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The Persian Leopard

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For joining the Friends of the Cat Group please contact Christine Breitenmoser at ch.breitenmoser@kora.ch

Original contributions and short notes about wild cats are welcome
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Editors: Christine & Urs Breitenmoser
Co-chairs IUCN/SSC
Cat Specialist Group, KORA
Villettengässli 4, 3074 Muri,
Switzerland
Mobile ++41(79) 789 84 65 (C)
Mobile ++41(79) 410 14 39 (U)
<u.breitenmoser@kora.ch>
<ch.breitenmoser@kora.ch>

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JOSÉ DIAS FERREIRA[1] AND ALEXANDER SLIWA[2*]

Ex situ conservation of the Persian leopard - the EAZA leopard EEP

The Persian Leopard Breeding Programme together with the Felid TAG of the EAZA is responsible for securing a self-sustaining captive population with the highest possible genetic diversity of this threatened leopard subspecies. The *ex situ* population is serving as a source for breeding leopards in the Sochi Breeding Center in the Russian Caucasus, but also aims to introduce further new founders into the captive population. Multiple tasks are carried out, including capacity building, assessing and improving the holding conditions and husbandry in institutions as well as facilitating the preservation of genes of underrepresented bloodlines through reproductive research and assistant reproductive techniques.

Introduction and organisational aspects

Formed in 1992, the EAZA's (European Association of Zoos and Aquaria) goal is to facilitate cooperation within the scientifically led European zoo and aquarium community with regard to conserving their captive (*ex situ*) animal populations, and more generally to advance education, research, and *in situ* conservation (EAZA 2016). Member zoos are bound by guidelines for collaboration in breeding programmes. The EAZA Taxon Advisory Groups (TAGs) decide, which species are recommended for management under EAZA Ex-situ Programmes (EEP), what the roles of each EEP for the respective taxon is, i.e. as an insurance population, source for animals for reintroduction, or educational. Within an EEP, several member zoos are breeding the species and working together under the supervision of the EEP coordinator. Regarding the Persian Leopard EEP, both the coordinator and the Felid TAG chair serve as partners for GOs and NGOs for *in situ* projects.

The primary goal of the Persian Leopard (PL) EEP, established in 1990, is to keep the captive population of this subspecies self-sustaining, genetically and behaviourally healthy, to serve as an insurance or source population for reintroductions or reinforcements, should the wild population decline further. Outside the EAZA region, only few PLs are kept in North America, Japan and in several range countries, which by themselves cannot form a self-sustaining breeding population.

History of the EEP

After the establishment of the PL EEP in 1990, there was a quick increase from 70 to 80 leopards within 3 years (Fig. 1). The population then remained largely stable at 80 individuals for 15 years. In this phase, the interest of the zoos to hold PL dwindled, which was linked to an increase in population number of the Amur leopard (*P. p. orientalis*) in EAZA zoos, as a preparation for a reintroduction programme in the Russian Far East (Christie & Arzhanova 2010). Meanwhile the PL EEP population was slowly aging (Fig. 2) and increasingly, PLs found their way to non-EAZA zoos. Some older male leopards were impossible to pair with females, resulting even in females being killed or injured. These males needed to be kept alone, leading to space problems in the EEP zoos.

Leopard is a complicated felid to breed, starting from the pairing of partners, which, when not done carefully for all individuals regarding age, temperament and enclosure conditions, can lead to severe aggression (Raffel 2006). A female usually produces two kittens (mean litter size = 1.9; Ferreira et al. 2017). Offspring typically stay with their parents until 15–18 months of age, but even longer if no new offspring are born (Stein & Hayssens 2013, Ferreira et al. 2017). The kittens undergo a relatively long period of socialisation and learning from their mother e.g. by observing her hunting behaviour (Stein & Hayssens 2013). Females hence produce a litter on average every second year, starting at 3–4 years of age. They remain fertile up to the age of 12–17 years; males can reproduce until the age of 20 years. Compared with i.e. Iberian lynx, which can produce a litter of 3 kittens every year (Vargas et al 2008), the leopard has a low productive rate. Nevertheless, the population continued to slowly increase from 100 in 2005 (Raffel 2006) to 103 in 2021 (Fig. 1).

