

An evaluation of artificial propagation projects of wild ungulates  
in the Region of Republican Subordination and Khatlon Province,  
Republic of Tajikistan

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**Cover plate caption:** Nurek Dam reservoir (background) and a reforested habitat (foreground) in a 17-km<sup>2</sup> area from which livestock have been excluded thanks to a fence erected by the Committee for Environmental Protection under the Republic of Tajikistan, Nurek's small enclosure, Khatlon Province, Tajikistan, 25 September 2010. Photo ©Stéphane Ostrowski.

**Keywords:** captive breeding, introduction, reintroduction, restocking, goitered gazelle, Bactrian deer, Bukhara ural, Nurek, Ramit, Tigrovaya Balka

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## EXECUTIVE SUMMARY

The Committee for Environmental Protection under the Republic of Tajikistan has expressed the interest to develop a semi-captive breeding project of non-domestic ungulates in two enclosures near Nurek Dam reservoir, in order to restock threatened wild populations. During our evaluation we have determined that the smallest enclosure (17 km<sup>2</sup>) would not be suitable for such effort, which would conflict with the extensive agricultural and silvicultural commercial development it represents. The largest, still unachieved, enclosure (c. 25 km<sup>2</sup>) would be suitable for such a captive breeding activity under several restrictive conditions which comprise the achievement of the perimeter fence, a significant reinforcement of its structure, building of appropriate breeding/hospital/quarantine enclosures, conception and endorsement of a development and implementation five-year-plan, and securing sufficient financial and human resources to operate the facility for the time being of this first plan.

Should any ungulate be considered for semi-captive breeding in Nurek, the Bukhara urial (*Ovis orientalis bocharensis*) would qualify as the priority species. The markhor (*Capra falconeri*) could be considered as the next possible candidate species under the restriction that enough financial resource is secured to support a winter food supplementation. In any case it is strongly recommended to start with a single species project and expand it after several years to another species when enough knowledge and experience would be acquired. For a variety of reasons, discussed in the document, and contra what has been proposed by CEPRT, we discourage breeding in Nurek the Asiatic ibex (*Capra sibirica*), the goitered gazelle (*Gazella subgutturosa*), the Bactrian deer (*Cervus elaphus bocharensis*) and the sika deer (*Cervus nippon*).

In Qaratag, there is a commercial farm of sika deers (*Cervus nippon*), a species non-indigenous to Tajikistan. Because of the disastrous damages this species can cause when introduced to a new environment, these sika deers must be kept in strict captivity and must never be considered for introduction in the wild in Tajikistan.

The Bukhara deer (*Cervus elaphus bactrianus*) was introduced in Ramit Strict Nature Reserve in the early 1960's. After a successful acclimatization the population was eradicated during the recent armed hostilities (1992-1997). Nowadays there is some level of support in favour of another introduction. However, any introduction (versus reintroduction and restocking) is ethically questionable. Besides conditions are nowadays less favorable to achieve success in Ramit. We believe that any Bactrian deer propagation project in Tajikistan should be developed with a habitat restoration effort, and conducted exclusively within the historical range of this subspecies; in the lowland (<1,000 m asl) riparian (tugai) ecosystem where the deer can survive throughout the year without food supplementation. This approach would be the most valid from both the points of view of species conservation and cost-effectiveness.

About the on-going project of goitered gazelle (*Gazella subgutturosa*) propagation in Tigrovaya Balka Strict Nature Reserve, it seems that any further restocking effort of this species in this reserve would need preliminary peer-reviewed scientific investigations to prove its validity. Should it be validated, restocking will need a much more careful and thorough technical implementation.

In Tajikistan all the projects I have evaluated were initiated by the government, or at least by official authorities, without involvement of local communities. Yet because local people's activities that result in habitat degradation often have a significant impact on the decline of a species, it is important that early in a reintroduction effort, the organizers involve the local community such that they become collaborators in, rather than obstacles to, the programme.

## 1. INTRODUCTION

### 1.1. CAPTIVE BREEDING

During the last decades the use of captive breeding in species recovery has grown dramatically worldwide. This technique can play a crucial role in recovery of some species for which effective alternatives are unavailable in the short term. But captive breeding has also been invoked prematurely and should not be employed before a careful field evaluation of costs and benefits of all conservation alternatives has been accomplished. Captive breeding should be viewed as a last resort in species recovery and not a prophylactic or long-term solution because of the inexorable genetic and phenotypic changes that occur in captive environments.

In this report I have evaluated captive-breeding projects according to eight different criteria that could pose significant limitation to this approach.

#### Text box 1. Evaluation criteria for captive-breeding projects

1. The establishment of a self-sustaining population
2. Anticipated success in reintroduction
3. Cost
4. Risk of domestication
5. Suitability of the proposed area
6. Preemption of other recovery techniques
7. Disease risk
8. Maintenance of administrative continuity

## 1.2. REINTRODUCTION

### 1.2.1. Terminology

The International Union for the Conservation of Nature and Natural Resources (IUCN) (1987) uses the word translocation as an umbrella term to define the movement of "living organisms from one area with free release to another." The definition encompasses introductions, reintroductions, and restocking.

The term translocation is more commonly used, however, for the capture and transfer of free-ranging animals from one part of their historic geographic range to another. Translocation can augment the local population or recolonize formerly occupied habitat.

An introduction is the release of either captive-born or free-ranging, wild-born animals into an area outside of their original range. Introductions may be accidental or deliberate. Rarely conducted for conservation purposes, they are more often undertaken for economic or recreational benefit. For example, the British introduced European red foxes (*Vulpes vulpes*) to Australia and North America for sport hunting, a deliberate initiative that has caused considerable damages to the native fauna. As a matter of fact introductions usually disrupt natural populations. IUCN (1987) strongly discourages introductions because of the damage they cause to natural ecosystems. For example, the introduction of grey squirrels (*Sciurus carolinensis*) into England has resulted in a decline in the native red squirrel (*Sciurus vulgaris*) population because of interspecific competition (Bertram and Moltu 1986).

Reintroduction in a broad sense is a translocation that releases animals of any origin into an area within their original geographic range, usually where populations have significantly declined or disappeared because of natural catastrophes or human interference. The term restocking is often used when animals, regardless of origin, are released into an area already containing conspecifics; its purpose is to build up the number of individuals of a species.

In the remainder of this report, I use the term reintroduction to refer specifically to the release of animals held in captivity, both wild- and captive-born. I use the term translocation for the movement and release of wild-caught animals. In both cases, I am referring to releases within the species' native geographic range.

### 1.2.2. Aims of reintroductions

The standards that are developed to evaluate the success of reintroductions and restocking depend on the goals; these must be clearly defined and usually have an applied purpose. For example, reintroduction may be part of a comprehensive conservation effort for an endangered or threatened species that includes habitat restoration and public education programs. By contrast, the goal may be only the manipulation of the genetic or demographic composition of a population when the species

exists in small groups in insular habitats that preclude outbreeding. Alternately the aim could also be repopulation of an area where a species has been totally extirpated.

Besides, reintroduction and restocking may serve recreational purposes. For example, wild turkeys (*Meleagris gallopavo*) have been released throughout North America (their current range now exceeds their original distribution) mainly for sport hunting and aesthetic reasons (references in Fyfe 1978), and red squirrels from Scotland have been released into Regent's Park in London, in part for sentimental reasons (Bertram and Moltu 1986).

The specific goals of a conservation-oriented reintroduction and the criteria by which success is evaluated depend both on the species' status in the wild and in captivity and on the political and social conditions in the region surrounding the release site. Thus success cannot always be measured by counting the number of surviving animals. For example, if a species' survival depends on habitat preservation and reintroduction results in a broader conservation program including greater habitat protection, then the reintroduction could be judged a success even if every reintroduced individual dies soon after release.

Similarly, the survival of released animals may be less important than the achievement of a certain genetic composition in a wild population. Thus, reintroduction is an appropriate technique when it will have a positive effect on the demography and genetics of the wild population, when there is suitable habitat available, and when external factors limiting population expansion have been controlled. Reintroduction may also serve as a dramatic focus to encourage less attractive aspects of a conservation program, such as improving reserve protection and management.

In the present document we evaluate reintroduction/restocking projects according to nine different criteria that are prerequisites for success.

Text box 2. Evaluation criteria for reintroduction and restocking projects

1. Self-sustaining population of origin
2. Suitable habitat
3. Anticipated success in reintroduction
4. Elimination of factors causing species decline
5. Feasibility studies
6. Choice of release site
7. Health monitoring
8. Long-term monitoring and follow-up
9. Education and public relations

### 1.2.3. When reintroduction is not appropriate

Costs can be prohibitive; the expense of reintroduction often disqualifies it as an option. Financial support is needed for salaries; field headquarters and subsistence; vehicles (and their maintenance) for transport in the area of the reintroduction; caging, permits, record-keeping, transport, and quarantine for animals selected for release; equipment and supplies for monitoring the released animals. Other expenses are incurred by the conservation education effort, habitat protection, the pre-and post-release preparation, health monitoring research on and management of the captive population, and field studies of the status and behavioral ecology of the free-ranging wild population (Kleiman et al. 1986).

Although the glamour and publicity surrounding the reintroduction of an endangered species may provide positive benefits by focusing public attention on conservation issues, a reintroduction should not be tried if it is not accompanied by an analysis of causes of the species decline and steps to reduce continued threats to the species survival. Otherwise, the reintroduction may decrease rather than increase a species' chances of survival.

Reintroductions of captives should also not be considered a solution to the problem of surplus captive animals and shortage of facilities. Releasing captive-born animals without preliminary groundwork and follow-up may turn out to be inhumane and seriously jeopardize the wild population.

## 2. NUREK'S RESERVOIR PROJECT

### 2.1. BACKGROUND INFORMATION

#### 2.1.1. General location

Nurek's reservoir is an artificial lake resulting from the construction of a hydroelectric power dam between 1961 and 1980. There is a 144-km<sup>2</sup> special purpose preserve or *zakaznik* (= IUCN category IV protected area) established in 1984 in the north-eastern part of Nurek's reservoir that comprises the southern slopes of Surkhukh Range, part of waters of Nurek's reservoir and 50 km<sup>2</sup> of Vakhsh Range. Yet the project I was requested to evaluate is not situated in the immediate vicinity of this preserve but in the south-western part of the reservoir in Vakhsh mountain range.

#### 2.1.2. Implementer

The project is carried-out and supervised by the Committee for Environmental Protection under the Republic of Tajikistan (CEPRT).

#### 2.1.3. Land ownership

The area within the fence belongs to the government of the Republic of Tajikistan.

