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The Persian Leopard

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Cover Photo: Persian Leopard in Kazakhstan © USNR/CADI/ACBK, camera trap picture taken 1 January 2020, photo was provided by Tatjana Rosen

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Experience of the leopard recovering through reintroduction in the Russian Caucasus

A reintroduction project has started in Russia in 2007 with the goal to create a Persian leopard population nucleus in the northern part of its historical range, where the species disappeared due to direct and indirect human influence in mid-20th century. A small resident group should give opportunity of breeding also for leopards migrating naturally from the south. The reintroduction will give the opportunity to re-integrate leopard genes accumulated in zoos into the wild population. The project includes stages of breeding leopard pairs originated from zoos in a special center; training youngling to make them able to survive in the wild, checking their readiness, releasing those who are ready, post-release monitoring with GPS-VHF collars and field surveys of kill-sites and other important places. Modelling the habitat in its present stage is done when new release sites are planned. Nowadays, two release sites work, the North-West Caucasian and Central Caucasian (Ossetian). Successful survival of released animals during a full year cycle was confirmed, but breeding was not observed so far.

Why reintroduction instead of natural recolonisation?

Historically, the Russian Caucasus was the western edge of the leopard range (Dinnik 1914, Geptner & Sludsky 1972), a region with unique natural complexes and a very rich biodiversity. Most ecological food chains or food webs still exist undisturbed in natural structures. The Russian Caucasus includes large areas of preserved habitats with the potential for leopard migration and resettlement (Rozhnov et al. 2018, Rozhnov et al. 2019, Rozhnov et al. 2020a, Rozhnov et al. 2020b). The Russian part of Caucasus is the region with the highest potential for leopard recovery in the whole range of *P. p. tulliana* because it is the least affected by external influences. The region has a system of natural complexes, which can be preserved for a long and retained their "biological identity". However, the Caucasus ecosystems are vulnerable as they depend on relict faunistic and botanical complexes often classified as rare and endangered (Rozhnov et al. 2020a). The gaps between territories nowadays inhabited by Persian leopards in the north part of its extant range are huge and natural corridors for reaching the northern Caucasus are fragmented (Breitenmoser et al. 2017). The western part of the Lesser Caucasus from Turkey to South Georgia has virtually no leopards (1–2 animals detected). There is a certain probability of spreading from small natural population in Iran and Turkmenistan towards the west but much less to the north into the good habitats of the Greater Caucasus. The chance that leopards reach the Russian Caucasus through natural migration from Iran is presently very low (Mousavi & Moqanaki 2017), and single individuals would be lost in the vast areas of the Greater Caucasus. On the other hand, with a successful leopard reintroduction in the north part of the range, offspring could migrate to the south and supplement the small wild population nuclei (Rozhnov & Lukarevskiy 2008).

Why release ex situ-born individuals and not do wild-to-wild translocations?

Restoring leopard in the Russian Caucasus is only possible through reintroduction (Rozhnov & Lukarevskiy 2008). The wild population in the border of Turkmenistan and Iran contains not more than 300–500 individuals (Kiabi et al. 2002) and is too weak to remove animals for translocation. The risks for the wild population would be bigger than the possible gain (IUCN/SSC 2013). Furthermore, released animals could die before breeding, an important aspect when releasing animals at the age of dispersal and resettlement (e.g. 2 years old; Rozhnov et al. 2020b). Natural dispersal of young leopards is an important period of the animal's life cycle, because this way they find and establish their own home ranges, but at the same time, this age bears also the highest risk of death. The plan is to release at least 50 individuals into the Russian Caucasus to establish a breeding core of a population (Rozhnov et al. 2020b).

Methods developed for rearing leopards in the SBC

Breeding and training approach (without EEP details)

The breeding and training of leopards for release into nature has been implemented since

Fig. 1. Structure of Sochi Breeding Center (SBC). a) Training enclosures (0.6–0.95 ha) for young leopards to be prepared for the wild; b) Breeding enclosures (~0.3 ha) for breeding individuals received from zoos (Photo SBC, WWF-Russia, Russian Federal Project of Persian leopard reintroduction, Ministry of Environment and Natural resources of Russian Federation).

