). The released animals scattered rapidly. Although reproduction has been documented, there was no indication that a viable core population developed in the following years (Gossow & Honsig-Erlenburg 1986). Since then, lynx presence has continuously been reported from large areas of central Austria, especially from western parts of Styria and most of Carinthia. Following the intensive monitoring of the released lynx, monitoring in the Austrian Alps mostly depended and still depends on unsolicited reports by hunters. Since the early 1990s these reports have been scattered over a vast area, giving indication on the presence of a few solitary individuals roaming in central Austria (Huber & Kaczensky 1998, Huber & al. 2001).

We describe the current situation of the lynx in the Austrian Alps based on reports on lynx presence documented between 2000 and 2004.

Methods

Data collection on the status and the distribution of the lynx in the Austrian Alps depends for most areas on the collection of unsolicited reports on the presence of the lynx by the provincial hunters associations. Hunters have been asked to report all signs of lynx presence. To increase interest and knowledge on the species – a number of articles have been published in hunting magazines, and training courses on the identification of carnivore signs of presence have been held in some areas. Most of the collected reports have not been re-examined in the field by people with detailed knowledge on the species, due to organisational difficulties and especially lack of funding. A later confirmation often proved difficult as many reports were poorly documented.

There are two major exceptions from the above described situation. One exception is the province of Upper Austria where the provincial hunters association is paying their members € 72 for reports on ungulates killed by lynx. Reports have to be documented by pictures of the kill and confirmed by a person trained in the identification of lynx kills. Since the start of the program a number of training sessions have been held to train hunters in the identification of signs of carnivore presence. The other exception is the national park Kalkalpen in Upper Austria, where a monitoring scheme has been installed. The monitoring consists of systematic snow-tracking surveys, installation of camera traps and a systematic collection of reports from hunters, foresters and locals.

Compensation for large carnivore damage on livestock is regulated separately for each species and each province. In the provinces of Carinthia, Styria and Lower Austria damage caused by lynx is compensated by an insurance maintained by the respective hunters association. For the other provinces no compensation system has been established, but there are a variety of funds available to provide compensation payment for livestock losses. All claims for compensation have to be examined by people trained in the identification of carnivore signs.

All documented reports on lynx presence in the Austrian Alps have been collected on a yearly base by the authors to ensure equal data interpretation and to provide status reports for the Austrian Alps across the provinces.

For the present report we analysed reports on the presence of lynx for the years 2000 to 2004 from all organisations, which to our knowledge, collect such data. We classified all records on lynx presence according to SCALP-criteria as published by Molinari-Jobin & al. (2003). We distinguished three levels of reliability according to the possibility to verify the report. Category 1 (C1) data represent "hard facts" such as lynx found dead, lynx captured, or pictures of lynx taken by camera-traps set by known people. We added scats, identified using DNA techniques, or hair analysis to this category as we believe that they provide very reliable data. Category 2 (C2) represent wildlife or livestock kills as well as tracks and scats confirmed by a person with profound knowledge on the lynx. Category 3 (C3) represent prey remains and other indirect signs of lynx presence not verified by someone trained in the identification of such signs. Additionally this category includes observations and vocalisations, as they can not be verified retrospectively. Reports that did not seem plausible were rejected from the dataset when we re-examined all records for the analysis.

Results

For the period January 2000 to December 2004, we were able to document 225 records of lynx presence for the Austrian Alps. 51.5% (116) of these records were classified as category 3 data (Tab. 1), signs of lynx presence that could not be confirmed but seemed plausible. In contrast to previous years we could also document a number of verified records. 103 reports on prey-remains and tracks have been confirmed by trained people and classified as category 2 data. Six records from this five-year period concerned hard-facts (C1). In 2002 fragments of a lynx skeleton were found near the border of Eastern Tyrol and Carinthia. No indication on the cause of death could be determined as only bones of the frontal extremity were found. In 2000 and 2001 a camera-trap, installed in the national park Kalkalpen, took pictures of a lynx with large spots. Although the two pictures were once from the left and once from the right side of the lynx, additional photos recently taken confirm that all pictures show the same individual. Video footage taken in the same region early 2005 did not yield enough details for individual identification of the taped lynx. Finally three scats were analysed using hair identification techniques and identified as lynx scats. One scat was found in 2002 in the Northern Limestone Alps west of national park Kalkalpen. The other two were found in Central Austria in the Niedere Tauern mountain range.

Tab.1: Number of records collected on the presence of lynx in the Austrian Alps, categorised into the three SCALP classes of data classification.