#### 2.1.4. Aims of the project

According to Dr. Zikirov, Chairman of the CEPRT, the broad aims of the project are to maintain within two enclosures, in semi free-ranging conditions, a variety of threatened species of wild ungulates indigenous to the country, to “let them breed” and in the long-term use these populations for future restocking or reintroduction programs in Tajikistan. According to this statement it resorts that *sensu stricto* the proposed initiative is a captive breeding project, albeit in semi free-ranging conditions, followed in the longer term by a reintroduction effort. This is a very important point because it implies that the captive breeding effort will have to consider the environmental suitability of the enclosure, as it will be done in semi-captive conditions. The suitability of the habitat will weigh to a large extent on the choice of species to breed. According to Dr. Zikirov ungulate species considered for the project are the Bukhara urial (*Ovis orientalis bocharensis*), the Asiatic ibex (*Capra sibirica*), the markhor (*Capra falconeri heptneri*), the goitered gazelle (*Gazella subgutturosa*), the Bactrian deer (*Cervus elaphus bactrianus*) and the sika deer (*Cervus nippon*).

It is the intention of CEPRT to create in the near future an official *zakaznik* level protected area that will comprise two enclosures of 17 km<sup>2</sup> and 25-26 km<sup>2</sup>, respectively, and 160-170 km<sup>2</sup> of mid-mountain landscape. It is however my understanding that there exist no written document detailing the development plan for this project and the level of future involvement of CEPRT in its implementation.

#### 2.1.5. History

The project has apparently started five years ago with the plantation of trees in two areas. Most of this reforestation effort involved stands of fruit trees and non-indigenous essences of many deciduous and coniferous species. This “reforestation/agricultural” activity has continued until 2010 with the plantation of 49,000 additional fruit trees in the largest area. Concomitantly to this tree plantation activity it was decided to enclose both areas with a fence.

#### 2.1.6. Current status

The project is composed of two enclosures distant in straight line about 6-7 km from one another. The smallest one (17 km<sup>2</sup>), contiguous to the reservoir, has an already completed fence and the larger enclosure (25-26 km<sup>2</sup>) has a fence under construction. Because most of the surface of the smallest enclosure has been generously reforested with fruit and coniferous tree species, I believe that considering it as a possible site for a semi-captive breeding project of wild ungulates would conflict with the extensive agricultural and silvicultural commercial development it represents. I therefore concentrated the assessment work on the largest, marginally reforested enclosure.

#### 2.1.7. Habitat

The largest enclosure is at N38.19069 – E69.32155 (game guard station position) about 12 km north of the city of Danghara, Khatlon Province, and about 7 km south of the south-western part of Nurek’s

reservoir. It is built in a mountainous landscape in Vakhsh Range that extends along the left bank of the middle course of the Vakhsh River and Nurek's reservoir. It is a mid-mountain habitat of the Gissaro-Alai open woodland ecoregion (Olson et al. 2001). The range is composed chiefly of sandstone, limestone and clay. Topsoil is mainly loess, a homogenous and highly porous wind-blown sedimentary deposit made of silt, sand and clay, which is very friable and erodes readily but also tends to develop into highly rich soils. The enclosed area has numerous fresh-water springs (10 located during the survey).

#### 2.1.8. Flora

Although the lower reaches (1,200-1,500 m asl) of the area are locally planted with fruit trees, almost two third of the area is still "wild". In this part of the enclosure the floral coenotype is a transitive form of hard-leaved xerophilous light forest where shrubs tend to predominate over trees. Deciduous trees and shrubs occur in relatively dense stands across the area and can also form very dense forests especially in the gullies and ravines where moisture level is seasonally increased or near water springs. The forest canopy is dominated by the species *Amygdalus* sp., *Pistacia vera*, *Cercis* sp. and scattered *Juniperus* sp. In the often very dense underbrush layer the species *Amygdalus* sp., *Prunus* sp., *Sorbus* sp., *Rosa* sp., *Ziziphus* sp. and *Berberis* sp. predominate. There are also vast tracks of steppe grasslands with a preponderance of Poaceae family (e.g. *Bromus* sp., *Festuca* sp.) and ephemeral plant species, which extend between forested areas and towards the summit of the enclosure (1892 m asl). Overall the vegetation cover is in very good conditions as it has been only marginally foraged by livestock and was actively protected from fuel wood collection for the past five years (Plate 1). The area has not been recently affected by drought.

👉 Important note: Before releasing any ungulate in the enclosure I recommend to have botanists examine plant diversity to detect the presence of rare, threatened or genetically important for agriculture plant species that should be protected from captive herbivores. Among the many rare and threatened plants in Tajikistan the following five species have been recorded in the region: *Jurinea tadshikistanica*, *Tulipa subpraestans*, *Iris lineata*, *Crocus koralkovii*, *Eremurus aitchisonii* (Safarov 2003).

#### 2.1.9. Vertebrate fauna

We did not carry out any extensive survey of the fauna in the enclosure. But owing to the richness of the plant cover and the numerous water sources, reptiles, amphibians and rodents are likely abundant. Birdlife seemed also rich and we counted during one visit three kestrels (*Falco tinnunculus*), four long-legged buzzards (*Buteo rufinus*) (these two species are notorious rodent feeders) and two griffon vultures (*Gyps fulvus*). Passerines, including migratory species, were very abundant in the forest canopies and underbrush layers, and chukar partridges (*Alectoris chukar*) were heard on two occasions. About carnivore mammals, we interviewed the game guards who responded that red foxes (*Vulpes vulpes*) and jackals (*Canis aureus*) were common in the area. We did see one red fox in the upper reaches of the enclosure and even one jackal in the smallest enclosure.



Plate 1. The predominant floral coenotype in Nurek's largest enclosure is a transitive form of hard-leaved xerophilous light forest where shrubs tend to predominate over trees. Nurek Dam reservoir is visible in the distant background. Nurek's large enclosure, Khatlon Province, Tajikistan, 25 September 2010. Photo ©Stéphane Ostrowski.

They also mentioned that brown bears (*Ursus arctos*) were present in the area, and that at least one specimen was still present within the uncompleted enclosure. About ungulates, four species occur in the area. The wild boar (*Sus scrofa*) is apparently very common as suggested by the abundance of tracks found in the area, particularly around fresh-water sources (Plate 2). I was surprised to learn that 24 sika deers had recently been released in the area and that 21 Bukhara urials, and two male and one female Bactrian deers are kept captive in a 10-ha enclosure built near the main game guard station.

#### 2.1.10. The perimeter fence

Since 2009 the management of the area has decided to enclose the area with a fence to exclude large predators, facilitate management of captive ungulates and control human intrusions. The work has progressed fast and when we visited the area I estimated that at least 75% of the structure was achieved. What remains to be erected would need to be accurately measured but I estimate that it should be close to 1.7 km in straight line. If a straight course is anticipated to complete the perimeter enclosure, no more than 4 km of fence should be required, when accounting for the broken terrain.



Plate 2. Foot-prints of wild boars (*Sus scrofa*), allegedly a common ungulate species in the area, cast in the mud around a fresh-water spring. Nurek's large enclosure, Khatlon Province, Tajikistan, 30 September 2010. Photo ©Stéphane Ostrowski.

The current perimeter is fenced with a simple chain-link not overlaid with any other mesh (Plate 3a). The size of the mesh (65 x 65 x 3 mm) is small enough to effectively exclude domestic stock and potential large predators such as wolf (*Canis lupus*), jackal, and bear, yet because the fence is not buried in the ground and improperly stretched between uprights these animals can easily access the area by digging under the fence. In fact we have already found such passages actively used by wild boars (Plate 3b). Total fence height is 3.0 m. Non-galvanized steel line posts (round section) have been placed, quite erratically, every 3.2 to 6.2 m with only 0.5 m sunk into the ground in a relatively thin (on average <math><0.1\text{ m}^3</math>) low-density concrete footing (Plate 3c).

There are no steel extensions with additional wires at the top of the fence to prevent intruders from scaling the fence, and corner posts are not made of thicker steel compared to line posts and are not reinforced with strength and angle bars, as is the rule for such long and high fence. Because of the inadequate concrete footing of posts, in volume, depth and density (almost no gravels are incorporated in it), and the porous nature of the largely sedimentary topsoil, the fence has been observed to already sink at several locations (Plate 3d). Such situation will undoubtedly deteriorate in coming years particularly during winters when snow will accumulate and weigh on the structure.



Plate 3. The unachieved perimeter fence of Nurek’s large enclosure presents serious structural flaws. Clockwise starting from upper left corner; a) Corner posts are not reinforced with power arms and stretchers; b) The fence is not buried in the ground allowing animals to easily dig their way through; c) The fence sinks at several locations and d) Concrete footing of posts is inadequate to uphold this 3-m high fence. Nurek’s large enclosure, Khatlon Province, Tajikistan, 30 September 2010. Photos ©Stéphane Ostrowski.

Because of these structural flaws the fence does not exclude large predators from entering the area, which will likely pose management problems when captive ungulates will be released in the enclosure. This situation is unlikely to change with the completion of the perimeter fence but will require significant reinforcements of the entire structure. Whether released ungulates will also use these structural flaws to leave the enclosure remains uncertain as experience shows that the success of enclosing animals may be largely attributed to their lack of desire to escape. Should a captive-breeding project be still considered despite the significant risk of unwanted dispersal of semi-captive animals from the enclosure and the possible intrusion of predators it will be crucial for ethical and ecological reasons to restrict the breeding effort to ungulate species native to the area.

👉 Important note: When combined to an efficient guarding system, the fence will probably deter local people from cutting wood, tending their domestic stock and hunting inside the enclosure. Yet excluding natural resources from local people is unlikely to be successful on the long term without

implementing some forms of compensations. Such measures will have to be incorporated in the area's management plan, which to my understanding does not exist.

**Text box 3. Main recommendations for Nurek's enclosures**

Although the smallest enclosure (17 km<sup>2</sup>) near Nurek Dam reservoir would not qualify as a captive-breeding facility owing to the extensive agricultural and sylvicultural development, the largest, still unachieved, enclosure (c. 25 km<sup>2</sup>) should be suitable for a semi-captive breeding project of non-domestic ungulates under the conditions that the perimeter fence is achieved, and a significant reinforcement of its structure is done.

## **2.2. SUITABILITY OF UNGULATE SPECIES CONSIDERED FOR BREEDING IN NUREK'S ENCLOSURE**

As stated earlier ungulate species intended to be captive-bred in Nurek comprise the Bukhara urial, the Asiatic ibex, the markhor, the goitered gazelle, the Bactrian deer and the sika deer.