Fig. 2. Releasing of the female named Volna in the territory of Central Caucasus (Republic of North Ossetia-Alania) in the strictly protected National Park "Alania" in 2018 (Photo Regional Project of recovering Caucasian Leopard in North Ossetia under the IEE RAS & RusHydro management, Russian Federal Project of Persian leopard reintroduction).

2013 in a specially built and equipped Leopard Breeding Center in the Sochi National Park (SBC; Fig. 1). The Center's infrastructure currently allows regular breeding and providing young leopards for training and releasing. The aim is to establish reproductive groups (using cubs from different litters) in the Russian Caucasus in three regions selected. The SBC has the following characteristics, it: (1) is well-guarded; (2) has large (0.5–0.9 ha) isolated enclosures with vegetation and relief as found in the Caucasus; (3) has open-air enclosures where young leopards develop and feed without contact to humans, and can train their hunting skills; (4) has facilities and conditions for veterinary examinations and timely assistance to animals; (5) has a video monitoring system that allows to observe leopards remotely in all enclosures at any time. The main goal of the SBC is breeding leopard pairs provided by EAZA EEP zoos, rearing and training of young Persian leopards for their subsequent release into the designated places of their natural range (Rozhnov et al. 2020b).

Only pure-bred Persian leopards with confirmed genetic status must be used. The selection of these leopards from the zoos of Russia and Europe is carried out by EAZA experts, based on the EEP Studbook. After some kittens were born, grew up and were trained in the SBC, they are released into nature, where they spread through the habitats in a natural way. Other offspring, which are not related to the previously released animals should thereafter be selected for the further releasing on the same release sites. It is important to observe the genetic diversity of the population increasing and to reduce the potential inbreeding probability as it could appear as a result of leopards' reproduction with each other in the wild.

Behaviour is one of the most essential adaptations allowing animals to survive in a diverse environment. A correct behavioural response in any unique situation is key for the survival of an individual and, indeed, the entire species. Behaviour formation in leopards occurs during postnatal ontogenesis in accordance with the development of all morphological structures. The maturation of an animal's body and brain structures are tightly coordinated with the development of behavioural processes. This phenomenon happens during the so-called sensitive periods, which are age- and species-specific and occur in an exact, determined order one after another. Studying the ontogeny of leopards' behaviour creates a scientific basis for the correct methods for their rehabilitation and raising them for future reintroduction into the wild. The main focus of environmental enrichment during raising of young leopards in the SBC is to introduce active stimuli (releasers) in time at those places (enclosures) where kittens grow and young leopards are being kept. These active stimuli (releasers) help to initiate and normalise the formation of certain types of behaviour. During each period, kittens and young animals are especially sensitive to very specific releasers. Details for each behaviour type are described below: (1) social competence; (2) the ability to obtain food (hunting); (3) motor skills development; (4) environmental adaptability; and (5) human avoidance skills (Rozhnov et al. 2020b). Selecting animals for being released implies a proper decision-making system. Only healthy and socially competent leopards can be released, which have individually passed a standardised examination (testing hunting skills, avoidance of humans, avoidance of living objects associated with humans, e.g. domestic animals). The decision on releasing is made on the basis of a specially developed system of inciting tests based on a detailed and standardised testing plan (detailed in Protocol No. 6; Rozhnov et al. 2020b).

