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Research Article

Monitoring the Lynx in the Alps

Anja Molinari-Jobin[a,*], Sybille Wölfl[b], Eric Marboutin[c], Paolo Molinari[d], Manfred Wölfl[e], Ivan Kos[f], Michael Fasel[g], Iztok Koren[h], Christian Fuxjäger[i], Christine Breitenmoser[j], Thomas Huber[k], Mateja Blažič[l], Urs Breitenmoser[m]

[a] *SCALP, Tarvisio, Italy*
[b] *Luchsprojekt Bayern, Lam, Germany*
[c] *ONCFS, Gières, France*
[d] *Italian Lynx Project, Tarvisio, Italy*
[e] *Bayerisches Landesamt für Umwelt, Hof/Saale, Germany*
[f] *University of Ljubljana, Ljubljana, Slovenia*
[g] *Office of Forests, Nature and Land Management, Department of Nature and Landscape, Vaduz, Liechtenstein*
[h] *Slovenia Forest Service, Tolmin, Slovenia*
[i] *NP OO Kalkalpen, Molln, Austria*
[j] *KORA, Muri, Switzerland*
[k] *Am Berg, Afritz, Austria*
[l] *Environmental Agency of the Republic of Slovenia, Ministry for Environmental, Spatial Planning and Energy, Ljubljana, Slovenia*
[m] *Institute of Veterinary Virology, University of Berne, Bern, Switzerland*

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Abstract

The project *Status and Conservation of the Alpine Lynx Population* (SCALP) is an ongoing program aiming to co-ordinate the lynx monitoring and propose conservation activities in the Alps. The SCALP project was initiated from several active lynx researchers as an informal group in the early 1990s – twenty years after the reintroductions in Switzerland, Italy, Slovenia, and Austria. To propose adequate management measures, a sound monitoring of the Alpine lynx population needs to be in place. In the early 1990s the first efforts were made to put all available data on lynx presence together. The least common denominator of data collection in the Alps was – and still is – the compilation of direct and indirect signs of lynx presence. To standardise the interpretation of the data collected, SCALP experts agreed on a categorisation of occurrence records, where each record is evaluated retrospectively whether it can be verified for correct species identification and whether it has been verified for correct species identification. Therefore, for the monitoring of the lynx throughout the Alps in the frame of the SCALP surveys, the collected data are classified in three categories according to the following SCALP criteria: Category 1 (C1): "Hard facts", verified and unchallenged observations; Category 2 (C2): Observations controlled and confirmed by a lynx expert (e.g. trained member of the network); Category 3 (C3): Unconfirmed category 2 observations and all observations such as sightings and calls which, if not additionally documented, by their nature cannot be verified. The SCALP criteria allow to both combine and distinguish reliable and only partly reliable data for a better interpretation of the actual distribution.

Introduction

Today, the Alps provide an appropriate living space for lynx *Lynx lynx* in regard to habitat and prey abundance, as experiences with rein-

*Corresponding author
Email address: a.molinari@kora.ch (Anja Molinari-Jobin)

troduced populations in Switzerland and Slovenia have revealed (Molinari-Jobin et al., 2010). However, almost 40 years after the reintroduction of lynx into the Alps all occurrences are still small and disconnected. Expanding and merging these is crucial for their long term persistence. However, natural spread of lynx in the Alps is very slow or non-existent, probably as a combination of species-specific particularities, landscape constraints, and high anthropogenic losses (Molinari-Jobin et al., 2010).

The Alpine lynx population is protected by the Council of Europe's Convention on the Conservation of European Wildlife and Natural Heritage (Bern Convention) and the European Union's Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive). After endorsement, these treaties must be implemented by national and regional legislation. Certain reservations against the full protection of the species are possible upon ratification but the countries must strive for, and maintain, a "favourable conservation status" of the species and European Union member states must report on the status of the population every six years.