### **2.2.1. The Bukhara urial**

In Tajikistan the Bukhara urial is found in the north sides of the Amu Darya and Pyanj rivers, where it inhabits the Babatagh and Karatau ranges, and the Vakhsh Range on the east bank of the Vakhsh River (Weinberg 2003). In Surkhukh the population was estimated at 70-270 specimens in 1999 (Tyshkevich 1999). Recent observations have confirmed that the species is still present in Vakhsh and especially Surkhukh ranges north of the reservoir, yet it is heavily persecuted by illegal hunting and perhaps on the brink of extinction (A. Saidov<sup>1</sup> pers. comm. 2010). The relict population of urial in the south-western part of the Pamir is of uncertain taxonomic status but differs in phenotype and preferred habitat from the subspecies present in the rest of Tajikistan. Bukhara urials inhabit moderately to very arid habitats, especially grasslands, but they also occur in agricultural fields and woodland areas. They feed on grasses and shrubs, and also grains. During winter the species inhabits areas with snow <20 cm, and can use snow as water source. Because the Bukhara urial is native to Nurek's area it will likely adapt well to the enclosure's environment. But during winters with heavy snow falls it is likely that urials may need food supplementation. Any accidental dispersal of the species in the area (through damaged perimeter fence for example) would however be ethically acceptable. This species should be considered as the most suitable candidate for semi-captive breeding in Nurek's enclosure.

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<sup>1</sup> Mr. Abdusattor Saidov, director of the Institut of Zoology, Dushanbe, under the Academy of Sciences of Tajikistan

### 2.2.2. The Asiatic ibex

The species inhabits cliffs and rocks, often on steep slopes, but at very different altitudes (600–5,000 m asl) and within patches of pastures with high available plant biomass (sometimes  $>200 \text{ g m}^{-2}$ ) where it aggregates during winter. The species avoids tall grasses, closed shrub areas and forests. Because of high hoof pressure and short legs, ibexes are vulnerable in deep snow ( $>30\text{--}40 \text{ cm}$ ). Snow-rich winters could be disastrous for this species. It is said that Asiatic ibexes still occur in the upper reaches of this part of Vakhsh mountain range, essentially in winter (Nurek's game guards, pers. comm. 2010). But Nurek's enclosure encompasses very little cliffs and rock habitats, and is mainly vegetated with shrub and tree species seldom eaten by ibexes (Sapozhnikov 1984). This type of habitat is likely to be very marginally used by free-ranging ibex still occurring in the area, and perhaps only during winter time. There are subalpine ecosystems in Vakhsh Range, which would be more suitable to ibexes, but unfortunately none of them have been included in the enclosure. Last, Asiatic ibexes are still numerous in Tajikistan and often in unthreatened populations. Captive breeding and reintroduction of this species are therefore unnecessary. In view of the above and other environmental and sanitary risks (see disease concern), I do not recommend using Nurek's enclosure for a semi-captive breeding of Asiatic ibex.

### 2.2.3. The markhor

Markhors inhabit fallen stones of foothills, cornices and slopes of gorges, precipitous cliffs sometimes several hundred meters in height. In Tajikistan they have become adapted to the warmer part of the mountains and occur essentially in the Kazratishokh and Darvaz ranges and perhaps in fragmented micro-populations in other areas such as Vakhsh and Tuyuntau ranges. Markhors feed on twigs of trees, shrubs, herbs and grasses in islets of mixed forest and shrub-land along gorges. Preferred plant species belong to *Acer*, *Amygdalus*, *Astragalus*, *Pistacia* and *Ungernia* genera (Sapozhnikov 1975, Sokov 1993). They avoid areas that receive significant snow fall. Markhors inhabited Vakhsh Range until the dam was erected and part of their habitat flooded (A. Saidov pers. comm. 2010). It is unknown whether they still occur in the area. Although the vegetation in Nurek's enclosure seems to match preferences of markhors, the habitat has little cornices, gorges and cliffs preferred by the species and the winter snow cover may render this area absolutely unsuitable for markhors during this season. Under such circumstances a semi-captive breeding of markhors in Nurek's enclosure should not be prioritized.

### 2.2.4. The goitered gazelle

This species of gazelle occupies a wide variety of desert and semi-arid habitats. In the Middle East it occurs in flat and gently rolling terrains, but prefers throughout Central Asia foothills with broken grounds, and mountain valley and plateaus, avoiding rocky cliffs, thick woody vegetation, and lands used for agriculture or intensive livestock grazing and areas devoid of gullies and ravines. The northern distribution is limited by snow depth in winter, because these gazelles cannot reach food

where snow cover reaches depths of 10 cm. Here, aggregations of several thousand may form at lower altitudes in winter to avoid the snow, but disperse to higher altitudes in summer. Goitered gazelles can live from sea level up to around 3,000 m in China, and can even climb to elevations of 3,500 m during the warmer months in Kazakhstan.

In Tajikistan the species survives in low numbers (est. total < 400) and is largely restricted to arid and semi-arid lowlands in the south-west (Pyanj-Karatau, Tigrovaya Balka) and north-west (Sughd Province) (Red Data Book of Tajikistan SSSR 1988). It seems that in more favourable times goitered gazelles were visiting higher grounds during summer, yet it is no longer the case, and connecting corridors are nowadays urbanized or exploited by agriculture. In any case the relatively densely forested range of Nurek is not typical of habitats preferred by the species. Besides game guards said that snow cover depth in Nurek frequently exceeds 10 cm in winter. In such circumstances captive goitered gazelles will need food supplementation even during mild winters. Eventually should goitered gazelles escape the perimeter enclosure they would encounter an unsuitable habitat and will likely not survive, especially if it happens in winter.

Because of the unmatched habitat preference, the extra costs incurred from food supplementation even in winters with little snowfalls, and the risk of unwanted dispersal into an unsuitable habitat, it is not recommended to breed (or release) this species in Nurek.

#### 2.2.5. The Bactrian deer

The Bactrian deer, also called Bukhara deer, is the sub-species of red deer indigenous to Central Asia. It is a lowland species that inhabited historically riparian corridors in the floodplains of the Amu Darya (Afghanistan, Tajikistan, Turkmenistan and Uzbekistan) and Sir Darya (Kazakhstan and Uzbekistan) rivers. This habitat, locally known as tugai, is characterized by thickets of trees and grassy clearings interspersed with wetlands. By the late 1990's the total population was estimated at 300-400 animals, most of them remaining in Tigrovaya Balka strict nature reserve or *zapovednik* (= IUCN category I protected area) in Tajikistan and as reintroduced groups in several scattered areas along the Amu Darya drainage system in Tajikistan and Uzbekistan. Thanks to local protection and reintroduction efforts (such as in Zerafshan *zakaznik* in Tajikistan and in Uzbekistan or along the course of the Syr Darya in Kazakhstan) the population has increased in the last decade and is now estimated at 1,000-1,300 specimens throughout its range (O. Pereladova<sup>2</sup> pers. comm. 2010). In Tajikistan the Bukhara deer is of conservation concern with perhaps 150-200 animals remaining along the Pyanj River and another 50-70 animals in Zerafshan. The population reintroduced in Ramit *zapovednik* in the early 1960's was completely extirpated during the five years of civil war (1992-1997).

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<sup>2</sup> Dr. Olga Pereladova, head of WWF Central Asia program

A large number of deer species have been introduced in different parts of the world, often in sub-optimal habitats (Long 2003). There is evidence from several continents of increased environmental damage caused by deer, from both native species and long established introductions, consequent on increased population resulting from changed management (involving reduction in both predation and hunting pressure) and possibly forest fragmentation (Fuller and Gill 2001, Rackham 2003).

The red deer is classed as an 'intermediate mixed grazer' indicating that it can feed on a combination of shrub, understorey and grass species depending on availability (Whitehead 1972). Besides the red deer is known to have a very broad feeding niche compared to other deer species and consume a very wide variety of plants. Despite being native to lowland riparian areas, since the 1960's the Bactrian deer has also acclimatized to mid-mountain habitats (Flint et al. 1990). Deers can move easily in fresh snow (20-30 cm) and deer concentrations are common in winter where snow is < 50-60 cm and food accessible (tree and shrub twigs). In winter they can also consume snow as a source of water. For all these reasons Bactrian deers would likely adapt well to the environmental conditions of Nurek's enclosure.

However, there are several important negative aspects to Bactrian deer propagation in Nurek. Red deers consume large volumes of food. In captivity adult specimens may consume 8-12 kg of hay and 2-3 kg of additional cereal forage every day. The effect on the vegetation cover of a non-controlled population in an enclosed area such as Nurek could quickly become disastrous. Impacts of feral deer in non-indigenous biota in Central Asia have not been studied. But documented impacts of introduced deers in conservation reserves across the world comprise over-grazing, over-browsing, trampling, ring-barking, antler rubbing, dispersal of weeds, creation of trails, concentration of nutrients, exposing soils to erosion/accelerating erosion, and the subsequent degradation of water quality in river systems. The seriousness of impacts in an area like Nurek's enclosure is likely to depend on the population density but, because of their cryptic nature, and likely suboptimal monitoring of the area, early signs of damage may not be detected or may be ignored. Grazing and browsing of plant seedlings and saplings by deer may also impose heavy impacts and substantial extra costs on ecological restoration projects (Augustine and Frelich 1998, Opperman and Merenlender 2000). Other studies have documented impacts of increased deer populations on invertebrates (Rambo and Faeth 1999, Stewart 2001), understorey species composition (Rooney *et al.* 2004), tree regeneration (Augustine and Frelich 1998, Fuller and Gill 2001, Rooney 2001), bird diversity (McShea and Rappole 2000), and ecosystem processes (Rooney *et al.* 2004).

Although detailed extrapolation from studies involving different species of deer, different flora and different environments from those in Tajikistan may not be possible, the available research supports a common generalization that increasing numbers of deer may strongly modify the abundances of particular animal and plant species and overall composition in a wide range of plant communities. The range and importance of the reported negative effects suggest that a large deer population in a relatively small confined area such as Nurek enclosure will lead to a variety of changes in natural and

semi-natural communities, and also reduce the success of semi-captive breeding projects for other ungulate species. Last, but of great concern, would be an accidental dispersal of Bactrian deers outside the enclosure. Such event could cause species, populations or ecological communities around the enclosure that are not threatened to become threatened.

An additional problem posed by a Bactrian deer project in Nurek (or anywhere else) is related to the difficulty to constitute a founder population of semi-captive animals. Upon our visit they were three individuals originating from Tigrovaya Balka *zapovednik* kept captive in Nurek; one adult female and two adult males. After several years in captivity these animals have not yet reproduced, suggesting that there could be a social or fertility problem in the group. Increasing the stock of breeders is therefore necessary but would need to translocate more animals from other captive stocks, which are rare in Tajikistan (Shakhrinau nursery, Dashtimaidon *zakaznik* ?) or difficult to access in Uzbekistan and Kazakhstan. The recommendation to consider only captive born animals is rooted in two considerations, one technical and the other ethical. Technically captive born animals are tamer than wild ones and would be easier to translocate, to maintain and breed in captivity, but would also need a thorough medical screening before being introduced into Nurek. From an ethical point of view it would be very questionable to harvest to any extent the relict and threatened populations of free-living Bactrian deers in Tajikistan or the recently re-introduced populations in Uzbekistan and Kazakhstan.