Release concept (spatially, timing) and experiences

During the project implementation, siblings of different sexes are released at different release sites to prevent inbreeding. Thus, from two pairs bred in the SBC, males from Pair 1 and females from Pair 2 were released in the Caucasus Nature Reserve (North-Western Caucasus), and contrary, females from Pair 1 and males from Pair 2 in the Central Caucasus (regions of North Ossetia and Kabardino-Balkaria). That way, brothers and sisters have a low probability to meet each other for breeding. The optimal age for releasing was established as 2 years (Rozhnov et al. 2020b). If animals stay longer in the SBC, they get used to people (staff of the SBC). 1.5–2 years is also the age for young leopards for dispers-ing in nature (Balme et al. 2013, Fattebert et al. 2015, Rozhnov et al. 2015, Vitkalova & Shevtsova 2016), hence the natural behaviour of searching and establishing their own home ranges. This is, however, also the weak side of the reintroduction project, because this age includes a higher risk of losing animals from the reintroduction site through dispersal. Young leopards should be released in early summer, when wild ungulates have calves, daily temperatures are relatively high, and hiding conditions are perfect to perform first hunts in the natural environment. Furthermore, potential competitors or kleptoparasites like bears prefer grass diet. Before release, all animals passed veterinary check-control, were dehelminted and vaccinated.

Post-release monitoring is a crucial part of the Project (Rozhnov et al. 2018, Rozhnov et al. 2019). All animals released were equipped with GPS/satellite collars (Lotek, Canada), which incorporate a VHF transmitter. The main features of the collars and parameters

for the remote monitoring were set as follows:

- 12–24 locations per day. This frequency of locating the animal provides precise information about its movement, allowing searching for successful hunting places;
- 1–2 data transfers to the server per day. This level is the minimum requirement that enables a prompt reaction in case of conflict situations;
- The availability of an accelerometer to register motion, in order to detect collar ejection, death of an animal, etc. Data on leopard activity enables the determination of behaviour, the intensity of movement and to analyse how it changes in time in connection with other parameters, such as distance travelled per day;
- The availability of a VHF transmitter is required for the work of the field team, enabling rapid response in case of conflict situations, as it avoids meeting the animal. It furthermore allows to search for the collar once it has been discarded, or to find the animal if it needs to be re-caught;
- The drop-off mechanism is necessary to release the animal from a collar that has stopped working. When the collar is found, it is possible to download accumulated accelerometer data, which are not transmitted via satellite (Rozhnov et al. 2019, Rozhnov et al. 2020b).

Kill sites assumed on the basis of clusters of coordinates are checked in the field by a group of zoologists to confirm the type of prey killed. All leopard scats are collected for analysis of the leopard's diet, as small preys might not be detected by kill sites checking. Furthermore, a system of photo traps is established in the range of the release site to observe leopard movements after the collar's battery runs low. Photos also help to assess a leopard's body condition changes in time, and to eventually detect other individuals that may come into the territory.

First experience and follow up

The first stage of the Programme for the Restoration of the Persian Leopard in the Caucasus (2008 edition) included a set of tasks that were successfully implemented: the choice of site and the construction of the SBC; selection of leopards and their acclimatisation in the SBC; breeding of leopards; training of offspring for being released; approbation of leopard training methods; preparing of the site for the first release of subadult leopards; assessment of an additional territory of the Caucasian Nature Reserve suitability for the first leopards' releasing; preparation of the release and follow-up monitoring of the animals; and finally releasing the first animals. In July 2016, the first three leopards (two males and one female) were assessed suitable for living in the wild according to a preliminary protocol. They were successfully released in the Caucasus Natural Reserve.

In July 2018, during the second phase of the Programme, three leopards were trained for living wild at the SBC, and reintroductions in the Caucasus continued: One male was released in the Caucasus Nature Reserve, and another male and a female in the Alania National Park in the Republic of North Ossetia (Fig. 2).

Up to spring 2022, three males survived in Western Caucasus, and two females and one male in the Central Caucasus (Table 1). The main causes of mortality of the released individuals were natural hazards, e.g. deep snow and avalanches, and starvation due to weakness caused by the blood parasite Cytauxzoon felis. In November 2021, an unknown wild male leopard (Fig. 3) was detected by a photo trap in the territory of Kabardino-Balkaria, where one of the females released in 2018 established her home range. Two more wild individuals were detected in February 2022 and March 2022 at the territories of Chechnya and Dagestan, respectively.