Monitoring at the landscape scale presents particular challenges: (i) data collection over a large area is inherently costly so methods for minimizing costs will be particularly significant. (ii) Monitoring systems vary greatly across the Alps and depend on the kind of hunting management. The least common denominator of lynx monitoring in the Alps is based on the collection of lynx signs of presence. However, the reliability of ecological field data depends, among other things, on the experience of the observers and varies with their training and education, interest, and consciousness. Depending on the environmental conditions, species identification is often difficult even for experts (DeMatteo and Loiselle, 2008). Distinguishing genuine records of lynx presence from records erroneously attributed to lynx is a challenge. In this paper we describe a practical approach to disclose problems induced by varying reliability in various kinds of lynx observations.

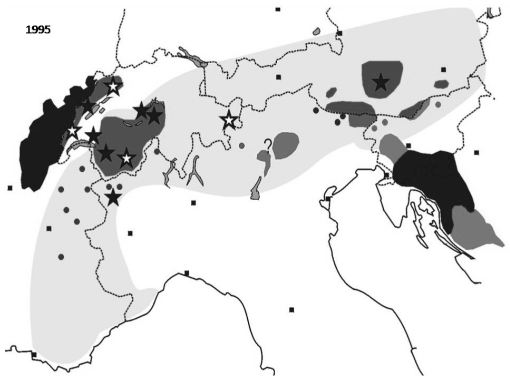

Figure 1 – Distribution of lynx in the Alps (grey shade) and adjacent Dinaric and Jura Mountains during the early 1990s (from Breitenmoser et al. 1998). Stars denote the reintroduction sites (black = official, white = unofficial), darker areas indicate the subpopulations, isolated dots show the presence of vagrants.

Lynx monitoring in the Alps

To allow a convincing evaluation of the status of the species in the Alps and propose adequate management measures, a scientifically robust monitoring of the Alpine lynx population needs to be in place. In the early 1990s the first efforts were made to compile all available data on lynx presence. The resulting distribution map (Fig. 1) that was presented in 1995 at the first Alps-wide lynx conference however lacks consistency and a common interpretation. The Alps are shared by 7 countries, in which there may even exist departmental, regional, cantonal and provincial differences in wildlife management. Lynx monitoring systems are adapted to the national wildlife management system, but inevitably were/are established only after the arrival of lynx. As a consequence, monitoring systems and efforts vary considerably between countries and regions.

The least common denominator of data collection in the Alps is the compilation of direct and indirect signs of lynx presence, so called "chance observations". These observations are called "chance" because they are not generated through a systematic field project (Breitenmoser at al., 2006). The making and the reporting of chance observations depend on the presence and the awareness of an observer. Chance observations are therefore biased regarding their distribution and their reliability. Besides, to infer distribution, trend and abundance from any kind of field observations involves two possible basic errors:

1. *False negative*: the species is present, but not detected.
2. *False positive*: although the species is absent, it is wrongly recorded to be present (e.g. as a consequence of species misidentification).

Conservation biologists and wildlife managers must be reasonably sure that the presence of a species has been correctly determined. While a variety of methods for animal abundance estimation provide different methods of estimating detection probabilities for specific kinds of count statistics (Buckland et al., 2001; MacKenzie et al., 2002; Nichols and Karanth, 2002; Otis et al., 1978; Pollock, 1982), the issue of erroneous identification and false detection, has been addressed much less (but see Miller et al. 2011; Royle and Link 2006). But errors in species identification can cause an over-estimation of the distribution or abundance of a species and also inflate indices of trends, leading to an overly optimistic assessment of the status and an incorrect prioritization of conservation efforts (Molinari-Jobin et al., 2012).

We used a standardised interpretation key based on a categorisation of possible presence records, where each record is evaluated retrospectively whether it can be and whether it has been verified for correct species identification (Molinari-Jobin et al., 2012). Thus, each occurrence record gets an attribute of whether or not it has been verified and confirmed or not. Therefore, for the lynx monitoring throughout the Alps, all data collected are assigned to one of three categories according to the following SCALP criteria:

C1 : Confirmed “hard facts”, verified and undisputable records of lynx presence such as (1) dead lynx, (2) captured lynx, (3) good-quality and georeferenced lynx photos (e.g., from camera traps), and (4) samples (e.g. excrements, hair) attributed to lynx by means of a scientifically reliable analysis.

