3. Ex-Situ management for reintroducing Carpathian Lynx

3.1 Breeding Lynx for reintroduction

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3.1.1 Enclosure design

This chapter provides guidance to what has been considered to be appropriate for enclosures in location, boundary, substrate, furnishings and maintenance, and dimensions for breeding Eurasian lynx for reintroduction.

3.1.1.1 Location, size and structure of breeding enclosures

In zoos, the availability of space should be adapted to a species' physical characteristics, body size and number of individuals. For Eurasian lynx, the total area of breeding enclosures for reintroduction must be at least 1,000 m^2 if there is only one enclosure. Ideally, the exhibit should consist of two or more separable enclosures of at least 600 m^2 each, adjacent to each other. If no breeding recommendation should exist, the separation of the sexes during the mating season is important for the reproductive health as prolonged medical contraception may lead to reduced fertility. Enclosures of approximately the same size ensure similar holding standards for all specimens.

To ensure quiet rearing conditions with less stress for the mother and reduced exposure of the cubs in their first weeks of life, it is advantageous if the breeding facilities are located in a remote part of the institution. Breeding facilities should also not be exposed to excessive traffic noise (e.g., <100 m from highways). If breeding for reintroduction takes place in an enclosure on display for visitors, the facility must provide sufficient retreat for mother and cubs during the sensitive imprinting phase. Visitor accessibility should be restricted to no more than 2 sides of the enclosure. On the inaccessible sides, there should be vegetation serving as a visual barrier and the minimal distance to footpaths should be at least 20 m, unless there is an impermeable visual barrier such as a high wall. Enclosures with more than 2 accessible sides can be acceptable, if total enclosure size is at least 2,000 m^2.

Mellen et al. (1998) has pointed out that an enclosure's complexity is more important than its size in small felids. Complexity is defined by the number of visual barriers added to the enclosure. Visual barriers like logs, rocks, trees and dense vegetation provide further structure to hide. All used structures and substrates should be natural. Trees should be kept climbable without providing points for escape from the enclosure.

Enclosures should have a shift or secondary holding area in order to safely move animals from their primary enclosure for cleaning, feeding and medical procedures (Krelekamp 2004). Doors between these areas should be remotely operated shift doors (sliding or guillotine types are preferred) (Mellen & Wildt 2003). In order to reduce habituation and association of food with people and to reduce stress and any visual distraction, the fencing/barriers of the secondary enclosure must be almost fully covered, leaving only a few spy-holes for visual observation of the individual (Behnke & Walzer 2019).

3.1.1.2 Boundary

Most lynx are contained by using wire mesh, glass and gunite (sprayed concrete). If wire mesh is

used, the fencing material should be imbedded into a concrete base (footings) that prevents the animals from digging themselves out. Gauge of wire mesh should be fine enough so that a cat cannot reach through and snag a keeper or reach into an adjacent enclosure (Mellen & Wildt 2003). The climbing skills of Eurasian lynx should be taken into account; enclosures must therefore best be entirely covered or the barriers must be made high enough (4,5 m if open on top) or properly electrified to prevent the lynx from jumping out. The top-part of a non-covered barrier should be an inclined plane, sloping in the direction of the enclosure (Figure 3.1.1). Electric fencing should be attached on the inside at the top (pers. comm., J. Lengger).