In view of the above, semi-captive propagation of Bactrian deers in Nurek should be considered only under four restrictive conditions: 1-The perimeter fence is adjusted and reinforced enough to avoid accidental dispersal of the species outside the enclosure, 2-A detailed monitoring and management plan of the semi-captive population is designed, peer-reviewed, officially adopted, and put in effect, 3-The founder stock is strictly composed of captive-born specimens and 4-The captive population is constantly monitored and actively regulated.

#### 2.2.6. The sika deer

IUCN (1987) strongly discourages introductions because of the damage they cause to natural ecosystems. The sika deer is alien to Tajikistan and there are no ecological or economical justifications to such propagation project, even in fenced habitats. We strongly recommend eradicating as quickly as possible all the animals unfortunately released in Nurek and their offspring.

It is crucial that this species is never introduced in Tajikistan owing to the considerable economical and environmental damages it can generate (see also sika deer captive breeding in Qaratag)

#### Text Box 4. Candidate ungulate species for Nurek's project

I have summarized in Table 1 the qualitative results to preliminary evaluation criteria applied to the six ungulate species considered for semi-captive breeding in Nurek. In view of these results, should any ungulate be considered for semi-captive breeding in Nurek, the Bukhara urial would qualify as the priority species. The markhor should be considered as the next possible candidate species under the restriction that enough financial resource is secured to support a winter food supplementation. In any case it is strongly recommended to start with a single species project and expand it after several years to another species when enough knowledge and experience would be acquired. Multiplying the number of species bred in captivity in Nurek will also increase significantly the cost of the project, the risks of inter-species conflicts and of disease outbreak. The economic rationale behind building a long and costly perimeter fence is to use the facility as a semi-captive operation with minimal artificial food supplementation, hence significantly reducing operative costs. Breeding multiple species or non-indigenous species, such as the Bukhara deer or the sika deer, which could damage new environments, would alleviate this economical benefit.

Table 1. Comparative suitability for semi-captive breeding in Nurek's enclosure of six non-domestic ungulate species, according to seven qualitative criteria

	Indigenous to Tajikistan <sup>1</sup>	Occurs in mid-mountain forested habitats <sup>2</sup>	Suitability of natural forage in Nurek <sup>3</sup>	Typical habitat within the enclosure <sup>4</sup>	Tolerance to snow cover (20 cm depth) <sup>5</sup>	Ethical acceptability of an accidental dispersal <sup>6</sup>	Level of damage to environment <sup>7</sup>
Bukhara urial	Yes	Yes	Yes	Yes	Good	Yes	Unknown
Asiatic ibex	Yes	Marginally	Unknown	Marginally	Good	Yes	Unknown
Markhor	Yes	Yes	Yes	Marginally	Low	Yes	Unknown
Goitred gazelle	Yes	No	No	No	Very low	No	Medium
Bactrian deer	Yes	No	Yes	No	Very good	No	High
Sika deer	No	Yes	Yes	No	Very good	Unacceptable	High

<sup>1</sup>Tajikistan is part of the current or historical distribution range of the species or subspecies; <sup>2</sup>Does the species or subspecies occur naturally in forested habitats of mid-mountain ranges (1200-2500 m asl) anywhere in its distribution range? <sup>3</sup>The vegetation community in Nurek's enclosure has at least six plant genera commonly used for food by the species or subspecies in its natural habitat; <sup>4</sup>Nurek's enclosure has typical habitats for the species or subspecies; <sup>5</sup>The species or subspecies tolerates 20 cm of snow in winter; <sup>6</sup>Would it be ethically acceptable that a specimen of this species or subspecies escapes from Nurek's enclosure to the surrounding environment? <sup>7</sup>What is the documented level of environmental damage caused by introduced populations

## 2.3. TECHNICAL ASPECTS OF CAPTIVE BREEDING OF BUKHARA URIAL IN NUREK

### 2.3.1. Achieving self-sustaining captive populations

It is often assumed that self-sustaining captive populations can be readily achieved for most endangered and threatened taxa. But obtaining consistent reproduction and survivorship under captive conditions has proven difficult with many species. Fortunately, urials have a recognized track-record of relatively easy breeding under captive conditions.

The main problem I foresee concerns the creation of the founder stock of breeders. Aside of the Siberian ibex, the Marco Polo sheep (*Ovis ammon polii*) and the wild boar which still occur in good numbers in the wild in Tajikistan, all other ungulate species are endangered. In such circumstances it is not advised to increase the level of threat on these populations by removing potentially valuable animals from these threatened stocks. In Tajikistan the urial and markhor are frequently captured as young animals, reared and kept in captivity for a variety of reasons. Because of the illegality of these practices, and of the impossibility to release hand-reared animals, the founder stock for Nurek could be created from the confiscation of these valuable specimens.

Although there are no standard rules and successful captive breeding of wild ungulates have been started with as few as four founders — two males and two females, assumed unrelated, in the case of the Mesopotamian fallow deer (*Dama dama mesopotamica*) (Jantschke 1991) — the number of founder urials in the captive population will have to be maximized in order to decrease the inexorable inbreeding effect and genetic erosion observed in most captive-breeding operations. As a rule of thumb, the sex ratio of the founder captive population should be 1:1 (equal number of males and females) in order to maximize gene expression.

There is in Nurek enclosure a captive population of 21 Bukhara urials which originate from Pjanj Karatau area (south-west of Tajikistan) (Plate 4). Historically an adult couple was brought to Nurek in 2005 and more animals added to the herd in 2006 and 2007. It will be important to document more accurately the history of these relocations, in particular the number, age and sex-ratio of animals transported to Nurek will have to be documented and also the number of potential founders which have died in the enclosure since the beginning of the project. This information will help assess the sustainability of the captive population without relying on costly genetic investigations. Moreover any new animal added to this population will have to be identified and marked with ear notches in order to better monitor the future founder composition of the herd. Once founder animals are identified, I recommend isolating them in small (<0.1 ha) sub-enclosures either in couples or groups of one male with two/three females in order to start a reasoned captive breeding. The first generation of offspring will be marked, vaccinated and released within the larger perimeter enclosure.



Plate 4. A tame adult male specimen of Bukhara urial (*Ovis orientalis bocharensis*), originating from Pyanj-Karatau in south-west Tajikistan, maintained captive in a 10-ha pre-release enclosure in Nurek. Nurek's large enclosure, Khatlon Province, Tajikistan, 30 September 2010. Photo ©Stéphane Ostrowski.

This population management will help rationalize and balance the founder representation and diminish the inbreeding level within the captive herd. It will also help achieving self-sustainability at a faster rate.

### 2.3.2. Anticipated success in reintroduction

Wolf *et al.* (1996) assessing the results of reintroduction and translocation outcomes have shown that such operations appear to be more successful when: 1/the release is made in the core of the historical range of the species, 2/the habitat quality is good-to-excellent, 3/the species released is native to the habitat, and 4/a large number of animals is released. Another study assessing published results of animal relocations found that re-introduction seems to be more successful when the source population is wild, a large number of animals is released (>100), and the cause of original decline is removed (Fischer and Lindenmayer 2000).

Without being in its core, Vakhsh mountain range is within the historical range of the Bukhara urial. Although the mountain habitat near the large enclosure would require careful assessment and certainly protection, it remains, at least officially, preserved such as in Nurek *zakaznik*. Finally the

urial is native to the habitat and it could be bred semi-wild and in large numbers inside the enclosure. All these factors favour, provided hunting the main cause of decline of urials in Tajikistan is actively controlled in the area, the success of a future Bukhara urial reintroduction in Vakhsh Range.

### 2.3.3. Cost

The cost of captive-breeding for recovery of endangered species is often very high and increases with the number of species involved. For this reason we strongly recommend at first to limit Nurek's project to a single-species initiative.

Nurek's project will need two levels of financial resource investment, respectively related to structural investment and operational cost.

The structural investment should comprise the perimeter fence (achieved at 75%)<sup>3</sup>, a recipient 5/10-ha enclosure (achieved), a variety of sub-enclosures for confined breeding (4 x 0.1 ha), quarantine (2 x 0.1 ha) and isolation of sick/injured animals (2 x 0.01 ha) (all lacking) and at least two separate buildings: a game guard station with an administrative/technical room and a fodder storage building (uncompleted). To reinforce the perimeter fence and stop animal movements underneath the fence (adding buried chicken mesh all along the perimeter, adding angle and tension bars for corner posts, reinforcing concrete footing for corner posts, adding tenders and stretchers to segments of sinking fence), a significant amount of extra financial and physical resources will be required.

Concerning operative costs, many expenditures should be accepted as intrinsic to the strict captive breeding, semi-captive propagation and reintroduction of urials. They comprise costs of animal feeding while in quarantine and strict captivity (c. 1.5-2.5\$/animal/day), supplementary feeding for semi-captive animals during harsh winters (c. 1.5\$/animal/day), and permanent salt lick support (50\$/year/site). Should also be added the cost of comprehensive disease precaution [importation screening (75-100\$/animal), systematic prophylactic measures (15\$/animal/year in strict captivity) and occasional treatments (20\$/animal/year in strict captivity)], of perimeter and sub-enclosure fence maintenance, urial translocation, miscellaneous transportations (fodder, personnel), guard station operation, patrol horse maintenance, salary coverage of game guards, administrative staff and animal keepers. The needed level of financial resource support will have to be determined for the next five

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<sup>3</sup> Assuming 4 km of linear fence would complete the perimeter fence, it will require, for a similar standard of fence, either 4 km of 3-m-high or 2 x 4km of 1.5-m-high chain link fence (65 x 65 x 3 mm), about 900 4-m-long non-galvanized steel line posts (one post on average every 4.5 m), 900 m of 3-mm galvanized steel cable (1 m/post), 2x4-km of 1-cm thick steel round bars (between-post stretchers). For concrete footing of linear and corner posts, assuming 800 L of gravels + 400 L of sand + 350 kg cement per m<sup>3</sup> of concrete, and 0.1 m<sup>3</sup> of concrete per post, it would translate to 31.5 tons of cement, 280,000 L of gravels and 140,000 L of sand (this is an extremely comfortable estimate since current concrete footing volume is probably closer to 0.05m<sup>3</sup>/post and almost no gravels are incorporated into it!). Should also be added costs of material/water transportation, bulldozing, welding and manpower. It is difficult to estimate the cost of fencing as it largely depends on the quality of the material but it should probably fall between 15\$-25\$/linear meter.

years and secured, a pre-requisite for ungulate captive-breeding operations. Five years is a minimum duration for breeding relatively long-lived species before anticipating any reintroduction/restocking efforts. In comparison, captive-breeding projects of goitered gazelle, mountain gazelle (*Gazella gazella*), Arabian oryx (*Oryx leucoryx*), or Nubian ibex (*Capra ibex nubiana*) in modern facilities in the Middle East were carried-out for 4 to 7 years before reintroductions could be carried out.