Data category	1995–1999	2000–2004
CATEGORY 1		
lynx found dead	1	1
captue	–	–
camera-trap pictures	–	2
analysed scats	–	3
TOTAL	**1**	**6**
CATEGORY 2		
prey remains	7	56
tracks	5	48
TOTAL	**12**	**104**
CATEGORY 3		
prey remains	55	56
tracks	35	23
sightings	34	31
vocalisations	–	4
markings	–	1
TOTAL	**124**	**115**
TOTAL	**137**	**225**

Although the number of lynx records did almost double from the previous reporting period (1995–1999: 137; 2000–2004: 225), the area of distribution of the records did shrink. Confirmed records (C1 and C2) were found concentrated in two areas (Fig. 1). One of these areas is around the national park Kalkalpen in the northern limestone Alps of Upper Austria. The second area is the Niedere Tauern mountain range in Styria. Unconfirmed records are distributed over greater area, with reports also coming from the eastern edge of the northern Limestone Alps and the Fischbacher Alpen, both in Styria, as well as from the north-western part of Carinthia. Reports on lynx presence have also been given from Vorarlberg – the western most province of Austria bordering Switzerland and Liechtenstein. Following the first reports from Vorarlberg a training session on the identification of lynx signs has been held. The trained hunters have not been able to confirm any of the numerous

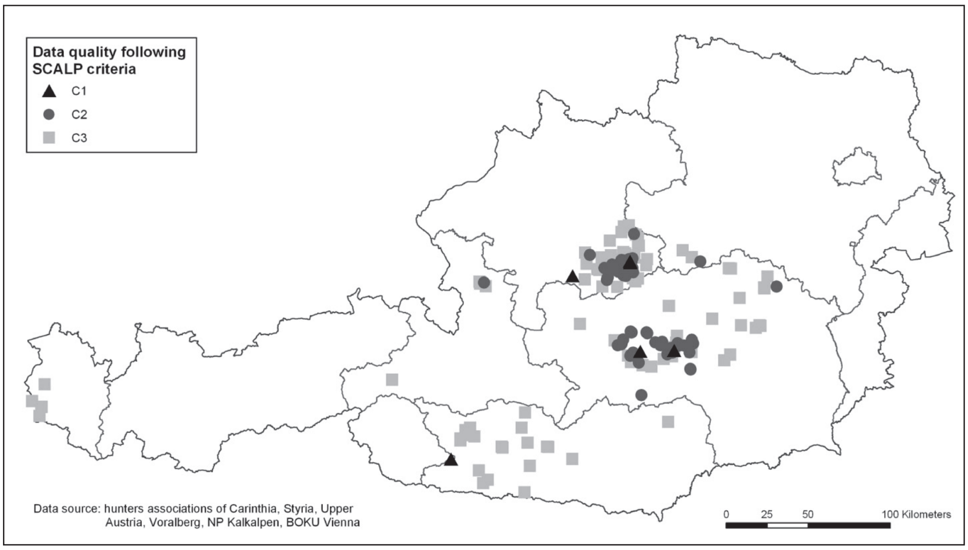

Fig.1: Distribution of records on signs of lynx presence in the Austrian Alps for the period 2000-2004.

reports on the presence of the large cat. Single plausible reports on the presence of lynx continue to come from the Osterhorn range near the city of Salzburg.

For the whole period 2000–2004, we know of 15 reports concerning depredation on livestock. Unfortunately no one experienced in the identification and handling of livestock depredation investigated the incidents in the fields, nor was good photographical documentation available. Therefore eight of these incidents had to be classified as attacks by canids or could not be evaluated in any way due to missing documentation.

For the whole period 2000–2004 we did not receive any plausible reports on reproduction in the Austrian Alps.

Between 2001 and 2004 24 reports on found roe deer remains have been filed by hunters from alpine region of Upper Austria in order to receive 72€ for reporting lynx kills from the local hunters association. When analysing the well documented reports for this paper, we found, that ten of the documented roe deer kills were most probably caused by dogs. Based on the given information the other 14 reports documented lynx kills.

Discussion

For the period 1994–1999 reports on lynx presence have been scattered over a large area of the Austrian Alps, but there have been only very few confirmed records (Huber & al. 2001). The authors concluded that there was no evidence for an established lynx population in Austria. The scattered signs of lynx presence were thought to give evidence for a few solitary individuals only. For this reporting period (2000–2004), the number of documented signs of lynx presence has increased, but a great proportion of the reports were clustered in two areas. From the temporal and spatial distribution of the signs we conclude that more than one lynx can be found in both of these areas – the Niedere Tauern and the area including the national park Kalkalpen. Outside of these two regions there are lots of rumours on lynx presence but there are very few documented records on prey items or tracks. There are some reports from the north-eastern Limestone Alps, and western parts of Carinthia, due to delayed reporting and a lack of funding we have not been able to either confirm the reports personally or initiate a network of local contacts well trained in the identification of signs of lynx presence. Because of the low number of reports and the fact that there are no confirmed records we can not confirm the presence of lynx in these areas. A similar situation can be found in Vorarlberg, along the border towards Switzerland. A year after the first releases of lynx in the re-introduction program for north-eastern Switzerland (Ryser & al. 2004), reports on lynx sightings and kills emerged in Vorarlberg. A training session on the identification of lynx kills and tracks was held in cooperation of the local hunting association. Reports on sightings, vocalisations, tracks and even found prey-remains continued to arise, but even though a small proportion of the few documented observations sound plausible, none has been confirmed yet. Rumours on the presence of the large cat can be heard from many areas of the Austrian Alps, but there are few documented, plausible reports. Even from some areas of known lynx presence, for example the northern Limestone Alps – there are very few signs reported by the local hunters. Austrian hunters do not seem too interested in the lynx or in reporting signs of lynx presence. Even the program initiated by the hunters association of Upper Austria had only moderate success in getting 14 reports on lynx kills in three year. At least two lynx have been confirmed in the area for this period. Still we are convinced that lynx monitoring can only be established in close cooperation with the local hunters. The Austrian hunting system is based on hunting territories of rather small size without any system of professional game wardens. But the lynx is under the jurisdiction of the hunting law in most of the provinces – giving the hunters the legal responsibility for the species. There are many hunters that do know a lot about the lynx. The data on the lynx in the Niedere Tauern mountain range would not have been available without the knowledge and the activities of the local hunters. Based on the commitment of these hunters and the activities in the national park Kalkalpen the quality as well as the quantity of the reports has improved when compared to the previous reporting period (Tab. 1 and Fig. 2). Most of the improvement is due to the activity of single persons or local organisations and has been concentrated on two rather limited areas. For the rest of the Austrian Alps monitoring still

