EAZA Best Practice Guidelines

Bactrian wapiti
(Cervus hanglu bactrianus)

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Preamble

Right from the very beginning it has been the concern of EAZA and the EEPs to encourage and promote the highest possible standards for husbandry of zoo and aquarium animals. For this reason, quite early on, EAZA developed the "Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria". These standards lay down general principles of animal keeping, to which the members of EAZA feel themselves committed. Above and beyond this, some countries have defined regulatory minimum standards for the keeping of individual species regarding the size and furnishings of enclosures etc., which, according to the opinion of authors, should definitely be fulfilled before allowing such animals to be kept within the area of the jurisdiction of those countries. These minimum standards are intended to determine the borderline of acceptable animal welfare. It is not permitted to fall short of these standards. How difficult it is to determine the standards, however, can be seen in the fact that minimum standards vary from country to country.

Above and beyond this, specialists of the EEPs and TAGs have undertaken the considerable task of laying down guidelines for keeping individual animal species. Whilst some aspects of husbandry reported in the guidelines will define minimum standards, in general, these guidelines are not to be understood as minimum requirements; they represent best practice. As such the EAZA Best Practice Guidelines for keeping animals intend rather to describe the desirable design of enclosures and prerequisites for animal keeping that are, according to the present state of knowledge, considered as being optimal for each species. They intend above all to indicate how enclosures should be designed and what conditions should be fulfilled for the optimal care of individual species.

Contributors

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Editors

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Language review

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Summary

This document reflects the current knowledge of keeping the Bactrian wapiti (*Cervus hanglu bactrianus*) under human care. It provides information on successful managament in EAZA institutions as well as in deer farms and breeding facilities in Central Asia.

The document is composed of two sections. Section 1 provides overview of biology, ecology, behaviour and population status in the wild by summarizing published information. Section 2 covers all known information on management under human care, including housing, feeding, breeding, behaviour, handling and veterinary care.

This document is dedicated to all holders (past, present and future) of the Bactrian wapiti. With your help, we were able to learn more about this beautiful subspecies and can continue to learn more in future. This document in not final and will be modified if further relevant husbandry information is found.

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Content

Section 1: Biology and field data

1.1 Taxonomy

The Bactrian wapiti is a subspecies of the Tarim red deer (*Cervus hanglu*). The taxonomy of this subspecies has undergone repeated revisions and different sources have evaluated the taxonomy of the species. An overview of the taxonomic changes is presented below.

1.1.1 Taxonomic history

For many years, Bactrian wapiti has been considered as a subspecies of Red Deer (*Cervus elaphus*) under the nomenclature *Cervus elaphus bactrianus* Lydekker, 1900 (Wilson and Mittermeier, 2011).

Pitra et al. (2004) define the species as *Cervus yarkandensis* and Bactrian wapiti as its subspecies named *Cervus yarkandensis bactrianus* Lydekker, 1900. This nomenclature is also used by Pluhacek et al. (2010).

Lorenzini and Garofalo (2015) suggest that the Central Asian subspecies should be recognized as the Tarim red deer *Cervus hanglu* Wagner, 1844, as the name with priority over *C. yarkandensis* and *C. elaphus*. Based on their genetic research, they proved to be a well differentiated and statistically highly supported subclade of deer populations from Central Asia (subspecies *bactrianus*, *yarkandensis* and *hanglu*). But, more genetic research is recommended in Central Asian deer taxa.

Cervus hanglu was elevated to a species level for the purpose of the IUCN Red List assessment in 2016 and the Bactrian wapiti is currently classified as its subspecies, *C. h. bactrianus*. However, it should be noted that future clarification on genetic relatedness, especially studies with nuclear markers and more formal morphological description, may lead to further revisions to the taxonomy of this provisional species, as more information becomes available (Brook et al., 2017).

1.1.2 Species Taxonomy

Class	Mammalia	Mammals
Order	Cetartiodactyla	Whales and Even-toed Ungulated
Family	Cervidae	Deer, Elk, Moose and Caribou
Subfamily	Cervinae	Old World Deer
Genus	Cervus	
Species	*Cervus hanglu*	Tarim red deer
Subspecies	*Cervus hanglu bactrianus*	Bactrian wapiti
Subspecies	*Cervus hanglu hanglu*	Hangul
Subspecies	*Cervus hanglu yarkandensis*	

Figure 1.1: Classification of Bactrian wapiti (Brook et al, 2017).

Three subspecies of *Cervus hanglu* are generally recognized. Although *C. h. bactrianus* and *C. h. yarkandensis* were not supported as distinct subspecies by molecular data (Lorenzini and Garofolo, 2015).

1.1.3 Common names

Language	Name
English	Bactrian wapiti, Bactrian deer, Bactrian red deer, Bukhara deer, Bukhara red deer
French	Cerf de Bactriane
Spanish	Ciervo Bactriano
German	Bucharahirsch, Bakterischer Rothirsch
Czech	jelen bucharský

Figure 1.2: Common names of Bactrian wapiti (Brook et al, 2017).

For the purpose of this Best Practice Guidelines, the taxonomic classification of *Cervus hanglu bactrianus* with the common name "Bactrian wapiti" will be used.

1.2 Morphology and physiology

1.2.1 Body measurements

The Bactrian wapiti is a big deer species, long-legged and short-tailed taxon with a long and rectangular body. Shoulder height is about 120 cm, body length about 180 cm and skull length about 39 cm. Birth weight is from 8 to 12 kg (Bannikov, 1978; Geist, 1998; UNEP-WCMC, 2020). Weight information of adults is not known.

1.2.2 General description

The body is light coloured, foxy red to yellowish grey on the upper parts and a bright rump patch. The muzzle and chin are white. Animals are overall somewhat brighter in summer than in winter. The spring moult begins in April and finishes in June (Bannikov, 1978). The winter coat, which grows long by October until December, has more densely standing, but thinner hair than the summer coat (Bannikov, 1978; UNEP-WCMC, 2020).

