2.7 Monitoring lynx distribution at the Carpathian metapopulation level

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Distribution is a key parameter in assessing the status of a species or population. Although the "where"- question seems intuitively easy to answer, there are some important drawbacks when it comes to the monitoring of the distribution of elusive species such as lynx, which occupy large home ranges. The raw data upon which distribution is inferred consists of direct and indirect signs of presence made by researchers themselves or reported to them through a monitoring network. These field data are typically prone to two kinds of observation errors: false-negative and false positive errors (Royle & Link, 2006). In the context of species distribution, false-negative observations arise when a species is overlooked where in fact it occurs. False-positive observations arise when a species is recorded erroneously at a place where it does not occur, for instance, because another species is mistaken for the study species. Conservation biologists and wildlife managers must ensure that the presence of a species has been correctly determined (Molinari-Jobin et al., 2012) or account for misidentification when creating distribution maps (e.g. Louvrier et al., 2019).

Monitoring the lynx' distribution poses particular challenges: (1) data collection over a large area is inherently costly, so choice of adequate methods to provide useful information with minimal costs is even more crucial than in other monitoring programs (Jones, 2011). (2) Although lynx has very specific characteristics that make it easily recognisable also to laypersons, misidentifications are nevertheless common (Huber & Kaczensky, 1998; Molinari-Jobin et al., 2012). Most often lynx signs of presence have been confounded with the ones from wolves or foxes, but even tracks of hares have been reported as belonging to lynx. (3) Species detection probability is typically far less than 1 and tends to vary over space and time (Kéry & Schmid, 2004).

2.7.1 Collection of signs of presence

The basis for monitoring the distribution is the collection of records of signs of presence. Based on its elusiveness, one always struggles for a sufficient amount of data and information when monitoring the lynx (Breitenmoser et al., 2006). Therefore, "make use of whatever you get" will always be an essential part of the monitoring. This implies that all lynx data is collected and compiled in distribution maps no matter whether it stems from passive or active monitoring, a chance observation or from intensive camera trapping.

While it is relatively easy to collect lynx data that accumulates in the frame of specific projects, collecting data from different interest groups or the general public is a challenge: (1) the making and the reporting of chance observations depend on the presence and awareness of an observer (Breitenmoser et al., 2006); and (2) this citizen-science approach requires that citizens know to whom to report lynx signs of presence to. The national or regional organisations in charge of lynx monitoring usually provide the possibility to report signs of presence either on their websites, or rely on a network of local experts, i.e. people which have been trained in the recognition of lynx signs of presence. These experts can be game wardens, foresters, hunters, or other volunteers which are locally known by the citizens and can additionally help with snow tracking to sample genetic material such as scats or support the camera trapping (see Breitenmoser et al. (2006) and Louvrier et al. (2018) for further details).

All signs of lynx presence are included in the regional or national database. Signs of presence are typically direct sightings of lynx, or indirect signs such as tracks, prey remains, scats, vocalisations, dead lynx, photos or videos of lynx (by chance or collected through camera trapping). The minimum requirements for records to be included into the database are:

- the type of sign reported;
- the date of the observation;
- the coordinates;
- whether the observation involves a reproductive event (observation of a young lynx) or not; and
- whether there is photo documentation or it has been validated by a trained person, in order to classify the record according to the SCALP category (see below).

2.7.2 Verification of records: the SCALP criteria

To address the issue of species misidentification, all the reported records must be verified. For this purpose, SCALP (Status and Conservation of the Alpine Lynx Population, a network of lynx experts from the Alps) has developed a protocol to standardize the data interpretation (Molinari-Jobin et al., 2003, 2012). The interpretation key is based on a categorization of possible presence records, where each record is evaluated retrospectively whether it can be and whether it has been verified for correct species identification.

The so-called SCALP criteria distinguish three categories based on the verifiability of a record:

- **Category 1 (C1):** "Hard facts", verified and unchallenged observations such as (1) dead lynx, (2) lynx captured, (3) clear photos of lynx, and (4) samples (e.g. hair, scat) attributed to lynx by means of (genetic) laboratory analyses.
- **Category 2 (C2):** Observations which have been checked and confirmed by an expert trained in the recognition of lynx signs of presence. Category 2 data typically consist of (1) killed livestock or (2) wild prey, and (3) lynx tracks.
- **Category 3 (C3):** Unconfirmed category 2 observations (prey remains, tracks) too old or badly documented and all observations which by their nature cannot be verified such as direct sightings of lynx and calls which have not been registered.

The categorisation of signs of presence is done by the regional/national body in charge of monitoring. Owing to a rather rigorous view about what constitutes a confirmed record of lynx presence, we assume that false-positive records are absent in C1 data, might rarely occur in C2 data (Fig. 2.7.1) and occur more frequently among the C3 i.e. unverified records (Molinari-Jobin et al., 2012).

Fig. 2.7.1. To verify lynx signs of presence good documentation is key. Photo: Anja Molinari-Jobin

The SCALP criteria introduce a simple method to assess the reliability of lynx observations. This method allows to distinguish between areas with confirmed lynx presence and areas where only unconfirmed data exist. During the past 20 years, the proportion of C1 data has significantly increased compared to C2 and C3 data thanks to the wide use of camera traps which has been facilitated by their relatively low cost. C1 data has therefore become the backbone of monitoring the lynx distribution in Central Europe, not only in areas where specific camera trapping sessions are carried out. Collecting lynx photos from the general public or specific interest groups can be especially fruitful (e.g. Meek and Zimmermann, 2016). FACE, the European Federation for Hunting and Conservation, estimates that there are ca. 7 Mio hunters in Europe. Even if only a small proportion of hunters uses a camera trap, the number of additional "eyes in the forest" is impressive. If this "grey" data can be used for the official monitoring, it represents an additional source of information of C1 data that can be collected at low cost, besides widening the monitoring array, as this data is independent of specific research/monitoring activities.