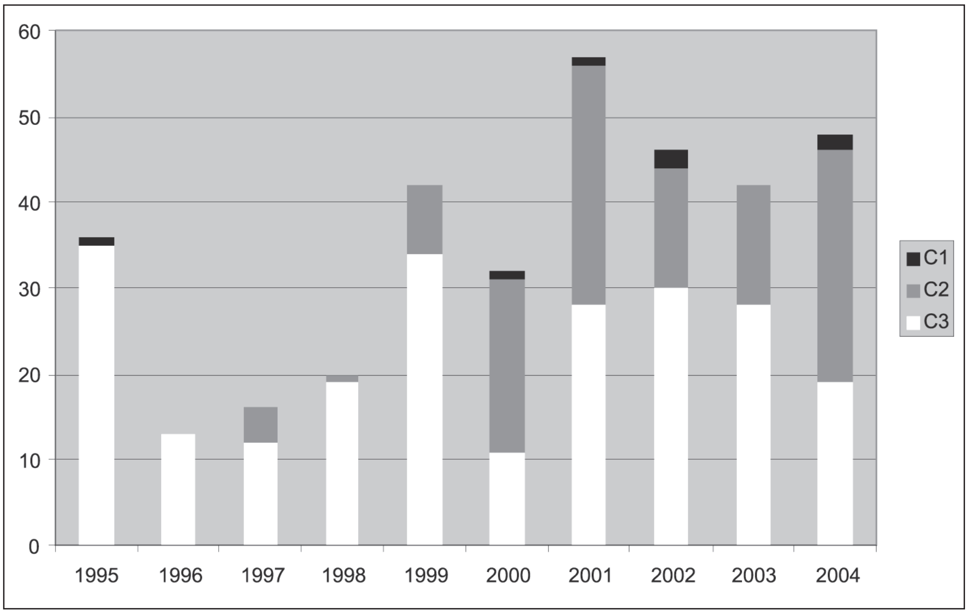

Fig. 2: Trend in numbers of reported signs of lynx presence from the Austrian Alps 1995-2004. Reports are categorised according to the SCALP classes of data classification.

depends on voluntary reports by the public and especially by hunters, data quality and quantity has not improved. As we are missing valuable local contacts and consequently good data on large areas of potential range in the Austrian Alps – we feel unable to evaluate the actual distribution of the lynx in the Austrian Alps, much less to evaluate population size and trend. For the period of 2000 to 2004 the documented reports give no indication for a viable population of lynx in the Austrian Alps, but we cannot judge whether there are more of the secretive cats around, than we know.

Based on the restraints faced in Austria, Huber & Laass (2005) tried to develop a scheme to determine the situation of the lynx considering the favourable conservation status as determined by the Habitats-Directive of the European Union (92/43/EWG). Member states of the European Union are committed to report the status to the European Commission by 2007. Based on the currently available data, we do not feel able to provide a well founded evaluation of the status of the lynx at the time being.

Besides the lynx occurrence in the Alps, lynx can be found in northern parts of Austria, as lynx from the Bohemian-Forest population have spread into Austria. After a peak in the late 1990s, the Austrian part of the population is now considered stable on a low level (Laass & Engleder 2005, Engleder pers. comm.). The monitoring in this area mostly depends on reports by hunters, but a local environmental group has created a network of personal contacts. Closely attending this network of personal contacts needs a lot of effort, but yields much more meaningful data than unsolicited reports. We think that without a system of personal contacts among the local hunters for most parts of the Austrian Alps, we will not be able to evaluate the conservation status of the lynx. Setting up such a network and continually attending to it needs funding and can not be done on a voluntary base only as the monitoring has been done up to now in the Austrian Alps.