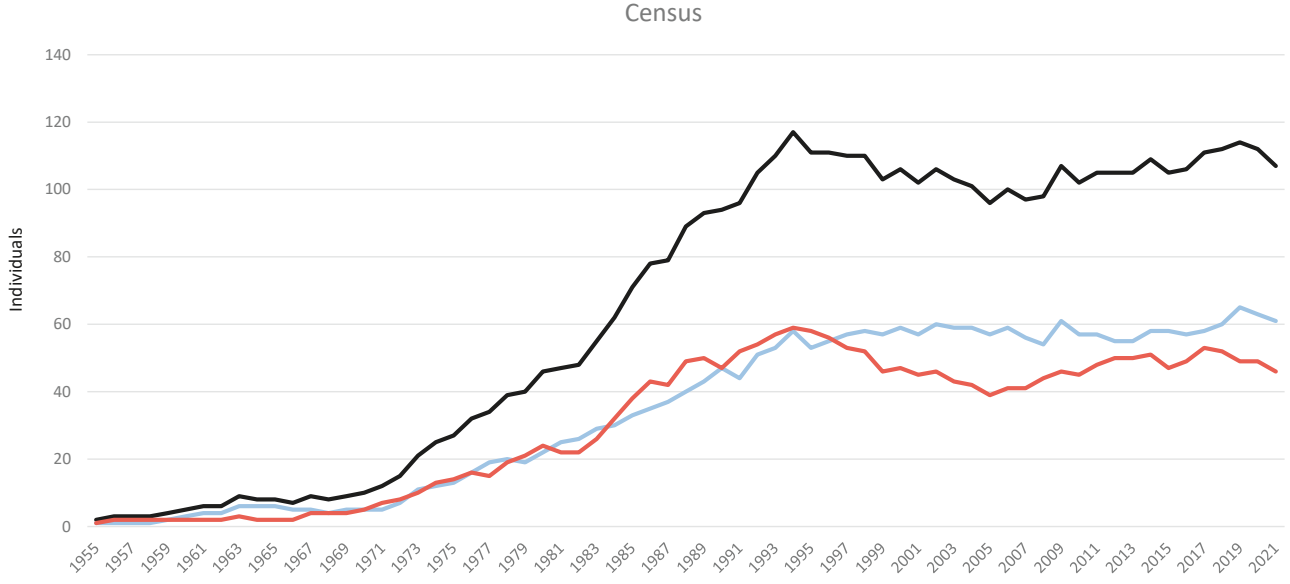

Fig. 1. Development of the Persian leopard population in European Zoos 1955–2021. The EEP was established in 1990.

The EEP as a source for reintroduction in the Caucasus

The Ministry of Natural Resources (MNRE) of the Russian Federation planned the reintroduction of leopards in the north-western Caucasus by breeding wild-caught leopards in the specifically built Sochi Breeding Center (SBC) (Rozhnov & Lukarevsky 2008). As sourcing suitable Persian leopards from the wild turned out to be impossible (Rozhnov et al. 2022), the MNRE asked assistance from IUCN and EAZA. After a visit to the SBC in October 2011, EAZA agreed that the PL EEP would provide leopards and technical support. A MoU was signed between the three institutions in 2012, and the Felid TAG and the IUCN SSC Cat Specialist Group were mandated to implement the MoU on behalf of EAZA and IUCN, respectively. Four members of these organisations formed the Caucasus Leopard Reintroduction Advisory Group – CLRAG (Fig. 3; Breitenmoser et al. 2015). The CLRAG is communicating with the MNRE, but also directly with the SBC on aspects of pairing of leopards (breeding recommendations), husbandry, medical interventions if EEP leopards are concerned, and on the assessment and permits for release offspring of EEP leopards. In order to integrate the SBC into the conservation breeding programme, the MNRE (as the owner of the SBC) joined the EEP as a non-EAZA member.