Based on these first encouraging experiences, the necessity for planning further actions became obvious (e.g. Rozhnov et al., 2020b). The follow-up involves continuous monitoring of released animals (Fig. 4), developing of an standardised, steadily updated database, compiling information of all leopards in the Programme, investigating the selected terrain with special field expeditions, ground-proving the map (spatially explicit plan) and using it to identify other places suitable for reintroduction, and planning other release sites beyond the Caucasus Nature Reserve. At the SBC, further leopards for breeding need to be selected to generate more offspring for releases. A breeding plan was developed considering all experiences so far, and breeding and training in accor-

Table 1. Summary information on leopards bred in the Sochi Breeding Centre and released to the Russian Caucasus. Overall mortality of released animals was 40% (20% during 1st year after release).

Number of leopards	Total	Males	Females	Western Caucasus	Central Caucasus
Born in the Center	25	12	13	-	-
Trained for releasing*	20	10	10	-	-
Assessed for readiness for living free	13	7	6	5 males 2 females	2 males 4 females
Released to the wild	10	6	4	4 males 2 females	2 males 2 females
Survived in the wild for 1 year	8	5	3	4 males 1 female	1 male 2 females
Died in 1st year after release	2	1	1	1 female	1 male
Died in 2nd year after release	2	1	1	1 male 1 female	0
Still alive in the wild in February 2022	6	4	2	3 males	1 male 2 females
Having bred in the wild	0	0	0	0	0

* In 5 leopards in training in the SBC in February 2022.

Fig. 3. Wild leopard detected in the Central Caucasus (Kabardino-Balkarskian Republic, strictly protected National Park "Prielbrusie") in November 2021. This male was repeatedly pictured in December 2021, and in January, February and March 2022 (Photo IEMT RAS, WWF-Russia & National Park "Prielbrusie", Russian Federal Project of Persian leopard reintroduction, phototrap was established by Alim Pkhitikov, leader of Field Monitoring Group).

dance with the plan continues. The system for assessing the animals to confirm their readiness for living in the wild was updated. Complementary work includes the monitoring of the dynamics of leopard habitats and the reconstruction of the historic distribution of the subspecies based on literature.

Discussion

To reach the final goal, we also need to understand details such as the pathogenic situation in the leopard's range, and the project must increase the number of animals reintroduced. Obviously, the speed of the releases is now too slow to create a reproducing population nucleus. As work on tigers has shown, even five animals released at the same time into an area with a low-abundance presence of wild individuals can lead to recover a group of 20 individuals within 10 years (Rozhnov et al. 2021). But in absence of wild individuals, as it is the case for the leopard reintroduction project, it is advisable to release at least 10 individuals during each release phase. The present holding capacity of the SBC is three breeding pairs, and the targeted capacity not more than four pairs. This will not be enough to generate the number of young leopards needed to increase the efficiency of the programme. Comparable reintroduction programmes maintained at least two breeding centers, allowing to (1) increase in the number of simultaneously produced/released individuals, and (2) avoid the breakdown of the project in an emergency situation such as an epizootic.

Conclusion

The leopard reintroduction project in the Russian Caucasus has been implemented since 2007. As its strong side can be named: (1) the SBC infrastructure is generally well organised and allows efficient breeding and raising leopards; (2) the system of testing animals for their readiness for being released showed its effectiveness; (3) the post-release monitoring is robust and worked well even under the difficult conditions in the Greater Caucasus. Weak sides are still (1) some aspects of breeding and training of animals in SBC and (2) the small number of animals produced and released in a given year.

The Caucasus Leopard Reintroduction Project is a pioneer project in large felid conservation. There are not many reintroduction projects for cat species in total, and very few involved breeding and raising animals in captivity (Breitenmoser et al. 2002, Vargas et al. 2008, Breitenmoser et al. 2019). For large felids such as leopards, the project in the Russian Caucasus is the only of its kind – a complex and comprehensive project uniting a lot of people and organisations under one roof. Both, mistakes and successes learned from that project are providing important experiences for future projects.

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Fig. 4. Female leopard released in Caucasian Nature Reserve in 2020 (Photo S. Trepet and A. Pkhitikov).

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