Acknowledgements

This report is based on reports of lynx presence collected and submitted by the hunter's associations of Upper Austria, Styria, Carinthia, Vorarlberg and Salzburg, and the national park Kalkalpen. We are thankful for every effort taken to examine reports and confirm signs of lynx presence. Financial and logistical support was granted by WWF Austria, the national park Kalkalpen and the University of Natural Resources and Applied Life Sciences. We thank A. Molinari-Jobin and P. Molinari for beneficial reviews.

Zusammenfassung

Seit der Wiederansiedlung 1976–1979 in der westlichen Steiermark wurden Luchse in weiten Bereichen der österreichischen Alpen nachgewiesen. Aufgrund der Verteilung der Nachweise mußte davon ausgegangen werden, dass es sich eher um verstreute Einzeltiere handelte als um eine lebensfähige Population. Um den aktuellen Zustand des Luchsbestands in den österreichischen Alpen zu beurteilen, haben wir die Qualität und die Verteilung der Hinweise auf die Anwesenheit von Luchsen analysiert. Die Luchsnachweise wurden von den Jägerschaften der Bundesländer Steiermark, Kärnten, Oberösterreich und Vorarlberg, vom Nationalpark Kalkalpen bzw. vom Institut für Wildbiologie und Jagdwirtschaft der BOKU Wien gesammelt und zur Verfügung gestellt. Für die Periode 2000–2004 wurden im österreichischen Alpenraum 225 (C1: 6; C2: 104; C3 115) Hinweise dokumentiert. Die Qualität und Quantität der Nachweise hat sich somit seit der letzten fünf Jahre wesentlich verbessert (127 Nachweise, C1: 1; C2: 12; C3: 124). Allerdings stammen alle gesicherten Nachweise (C1 und C2) aus der Region des Nationalparks Kalkalpen beziehungsweise aus den Niederen Tauern. In beiden Regionen konnte durch die Aktivität von lokalen Kontaktpersonen das Luchs-Monitoring wesentlich verbessert werden. Weitere Meldungen über die Anwesenheit von Luchsen kommen aus der nördlichen

Steiermark, aus den westlichen Bereichen Kärntens, sowie aus dem Grenzgebiet zwischen Vorarlberg und der Schweiz. Leider konnten die meisten dieser Meldungen nicht überprüft werden. Aufgrund der Verteilung und der Qualität der vorliegenden Nachweise ist es nicht möglich die tatsächliche Verbreitung des Luchses zu beurteilen. Aussagen zur Populationsgrösse oder –trends wären Spekulation. Aus vielen Regionen der österreichischen Alpen werden Gerüchte über die Anwesenheit des Luchses bekannt, leider fehlen bislang bestätigte Meldungen. Daher sehen wir den Aufbau eines Netzwerks an lokalen Kontakten sowie die Etablierung eines zentralen Koordinators als essentiell an, um den Status des Luchses in Österreich ausreichend beurteilen zu können.

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Ryser, A., K. von Wattenwyl, M.P. Ryser-Degiorgis, Ch. Willisch, F. Zimmermann & U. Breitenmoser 2004: Luchsumsiedlung Nordostschweiz 2001 – 2003, Schlussbericht Modul Luchs des Projektes LUNO. KORA Bericht **22d**, Bern, Schweiz, 60pp. (in German).

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Statistik Austria 2004: Statistisches Jahrbuch Österreichs 2004 – Statistical Yearbook 2005 Austria. Statistik Austria, Wien, 620pp.Fig.1: Distribution of records on signs of lynx presence in the Austrian Alps for the period 2000–2004.

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Sprejeto (accepted): 2007-01-29

Present status and distribution of the lynx in the German Alps 2000–2004

Status in razširjenost risa v Nemških Alpah 2000–2004

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Abstract: The short survey of monitoring *Lynx lynx* in German Alps was reported.
Keywords: *Lynx lynx*, German Alps, monitoring

Introduction

In spite of some reports and rumours lynx presence in the German part of the Alps could not be confirmed during the last decade (Kaczensky 1998, Wölfl & Kaczensky 2001, Von Arx & al. 2004).

Results

For the period 2000 until 2004 some findings were reported as well. In May 2003 a female lynx one year old escaped from the Zoo in Innsbruck, Austria and could be observed some times afterwards in the Lower Inn Valley (Laass, pers. communication). Unconfirmed observations have been reported before that escape in parts of the Karwendel and the Tannheimer Tal (Ullrich, pers. communication).

During the period we have several rumours from the Western part of the German Alps, the Allgäu. However, most of the reported kills were not documented. In October 2003 a dead roe deer has been examined near Oberstaufen in the Allgäu and judged as a lynx kill by a trained person (Fig. 1). However, photos taken did not give a clear picture.

Conclusion

Apart from some rumours we still miss confirmed lynx presence stemming from wild animals. Therefore Germany will try to enforce a network of skilled people and judging and documenting possible lynx evidence, according to the actions proposed in the PACS (Panalpine Strategy for the Lynx; Molinari-Jobin & al. 2003). In a first step, during a meeting of the Bavarian professional hunters' association in May 2006, 80 hunters mainly from the Alpine region have been informed about lynx ecology and signs of presence (tracks, kills, scats).