Sexual dimorphism occurs. Males can be easily recognized because of the presence of the antlers and neck mane.

Newborn calves have a light coat with scattered white spots on the sides, which are lost after 2 – 3 months (Wilson and Mittermeier, 2011).

1.2.3 Antlers

The Bactrian Wapiti has five tine, medium-sized antlers. A crown is formed rarely which is considered to be a primitive morphological trait. The weight in fully adult stags is between 3,4 and 5,5 kg (Geist, 1998).

Antlers occur only in males. The annual antler cycle is connected to testosterone. Testosterone directly promotes the development of the permanent bases of the antlers – pedicles, from the frontal bone. Pedicles begin to grow at 9 – 10 months of age. The first set of antlers starts to grow in the second year of life. The first antlers are always very small, a simple pair of short spikes, but the following antler sets become larger and branched (Wilson and Mittermeier, 2011).

During the period of their growth, antlers are covered with velvet. The velvet is a very sensitive hairy skin with blood vessels and nerves which nourish the antler. Growth is very rapid and it requires large quantities of minerals, especially hydroxyapatite, a crystalline calcium phosphate. The concentration of biologically active compounds in the velvet is 1,7 higher than in Sika deer (*Cervus nippon*) and Siberian wapiti (*Cervus canadensis sibiricus*) (Pereladova, 2004). When velvet antlers reach their final size, the blood vessels gradually close. The blood flow stops, the velvet skin dies and falls apart. The antlers have now hard, nearly dead bone structure with a reduced vascular system with some viable bone cells connected to a living bone – pedicle (Wilson and Mittermeier, 2011). This happens from the end of July to the beginning of August (Bannikov, 1978).

The decline of testosterone levels after the rut induces the rapid and shortlasting activation of special cells (osteoclasts) that resorb the bone where the antler joins with the pedicle, causing the antler to fall off (Wilson and Mittermeier, 2011). This occurs from the end of February to the beginning of March (Bannikov, 1978)

1.2.4 Digestive system

Like other deer species, the Bactrian wapiti is ruminant and a foregut fermenter. The Bactrian wapiti has 34 teeth, with rudimentary upper canines. The gall bladder is absent (Wilson and Mittermeier, 2011).

1.2.5 Longevity

There is no data about longevity of wild animals.

1.2.6 Genetics

The investigation of the karyotypes of four animals kept at Beijing Zoo showed 67 chromosomes in three offspring of a stag containing 66 chromosomes (Wang and Du, 1981). The karyotype of one female from Cologne Zoo (imported from the former Soviet Union) comprised 68 chromosomes (Schreiber, 1994). Schreiber (1994) indicating a Robertsonian translocation system was found in this taxon.

The karyotype does not show differences in chromosomal morphology from Red deer (*Cervus elaphus*) (Schreiber, 1994).

1.3 Zoogeography and ecology

1.3.1 Distribution

The Bactrian wapiti only occurs in Central Asia along the Amu Darya and Syr Darya rivers and their tributaries in Afghanistan, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan (Nowak, 1999). Historically, it also inhabited the river valleys along the Murgab and Tedjen rivers in Turkmenistan and Zarafshan (in Tajikistan and Uzbekistan) and the Ily river (in Kazakhstan) (Bannikov, 1978), but its range was much reduced in the 1960s (Brook et al, 2017).

1.3.2 Population

The population was seriously threatened in the 1960s, especially because of habitat destruction and fragmentation and direct elimination (poaching). In the 1960s only 10 % of natural riparian forests remained in the Amudaria river valley, the rest had been replaced by fields.

The Bactrian wapiti disappeared from Tedjen, Murgab, lower Amudaria, Zarafshan, and the entire Syrdaria valley (Pereladova, 2013).

In the 1960s and 1970s, a number of special reserves were established for protection of the subspecies, and special activities were undertaken in order to restore the Bactrian wapiti to its natural habitat. The population at the time was about 900 individuals in 13 groups in 1989 (Pereladova, 2013).

As a result of poaching, the population decreased to only about 350 individuals throughout the area in 1991 after the breakup of the former Soviet Union. Moreover, the major groups, which survived in the Amu Darya river valley, were under threat due to various natural disasters, such as floods, disease outbreaks, etc.

As a result of restoration activities and reintroduction, Bactrian wapiti numbers increased from 350 in 1991 to 1 900 in 2011 (Pereladova, 2013), and to 2 700 in 2015 (Pereladova, pers. comm; cited by Brook et al, 2017).

More recent data about the total population size is not available. An overview of populations per country is given below.

Uzbekistan

The highest numbers of animals live in the Lower Amu Darya State Biosphere Reserve (LABR, former Badai-Tugai State Nature Reserve) and the Kyzylkum State Nature Reserve. Both of these reserves lie along the border with Turkmenistan, therefore the populations are shared.

The numbers of animals in Kyzylkum declined very quickly. About 70 wapitis lived there in 1997 but only 7 – 10 wapitis were recorded a year later as a result of river-flood and poaching (Pereladova and Sempere, 1999). Fortunately, the population managed to survive and about 130 animals were recorded in 2011 (Peraladova, 2013).

The LABR had about 80 animals in 1998 and 666 in 2011 (Pereladova and Sempere, 1999; Pereladova 2013). In 2019, a regional project was carried out and it was estimated that population is between 1 320 – 3 344 individuals (Cornelis et al, 2020).

In 2000s, the population was reintroduced to the Zarafshan State Nature Reserve. The population is transboundary and is shared with Tajikistan. In total 180 individuals were found there in 2011. There are also other groups counting around 240 animals in other territories (Pereladova, 2013).

