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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).

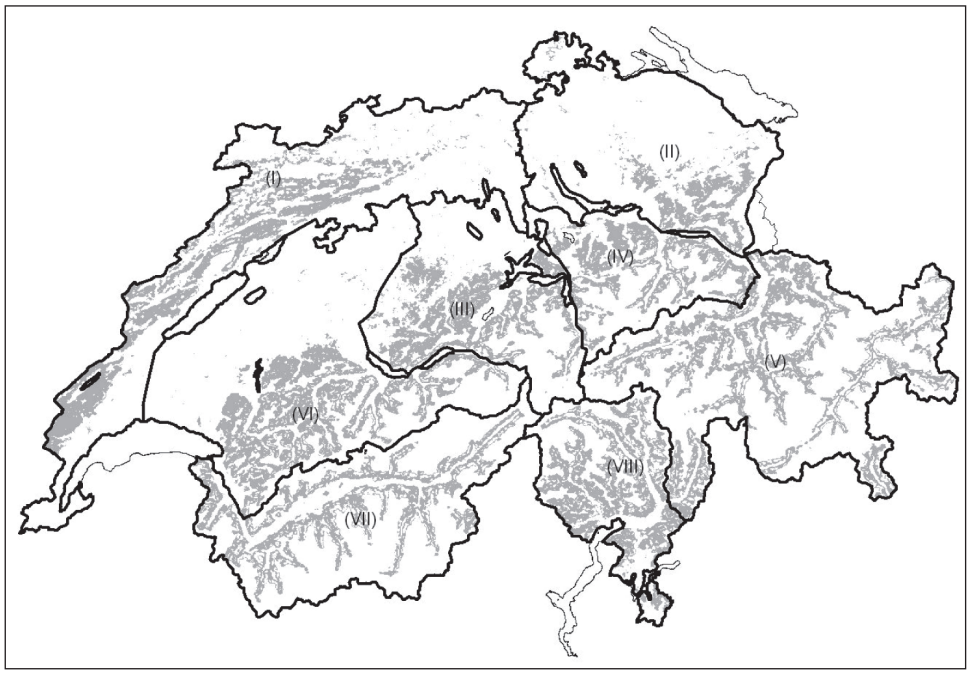

Fig. 1: Potential habitat (grey) and division of Switzerland into 8 large carnivore management compartments (I = Jura Mountains, II = North-eastern Switzerland, III = Central Switzerland West, IV = Central Switzerland East, V = Grisons, VI = North-western Alps, VII = Wallis, VIII = Ticino).

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.