In a technical paper the Bavarian Nature conservation agency (Landesamt für Umwelt) describes the German Alps as suitable lynx habitat (Landesamt für Umwelt, in preparation). Within the next few months a regional working platform of various interest groups will be formed mainly focussing on monitoring efforts in the beginning.

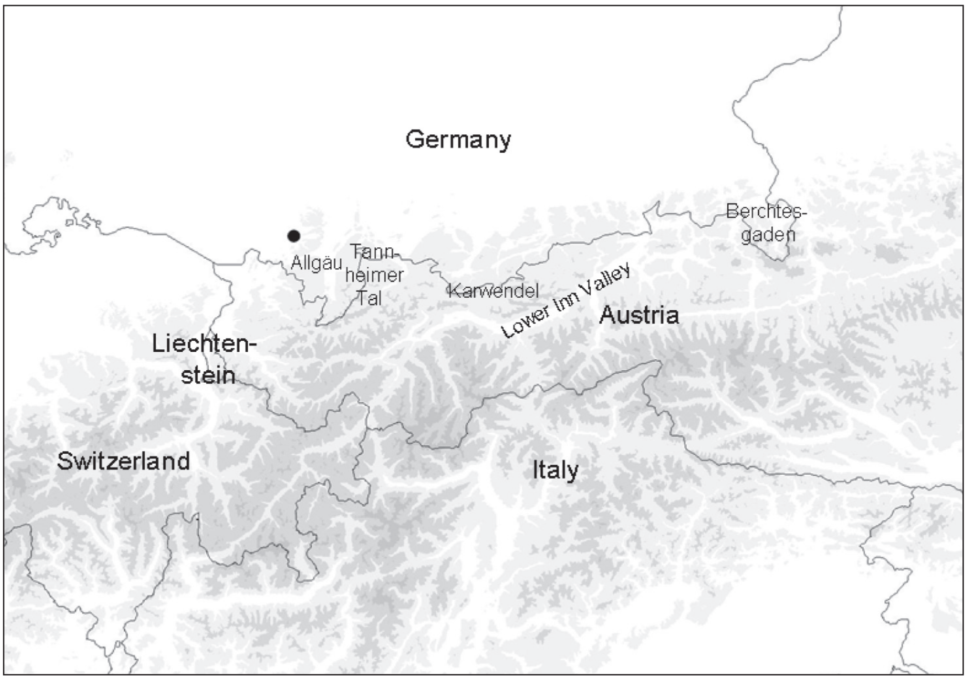

Fig. 1: Map of the German Alps with some places mentioned in the text and the site of the roe deer killed by lynx (black dot).

Another step will be the organization of a SCALP core group meeting in 2007 in the Bavarian Alps probably linked with a session of the above mentioned regional working group.

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The lynx in Liechtenstein

Ris v Liechtensteinu

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Abstract: The only observation of *Lynx lynx* in the last decade in Liechtenstein was reported.

Keywords: *Lynx lynx*, Liechtenstein, monitoring

The observations of one lynx (Fig. 1) in January 2004 and one in January 2005 have still been the only data of lynx in Liechtenstein since their extinction about one hundred years ago and since the last SCALP status report published (Fasel 2001). The locality of the observations, the forest of the village Schaanwald, near the border to Vorarlberg/Austria, is very near to possible observations in Vorarlberg (Laass & al. this issue). It may be the same animal or animals. Suspecting that the observation might be related to a radio-collared lynx translocated to eastern Switzerland (Ryser & al. 2004), the area of the observations was examined for radio-signals, but with no success. In addition, several samples of excrements have been examined, but they all originated from dogs or foxes. The same result was found with several roe deer and chamois remains found in the forest and suspected to be lynx kills.

We expect immigration of lynx from neighbouring Switzerland to happen in the near future, as Liechtenstein is only separated from the North-Eastern Swiss occurrence by the river Rhine. Experts suppose that the Rhine valley is to be easily crossed by lynx. Foresters and hunters are informed about the situation. They keep an eye on possible tracks of lynx and will report them to the local authority.