In 2011, around 1 200 wapitis in total lived in Uzbekistan (Pereladova, 2013). The current numbers can be only guessed because more recent data from all areas is missing. According

to the latest numbers from LABR and the numbers from 2011 from other territories we can estimate that more than 2 600 individuals lived in Uzbekistan in 2019.

Tajikistan

The main population, which is recovering, lives in the Tigrovaya Balka State Nature Reserve, which is one of the first strict nature reserves of the former Soviet Union and the oldest nature reserve in Tajikistan and Fakhor and Khamadoni Districts (Brook et al, 2017).

By the end of the 1980s, between 250 – 700 individuals lived in Tigrovaya Balka, Ramit State Nature Reserve and in the riparian forests of Vakhsh and Piandj. In 1996, only eight animals were found in Ramit and probably around 100 in Tigrovaya Balka. It was estimated that no more than 40 animals lived there in 1998 (Pereladova and Semere, 1999).

In 2011, more than 150 individuals were found in Tigrovaya Balka, and 140 animals were transboundary with Uzbekistan (Peraladova, 2013).

Kazakhstan

The subspecies was eliminated in Kazakhstan in the 1960s and later reintroduced to the Karatchingil hunting farm, the Altyn-Emel National Park and Syrdarya-Turkestan State Regional Natural Park (Brook et al, 2017).

The reintroduction to Karatchingil started in the 1980s, when 21 Bactrian wapitis were transported from Tajikistan. The population in the farm increased to 80 individuals in 1999, to 350 individuals in 2011 and to more than 700 individuals in 2017 in farm and adjacent lands (Pereladova, 2013; The sixth national report, 2018). Due to the increased numbers of animals in the farm, a part of the wapiti population has to move annually to the adjacent lands. Unfortunately, some of the animals are killed by poachers. However, individual animals and groups have reached the mouth of the Charyn River, the Charyn ash grove and the Ili River floodplain to the Panfilov Bridge, 200 – 300 km east of the Karachingil hunting farm (The sixth national report, 2018).

The Syrdarya-Turkestan State Regional National Park had 54 animals - 24 free ranging and 30 animals in Turkestan nursery pens in 2011. The population grows every year and it has increased to 146 individuals - 68 free ranging and 78 in pens in 2017 (Pereladova, 2013; The sixth national report, 2018). It should be particularly noted that individual animals and groups inhabit the area from Syrdarya-Turkestan NP down the river to the Tartogai forest, located in the Kyzylorda oblast, 110 km off the park, and up the river the wapiti settled at the mouth of the Arys River (The sixth national report, 2018).

In 2009, 10 free ranging animals were released in the Altyn-Emek National Park and 15 – 20 animals were kept in pens for future releases (Pereladova, 2013). More recent data are not known.

In 2017, the second enclosure for the conservation and reproduction of the Bactrian wapiti was built in Bairkum area in the Syrdarya River floodplain and the relocation will continue more intensively in the future (The sixth national report, 2018).

In total, more than 870 individuals lived in Kazakhstan in 2017.

Turkmenistan

The subspecies lives scattered in the area and occurs only in low numbers of 120 individuals (in 2011) at 8 sites along Amu Darya river, in the middle and upper reaches (Pereladova, 2013).

Afghanistan

The subspecies has mostly disappeared from Afghanistan. The subspecies possibly occurs in the north, in the wetlands of the Amu Darya in Kunduz Province and in Takhar Province close to the border with Tajikistan (Brook et al, 2017).

It has dramatically suffered from over-hunting and loss of habitat. Ostrowski et all (2008) states that during the survey there were no indices of Bactrian wapiti presence (footprints, scats, marking trees or antlers) none had been found and that none of the interviewers had actually seen the species in recent years. In Aye Khanum a respondent mentioned that an individual was recently seen in the forest of Khoja Baudin.

An unknown number of animals permanently occupies the area of the Hazrat-e Bostan forest. Some animals were also seen in the north and northeast of Darquad District (Takhar Province). Darquad shares an international border with Tajikistan and it is not excluded that those animals originated from Tajikistan (Moheb et al, 2016).

1.3.3 Habitat

The Bactrian wapiti inhabits predominantly a riparian forest called Tugai along the riverbanks and floodplains of semi-arid and desert areas. The environment is the most extreme when compared with those usually inhabited by Red deer (*Cervus elaphus*). Precipitation in the habitat is usually lower than 200 mm per year and the air temperature in summer often exceeds 45° C (Bannikov, 1978).

The dominant flora of those forests includes poplar (*Populus pruinosa*), oleaster (*Elaeagnus* sp.). tamarix (*Tamarix* sp.) and reeds (*Phragmites communis*) (Bannikov, 1978). Some significant groups inhabit reed bushes with very limited tree cover (Brook et al, 2017).

In winter and especially in early spring, the wapitis regularly come out of the Tugai forests into the desert where they stay amidst saxaul (*Haloxylon* sp.)[1] shrubs or in the open desert (Bannikov, 1978).

1.3.4 Threats

Narrow habitat needs makes the subspecies very vulnerable. The population of Bactrian wapiti has declined due to (Bannikov, 1978; Karlstetter and Mallon, 2014):

- habitat loss
    - illegal logging
    - illegal grazing
    - forest loss due to fires
- habitat fragmentation
- illegal hunting and poaching
- ecological disasters connected with artificial regulation of water regime and climate change
    - floods
    - droughts
    - cold winters with heavy snowfalls

The main threats to the Bactrian wapiti are illegal hunting and loss of natural habitat. The riparian forests are fed and depend on the rivers they follow which allow the growth of trees in an otherwise dry climate. With the development of intensive agriculture, the river waters have dropped to alarmingly low levels at some sites (e.g. Tigrovaya Balka State Nature Reserve, Tajikistan). The impact of a changing climate towards an increase in temperature might further accelerate the fall of ground water levels and thus threatens the persistence of the Tugai forests (UNEP/CMS 2011).