Some costs of captive breeding of urial could perhaps be met by Nurek's agricultural revenues (fruit tree production) or any other kind of economical development appended to this project related. But the major financial support should probably come from the government who is the main project implementer.

It should also be considered that the monies needed for effective *in situ* conservation of urials may be much more modest than what is needed for captive breeding (= *ex situ* conservation). This should be weighed against captive-breeding approach in the decision to initiate urial propagation in captivity. In addition *in situ* approaches usually apply to habitat scale meaning that multitudes of species beyond the target species are simultaneously conserved, and this should be considered in the differential cost between *in situ* and *ex situ* approaches.

#### 2.3.4. Domestication

Many of the problems affecting captive preservation and reintroduction of endangered species are results of genetic and phenotypic changes that occur in captivity. Species become progressively more adapted to captivity even when comprehensive genetic management is practiced. Given several generations, one can expect to see populations that differ from wild stocks in significant ways, with most, if not all of these differences having deleterious effects on fitness in the wild. Upon release such captive stocks may be incapable of producing viable wild populations and/or may exert deleterious genetic pressures on remnant wild populations. For these reasons it has been advocated that captive breeding programs for reintroduction should not be started any sooner than is clearly necessary.

Although the urial is reputedly prone to domestication, one advantage of Nurek's project regarding the risk of domestication is that captive-breeding will probably take place in two steps. Founder specimens should be kept in strict captivity condition whereas their offspring will be released in the enclosure. Propagation of this second generation is expected to happen in semi-free ranging conditions, where animals will less quickly adapt to captivity and where selection for traits such as tameness will be decreased.

#### 2.3.5. Suitability of the area

When considering the suitability of any area for semi-captive breeding (as opposed to strict captive-breeding) of a given species the first step consists at considering whether the area is within its historical range and if a native population still exists in the area. According to published information (<http://www.iucnredlist.org/apps/redlist/details/15739/0>) and personal communications of A. Saidov,

urials still occur, although in small numbers, in Surkhukh Range and possible in the south-western part of Vaksh mountain range.

The second step of this evaluation consists at assessing whether the enclosed range has any suitable range cover for urials, and assess its quality. Sapozhnikov (1984) mentioned that in Tajikistan Bukhara urials feed in preference on *Amygdalus*, *Bromus*, *Caragana*, *Centaurea*, *Euphorbia*, *Koelpinia*, *Medicago*, *Onobrychis*, *Pistacia*, *Potentilla*, *Rumex*, *Salsola* and *Trigonella* plant genera. During our brief visit to Nurek we have observed seven of these 13 genera and considering the type of plant community it is likely that most of them are present in the enclosure. Nurek's habitat is also very similar physiogeographically to urial habitats I have visited in central Afghanistan and Iran. Overall the quality of the vegetation cover in Nurek is good to locally excellent. To a large extent the area has not been recently exposed to livestock grazing, and herbaceous, shrub and forest vegetation layers were globally in good condition and matched the food requirements of a native resident herbivore species. At least 10 fresh-water springs are present within the enclosure (Plate 5). There are no evidences of mineral rich grounds in the area which is mainly covered by sedimentary topsoil and therefore artificial salt licks will have to be put in place permanently in case semi-captive propagation of urials is developed.

To which extent the natural vegetation will allow to cover the yearly food requirements of semi free-ranging urials will depend on the enclosure carrying capacity, on the population size, individual energy requirements, and on the accessibility of the vegetation during winter. I propose herein rough projections that highlight the method that could be used in the future to draw such estimates.

An appropriate estimation of ground-layer plant biomass of Nurek's enclosure during an average-rainfall year would require accurate mapping, plant coverage assessment and estimation of total dry matter availability. We recommend doing such investigations in the future. In the meantime assuming that 40% of the area is covered with open woodland with an average ground-layer biomass of  $25 \text{ g m}^{-2}$ , 15% of the area is covered with mixed shrub land/grassland with an average ground-layer biomass of  $100 \text{ g m}^{-2}$ , another 10% of the area is covered with semi-arid good-quality grassland with an average biomass of  $150 \text{ g m}^{-2}$  and 35% are agricultural or rocky barren grounds inaccessible to urials, the average ground layer biomass accessible in summer to urials during an average-rainfall year would be c.  $40 \text{ g m}^{-2}$  or  $40 \text{ tons km}^{-2}$  or 1,000 tons of ground-layer dry plant matter for the  $25\text{-km}^2$  enclosure. Because snow is likely to restrict considerably food resources, the maximal carrying capacity should be calculated depending on winter conditions. If in winter 90% of this biomass remain inaccessible under snow and partially foraged by other animals such as wild boars, it would leave c. 100 tons accessible for urials for an anticipated four months of winter with significant snow cover. The next step consists at estimating the dry matter intake of urials. Based on studies of field metabolic rates in semi-arid and arid ungulates (Nagy *et al.* 1999, Nagy and Knight 1994, Williams *et al.* 2001) we estimate the average field metabolic rate of adult urials ( $30\text{-}40 \text{ kg}$  for a female and  $40\text{-}60 \text{ kg}$  for a male; Savinov and Bekenov 1983) at  $25,000 \text{ kJ/day}$ .



Plate 5. A fresh-water spring in Nurek. We have recorded at least 10 of these natural water sources within the large enclosure. Nurek's large enclosure, Khatlon Province, Tajikistan, 30 September 2010. Photo ©Stéphane Ostrowski.

Assuming that the metabolizable energy content of their winter food is 10 kJ/g dry matter (approximated from Nagy and Knight, 1994), then each adult would consume 2.5 kg dry matter/day or 300 kg forage dry matter during the four months of winter conditions.

These assumptions tell that Nurek's enclosure could maintain in theory a maximum of 300-330 adult urials during snowy winter without extra food supplementation. Evidently with the growing population, the inevitable ground erosion and consequent reduced rate of plant recovery, managers should foresee a reduction of available food biomass with time. Yet even when assuming a 75% decrease of winter forage biomass with time, the area would still be able to support without food supplementation 75-85 adults in winter, or about 3-3.5 animals km<sup>-2</sup>. For comparison maximum densities reported in the literature for free-living urials in Central Asia vary between 1 animals km<sup>-2</sup> in Khazratishokh Range, Tajikistan, in 1965, and 8 animals km<sup>-2</sup> in Ustyurt Plateau, Kazakhstan (*Ovis orientalis cycloceros*) in 1980 (Sapozhnikov 1976, Plakhov 1999).

These calculations rely on extrapolations and approximate assumptions, and should not be considered accurate. In addition they assume that no other large herbivore species, aside of the wild boar, share the area with urials. Yet the assumptions I have used are conservative and show that in principle Nurek's

enclosure could host a large enough population of semi-captive urials to maintain a long-term reintroduction/restocking program.

### 2.3.6. Preemption of other recovery technique

Captive-breeding can divert attention from the problems causing a species' decline and become a technical fix that merely prolongs than rectifies problems. Long-term solutions are often politically more complex than captive breeding solutions, so it is tempting for managers to deemphasize efforts for wild populations once a captive population is created. When captive breeding is associated to efforts at saving wild populations, it can lead to habitat preservation by serving as a focus to enhance public interest. Unfortunately captive breeding is often uncoupled from *in situ* conservation and when successfully undertaken it can even give the false impression that the species is safe, undermining rather than enhancing preservation of the habitat so that its destruction can proceed.

Bukhara urials in Tajikistan are of great conservation concern and have suffered during the recent past considerable population decline, from >5,000 animals 50 years ago to <400 nowadays (Safarov 2003). This decline has happened throughout the species' range including in protected areas supposed to preserve the species (Shirkent historical-nature park, Dasht-i Jum *zapovednik* and Iskanderkul, Childukhataron, Dasht-i Jum, Karatau, Oktash and Nurek *zakazniki*). In view of this failure a captive-breeding effort may appear as one of the very few effective conservation measures developed by national authorities to save this subspecies of wild sheep from what increasingly appears as an ineluctable extinction. However, considering the long-term goals of Nurek's operation it will be essential to couple the *ex situ* breeding activity with habitat preservation. This effort should start from the inception of the project and probably be focusing at the range immediately adjacent to the enclosure. CEPRT has indeed expressed through the voice of its chairman, the interest to incorporate both enclosures in a c. 200 km<sup>2</sup> protected area of *zakaznik* level. This is a laudable wish that would need careful planning and delineation. For example it could be ecologically more valuable to develop such *zakaznik* towards the north-east, creating a corridor of protected habitat between the largest enclosure and Nurek *zakaznik*, rather than including the small enclosure, which is of little ecological value and separated from the bigger one by extensive agriculture and urbanized areas. In spite of many nature reserves there is a global failure at conserving threatened fauna (for example Bukhara urial) in the country, and we can legitimately question whether a new preserve will be of any conservation value. Other types of land conservation systems, perhaps more adequate at protecting urials, could also be explored, such as those relying on community-based natural resource use, hunting leases, or private conservancies.

### 2.3.7. Disease risk

Diseases are of great concern to captive-breeding and re-introduction projects worldwide. This consideration is derived from the documented observations that diseases have been deleterious to many captive breeding projects and on the plausible assumption that animals kept in captivity may

pose a risk of disease transmission to their wild conspecifics or to other species (livestock) when reintroduced into the wild (Cunningham 1996).

To reduce the risk of disease outbreak in the captive-breeding population, it will be essential that all founders of Nurek's captive population undergo a compulsory quarantine period (30-60 days) and thorough veterinary examination before entering the enclosure. Because such quarantine can reveal only a fraction of disease-infected animals, it will be important to have incoming stock intensively screened for infectious diseases that can be detected and are prevalent in Tajikistan<sup>4</sup> and receive appropriate vaccinations<sup>5</sup>. In case of animals kept captive before being incorporated into Nurek's population it will be important to ascertain that they have had a long history of non-exposure to potential disease carriers.

Disease risk may vary substantially from one taxonomic group to another and from one species to another. Because urials belong to Capridae family they are closely related to domestic goats and sheep and are susceptible to a wide variety of pathogens affecting their domestic relatives. To avoid the risk of disease spill-over between domestic ungulates pasturing outside the enclosure and urials kept semi-captive within the perimeter fence, a kilometer-width livestock-exclusion area (buffer zone) will have to be established around Nurek's enclosure. Evidently all livestock species, dead or alive, will have to be strictly prohibited from entering Nurek's enclosure.