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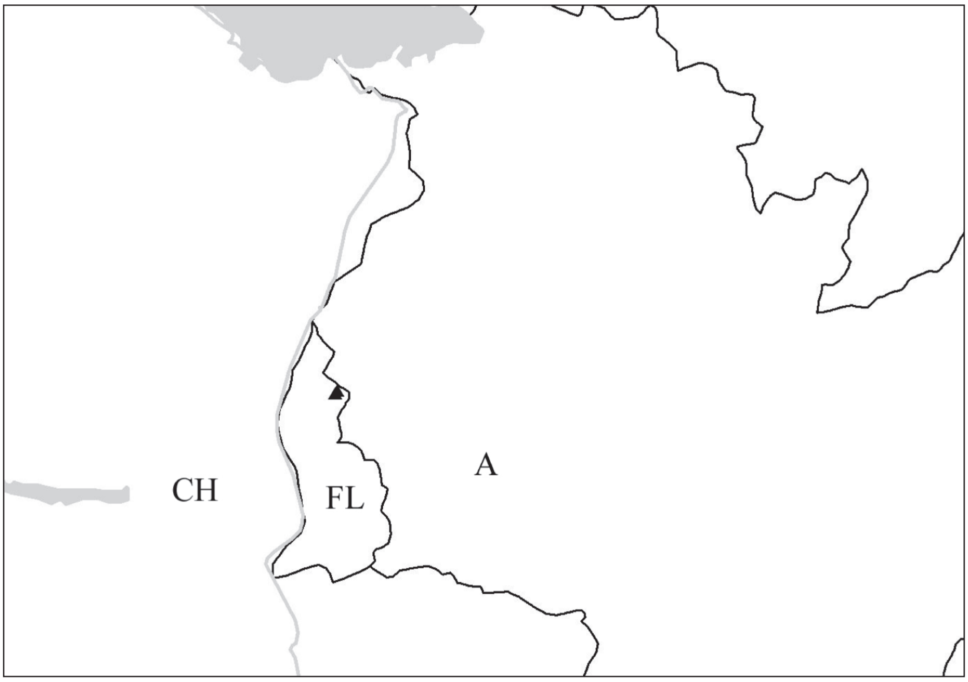

Fig. 1: Location of the only direct observation of a lynx in Liechtenstein during the five-year period 2000-2004 (black line = international boundary, grey = lakes, grey line = Rhine river). The land use data is from CORINE (European Topic Centre on Land Cover, Environment Satellite Data Center, Kiruna, Sweden), which classifies the land use types on a 250x250-m grid.

NAVODILA AVTORJEM

1. Vrste prispevkov

a) ZNANSTVENI ČLANEK je celovit opis originalne raziskave in vključuje teoretični pregled tematike, podrobno predstavljene rezultate z diskusijo in sklepe ter literaturni pregled: shema IMRAD (Introduction, Methods, Results And Discussion). Dolžina članka, vključno s tabelami, grafi in slikami, na sme presegati 15 strani; razmak med vrsticami je dvojen. Recenzirata ga dva recenzenta.

b) PREGLEDNI ČLANEK objavi revija po posvetu uredniškega odbora z avtorjem. Število strani je lahko večje od 15.

c) KRATKA NOTICA je originalni prispevek z različnih bioloških področij (sistematike, biokemije, genetike, mikrobiologije, ekologije itd.), ki ne vsebuje podrobnega teoretičnega pregleda. Njen namen je seznaniti bralca s preliminarnimi ali delnimi rezultati raziskave. Dolžina na sme presegati 5 strani. Recenzira ga en recenzent.

d) KONGRESNA VEST seznanja bralce z vsebinami in sklepi pomembnih kongresov in posvetovanj doma in v tujini.

e) DRUŠTVENA VEST poroča o delovanju slovenskih bioloških društev.

2. Originalnost prispevka

Članek, objavljen v reviji Acta Biologica Slovenica, ne sme biti predhodno objavljen v drugih revijah ali kongresnih knjigah.

3. Jezik

Teksti naj bodo pisani v angleškem jeziku, izjemoma v slovenskem, če je tematika zelo lokalna. Kongresne in društvene vesti so praviloma v slovenskem jeziku.

4. Naslov prispevka

Naslov (v slovenskem in angleškem jeziku) mora biti kratek, informativen in razumljiv. Za naslovom sledijo imena avtorjev in njihovi polni naslovi (če je mogoče, tudi štev. faxa in e-mail).

5. Izvleček – Abstract

Podati mora jedrnato informacijo o namenu, uporabljenih metodah, dobljenih rezultatih in zaključkih. Primerna dolžina za znanstveni članek naj bo približno 250 besed, za kratko notico pa 100 besed.

6. Ključne besede – Keywords

Število naj ne presega 10 besed, predstavljati morajo področje raziskave, predstavljene v članku. Člankom v slovenskem jeziku morajo avtorji dodati ključne besede v angleškem jeziku.

7. Uvod

Nanašati se mora le na tematiko, ki je predstavljena v članku ali kratki notici.

8. Slike in tabele

Tabele in slike (grafi, dendrogrami, risbe, fotografije idr.) naj v članku ne presegajo števila 10, v članku naj bo njihovo mesto nedvoumno označeno. Ves slikovni material naj bo oddan kot fizični original (fotografija ali slika). Tabele in legende naj bodo tipkane na posebnih listih (v tabelah naj bodo le vodoravne črte). Naslove tabel pišemo nad njimi, naslove slik in fotografij pod njimi. Naslovi tabel in slik ter legenda so v slovenskem in angleškem jeziku. Pri citiranju tabel in slik v besedilu uporabljamo okrajšave (npr. Tab. 1 ali Tabs. 1-2, Fig. 1 ali Figs. 1-2; Tab. 1 in Sl. 1).

9. Zaključki

Članek končamo s povzetkom glavnih ugotovitev, ki jih lahko zapišemo tudi po točkah.