Illegal hunting and poaching were the major reasons for a big decline of the species in the 1990s (Pereladova, 2013). In the 1970s, some domestic buffaloes escaped and invaded the Tigrovaya Balka State Nature Reserve and competed with the Bactrian wapiti for food sources. Bannikov (1978) adds that measures were taken in that time to remove the buffaloes from the Reserve.

[1] Saxaul is genus of shrubs or small trees with leaves reduced to small scales.

1.3.5 Conservation status

According to the IUCN Red List, Tarim red deer (*Cervus hanglu*) is listed as of Least Concern (LC) (Brook et al, 2017). Information about the specific status of the subspecies Bactrian wapiti was not evaluated.

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) has classified this subspecies (under the nomenclature *Cervus elaphus bactrianus*) in Appendix II as of 1975 (UNEP-WCMC, 2020).

According to Commission regulation (EU) 2023/966 this subspecies is (under the nomenclature *Cervus elaphus bactrianus*) listed in Annex B.

1.3.6 Conservation actions

As said in chapter 1.3.2. Population, some activities for the protection of the taxon were taken in the 1960s and 1970s, but they were not the only ones.

In 1989 the programme for Bukhara deer conservation and restoration**,** drawn up by Flint and Pereladova, was approved by all Ministries of Nature Conservation of Central Asian States of the then USSR. The Programme analyzed the history of the subspecies and suggested about 40 recommendations for the restoration of the subspecies and the possibility of increasing its population (Flint et al., 1990).

In 2002, The CMS/Bonn Convention Bukhara Deer Memorandum of Understanding (MoU) and Action Plan was developed and signed by representatives of Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan.

The Bukhara Deer Action Plan is the main tool for the conservation activities under the MoU. The plan provides guidelines for the restoration of the range and numbers of the Bactrian wapiti in suitable habitats, the development of a transboundary network of protected areas, legal protection measures and enhanced international cooperation.

In 2011, the First Meeting of the Signatories took place in Bergen, Norway. It was decided to develope ecological corridors for migration, strenghten anti-poaching activities, involve local people in conservation and improve transboundary cooperation, etc. It was also decided to extend the geographical scope of the MoU to include Afghanistan (UNEP/CMS 2011).

In 2020, a technical workshop under the Bukhara Deer MoU was organized online.

Additional information, reports and outcomes within MoU can be find here: http://www.cms.int/bukhara-deer

1.4 Diet and feeding behaviour

The Bactrian wapiti is a ruminant herbivore with very unique dietary preferences. Its diet is very limited most of the year and includes grasses, sedges, shrubs and to a lesser extent tree shoots (Pereladova, 2004, 2013). More than 120 plant species are known to be eaten by the subspecies, but the basic fodder plants include only 10 to 15 species. The basic food of the subspecies during all seasons of the year is herbaceous vegetation, especially grasses (grass *Aeluropus littoralis*, wild sugarcane *Saccharum spontaneum*, reed grass *Calamagrostis*, lime grass *Erianthus,* etc.). Seasonally, an appreciable role is also played by fallen poplar leaves, fruits of *Elaeagnus* and ephemeral desert plants, such as sand reed (*Carex pachystillis*), aristida (*Aristida* spp.) and brome-grass (*Bromus* sp.). The general importance of other plant species as food varies insignificantly in different parts of the range (Bannikov, 1978). The Bactrian wapiti eats only branches of willow, poplar, some other riparian forest species and saxaul up to 5mm thick (Sablina, 1970).

Comparative analyses with other deer species have shown that Bactrian wapiti possess specific physiological adaptations to the arid conditions of Central Asia, most notably to the very limited supply and quality of food resources. Pereladova (2013) describes a case when Bactrian wapiti and Sika deer (*Cervus nippon*) held together on deer velvet farms in 1970 -1980 in Tajikistan, were obliged to eat the typical Bactrian wapiti diet and this caused various diseases in the Sika deer, including problems with bones and blindness. According to the analysis, all these diseases were caused by a lack of a number of vitamins and minerals. The same author also describes health problems with abdominal distension and sickness in groups of animals which were held and fed with the same forage as other deer species in the Reserve de la Haute-Touché in France in 1990s.

Living in a semi-desert area brings with it the need for an adequate supply of water. On hot summer days, animals visit drinking places regularly, apparently every day. The animals seldom come to drinking places in spring when the temperatures are not too high and plants are succulent. In autumn and winter, the number of the animals coming to the drinking places is significantly lower (Bannikov, 1978).

1.5 Reproduction and sexual behaviour

1.5.1 Sexual maturity

As any other deer species, the sexual maturity depends on final body size, growth rate and nutritional status. The exact data when the first ovulation in females occurs is not stated for the Bactrian wapiti, but in most deer species it happens between 18 and 30 months. But, as said, the phenomenon is not strictly related to age but to attaining the threshold weight - around three quarters of the final body weight (Wilson and Mittermeier, 2011).

The situation in males is more complicated. Although, they attain puberty around the same age as females[2], they do not participate in reproduction right away. As in other deer species, stags begin to breed when they reach a body size sufficient to compete with other males (Wilson and Mittermeier, 2011).

1.5.2 The rut

The roars can be heard from the last week of August to the beginning of October, with a peak in mid-September. But these dates can change by a week depending on weather conditions, the condition of the animals and altitude (Bannikov, 1978). Wilson and Mittermeier (2011) states that Central Asian red deer[3] has a curious rutting call which begins as a roar and ends as a bugle. During the height of the rut the males roar all day and night with two peaks in the evening and in the morning (Bannikov, 1978).

Very specific reproduction behaviour is the formation of true leks during rut (Clutton-Brock et all., 1993, Pereladova and Sempere, 1999). In cases of high population density, adult stags drove younger ones away from the lek (Pereladova, 1998).

A physiological characteristic of Bactrian wapiti is the order of the various phenological processes. The rutting season in well-developed populations under natural condition precedes the molting period (growth of winter fur) (Pereladova, 2013).