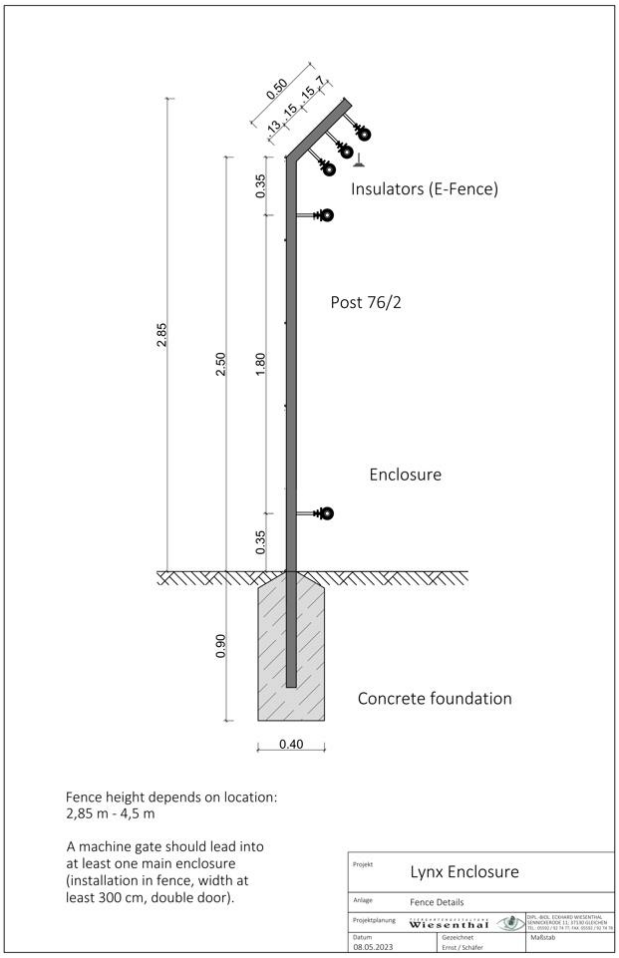

Fig. 3.1.1. Barrier of a non-covered enclosure of the Eurasian lynx, hot wires on top with a grounded wire in the middle

In a non-covered enclosure, trees and plants must be placed in such way that the lynx cannot use it to climb out (at least 3.5 m from fence). Institutions keeping more than one breeding pair must keep in mind that rivalling specimen may put a lot of stress on each other. In this case any space between adjacent enclosures should always be non-transparently masked (Mellen & Wildt 2003).

3.1.1.3 Dens

As lynx are solitary animals, each individual has to have access to at least one den located in a little disturbed part of the enclosure or in a secondary holding area. In the wild, females look for a den ei-

ther in a cave, in a hollow log, at the base of a tree or in dense vegetation (Breitenmoser & Breitenmoser-Würsten 2008). Several structures like caves, hollow logs, or huts and nest boxes must give the female a choice for giving birth.

3.1.1.4 Furnishing

Live plants can survive in lynx enclosures. Care must be taken to allow lynx to utilize the vertical component of an enclosure by providing elevated pathways. Lynx seem to prefer perching platforms at or near the top of their enclosure as a place from which they can hide and peer out.

Water features such as pools, re-circulating streams or built-in water features for drinking and eventual bathing are recommended. However, pools should be filled from a source of potable water. If animals routinely defecate in the pools, auxiliary sources of water should be provided. Pools should slightly slope and should contain shallow areas (Mellen & Wildt 2003) to allow for exiting.

3.1.2. Nutrition

Lynx are obligate carnivores that kill other animals for food. Because cats lack much of the metabolic flexibility of facultative carnivores or omnivores, they have therefore far more specific and demanding nutritional requirements than canids or ursids for example. In general, non-domestic cats share the same nutritional requirements as their domestic counterparts (Blomqvist et al. 1999). This chapter will focus on nutrition and methods of feeding of lynx for reintroduction.

3.1.2.1 Feeding lynx for reintroduction

Feeding of young lynx designated for reintroduction into the wild has an important role to play. The menu of wild lynx is long. According to Breitenmoser & Breitenmoser-Würsten (2008), in Switzerland 60% of analysed prey animals were roe deer, 25% chamois and the remaining 15% spread over no less than 18 different species. Amongst these juvenile deer, hares, foxes, grouse, domestic sheep and goats are mentioned. When rearing lynx for reintroduction it is important to prepare specimens for natural prey species and to not imprint them on livestock as a source for food. Consequently, it is essential that juvenile lynx are fed exclusively with natural prey species. Institutions raising lynx for reintroduction must have access to natural prey items. Depending on availability, this may for example include roe deer or red deer, chamois, wild fowl, etc. Whenever possible, carcasses should be checked by a zoo veterinarian before being fed to the lynx. Learning to open killed prey is extremely important. Thus, whole carcass feeding is the method of choice to teach cubs how to open prey items. It is important to note that the mother must also be accustomed to this kind of food, since she will present food items to the young in the first period.