10. Povzetek – Summary

Članek, ki je pisan v slovenskem jeziku, mora vsebovati še obširnejši angleški povzetek. Velja tudi obratno.

11. Literatura

Uporabljene literaturne vire citiramo med tekstom. Če citiramo enega avtorja, pišemo ALLAN (1995) ali (ALLAN 1995), če sta dva avtorja (TRINAJSTIĆ & FRANJIĆ 1994), če je več avtorjev (PULLIN & al. 1995). Kadar navajamo citat iz večih del hkrati, pišemo (HONSIG-ERLENBURG & al. 1992, WARD 1994a, ALLAN 1995, PULLIN & al. 1995). V primeru, če citiramo več del istega avtorja, objavljenih v enem letu, posamezno delo označimo s črkami a, b, c itd. (WARD 1994a,b). Če navajamo dobesedni citat, označimo dodatno še strani: TOMAN (1992: 5) ali (TOMAN 1992: 5-6). Literaturo uredimo po abecednem redu, začnemo s priimkom prvega avtorja, sledi leto izdaje in naslov članka, mednarodna kratica za revijo (časopis), volumen poudarjeno, številka v oklepaju in strani. Npr.:

HONSIG-ERLENBURG W., K. KRAINER, P. MILDNER & C. WIESER 1992: Zur Flora und Fauna des Webersees. Carinthia II 182/102 (1): 159-173.

TRINAJSTIĆ & J. FRANJIĆ 1994: Ass. Salicetum elaeagno-daphnoides (BR.-BL. et VOLK, 1940) M. MOOR 1958 (Salicion elaeagni) in the Vegetation in Croatia. Nat. Croat. 3 (2): 253-256.

WARD J. V. 1994a: Ecology of Alpine Streams. Freshwater Biology 32 (1): 10-15.

WARD J. V. 1994b: Ecology of Prealpine Streams. Freshwater Biology 32 (2): 10-15.

Knjige, poglavja iz knjig, poročila, kongresne povzetke citiramo sledeče:

ALLAN J. D. 1995: Stream Ecology. Structure and Function of Running Waters, 1st ed. Chapman & Hall, London, 388 pp.

PULLIN A. S., I. F. G. MCLEAN & M. R. WEBB 1995: Ecology and Conservation of Lycaena dispar: British and European Perspectives. In: PULLIN A. S. (ed.): Ecology and Conservation of Butterflies, 1st ed. Chapman & Hall, London, pp. 150-164.

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12. Format in oblika članka

Članek naj bo poslan v obliki Word dokumenta (doc) ali kot obogateno besedilo (rtf) v pisavi "Times New Roman CE 12" z dvojnim medvrstnim razmakom in levo poravnavo ter s 3 cm robovi na A4 formatu. Odstavki naj bodo med seboj ločeni s prazno vrstico. Naslov članka in poglavij naj bodo pisani krepko in v velikosti pisave 14. Vsa latinska imena morajo biti napisana ležeče. Uporabljene nomenklaturne vire navedemo v poglavju Metode. Tabele in slike so posebej priložene tekstu. Vse strani (vključno s tabelami in slikami) morajo biti oštevilčene. Glavnemu uredniku je potrebno oddati original, dve kopiji in elektronski zapis na disketi 3,5", na CD-romu ali kot priponko elektronske pošte (slednjega odda avtor po opravljenih strokovnih in jezikovnih popravkih).

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Vsak znanstveni članek bosta recenzirala dva recenzenta (en domači in en tuji), kratko notico pa domači recenzent. Avtor lahko v spremnem dopisu predlaga tuje recenzente. Recenziran članek, ki bo sprejet v objavo, popravi avtor. Po objavi prejme 30 brezplačnih izvodov. V primeru zavrnitve se originalne materiale vrne avtorju skupaj z negativno odločitvijo glavnega urednika.

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a) SCIENTIFIC ARTICLES are comprehensive descriptions of original research and include a theoretical survey of the topic, a detailed presentation of results with discussion and conclusion, and a bibliography according to the IMRAD outline (Introduction, Methods, Results, and Discussion). The length of an article including tables, graphs, and illustrations may not exceed fifteen (15) pages; lines must be double-spaced. Scientific articles shall be subject to peer review by two experts in the field.

b) REVIEW ARTICLES will be published in the journal after consultation between the editorial board and the author. Review articles may be longer than fifteen (15) pages.

c) BRIEF NOTES are original articles from various biological fields (systematics, biochemistry, genetics, microbiology, ecology, etc.) that do not include a detailed theoretical discussion. Their aim is to acquaint readers with preliminary or partial results of research. They should not be longer than five (5) pages. Brief note articles shall be subject to peer review by one expert in the field.

d) CONGRESS NEWS acquaints readers with the content and conclusions of important congresses and seminars at home and abroad.

e) ASSOCIATION NEWS reports on the work of Slovene biology associations.