1.5.3 Reproduction in females

Females are polyestrous. They ovulate periodically during the rut until they are pregnant. The mean estrous cycle of the Bactrian wapiti is not known.

1.5.4 Pregnancy and calving

The duration of pregnancy is 8 months. The females give birth to one calf only. In the natural habitat, calves are born from the end of April to the end of May with the peak in mid-May. Before giving birth the females search for a calm place, usually in dense brakes and always near a river bank (Bannikov, 1978).

1.5.5 Calves

Birth weight is from 8 to 12 kg (Bannikov, 1978; Geist, 1998; UNEP-WCMC, 2020). Calves are hiders. During the first two or three days, the calves lie down and the mother comes to feed

[2] Again, the exact date is not stated for the Bactrian wapiti so general data are used.

[3] Central Asian red deer can be recognized as the Bactrian wapiti (*Cervus hanglu bactrianus*) because in publication, this subspecies is under the nomenclature *Cervus elaphus bactrianus.*

them. At an age of about ten days, the calves start to follow their mothers but they get tired very quickly. They begin to eat grass and leaves at an age of about one month, but suckling continues till winter, possibly longer (Bannikov, 1978).

1.6 Behaviour

In comparison with other deer species, the Bactrian wapiti has specific acoustic communication, and territorial and social behaviour (Peraladova, 2004, 2013).

1.6.1 Activity and daily movements

The Bactrian wapiti's activity depends on the season. In summer, the species is active at night and in the twilight, spending the hot periods of the day lying up on bed grounds and resting in the shade under the trees. As soon as sunlight reaches the animal, it will change its bed ground and move into the shade. In the evening, shortly before sunset, the animals visit their drinking places, graze for a longer part of the night and are near the water again at dawn. By mid-August, they are often active in the hours before sunset and in the morning (Bannikov, 1978).

In autumn, during the rut, the adult males are active almost all day but mostly during the night. In late autumn, the animals can be seen grazing in the day, too (Bannikov, 1978).

In winter and spring, activity occurs mainly at night when they often come out into the desert to feed. However, they can often be found feeding several times during the day as well. During snowfall in the winter or dust storms and rains in spring, they seek shelter in the dense shrubs or reeds (Bannikov, 1978).

The daily movements are usually shorter in summer than in winter. Individuals or herds were found to move from several hundreds of meters up to 2 – 3 km per day while searching for food (Bannikov, 1978).

1.6.2 Migration

The Bactrian wapiti leads a settled life, keeping to permanent sites. In good habitat conditions with enough food and without social pressures, populations do not usually migrate. Non-periodical migrations are observed only during major spring and summer river floods. The subspecies is a good swimmer and can easily swim even wide rivers. Other migrations were observed during fires when the wapitis can move as far as 10 or 15 km away from their permanent habitat. In addition, seasonal migrations were recorded in saxaul (*Haloxylon sp.*) deserts (Bannikov, 1978).

Although, rare cases are known of single individual migration over long distances (Bannikov, 1978).

1.6.3 Predation

The Bactrian wapiti is a prey species. Historically, the subspecies was hunted by the Caspian tiger[4] (*Panthera tigris tigris*). Several deaths were recorded between in 1946 – 1950 in Tigrovaya Balka Reserve, Tajikistan. Nowadays, the species is mostly preyed on by wolves and feral dogs (Bannikov, 1978; The sixth national report, 2018).

1.6.4 Social behaviour

The subspecies is social and lives in herds. Herd size and composition vary throughout the year. Herds are biggest in winter when they consist of 5 to 7, or more seldomly of 15 to 20 individuals, and still more seldomly up to 50 to 60 individuals. The herds break up in spring, before the births of the calves. The females with their young keep separate and form matrilineal family groups. Adult males usually stay alone, and immature males form bachelor groups of 3 to 5. In autumn, during the rut period, harems are formed, consisting of an adult male and from 1 to 4, females, seldom more. In 1971, harems of an adult male and 4, 5, 7 females, and in one rare case 8 females, were observed in the Ramit State Nature Reserve in Tajikistan (Bannikov, 1978).

Both groups, matrilineal and mixed, are led by an adult female. During movements, the leading female is in the front and in the case of mixed groups the male is always last (Bannikov, 1978).

When the group/harem is frightened, the animal utters a bark and runs away with the other animals of the group following. The group covers the first 50 to 100 metres fast and in disorder, after 200 to 400 metres, it stops and listens. If no chasing follows, the animals calm down. If chased, the animals run in circles of long radius, trying to get into a position down wind from the pursuer (Bannikov, 1978).

As in any other cervid, acoustic communication is well-developed, using roars during rut season and shrill barks when frightened (Bannikov, 1978; Wilson and Mittermeier, 2011). The acoustic characteristics of the signals were discovered, such as a low frequency component with a format structure and a high frequency component with a harmonic structure - both independently modulated in one and the same signal (Peraladova, 2013). Acoustic communication was also recorded between mothers and their calves (Bannikov, 1978).

[4] Also called Turanian Tiger after the place of its occurrence in the Turan area.

Section 2: Management in Zoos

2.1 Outside enclosure

The outside enclosure should be placed in calm part of the zoo where there is not much car traffic, near the restaurants, gift shops etc.

Picture 2.1. Outside enclosure in Zoopark Chomutov. Photo: Aneta Konvalinková.

Picture 2.2. Outside enclosure in Tierpark Berlin. Photo: Maren Siebert.

2.1.1 Boundaries

As a big deer subspecies, the Bactrian wapiti needs a proper fence. It is recommended that the height be 2 m (6,5 ft), although a minimum height of 1,8 m (5,9 ft) can be allowed.