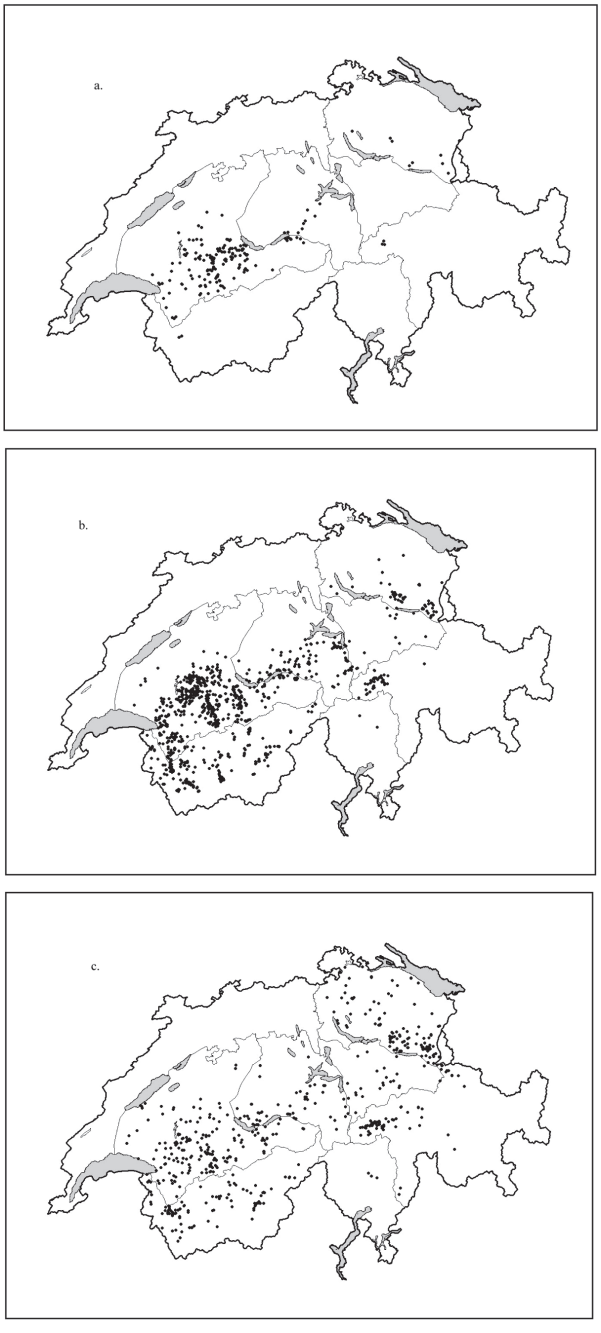

Fig. 2: Distribution of lynx signs of presence in Switzerland for the five-year period 2000-2004. (a) Category 1 data: dead lynx, lynx removed, photos. (b) Category 2 data: killed livestock, confirmed wild prey remains and tracks. (c) Category 3 data: unconfirmed wild prey remains and tracks, sightings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

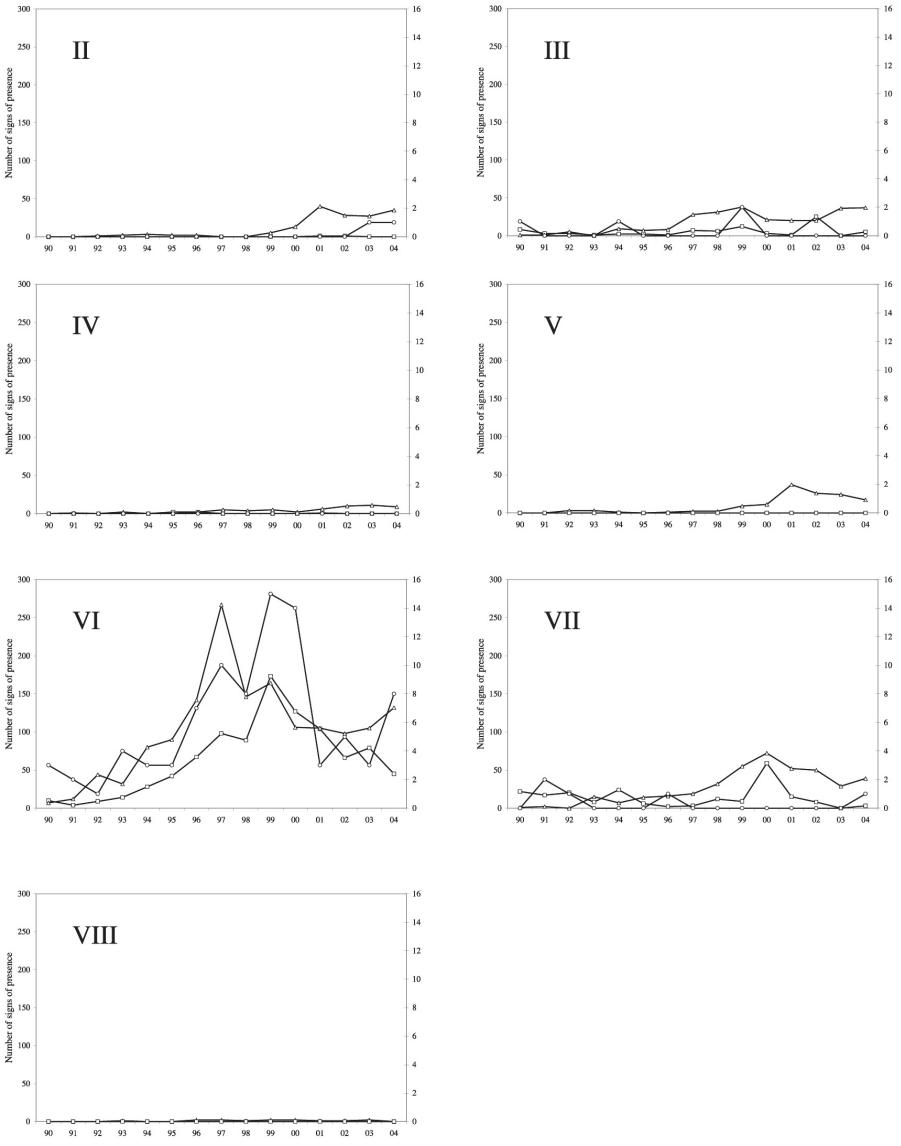

Fig. 3: Development of the number of lynx signs of presence per large carnivore management compartment (left x-axis: squares = livestock killed, triangles = occasional observations pooled; right x-axis: circles = dead lynx found and lynx removed from the population). The systematic monitoring in Switzerland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