3.1.2.2 Methods of feeding

At dawn and dusk, wild lynx would feed on the same carcass for up to seven days. Before lynx leave, the carcass is often covered with leaves, grass or snow. Not all individuals show this behaviour. The purpose of covering is not quite clear (Breitenmoser & Breitenmoser-Würsten 2008). However, this behaviour should also be practiced by lynx growing up in captivity. Thus, prey items should remain in the enclosure until they are practically eaten up or until the lynx no longer feed on it. Ideally, leaves or other litter is available for covering.

In order to reduce habituation and association of food with people, food should be provided while

the individuals are not directly present (e.g., while in the den or shifted to the secondary holding area) (Behnke & Walzer 2020). Direct interactions with keepers during feeding must be avoided and the visibility of the feeding site for visitors should be reduced to a minimum.

3.1.2.3 Water

Fresh, clean, potable drinking water should be available at all times. It should be provided in containers that cannot easily be overturned or emptied (Krelekamp 2004). Felids are known to routinely defecate in water bowls. This behaviour is difficult to discourage. Elevating water bowls at 15 to 30 cm above the ground sometimes discourages this behaviour (Mellen & Wildt 2003, Krelekamp 2004).

3.1.3 Behavioural enrichment

Behavioural enrichment is an important method in modern husbandry of captive felids. In Eurasian lynx designated for reintroduction certain techniques should be avoided. This relates above all to certain materials such as ropes, balls, hoses, boxes, odorants, spices, faeces of livestock etc. Nonetheless, hiding or fixing of food items especially in elevated places (e.g., trees) can provide better physical fitness for specimens. Likewise, the presentation of novel, but natural scents and items (remains like hair and faeces of prey species) will serve to stimulate.

3.1.4 Handling

Many of the procedures described in this chapter are contradictory to what has been developed as best practice in wildlife husbandry over the last years. Nevertheless, these measures are important to prepare captive born lynx for a life in the wild. A short protocol for zoo keepers on how to behave as soon as young lynx bred for releases are detected can be found in Appendix *IV Keeper protocol*.

3.1.4.1 General handling

The following measures are to avoid habituation to human contact or interaction. Daily handling as cleaning and feeding should be reduced to a minimum. Interactions between lynx and humans should cease while juveniles are present. Vital veterinary interventions are an exception in this respect (see section *3.1.5*). Speaking to animals directly should be prohibited for keepers. Visual examination of animals by staff is ideally performed by video surveillance or peep holes. Mothers with cubs shall be kept undisturbed for the first three months after birth. In this period, as well as during the time young lynx are kept in coordination enclosures (see section *3.1.6*), the above measures apply most strictly.

3.1.4.2 Training

In general, training can be very beneficial for managing captive species. Nevertheless, to avoid habituation, direct training of lynx destined for reintroduction must be avoided. Still, crate training can be beneficial prior to relocation, in order to enable immobilisation of individuals by means of blow-darting inside the crate. Lynx can be acclimated to their crate by giving them regular access to the crate (at least 3 weeks prior to release) (Mellen & Wildt 2003). They can be trained to enter the crate voluntarily by feeding them inside the container during this time (Blomqvist et al. 1999).

All training must be conducted in a way that lynx do not interact with humans.

3.1.4.3 Restraining

Physical capture and restraining are recommended for young lynx determined for release. This mainly should be used for short standard procedures like vaccinations or deworming of cubs (see section *3.1.5*). In this way, the young learn that people are hazardous. Older juveniles are traditionally netted (Mellen & Wildt 2003). This method requires expert technique and may entail the risk of trauma to animals and/or people. Thus, for longer procedures and older cubs, preference should be given to chemical immobilisation (see protocol *3.6 Anaesthesia*).

3.1.4.4 Behavioural assessment

Before young lynx are transferred to coordination enclosures (see section *3.1.5*), a first behavioural assessment is conducted within the breeding facility. To this end, a questionnaire on the animal's attitude towards humans and its ability to handle prey has been devised (see Appendix *V Behavioural assessment*) that can be filled out either by zoo keepers or by other persons familiar with the animal and its behaviour (zoo veterinarian, curator). The results of the questionnaire are evaluated by a selected expert panel from the Linking Lynx network and young lynx with unsuitable behaviour (i.e., clear habituation towards humans) can already be excluded from further preparation for reintroduction.