In cases of high stress (restraining, catching, disturbance), the wapitis are able to jump over 3 m height as stated in the reports from pens in LABR (Baday-Tugay pen) in Uzbekistan (Cornelis et al, 2020). However, it should be noted, that those were semi-wild animals, being prepared for reintroduction and not used to visitors or any people other than their keeper.

Appropriate fence material includes metal fence, wooden fence, walls and additional electric fence. Dry moats can also be used. With regard to the swimming ability of the Bactrian wapiti water-filled moats are not recommended.

The outside enclosure should not be accessible to visitors from all sides. At least two sides should be off the visitor route. To prevent feeding by visitors, they should not have access straight to the boundary. Additional stand-off barriers (wooden fence, tape fence, rope) with “no feeding” signs are recommended.

Picture 2.3. Stand-off barrier in Miskolc Zoo. Photo: Aneta Konvalinková.

2.1.2 Substrate

Natural ground cover is recommended with adequate grass for grazing and trees providing shade. Given the semi-arid conditions the Bactrian wapiti is used to in their natural environment, sand can be also used. However, in this case, grass should be provided as a part of their diet, especially in summer months.

It is also good to provide animals with several types of substrate in outside enclosure to reduce the need to trim the hooves.

2.1.3 Furnishing and maintenance

The outside enclosure should have an uneven terrain with logs, fallen big trees, stumps, big stones and trees which can provide several options for females to hide during the birth season. Dead trees and logs provide ideal rubbing posts for males shedding a velvet. A stream or pond is also possible, given the subspecies' affinity to riverbanks. In hot summer days or the rut season, wapitis (especially breeding male) like to cool in mud, so it is good to provide them with a small pond or terrain depression with mud. The Zoopark Chomutov uses a hose sprinkler for this and it works fine. Furthermore the enclosure should be furnished by hayrack(s), food and water troughs.

If possible, the outside enclosure should be cleaned 1 – 2 times a week. Special precautions need to be taken during the rut. It is not recommended to enter the enclosure during this time.

2.1.4 Environment

The Bactrian wapiti can be outdoors all year around. However indoor enclosure (shelter) and natural shadow should be provided in days of high temperatures in summer and too low temperatures in winter.

Picture 2.4. Herd in winter. Zoopark Chomutov. Photo: Helena Hubáčková.

2.1.5 Dimensions

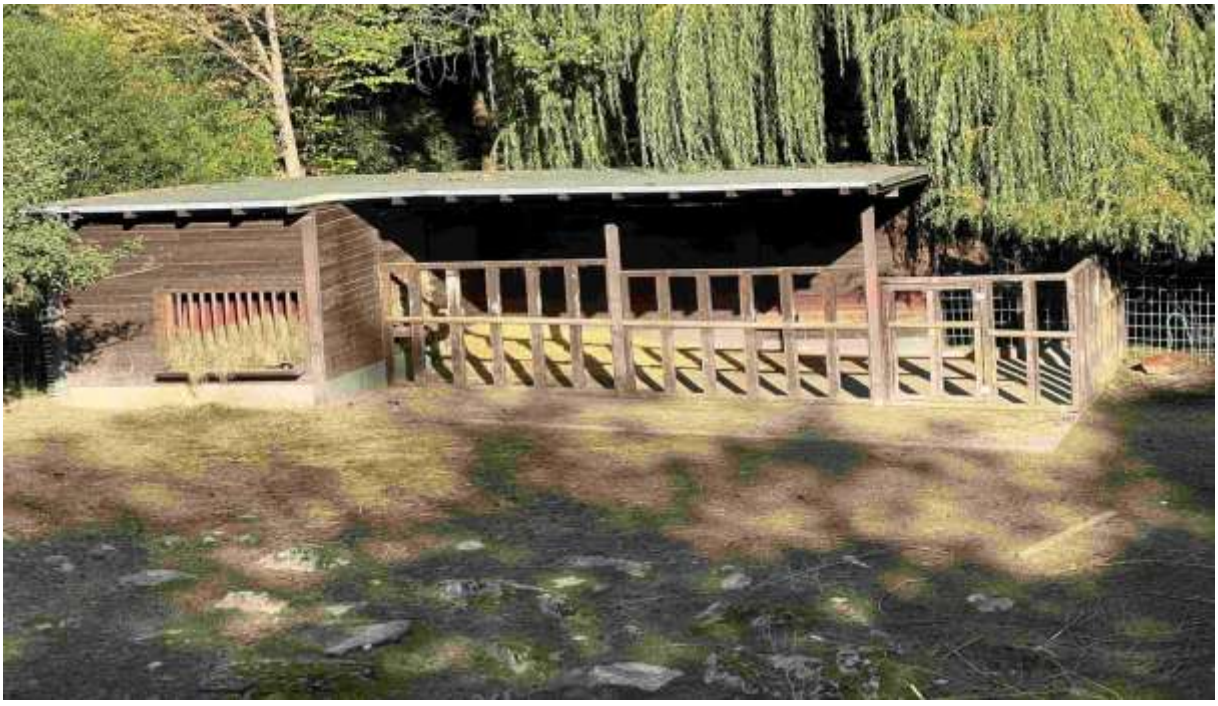
The recommended minimum dimensions can vary throughout national legislation. While planning an enclosure for a group of Bactrian wapiti it must be considered that they belong to the big deer species and their size almost reaches the size of Red deer. Taking into account the species' size, natural behaviour, and social structure, and also based on experience, the EEP recommends a minimum of 400 - 500 m2 per animal (e.g. a harem of four animals requires a minimal enclosure size of 1 600 - 2 000 m2).

2.2 Inside enclosure (shelter)

The animals should have access to an inside enclosure (shelter) all day. Here they can retreat from the public or other individuals in the enclosure and/or be separated. A roofed shelter also keeps food, like granules or pellets, dry in case of wet weather.

Animals do not need to be shut in overnight.