2. Originality of Articles

Manuscripts submitted for publication in Acta Biologica Slovenica should not contain previously published material and should not be under consideration for publication elsewhere.

3. Language

Articles and notes should be submitted in English, or as an exception in Slovene if the topic is very local. As a rule, congress and association news will appear in Slovene.

4. Titles of Articles

Titles (in Slovene and English) must be short, informative, and understandable. The title should be followed by the name and full address of the author (and if possible, fax number and e-mail address).

5. Abstract

The abstract must give concise information about the objective, the methods used, the results obtained, and the conclusions. The suitable length for scientific articles is approximately 250 words, and for brief note articles, 100 words.

6. Keywords

There should be no more than ten (10) keywords; they must reflect the field of research covered in the article. Authors must add keywords in English to articles written in Slovene.

7. Introduction

The introduction must refer only to topics presented in the article or brief note.

8. Illustrations and Tables

Articles should not contain more than ten (10) illustrations (graphs, dendrograms, pictures, photos etc.) and tables, and their positions in the article should be clearly indicated. All illustrative material should be provided as physical originals (photographs or illustrations). Tables with their legends should be submitted on separate pages (only horizontal lines should be used in tables). Titles of tables should appear above the tables, and titles of photographs and illustrations below. Titles of tables and illustrations and their legends should be in both Slovene and English. Tables and illustrations should be cited shortly in the text (Tab. 1 or Tabs. 1-2, Fig. 1 or Figs. 1-2; Tab. 1 and Sl. 1).

9. Conclusions

Articles shall end with a summary of the main findings which may be written in point form.

10. Summary

Articles written in Slovene must contain a more extensive English summary. The reverse also applies.

11. Literature

References shall be cited in the text. If a reference work by one author is cited, we write ALLAN (1995) or (ALLAN 1995); if a work by two authors is cited, (TRINAJSTIĆ & FRANJIĆ 1994); if a work by three or more authors is cited, (PULLIN & al. 1995); and if the reference appears in several works, (HONSIG-ERLENBURG & al. 1992, WARD 1994a, ALLAN 1995, PULLIN & al. 1995). If several works by the same author published in the same year are cited, the individual works are indicated with the added letters a, b, c, etc.: (WARD 1994a,b). If direct quotations are used, the page numbers should be included: TOMAN (1992: 5) or (TOMAN 1992: 5-6).

The bibliography shall be arranged in alphabetical order beginning with the surname of the first author followed by the year of publication, the title of the article, the international abbreviation for the journal (periodical), the vo-lume (in bold print), the number in parenthesis, and the pages. Examples:

HONSIG-ERLENBURG W., K. KRAINER, P. MILDNER & C. WIESER 1992: Zur Flora und Fauna des Webersees. Carinthia II 182/102 (1): 159-173.

TRINAJSTIĆ & J. FRANJIĆ 1994: Ass. Salicetum elaeagno-daphnoides (BR.-BL. et VOLK, 1940) M. MOOR 1958 (Salicion elaeagni) in the Vegetation in Croatia. Nat. Croat. 3 (2): 253-256.

WARD J. V. 1994a: Ecology of Alpine Streams. Freshwater Biology 32 (1): 10-15.

WARD J. V. 1994b: Ecology of Prealpine Streams. Freshwater Biology 32 (2): 10-15.

Books, chapters from books, reports, and congress anthologies use the following forms:

ALLAN J. D. 1995: Stream Ecology. Structure and Function of Running Waters, 1st ed. Chapman & Hall, London, 388 pp.

PULLIN A. S., I. F. G. Mclean & M. R. Webb 1995: Ecology and Conservation of Lycaena dispar: British and European Perspectives. In: Pullin A. S. (ed.): Ecology and Conservation of Butterflies, 1st ed. Chapman & Hall, London, pp. 150-164.

TOMAN M. J. 1992: Mikrobiološke značilnosti bioloških čistilnih naprav. Zbornik referatov s posvetovanja DZVS, Gozd Martuljek, pp. 1-7.

12. Format and Form of Articles

Articles should be send as Word document (doc) or Rich text format (rtf) using "Times New Roman CE 12" font with double spacing, align left and margins of 3 cm on A4 pages. Paragraphs should be separated with an empty line. The title and chapters should be written bold in font size 14. All scientific names must be properly italicized. Used nomenclature source should be cited in the Methods section. Tables and illustrations shall accompany the texts separately. All pages including tables and figures should be numbered. The original manuscript, two copies, and an electronic copy (after all corrections) on a 3.5" computer diskette, on CD-ROM or by e-mail must be given to the editor-in-chief. All articles must be proofread for professional and language errors before submission.

13. Peer Review

All Scientific Articles shall be subject to peer review by two experts in the field (one Slovene and one foreign) and Brief Note articles by one Slovene expert in the field. Authors may nominate a foreign reviewer in an accompanying letter. Reviewed articles accepted for publication shall be corrected by the author. Authors shall receive thirty (30) free copies of the journal upon publication. In the event an article is rejected, the original material shall be returned to the author together with the negative determination of the editor-in-chief.