Because exclusion of pathogens is a much more effective way to avoid problems than trying to eliminate pathogens once they are established, captive breeding should be maintained in isolated, best single-species, facilities closed to public, and staff should practice rigorous disease-prevention methodology comprising strict avoidance of contacts with domestic or wild stocks outside the enclosure.

In case the long-term development of Nurek will comprise captive breeding projects to breed different species of wild ungulates, it will pose an extra level of disease risk. Rearing communally different species of ungulates with poorly documented susceptibilities and unknown levels of immunity to various infectious agents will increase the risk of infectious agents spilling over from one species to another. Such risk will be decreased should a single species, such as the Bukhara urial, be considered for breeding.

### 2.3.8. Maintenance of administrative continuity

Multiple changes in administrative staff composition inevitably happen during the lifetime of most conservation projects because of the often slow rate of recovery of endangered species. This variability

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<sup>4</sup> A non-exhaustive list of infectious diseases to be screened includes: Peste des petits ruminants (PPR), foot and mouth disease (FMD), caprine contagious pleuropneumonia (CCPP), other relevant mycoplasmosis, brucellosis and tuberculosis.

<sup>5</sup> Proposed vaccinations include PPR, FMD, CCPP, pasteurellosis and enterotoxemia.

often occurs regardless of the performance level of the staff involved. Captive-breeding projects for endangered species are not unique with respect to lack of maintenance of administrative continuity. However, these programs are vulnerable to this administrative decay process because they are input-intensive, and because serious mistakes, once made, may be impossible to correct. In practice the difficulties in ensuring adequate administrative continuity are among the most serious problems faced by captive-breeding programs in the world. For Nurek's project, as for any other captive breeding, this problem should be weighed heavily against the decision to initiate a costly and input-intensive project, which is likely to last many years. Without prejudging of the continuity of the higher administrative personnel, often likely to change faster owing to older age, it is recommended to put in place the mechanisms that would help the programmatic continuity of the project across the lower administrative apparatus.

**Text box 5. Main recommendation for urial captive breeding in Nurek**

Semi-captive breeding of Bukhara urial in Nurek should follow strict technical standards, the building of appropriate breeding/hospital/quarantine enclosures, the conception and official endorsement of a development and implementation five-year-plan that will integrate all financial and human resources costs for the time being of the first plan.

## **2.4. RECOMMENDATIONS ABOUT FUTURE REINTRODUCTION/RESTOCKING PROJECT OF BUKHARA URIAL BRED IN NUREK**

### **2.4.1. Self-sustaining population of origin**

A prerequisite for the successful reintroduction or restocking of specimens of Bukhara urials is a viable, self-sustaining population of origin with as broad genetic representation as possible. The population of origin whether captive, semi-captive or wild must be able to endure the loss of many animals over a long period, while reintroduction/restocking techniques are developed and perfected.

For Nurek's project, self-sustaining population criteria will depend on the size, age composition, sex ratio and anticipated productivity (reproduction and mortality) of the captive-bred populations. When used in computer population demographic models (e.g. MARK, White and Burnham 1999), these demographic data driven outputs will allow managers to decide of a rate of "harvesting" of the captive populations for reintroduction/restocking purposes.

### **2.4.2. Suitable habitat**

An important cause of species' decline is habitat destruction. Where there is a viable population of origin, the lack of available suitable habitat is the single major reason for ruling out a reintroduction

program. The release area must have sufficient carrying capacity (Brambell 1977) to sustain growth of the reintroduced population. Ideally the site must be legally protected, as are reserves and parks, or under the supervision of a dedicated authority or community, and the protection must be effective, ideally several years ahead of the reintroduction operation (Aveling and Mitchell 1982, Borner 1985, Campbell 1980). Restocking is recommended only in a limited number of situations (IUCN 1987, see later comments for the project in Tigrovaya Balka). Yet it is recommended in case a population has dropped below critical levels and recovery by natural growth will be dangerously slow. But in such conditions the habitat loss is often one major cause of population collapse and any restocking operation should therefore be carried out after carefully assessing habitat condition.

In the case of the Bukhara urial in Nurek, it is vigorously recommended to protect and start restoring as soon as possible the habitat surrounding the enclosure, as this could be a prime recipient area for future restocking. The creation of a reserve without being necessarily an effective protection tool could provide the legal background to formalize a restoration effort. But other types of habitat conservation could also be initiated such as a community-based conservation project that will allow local people use sustainably their natural resources and also anticipate indirect economical revenues generated from habitat restoration and restocking efforts via the development of lucrative activities, such as tourism, 'urial-friendly' handicraft, medicinal plant commercialization, or international trophy-hunting.

#### 2.4.3. Elimination of factors causing species decline

It is essential that the factors that caused the species' decline originally must be controlled or eliminated before urial reintroduction or restocking is tried (Brambell 1977). The attempt to proceed otherwise has been shown to be one of the main causes of failure for reintroduction and restocking projects. Scientists must evaluate the urials' *in situ* status (i.e. distribution, population size, and demography) early in the program's development to identify accurately the causes for the current species decline. For example, the presence of intense hunting pressure may be ascertained in all Bukhara urial suitable habitats with even short surveys. People who hunt for meat, fur, trophies, or other body parts have been a major factor in the decline of large mammals and certainly for urials. Species' losses can also result from a variety of other reasons such as food competition, disease, and habitat destruction. An assessment of the prevalence of these threatening factors is needed where urial populations still occur.

#### 2.4.4. Feasibility studies

Detailed studies of the behavior and ecology of free-ranging wild-born animals may determine a species' critical needs. Necessary information should include descriptions of the animals' movements, home range size, habitat preferences, shelter requirements, and foraging and feeding behavior. These data should be collected, or compiled if already available, as they will constitute the future background of feasibility studies for Bukhara urial reintroduction/restocking.

#### 2.4.5. Choice of release site

Ideally the release site should be within the core of the historic range of the species, yet in practice it is often not possible to proceed that way. Besides it is sometimes difficult to determine where the genuine core of the historical range was. The best solution is then to settle the release site within the historical range of the species where the factors at the origin of the decline or disappearance of the species are best controlled.

For restocking operations the release of animals into a saturated stable natural population should be avoided, except to alter the genetic makeup of a population, because it results in social disruption and stress (Aveling and Mitchell 1982, Borner 1985). Newly released animals are unfamiliar with the habitat and potentially ignorant of proper social etiquette. They may overreact during encounters and are likely to be at a disadvantage when confronted with wild animals on established territories and in natural social groups. At best, encounters can result in flight and dispersal of the newcomers to a marginal habitat. At worst, the free-ranging animals might attack and seriously wound or kill the newcomers. However, there are no longer saturated stable natural populations of urials in Tajikistan.

#### 2.4.6. Health monitoring

As emphasized in the captive-breeding chapter, it is very important to monitor health of candidate specimens for release. The captives may carry disease agents to which they, but not the wild individuals, are immune (Aveling and Mitchell 1982, Brambell 1977, Caldecott and Kavanagh 1983). The survival of the wild population of an endangered species should never be jeopardized by the reintroduction of captives, unless the wild population's future existence depends entirely on the release. A clinical examination of animals to be released is not enough as many pathogens can be carried sub-clinically (without symptoms) by released animals. It is therefore essential to carry out thorough investigations that would determine at least the level of past exposure (serological tests) of animals to a variety of diseases or even better the presence of carried pathogens (antigenic tests). These screening operations are costly and need to be planned in the financial frame of any reintroduction/restocking project. For Bukhara urial we recommend to test at least their level of exposure to foot and mouth disease (FMD), peste des petits ruminants (PPR), tuberculosis, brucellosis and contagious caprine pleuropneumonia (CCPP). Other diseases could be considered, according to new circumstances and knowledge.

#### 2.4.7. Long-term monitoring and follow-up

The early wildlife reintroductions in the 1950's did not include much individual monitoring or long-term follow-up. Therefore, there is no way to evaluate whether the techniques used were successful and cost-effective. Monitoring, especially when using modern techniques such as radiotelemetry and continuous follow-up are important for both bird and mammal reintroductions (Scott and Carpenter 1987). Intensive monitoring can permit the collection of carcasses for pathological study to elucidate causes of death of released animals. In addition, long-term monitoring combined with ecological

studies of the wild population can show how soon captive-born animals achieve a behavior repertoire comparable to wild specimens and by what processes the changes occur. Finally, regular surveys of the species' status help assess the effects of the reintroduction on the entire population, if many animals are released.

Because post-release monitoring is always input-intensive and may use expensive methodologies (e.g. telemetry) it is essential to determine carefully its cost in financial, technical and human resources prior to the release and incorporate it in a reintroduction/restocking management plan. Because the release is often seen as the ultimate step to reintroduction and restocking projects and monitoring cost is very significant, it is often not accepted as intrinsic to the project. Yet this is a serious misconception because the result of post-release monitoring is the single most important indicator of the effectiveness and success of a complex and costly operation, often started many years before the actual release.

Most reintroductions have included provision of some essential resources, both to provide support for the animals and to control their movements. Arabian oryx (*Oryx leucoryx*) for example were released from enclosures with shelters, in the hope that the animals would remain in the vicinity or at least return to the shelters periodically (Stanley Price 1986). In most reintroductions, supplemental food and water have been provided temporarily at a central site; such a site can also be the primary location for trapping and examining the released animals. When to eliminate support is a major decision. It is not clear to what degree and how often we should challenge animals reintroduced using a soft-release strategy including post-release supplementation. It is easier to maintain them in a dependent, controllable condition.

Generally, the first few weeks after release are a period of constant flux, and sometimes almost hourly decisions, because the specimens begin to behave unpredictably (relative to the expectations). The problems after release are as complex as any that are faced during the entire reintroduction, but again there are no guidelines. How much and how long should food supplementation continue? How much and how long should humans be an important part of the lives of the released specimens? How much and how long should intensive monitoring continue? For each case history, the answers are likely to differ depending on the goals of the reintroduction and the species being studied. It has been thought that a common thread and a common problem are to reduce the human-animal contacts and encourage the specimens to avoid people, even while scientists continue to monitor the animals. Yet even this decision may not be appropriate if managers want to have a first generation of animals relatively tame and human-friendly, for example to boost project's revenues generated by tourism. On the contrary if the goal is to generate funds via sport hunting, then it is preferable from an ethical point of view to drive the reintroduced population to become wild as quickly as possible. The final goal of a reintroduction will dictate most of the technical aspects of the operation.

#### 2.4.8. Education and public relations

A reintroduction cannot ultimately succeed without the organizers of the project interacting with local and national governments, governmental and nongovernmental professionals, and the public. There must be a major investment in public relations and public education at both local and national levels. Ideally this effort should be integrated in the academic course, at all levels from primary to graduate school. Education about the reintroduction is important to ensure continuity and the long-term support, protection, and management of the species and its habitat. This educational effort will foster behavior change favorable to conservation.