For separation purposes or better handling procedures, it is recommended to have at least two shelters or to have the shelter divided into two parts (boxes). Each of the boxes (or both shelters) should have its own entrance and be interconnectible.



Picture 2.5. Shelter in Opel-Zoo. Photo: Jörg Jebram.

2.2.1 Boundaries

The shelter should not be visible to visitors. It should be roofed and have full-panelled sides. In cases where a shelter is divided into two parts, the dividing wall should have the bottom

half fully-panelled and the upper part slatted to allow visibility of the wapiti when separated. Appropriate boundary material includes solid brick or concrete walls or wood. It is important to mention that openings should be wide enough to allow adult stags with antlers to pass through.

2.2.2 Substrate

For cleaning convenience, the floors should be concrete or a comparable material. This should be covered with an insulating substrate, preferably straw. Depending on the climate and weather, extra bedding in winter is recommended.

2.2.3 Furnishing and maintenance

The shelter should be furnished with a hayrack, food and a water trough. Salt lick can also be placed inside.

The shelter needs to be cleaned daily. Special precautions need to be taken during the rut.

Picture 2.7. Shelter inside in Tierpark Berlin. Photo: Maren Siebert.

2.2.4 Environment

The shelter does not have to be heated but it is recommended, depending on the climate and weather, to give the animals extra bedding in winter. No lighting or photoperiod need to be considered because the subspecies spends most of the time outside.

2.2.5 Dimensions

The same as for the outside enclosure can be applied for the shelter, while planning, the size of the body and male's antlers must be taken into account. The recommended minimum dimensions can again vary throughout national legislation. Recommended height is at least 2,5 m (8 ft).

2.3 Feeding

As described in chapter 1.4 Diet and feeding behaviour, the subspecies is very unique in its diet in the wild. Nutritional data and diet composition have been described by Marmazinskaya (2012) for use in Central Asian nursery deer farms.

2.3.1 Basic diet

The diet should be composed of roughages, concentrates, mineral supplements and browsing. In general, most large ungulates (>250 kg) consume 1.5% – 2% of their weight in dry matter daily (Nijboer, 2020).

Roughage is represented by grass and hay which should be of good quality. It is possible to combine feeding by grass hay and alfalfa hay. In general, a leafy legume hay, e.g. alfalfa, should be used for species that are primarily browsers although they should be fed browse as well. Legume hays are higher in nitrogen and calcium and, if of good quality, are more digestible than grass hays (Nijboer, 2020). Grass can be provided as graze. If the animals cannot graze, grass and/or fresh alfalfa needs to be provided, especially in summer months.

Concentrate feed is represented by pellets and grain. Pellets for ungulates, elks, deer or browsers are used by holding institutions. From grain, oat is widely used, but it can be also provided in mixtures.

Grain	%
Wheat	15
Maize	15
Barley	43
Bran	25
Salt	1
Premix	1

Figure 2.1: Recipe of mixed fodder for the Bactrian wapiti (compiled on the basis of compound feed recipes for cattle) (Marmazinskaya, 2012).

The premix is based on vitamins, microelements and amino acids. In Zarafshan reserve, the vitamin and mineral additive "Zoomix A" or protein-vitamin additive for cattle "Vitavit-C" was added to mixed fodder (Marmazinskaya, 2012).

Regular provision of branches for browsing is important in this subspecies. Browse consists of leaves, bark, and branches of edible trees and shrubs. It can be stored dried, frozen or as silage. Precautions should be taken if feeding silage products. If the silage was not processed or stored properly or contaminated by animal or meat products, it may contain fungi or bacteria (e.g., *Clostridium botulinum*) that can produce lethal toxins (Nijboer, 2020). Browse can be used as a form of enrichment, as well as supplementing the main diet. From trees species can be used:

- Willow (*Salix* sp.)
- Hazel (*Corylus avellana*)
- Ash (*Fraxinu*s sp.)
- Elm (*Ulmus* sp.)
- Birch (*Quercus* sp.)
- Maple (*Acer* sp.)
- European hornbeam (*Carpinus betulus*)
- Hawthorn (*Crataegus* sp.)
- Alder (*Alnus* sp.)
- Oak (*Quercus* sp.)
- Black poplar (*Populus nigra*)
- Fruit trees

Special attention should be paid to the toxicity of oak. Long-term feeding of oaks in large amounts can be dangerous. Its toxicity is based on the action of tannins and their metabolites, especially digallic acid. Tannins are present in all parts of the plant. They have the ability to interact with proteins and form complexes with them. This results in an extraction of the proteins from the diet which can lead to reduced growth and body weight. Most cases of oak poisoning have so far been described in ruminants. The risk of poisoning is especially from acorns (Novotná et al, 2021).

The diet can be enriched by root vegetables (mangold, sugar beet, potatoes, carrots, cabbage, topinambur, fodder watermelon) and fruits (apples, quince, pears), but the amount should be limited to <5% of the total diet (Mazmazinskaya, 2012; Nijboer, 2020). If possible, it is necessary to give root vegetables also in summer and early-autumn periods because root vegetables, as a juicy feed, are especially valuable for lactating females. Carrots are a valuable feed for young animals. High carotene content, high digestibility and dietary qualities determine the importance of carrots in animal feeding, especially in the elimination of vitamin deficiency in the winter-spring period (Marmazinskaya, 2012).

The need for mineral nutrition increases during molting, horn growth, pregnancy and lactation, exhaustion, disease and injury. The Bactrian wapiti in their natural habitat receive sufficient amounts of minerals with drinking water and as part of forages (comb, saltbush, etc.) so the need for mineral supplementation is much lower or even absent, unlike the need in other deer species. Nevertheless, in captivity and after releasing, it is necessary to organize salt pans and observe whether they are used (Flint et al. 1989 cited by Maramazinskaya, 2012). From mineral supplements, salt lick is usually provided *ad libitum*.