2.7.3 Storing data and reporting

All data is entered in a database, which is the place of basic archive, but also the starting point for further analyses (Breitenmoser et al., 2006). Respective documentation like photos need to be identified and archived in order to be related to a specific record also in the future.

The minimum requirements for the database were presented in chapter 2.7.1. Additional information needed is the SCALP category as well as the origin of the data and the sampling scheme, i.e. chance observation, damages to livestock, dead lynx, genetic sample, photo/video provided by the monitoring network, or intensive camera trapping for e.g density estimation. Whenever possible, a separate file needs to be kept to track the monitoring effort (e.g. the number of nights a camera trap was active, snow tracking effort, number of network members in a region etc. (Williams et al., 2002). It is more informative knowing that a lynx has not been detected in an area despite a massive use of camera traps, versus knowing that no lynx was reported from the area but not knowing how much effort was put in place to detect it.

At international scale, SCALP produces distribution maps for biological years (May 1 to April 30) that make a distinction between signs of different SCALP categories and includes the information about reproduction (Fig. 2.7.2).

Although the SCALP map originally included only data from the Alps, it has started to expand to neighbouring areas in 2013, and now includes data from eleven countries and seven populations. Although this SCALP+ approach allows direct comparison of lynx distribution between regions and populations, it still suffers inherently from not accounting for detection probability. This is why it is extremely important to keep track of the monitoring effort. To improve the assessment of the actual lynx distribution and its changes over time, it is recommended to analyse the SCALP-categorized lynx data at least at the level of each lynx population every 5-6 years by means of site-occupancy modelling (MacKenzie et al., 2002, 2003) in order to get a measure of the false-negative error.

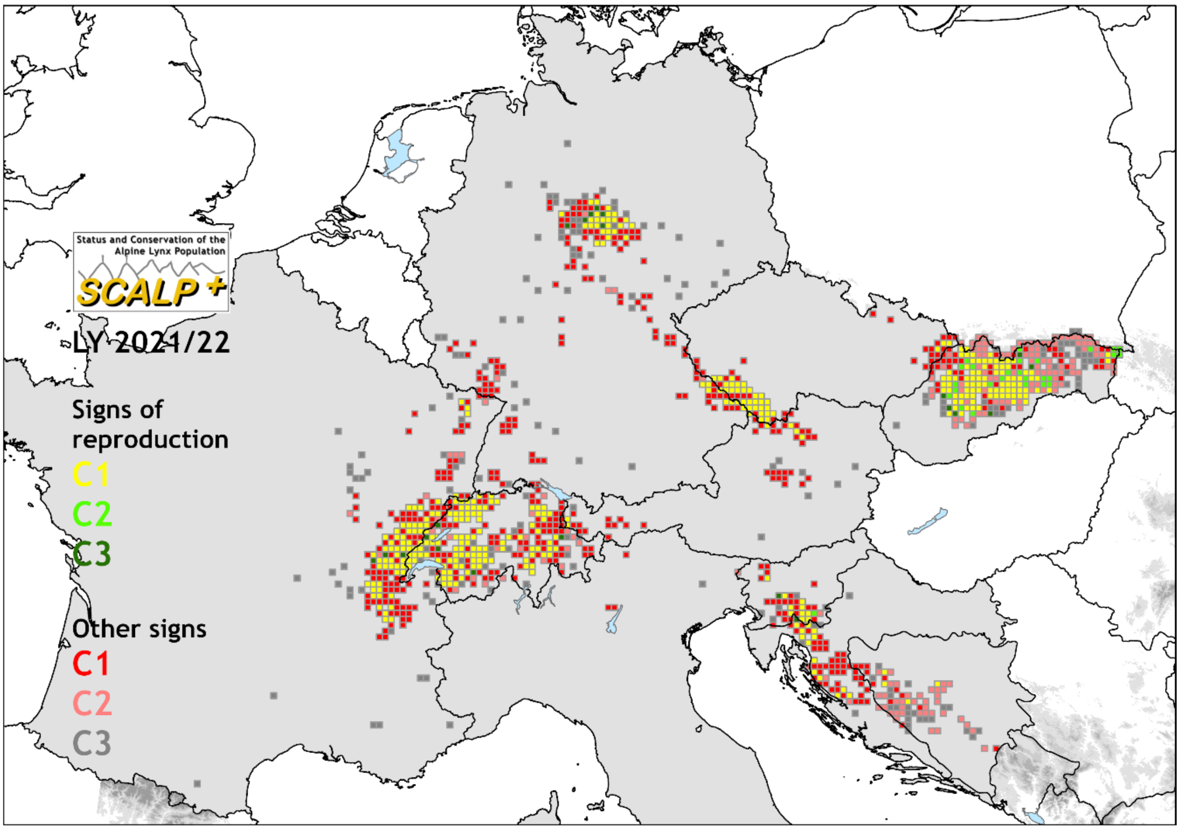

Fig. 2.7.2. Observed lynx distribution in eleven countries (grey) in lynx year 2021/2022 based on a 10x10 km grid. A distinction was made between different SCALP categories and whether the observation included a reproductive event or not (from Molinari-Jobin et al., 2024).

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