### 3. OTHER PROJECTS

During the course of the present mission I have evaluated three other projects: a captive breeding of sika deer in Qaratag, an introduction project of Bactrian deer in Ramit *zapovednik* and a restocking operation of goitered gazelle in Tigrovaya Balka *zapovednik*. Although I could visit the project in Ramit, I did not visit the two other projects but discussed thoroughly about them with the staff in charge of their supervision.

#### 3.1. SIKA DEER CAPTIVE BREEDING IN QARATAG

Qaratag Valley is 44 km west of Dushanbe and is famous for its scenic nature and rich vegetation. The captive breeding of sika deer in Qaratag valley is a commercial farm for meat, hide and antler velvet production. The sika deer is a species of deer native to temperate and subtropical forests of Eastern Asia. Once very common in the continental part of its range, the species survives only in fragmented or localized populations in China and Russia, respectively, and is still abundant in Japan. The species has been introduced in Europe, the USA, New Zealand and Australia, in temperate deciduous forest areas similar to their native habitat. Most of these introductions have had negative consequences, including hybridization with red deer, destruction of established and new woodlands and considerable damages to agriculture and forestry. For example sika deers have been shown to strip bark from woody plants and browse on reproductive structures (Akasi and Nakashisuka 1999). In research which rated the negative impact of alien mammals in Europe, the sika deer was found to be among the most damaging to the environment and economy along with the brown rat (*Rattus norvegicus*) and muskrat (*Ondatra zibethicus*) (also present as alien species in Tajikistan). Whenever established in an area, the species becomes very difficult to extirpate.

#### Text box 6. Main recommendation for Qaratagh project

As per the above considerations sika deers in Qaratagh must be kept in strict captivity and must never be considered for introduction in the wild in Tajikistan.

### 3.2. BACTRIAN DEER INTRODUCTION IN RAMIT ZAPOVEDNIK

As a preamble we remind that IUCN (1987) strongly discourages introductions because of the damage they cause to natural ecosystems.

As stated earlier in the present report, the Bactrian deer is typically a lowland species that inhabited historically riparian corridors in the floodplains of the Amu Darya and Sir Darya rivers. Despite having a natural distribution restricted to tugai ecosystems, the species has acclimatized successfully to mid mountain habitats where it was introduced. This success is due to a large extent to the very broad feeding niche of the red deer compared to other deer species and the very wide variety of plants it can consume (>120 species of plants reported). Another explanation of this successful acclimatization to mountainous areas is that red deers are long-legged animals that can move easily in fresh snow (20-30 cm) and survive in areas with relatively deep snow cover (40-50 cm) provided food remains accessible (tree and shrub twigs). Having said that, red deers introduced in lowland and mountain areas have had a variety of negative impacts on these habitats, whenever allowed to increase in numbers (see the earlier discussion concerning Nurek's project).

Ramit was established as a *zapovednik* in 1959 and encompasses 161 km<sup>2</sup> of mid-mountain (1,200-3,200 m asl) rocky landscape on the southern slopes of Gissar mountain range. The primary goal of this protected area was the conservation of a rich fauna and flora. Unfortunately because of its location armed hostilities that took place in Tajikistan in 1992-1997 affected vastly Ramit. Large mammals were extensively destroyed, forested area decreased by 15% and local population encroached durably in the area. Nowadays because of understaffing (13 permanent staff said Khamoidin Mahmudov<sup>6</sup>), poor salaries (20-25\$/month is the salary of a game guard), low capacity, poor equipment (only two binoculars, no cameras or hand-held GPS units), and poor communication, the personnel of Ramit is unable to efficiently control land encroachment, fuel wood collection, the increasing use of mountain slopes for cultivation, and livestock pasturing and poaching. However, Ramit has had a successful story of Bactrian deer introduction until the civil war wiped out this newly established population.

In the mid 1960's the Bactrian deer reached historical low population numbers throughout its range. The species was restricted to a few areas along the Amu Dariah River with the largest population of c. 250 animals residing in Tigrovaya Balka *zapovednik*. Thanks to appropriate protection and

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<sup>6</sup> Mr. Khamoidin Mahmudov is the director of Ramit *zapovednik*.

conservation measures the population began to grow steadily from the mid-60's. By 1976, the population in Tigrovaya Balka exceeded 300-360 animals and started expanding along the Pyanj River beyond Vakhsh River mouth (Bannikov 1978). In 1960-1961, 12 Bactrian deers from Tigrovaya Balka were introduced into Ramit *zapovednik* and by 1976 this population had increased to 190-200 specimens (Bannikov 1978), showing that the species could adjust to new mid-mountain conditions with a spectacular efficiency. By early 1970's because the 25-30 km<sup>2</sup> of riparian habitat favored by deers in winter became overpopulated, decision was taken to translocate nine specimens to the Sarykhosor Sanctuary in 1972 and 13 others to the Kusavlisai Sanctuary in 1975. Although largely restricted to the valley floor and its riparian vegetation during winter, deers were using successfully mountain slopes the rest of the year, where adult males could even be found as high as 2,900 m asl. The two main regulating factors on their demography were weather conditions and predation. In winter during heavy snowfall (>50 cm) deers had to be supplemented with hay and fodder. Wolves, and very occasionally lynx (*Lynx lynx*), were killing about 45 animals every year, and the snow leopard (*Uncia uncia*) and the brown bear were not preying on deers (Mahmudov pers. comm. 2010). Interestingly following the spectacular demographic increase between 1960 and 1976 the population seemed to level off, as in early 1990's it was again estimated at c. 200 animals, that could be fairly accurately counted during winter (Pereladova et al. 1997, Mahmudov pers. comm. 2010). Finally during the armed hostilities (1992-1997) the population was wiped out. Until recently there have been reports that a dozen specimens, which had moved to lower reaches of Kofarnigan River, might have survived, yet no firm evidence has ever substantiated this claim (Pereladova et al. 1999).

Although the Bactrian deer population in Ramit was eventually entirely destroyed, the cause of this extinction was exceptional and unpredictable. Three decades of survival of the Bactrian deers in Ramit suggest nevertheless that this new habitat suited well the species requirements.

The justifications to resume a second introduction project of Bactrian deer into Ramit, half a century after the first one, are however to be questioned. When the first project was initiated Bactrian deers were probably suffering the lowest population size in historical times. At that time their 'aggressive' propagation, including introductions, was justified because of the high risk of immediate extinction. Owing to the improved protection level and successful reestablishments in Tajikistan, Uzbekistan and more recently Kazakhstan, the total population size is nowadays estimated at 1,000-1,300 animals, triple of the population size in the mid-60's. Nowadays the conservation value of a second introduction in Ramit, is far less convincing in term of global conservation than 50 years ago. From the point of view of the declining status of deers in Tajikistan a habitat restoration and re-stocking operation in Tigrovaya Balka, in the very core of the Bactrian deer ecological range, would be scientifically more credible than an introduction in a mid-mountain habitat.

Also, there are several reasons to doubt that a second deer introduction into Ramit would be as successful as the first one. Fifty years ago during Soviet times the context for such project was more favorable. Wildlife protection was genuinely enforced, illegal hunting was severely fined, weapons

were less in circulation, livestock grazing was actively controlled within the protected area, scientific and guarding staff were empowered by their status and far better equipped than nowadays, budgets were made available to supplement deers with food every winter, the local economy was subsidized and until mid-1980's human densities in Ramit were low as most of the local laborer force had been relocated to cotton production in lowland areas.

Nowadays the situation would be less favorable to such project. Besides the riparian habitat, essential to the survival of Bactrian deer during winter, has been reduced by 20-30%, to no more than 20 km<sup>2</sup> in scattered fragments (Mahmudov pers. comm. 2010) (Plate 6), because of fuel wood harvesting, intensive grazing and browsing by livestock and damages caused by recent floods. This habitat would need several years of preliminary restoration before a deer introduction could be considered. Another source of debate would concern predator control policy. To maximize the growth rate of the deer population, wolf destruction via lethal jaw-trapping was actively practiced during the first introduction. Would a similar control policy be acceptable nowadays (particularly if the project is viewed as questionable from the point of view of global conservation for the species)? Not to mention the bad publicity associated with the project when sensitive non-target species, such as the lynx or even the snow leopard, will be captured in case a similar control method is employed.

Last, the reasons the Bactrian deer population introduced into Ramit has leveled off for almost 20 years following 15 years of steady growth are unclear. The relocations of a relatively marginal number of deers to other areas in the early 1970's cannot explain this demographic plateau. Predators were actively controlled, the population was apparently well protected and when necessary food-supplemented in winter. So what were the regulating/limiting factors? One possibility is that the population was illegally harvested (lack of protection) and in such circumstances it is likely that this threat would be even more intense nowadays, and certainly more complicated to control. A second possibility is that the population was legally harvested, but would this be acceptable according to the protection status of a strict nature reserve? A third possibility would be that the population had reached the ecological capacity of the area or damaged the vegetation cover to such extent that it wouldn't allow a higher foraging pressure? What about inbreeding level or even diseases? A retrospective study of the reasons of this demographic stabilization could also provide insightful recommendations to any new introduction project.

#### Text box 7. Main recommendation for Ramit project

In view of the above, should a Bactrian deer propagation project be considered in Tajikistan it is recommended to develop it with a habitat restoration effort, and to conduct it exclusively within the historical range of this subspecies of red deer: in the lowland (<1,000 m asl) riparian ecosystem (tugai) where the deer can survive throughout the year without food supplementation. This approach would be the most valid from both the points of view of species conservation and cost-effectiveness.



Plate 6. Kofarnighan River borders Ramit Strict Nature Reserve (on the right side of the picture) to the west. There are fragments of riparian habitat visible in the background, along the river banks. This habitat was intensively used during winter by the now extinct Bactrian deer (*Cervus elaphus bactrinus*) introduced in the area in 1960-1961. Today this lowland species would hardly find enough of this fast declining habitat to survive harsh winters. Ramit *zapovednik*, Region of Republican Subordination, Tajikistan, 26 September 2010. Photo ©Stéphane Ostrowski.

### 3.3. GOITERED GAZELLE RESTOCKING IN TIGROVAYA BALKA ZAPOVEDNIK

In the past the goitered gazelle was relatively common in the north-west and south-west of the country. But by the mid 1930's the population started a progressive but radical decline that has brought the species close to extinction in Tajikistan. The reasons for this decline comprised severe winters, agricultural intensification in lowlands, habitat destruction and hunting (Sokolov *et al.* 1990). Nowadays the species is confined to two or three threatened populations, a relict one of a dozen animals in the north-west of the country close to the international border with Uzbekistan, another one of unknown size but heavily persecuted in Pyanj Karatau and a larger one composed of c.200 gazelles in Tigrovaya Balka *zapovednik*.