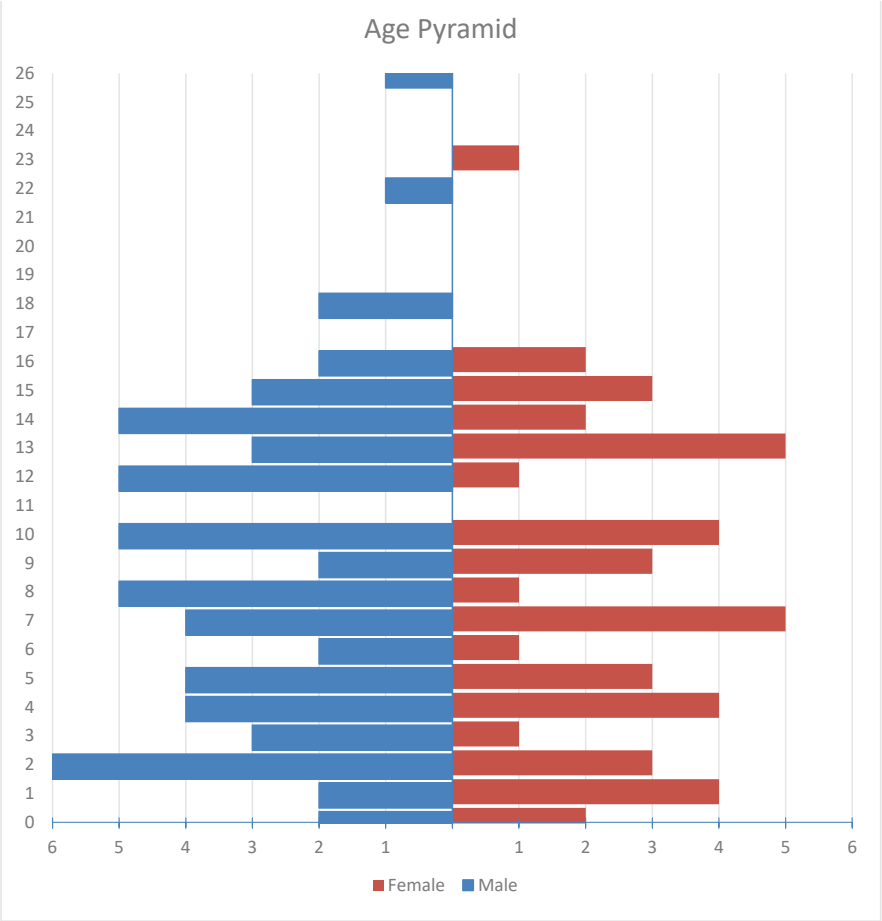

Fig. 2. Persian Leopard EEP Age Pyramid at 31.12.2021. Males are on the left side, females on the right.

Specific adaptation to the new role as source for reintroduction

Since 2012, specific measures have been implemented to enable the EEP specifically to serve as a source population for *in situ* releases. In 2017, a Long-Term Management Plan was developed (EAZA 2017). A target population of the PL EEP was set at 200 leopards, with the continuous role to serve as an insurance population, however with the additional task to provide leopards for the *in situ* programme. Measures implemented included:

- After raising awareness within and beyond the EAZA community, twelve new EAZA approved institutions joined the EEP. Numerous transfers between approved participants (zoos) allowed creating twenty new PL breed-ing pairs. A specific effort was made to in-clude zoos in range countries (Turkey and Georgia, with further candidates in Armenia, Iraq and Afghanistan), which can also serve local educational purpose.

Fig. 3. CLRAG at SBC in 2015. From left to right: Alexander Sliwa, José Dias Ferreira, Marianne Hartmann, and Urs Breitenmoser, with Natalia Dronova (PL Species Officer WWF Russia; Photo A. Sliwa).