3.1.5 Health care and preventive treatments

3.1.5.1. FIV (Feline immunodeficiency virus) and FeLV (Feline leukaemia virus)

Lynx active in the breeding programme and lynx in contact with a breeding pair are tested for FIV and FeLV. Approved methods are westernblot (FIV), Ag-ELISA (FeLV) and provirus PCR (FeLV). Only lynx negative for FIV and FeLV are accepted into the breeding programme. The testing is repeated in lynx after contact with any felid of unknown disease status or upon development of unspecific symptoms. All lynx are tested before translocations (e.g. transfer of juveniles to coordination enclosures). In inconspicuous cases (absence of clinical signs, confirmed negative status of parents, no positive cases at the institution) this might be done via SNAP FIV/FeLV Combo test.

3.1.5.2. Parasites

Living in near-natural enclosures and feeding on wildlife carcasses, most captive lynx will experience parasitic infections. An appropriate endoparasite-management will keep the parasitic burden low and at the same time prevent the selection of drug resistant organisms. This can be achieved through regular coprology (sedimentation-flotation method) followed by a diagnostic-based treatment. For the breeding pair testing and if necessary, treatment twice a year is advisable. Suitable timepoints are April (before the kittens are born) and autumn. Captive lynx that are translocated (e.g., transfer of juveniles to coordination enclosures) should be tested approx. two weeks before the planned transport. This allows time for adequate treatments and a follow-up examination to ensure treatment success.

3.1.5.3. Vaccination

In ex-situ situations the animal should be up to date on all recommended vaccinations, as outlined in Table 3.1.1. Recommended vaccinations should encompass feline leukemia (FeLV), panleukopenia (FPV), rhinotracheitis (FHV), and calicivirus (FCV) (vaccines containing inactivated virus are preferred).

It is useful to conduct a thorough review of all (including other) previously administered vaccinations. Furthermore, a comprehensive risk analysis, considering the facility's and country's specific circumstances, should be undertaken to determine whether additional vaccinations are warranted during the procedure.

Tab. 3.1.1. Vaccination scheme

Target population	Vaccinations
Captive kitten, 8 weeks	FeLV, FPV, FHV, FCV
Captive kitten, 12 weeks	FeLV, FPV, FHV, FCV
Captive breeding pair, once a year	FeLV, FPV, FHV, FCV
All lynx crossing national borders	Rabies

3.1.5.4. Microchip implantation & genetic sampling

All lynx are marked with a subcutaneous transponder. The transponder is placed in the left side of the neck. It is advisable to do the implantation at the first handling of kittens to ensure subsequent identification. A genetic sample of each juvenile should be taken at the same occasion (see Appendix *III Genetic sampling protocol* and *IV Keeper protocol*) so that the genetic sample ID can be directly linked to the chip number.

3.1.6 Transfer to coordination enclosure

Prior to reintroduction, zoo born lynx are transferred to a so-called coordination enclosure, where they can adapt to more natural conditions and their suitability for release into the wild can be assessed (see Appendix *VI Coordination enclosures*). This transfer should take place around the time of natural dispersal (February – April). Individuals should spend enough time inside the coordination enclosure for the “rewilding” process to come into effect but should be released in their second year of life (see chapter 3.4 *Rewilding of orphans and zoo-born lynx*).

The recommendations for feeding and handling outlined above must also be strictly applied during the animals’ stay in the coordination enclosure in order to further increase its shyness towards humans. Before the final decision about releasing a lynx is made, a second behavioural assessment is made (see Appendix *V Behavioural assessment*). The animal’s health condition is evaluated during handling for transport to the coordination enclosure as well as during the release procedure or whenever there is a clinical indication (see protocols *3.4 Rewilding of orphans and zoo born lynx*, *3.5 Quarantine* and *3.7 Clinical examination*). Lynx that prove unsuitable for reintroduction are reintroduced to the captive breeding programme or placed in suitable enclosures under coordination of the EEP studbook keeper.

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