Tigrovaya Balka *zapovednik* was established in 1938 in south western Tajikistan. It is a large flat area with three river (Pyanj, Vakhsh, Kofarnigan) terraces. It is composed of 497 km<sup>2</sup> of a mosaic of

habitats including floodland tugai forest (44%), freshwater bodies and marshes (20%), semi-deserts (29%), and shrubland (7%). Among the many threats to this rare ecosystem, agricultural development of the Vakhsh and Pyanj valleys, which started in the 1930s, affected the hydrology of the area, tugai suffered significant deforestation and drainage, and uncontrolled hunting and fishing resulted in decreasing numbers of many animal species. Goitered gazelles survive in the foothills and semi-desert ecosystems of the reserve.

In 2007-2008 a group of goitered gazelles was brought from Djeiran Ecocenter in Uzbekistan to Tigrovaya Balka. This foreign facility encompassing 51 km<sup>2</sup> of fenced arid ecosystem was established in 1978 as a breeding and research center for the native fauna of Uzbekistan. From a founding population of 44 gazelles the population has increased to more than 1,000-1,200 specimens in 2010. Because of this uncontrolled demographic growth in a largely fenced environment with rain-dependent food resources the captive herd suffers periodic population crashes caused by breeding defect and starvation when the ecological capacity offered by the enclosure is exceeded (Pereladova *et al.* 1998). With a population density 20 to 100 times higher compared to free-ranging natural populations in Central Asian arid habitats (Baskin and Danell 2003) and the limited ability to migrate to areas with better forages, the population of Djeiran is condemned to fluctuate following a boom and burst dynamic if a birth control is not put in effect. During periods of high population density such as it is this year the case, gazelles need massive food supplementation. Recently 460 tons of dry hay worth 60,000 \$ were claimed to be needed in an international appeal for emergency donation forwarded by Fergana.ru in its edition dated 8 June 2010 (also [//www.wwf.ru/resources/news/article/eng/6682](http://www.wwf.ru/resources/news/article/eng/6682)). Because of this chronic overpopulation situation the Djeiran Ecocenter is eager to destock part of the gazelle population to the profit of restocking and reintroduction projects.

The group of gazelles relocated to Tigrovaya Balka was brought to a restored 1-ha enclosure near the reserve office, where it stayed for one year in order to acclimatize to the new surroundings. According to Dr. Pereladova, “in May 2009, newborns were expected in the pen. However, the high density in the pens, predominance of male gazelles in the mixed group could negatively affect the animals. To avoid death of a part of expected newborns, we decided to release part of adult animals in April”. Five pregnant females were left in the pre-release enclosure, and the rest of the group (10 animals?) was brought to an area utilized by native free-ranging gazelles where they were released on April 23, 2009. Females with calves were released six month later (Pereladova pers. comm. 2010). Several released animals were marked with a black collar in order to be able to monitor them after release. No casualties or deaths occurred during the release and only two animals were lost during the one-year acclimatization phase (Saidov, pers. comm. 2010).

The positive aspects of this restocking operation include an apparently self-sustaining population of origin, a suitable habitat for release, some level of habitat protection, an appropriate choice for the

release site and an adequate management of the pre-release phase as suggested by the low mortality level of translocated gazelles during this period.

The main negative aspects of this operation are the lack of enhanced control of factors causing the decline of the species (illegal hunting and habitat destruction) prior to the release, the lack of thorough health monitoring, a largely deficient post-release long-term monitoring (Akramov<sup>7</sup> pers. comm. 2010) and overall, a questionable conservation value of the restocking operation.

These negative aspects need to be emphasized in order to be corrected, should another restocking operation be considered in the future. The goitered gazelle population in Tigrovaya Balka *zapovednik* is allegedly small because the suitable habitat is reduced and rampant illegal hunting remains uncontrolled. Adding new animals to this population will not boost its growth rate, as argued by a coterie of regional scientists, as long as these limiting factors are not put under effective control, which is currently not the case. No health check, aside of a superficial clinical examination, was done on these animals, particularly no clinical pathology investigations that could have evaluated the likelihood of these animals being healthy carriers of pathogens (Akramov pers. comm. 2010). This carelessness must be emphasized because it exposed indigenous animals to the risk of being infected by a pathogen they were not immune to, when the released animals intermingled with them. Monitoring of the released cohort is input-intensive but is essential to put in place as it sets the criteria to assess the success of the operation. It allows evaluating whether newcomers adjust well to the habitat, their level of dispersal, mortality rates and effective breeding input. Unfortunately because no modern method (e.g. telemetry) and no continuous monitoring efforts were developed (and only part of the released animals were marked) results are fragmentary and do not allow to assess sufficiently the level of success of the operation. But the reasons that motivated this restocking operation should also be discussed.

The reasons that were advocated to justify this operation, were the necessity to reach a “critical density which was supposed to guarantee frequent encounters and interactions of animals”, but also the willingness to increase the genetic diversity of the free-living population which is supposed to be low. However, the validity of both reasons could legitimately be questioned. As a matter of fact if we estimate the suitable habitat for the gazelle at c. 150 km<sup>2</sup>, corresponding to the totality of the sub-desertic biome of the reserve, the gazelle density estimated by the reserve’s staff prior to the restocking operation (1-1.5 gazelle km<sup>-2</sup>) was within normality for the species (Baskin and Danell 2003). Even if sub-optimal the density is unlikely to increase significantly following this restocking operation as the current population density may already be close to the ecological capacity of the habitat and limiting factors remain uncontrolled. To agree with the genetic reinforcement hypothesis evaluations of the allelic polymorphism (population heterozygosity) of the recipient and origin populations should have

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<sup>7</sup> Mr. Ubaidullah Akramov is responsible of the monitoring at the State Agency for Protected Areas in Dushanbe.

been done prior to the operation and compared. It is even possible that the genetic diversity of the translocated animals was lower compared to the indigenous free-ranging population of Tigrovaya Balka. Such situation resulting from the inevitable genetic drift affecting any population after 30 years of captive breeding could influence the ability of released animals to survive in a new habitat.

IUCN (1987) considers that restocking could be useful conservation tool where 1) it is feared that a small reduced population is becoming dangerously inbred; or 2) a population has dropped below critical levels and recovery by natural growth will be dangerously slow; or 3) where artificial exchange and artificially-high rates of immigration are required to maintain outbreeding between small isolated populations on biogeographical islands. None of these situations has been proven to occur in the gazelle population of Tigrovaya Balka. Inbreeding level in this population is unknown but possibly lower than in the population of origin; with an estimated size of 150–200 animals the population of gazelles in Tigrovaya Balka has not dropped below any critical level that would jeopardize its recovery (Djeiran's gazelle population started with 44 gazelles), and no needs of outbreeding maintenance in both populations has been identified.

To conclude no scientific works have been produced to confirm the validity of this restocking operation both from the points of view of density increase and genetic improvement. From a demographic point of view, it is even questionable that releasing c. 20 animals in a population of c. 200 animals (Akramov, pers. comm. 2010) would be of any value. The lack of appropriate monitoring will not help address the existence of possible adverse effects such as an increase in intraspecific conflicts between males (it was stated that the released stocks had a disproportionate number of males; <http://www.wwf.ru/resources/news/article/eng/5251>), or an unforeseen dispersal of released animals into sub-optimal habitats.

**Text box 8. Main recommendation for Tigrovaya Balka project**

Any further restocking of the goitered gazelle population in the zapovednik of Tigrovaya Balka would need preliminary peer-reviewed scientific investigations to prove its validity, and a much more careful and thorough technical implementation.

#### **4. FINAL RECOMMENDATIONS – LOOKING TOWARD THE FUTURE**

The ultimate goal of most reintroductions is the establishment of both viable captive and free-ranging populations of a species and the development of simple, inexpensive methods of moving animals back and forth between captivity and the wild for genetic management. Reintroduction is one of several ways to manage an endangered species and can be an important conservation strategy if guidelines are followed. However, reintroduction should never override other approaches to conservation, and

particularly not protection and restoration of remaining threatened population, which is a less glamorous but far more cost-effective approach.

Although the glamour and publicity surrounding the reintroduction of an endangered species may provide positive benefits by focusing public attention on the problem, a reintroduction should not be attempted if it is not accompanied by an analysis of causes of the species decline and steps to reduce continued threats to the species survival. Otherwise, the reintroduction may decrease rather than increase a species' chances of survival. None of the projects I have evaluated during this mission adhere satisfactorily to this principle.

Also, reintroductions and restocking of captives should not be considered a solution to the problem of surplus captive animals and shortage of facilities. Releasing captive-born animals without preliminary groundwork and follow-up may turn out to be inhumane and also seriously jeopardize the wild population.

For a reintroduction to be truly successful, long-term involvement is needed. In an underdeveloped country, a commitment to train a future cadre of professional biologists and technicians in captive-breeding, reintroduction methodology, wildlife biology, and conservation needs to be integrated with other activities so that the project can eventually be overseen on the very long term by a local expertise. To this end, a significant percentage of the project's total budget should be allocated for professional training and student involvement.

In Tajikistan all the projects I have evaluated were initiated by the government, or at least by official authorities, without involvement of local communities. Yet because local people's activities that result in habitat degradation often have a significant impact on the decline of a species, it is important that early in a reintroduction effort, the organizers involve the local community such that they become collaborators in, rather than obstacles to, the program. The best way to involve local communities is to emphasize the economic benefits they could retrieve from such operation. This principle also applies to thinly-protected reserves of Tajikistan.

Possibly of even greater value would be to initiate the reintroduction or restocking project through local communities. This would be a relatively novel approach for Tajikistan that is certainly worth exploring. Yet experiences have shown that a certain level of external scientific supervision is also needed for the project to comply with recognized standards and that it is valuable to involve a legitimate authority in the community-based project to avoid a possible disintegration of the initiative when economical benefits start appearing. As an example, the massive poaching by resentful members of a powerful tribe foreign to the largely community-supported Arabian oryx reintroduction project in Oman was at the origin of its collapse (Spalton et al. 1999).

In selling a community-based reintroduction project to government officials, the rationale behind the effort must be clear and the justification compelling. An abstract benefit, such as saving a species from extinction, is generally not enough to impress a harassed bureaucrat under pressure from starving,

landless people. Above all, it is necessary to be sensitive to the pressures affecting the activities of government officials and their resulting priorities, so that the activities of the reintroduction do not put them in difficult or compromising situations. Promoting non-invasive government collaboration often requires considerable skill and convincing arguments about the potential benefits of the program. For example, demonstrating local or international public support (e.g., through extensive media coverage) may promote an altruistic governmental involvement when it is needed.

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