C2 : Records confirmed by a lynx expert (e.g. trained member of the network) such as (1) killed livestock or (2) wild prey, and (3) lynx tracks or other assessable field signs.

C3 : Unconfirmed category 2 observations (kills, tracks, other field signs too old or badly documented, where however the description conforms to a lynx sign) and all observations such as sightings and calls which by their nature cannot be verified.

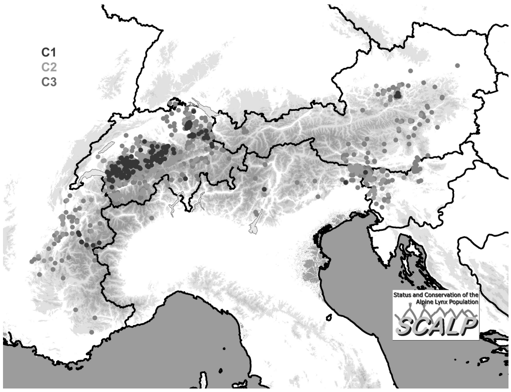

Figure 2 – Alpine lynx distribution (2006-2008), based on a standardised interpretation (C1 = hard fact data; C2 = confirmed records; C3 = unconfirmed records). Signs of presence of adjacent ranges are not shown.

The SCALP criteria allow to both combine and distinguish hard (e.g. confirmed = C1 and C2) and soft data (e.g. that cannot be or have not been verified = C3) for a better interpretation of the actual distribution (Fig. 2). We compared the different proportions of C1 versus C2 versus C3 data and their extensions during two distinct periods: 1995-1997 and 2006-2008 (Molinari-Jobin et al., 2012). The ratio of the perceived distribution areas as inferred from records of type C1 : C2 : C3 in the 1995-1997 period was 1 : 6 : 11. A decade later (2006–2008), the resulting ratio was only 1 : 3 : 5, indicating an improvement of the monitoring. Besides, comparing “hard” (C1 and C2) and “soft” data (C3) in space and time using site-occupancy modeling (MacKenzie et al., 2002, 2003; Tyre et al., 2003) revealed that cells with C1 and C2 observations had a higher probability of being detected and to persist, whereas cells with only C3 records had a lower probability of being detected and persistence, but a higher probability of colonisation. These findings may indicate a higher probability of false positive records in the C3 data type (Molinari-Jobin et al., 2012).

In all Alpine countries there are areas with isolated C3 data (Fig. 2), thus where the presence of lynx has not been confirmed. Isolated unconfirmed data shows regions where either (a) the species is present but tracks and kills have not been confirmed due to a lack of trained people or (b) the species is absent, thus the unconfirmed data stem from wrong species identification. The verification of a record is strongly dependent on the presence of monitoring personnel. In peripheral areas with only sporadic lynx observations and no organised network, the assessment of chance observations in the field is often logistically impossible. The classification of records proposed allows to quickly identify areas with an accumulation of category 3 observations where monitoring efforts should ideally be intensified. Distinguishing between hard and soft data also allows the incorporation of a simple reliability measure into distribution maps. This is particularly useful for species assessment on a landscape level, where from some areas the only data available may be soft data, a problem not unique to lynx in the Alps (e.g. see Duckworth et al. 2009, 2010 for the recent discussion on the presence of the fishing cat in Laos and Sumatra or Sarmento et al. 2009 for an underestimation of a population decline based on soft data only).

Lessons learned

- Logistical and financial constraints often make it necessary to rely on a monitoring data set in which the quality of the data varies from hard fact proves (C1) of species presence to confirmed (C2) to only assumed presence (C3). In such cases at least the interpretation should be done consistently according to an agreed standardisation and categorisation.
- When inferring the distribution of rare carnivores, especially for species with an expanding or shrinking range, we recommend a rigorous discrimination between fully reliable and un- or only partly reliable data (Molinari-Jobin et al., 2012).
- Categorisation in "hard facts", "confirmed" and "unconfirmed" records does not *a priori* improve the quality of the data, but it allows an internal critical review of the records and reveals shortcomings in the monitoring network.

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