Fig. 4. Semen collection procedure on PL Rica, Tehran, Iran 2017. From left to right: Iman Memarian (Tehran Zoo), Imke Lüders (Geolifes) and Rui Bernardino (Lisbon Zoo; Photo P. Tabrizizade).

Fig. 5. Location of zoos (needles) participating in the Persian Leopard EEP in 2021.

- EAZA zoos sponsored and staffed actions to improve the genetic composition of the EEP. The first successful artificial insemination with PL took place at Nordhorn Zoo, Germany; three semen collection procedures (Fig. 4) from PL founders (France, Iran, Russia) were performed (Ferreira & Sliwa 2017); Tehran Zoo with their potential PL founders for the EEP was approved as a non-EAZA EEP participant. Currently, there are ongoing efforts to source new founder PLs from Afghanistan and Iraq.
- Communication to the PL holders was stepped up to better manage a growing PL population and to keep everyone informed about the *in situ* activities involving EEP leopards.
- Different new designs of enclosures for keeping and breeding leopards were developed. Greater emphasis was given to enclosure furnishing and enrichment schemes for PLs. Advice particularly towards to new holders was provided before leopards were transferred. In some cases, technical visits were made to address site-specific problems.
- All these developments of the PL EEP were repeatedly presented at international conferences to inform wider circles of both i*n situ* and *ex situ* specialists.

The current EEP population stands at 106 (61.45) PL (Fig 1) in 40 holdings (31/12/2021; Fig. 5), having developed since 2012 from 85 (44.41) PL in 39 zoos. Renewed interest from holders was clearly stimulated through the perspective to provide leopards to support the reintroduction in the Caucasus. In the past 5 years, a total of 10 PLs were released in the Russian Caucasus (Caucasus Biosphere Reserve and Alanya National Park; Rozhnov et al. 2022); these leopards are no longer considered part of the EEP population.

The scientifically-led EAZA EEP zoos provide these services voluntarily and without specific funding for current (and future) felid reintroduction programmes: trained staff time to care for the animals, provide food and specific housing, organisation of transfers of sensitive and, in the case of leopards, potentially dangerous species between institutions, also including the specific breeding centres. International transfers are highly time consuming, and the professional capacity differs between institutions (zoos). It also includes negotiations regarding veterinary requirements, crate specifications, and permits, all in different languages which need translation. The mode and speed of transport, as well as international CITES and IATA regulations for import and export particularly for threatened and highly sensitive species is important and complex. For all of this, clear and timely communication (generally in English) is key to avoid misunderstandings and possible harm to the animals.

Training and advice to SBC staff and exchange of leopards

In 2013, five staff members of the Sochi Leopard Breeding Centre (SBC) participated in a 10 days training at Lisbon Zoo, Portugal, and Nordens Ark, Sweden, specifically tailored to the needs of the SBC regarding husbandry and veterinary care of leopards. In 2013 and 2014, repeated visits of the CLRAG to the SBC took place, in order to discuss improvements of enclosure structures, environmental enrichment, socialisation of cubs and the training for living in the wild.

After trials to breed Persian leopards from the wild population first failed, a proven breeding pair of PL (Fig. 6), was sent from Lisbon Zoo to the SBC in October 2012, which stimulated breeding there. In 2013, the first litter in Sochi was born from the Lisbon pair. In 2014, the Lisbon breeding female gave birth to 3 leopards sired by one of the wild-caught Turkmenistan males. These 3 offspring, born from a mating not recommended by the PL EEP, were subsequently transferred to European holders because they were closely related to the two genetic lines kept at SBC and were considered unsuitable for being reintroduced. In 2015, a sub-adult male was sent from the EAZA member Parc-des-Felins (Nesles, France) to the SBC to be trained and released. However, this leopard is still being kept isolated in the SBC. The Lisbon pair kept at SBC bred and raised three additional litters in 2016, 2018 and 2020. A second proven breeding pair was sent from the Nordens Ark Foundation (Sweden) to the SBC in late 2020 to introduce new genes to the programme and widen the gene pool of the founder population. In July 2021, the female gave birth to a litter of two kittens.

In 2017, following a semen quality check-up, a Persian leopard "Gaspar" was transferred from the EEP population (Lisbon Zoo) to the newly approved EEP participant, Tehran Zoo, to breed with a rescued wild female kept there. Unfortunately, this pair has not reproduced so far.

Discussion

Zoos have limited display and holding space for large cats, including Persian leopards, thus their interest in a programme is often proportional to their potential for involvement and to breed the cats. Most zoos are not specific centres for breeding-for-release and also need to consider economic aspects. Offspring of large cats are attractive to visitors, so breeding on display is highly liked by zoo managers, how-ever only with the opportunity to outplace these offspring due to limited holding capacity. Leopard cubs in displays are however not suited for being released to the wild because, because they are accustomed to people and may not avoid areas with human activity, which could eventually create human-leopard conflicts and jeopardise their survival. However, leopards which are not considered for release by an *in situ* programme and are also not needed for upholding the breeding population are obstructing holding space. Furthermore, the PL EEP also competes with the Amur leopard, the Chinese leopard (*Panthera p. japonensis*), and snow leopards (*Panthera uncia*) EEP for holding space within EAZA institutions.

The goal of the EEP is to conserve a high percentage of the wild gene pool. This requires integrating new founders from the wild into the EEP for safeguarding these genes. Altogether, monitoring the genetic constellation of the three populations is needed: (1) the wild, (2) the EEP, and (3) the founder population in the reintroduction project.

The PL EEP faced considerable challenges related to the commitment to help the reintroduction of the PL in the Caucasus. Over a nine-year period, the leopards from the EEP produced a total of 13 leopards at the SBC. A crucial challenge is the placing of SBC leopards, which are unsuitable for being released (for either genetic, behavioural or physical reasons) within the EEP holding community, as the SBC itself is lacking capacity in holding space for such animals.

The communication between EAZA/CLRAG and the SBC has not always been easy, not only because of language barriers, but also due to differing ideas about breeding, training, and release (e.g. age of such leopards). As there is no experience with the release of captive-born leopards (see also Rozhnov et al. 2022), all decisions need to be based on assumptions.

Over the next years, the EEP will have to provide more proven leopard breeding pairs to the SBC, to replace genetically over-represented and old leopards and to increase the output; essentially the turnover needs to be accelerated, although there is no holding space for surplus leopards at SBC. To achieve this, the EEP population must be very carefully managed, in order to provide sufficient suited breeders, but avoid surplus animals in the programme. This will require a close collaboration between the all partners and a agreement on the reintroduction scheme (Rozhnov et al. 2022). A zoo-based EEP has not the same possibilities as e.g. the six specific breeding centres created for the Iberian lynx reintroduction programme (Vargas et al. 2008). As breeding leopards requires much more space, time, and funding than breeding Iberian lynx, the capacity of specific centres such as the SBC will remain limited, and will continue to depend on breeding pairs provided by the EEP. There is an ongoing discussion on whether only animals bred and trained in the SBC, should be released or whether zoos may also provide animals suited to go directly into a training and re-wilding programme. Such an approach could considerably increase the output. Therefore, the EEP is currently considering the breeding in specific facilities with the aim to be able to provide a sufficient number of mentally and physically fit leopards either for further breeding or eventually for training for release. Either way, the reintroduction programme will need additional holding and training enclosures in order to prepare more individuals simultaneously (see also Rozhnov et al. 2022).

Fig. 6. Persian leopards 'Andrea' and 'Zadig' at SBC on 25 January 2013 (Photo Ministry of the Natural Resources and Environment (MNRE) of the Russian Federation).

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[1] EEP Coordinator Persian Leopard, Lisbon Zoo, 1549-004 Lisbon, Portugal <jdferreira@zoo.pt >

[2] EAZA Felid TAG chair, Cologne Zoo, 50735 Köln, Germany *<sliwa@koelnerzoo.de>