In tables below, feeding schemes are presented as they were developed on the basis of many years of experience of keeping in the nursery of Zarafshan Reserve (Marmazinskaya, 2012).

Type of feed (kg)	**Youngster**		**Adult**	
	Per day	Per year	Per day	Per year
Concentrates (12 months)	0,8	292	2	730
Hay (6 months, winter)	3,5	637	6	1092
Root vegetables and fruits (4 months, winter)	1,2	216	3	540
Fresh alfalfa or grass (7 months, warm season)	5	1050	10	2100
Mineral additives		3		7
Salt		3		7

Figure 2.2: The diet plan recommended for one animal per day and year (Marmazinskaya, 2012).

Month	**I**			**II**			**III**			**IV**			**V**			**VI**		
Decade[5]	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Concentrates	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Root vegetables and fruits	x	x	x	x	x	x	x	x	x	x								
Fresh alfalfa										x	x	x	x	x	x	x	x	x
Grass												x	x	x	x	x	x	x
Alfalfa and mixed grass hay	x	x	x	x	x	x	x	x	x	x	x							
Browse													x	x	x	x	x	x

Figure 2.3: The diet plan recommended for one animal per day and year (Marmazinskaya, 2012).

Month	**VII**			**VIII**			**IX**			**X**			**XI**			**XII**		
Decade	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Concentrates	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Root vegetables and fruits												x	x	x	x	x	x	x
Fresh alfalfa	x	x	x	x	x	x	x	x	x	x	x	x						
Grass	x	x	x	x														
Alfalfa and mixed grass hay										x	x	x	x	x	x	x	x	x

[5] A period of ten days in month

Browse	x	x	x	x	x	x											

Figure. 2.4: The schedule recommended for the Bactrian wapiti (Marmazinskaya, 2012).

Diet plans from selected holding institutions are presented in Appendix I.

2.3.2 Special dietary requirements

The diet usually differs throughout seasons (see Figure 2.5). Nutritional management plans should take into account three periods of strengthened feeding: the period of preparation for rutting (July - August), the period after rutting when animals, especially males, are very weakened (November - December), the period of antler growth in males and the period of pregnancy in females (Maramazinskaya, 2012).

2.3.3 Method of feeding

The food can be provided both outdoors and indoors. Feeding is possible once or twice a day. Hay should be presented *ad libitum* and presented by hayrack rather than off the ground.

Root vegetables are fed raw as whole roots or cut. Small root crops weighing up to 150 g should be chopped, as animals may choke. Strongly contaminated root crops should be washed or dry cleaned before chopping (Marmazinskaya, 2012).

The number of food sites should be determined according to the groups' feeding behaviour and the individuals' nature so that each animal is always comfortably fed.

2.3.4 Water

All animals need to have access to fresh water daily. Water may be provided in troughs, buckets and automatic watering. If the water is also provided by natural sources (e.g. ponds, streams), it must be regularly hygienically tested to ensure it is not harmful.

2.4 Social structure

2.4.1 Basic social structure

Under human care, the Bactrian wapiti can be held in a harem or bachelor group. Both of those systems have its specialities.

Harems, according to wild animal behaviour described in chapter 1.6.4 Social behaviour, are led by an adult female (Bannikov, 1978). It was described by some zoos that sometimes the dominant female (or females) can bully the weakest individual in the group. In this case, the zoo staff should take proper steps to minimize the bullied individual's mental and physical suffering and stress. This could be achieved by separating the individual during feeding time, relocation or separation of the animal, although long-term separation is not recommended. If there is no other solution, the institution should contact the EEP Coordinator and try to relocate the animal to a different institution. Also, if the holding institution is aware of this behaviour within their group, it should be discussed with the EEP Coordinator, and for future transfers to this group at least two animals should be sent from the same holding institution to ensure better integration into the group.

Harem structure also brings problems for young males who can be under pressure by adult stag. Those young males should be separated from the group until 2 years of age.

Picture 2.8. Harem in Zoopark Chomutov. Photo: Helena Hubáčková.

Animals which are under social pressure and stress for long period**s** of time, can be more prone to diseases. And since parasitological findings are very common in this species, to avoid future unwanted deaths, the institutions are required to keep the animals in good mental state and good welfare.

Bachelor groups are more stable. Increased locomotion and fights occur during rut even if the females are not present, although the fights do not escalate to anything serious (Louden, 2023, pers. comm.)

Picture 2.9. Males in Zoopark Chomutov. Photo: Miroslav Brtnický.

Picture 2.10. Bachelor group in Jerusalem Zoo. Photo: Noam Werner.

2.4.2 Changing group structure

Introducing new animal(s) to the group is mostly without any problems. Holding institutions answered in questionnaire that groups settle quickly without or with occasional fights and then a stable hierarchy is maintained**.**

While introducing a new animal, it is recommended to allow the individual to see, smell and hear the group it will be introduced into. Therefore, the animal should be placed in a shelter or small yard in the enclosure for a sufficient period of time and be released to the outside enclosure only after appropriate visual, olfactory and auditory exposure has been experienced.

2.4.3 Mixed exhibit

The Bactrian wapiti is not held in mixed exhibition with EAZA nor non-EAZA Bactrian wapiti EEP participants. However, mixed exhibits are recorded in San Diego Zoo within Association of Zoos and Aquariums (AZA).

2.5 Breeding

2.5.1 Mating

The mating season usually occurs from late August and September (Brtnický, 2023, pers. comm.). The animals display various behaviours associated with breeding. Typically, males show increased locomotion and vocalization (roar) and weight loss. It is reported from several holding institutions that stags become very aggressive towards keepers during this time. The females can become more nervous.

2.5.2 Pregnancy

The gestation period for this subspecies is 8 months. The females do not normally exhibit any specific behaviour during pregnancy and are not more prone to diseases.

2.5.3 Contraception

Because of the small population size and need to increase the population there is no need for contraception. Contraception can be used only with approval of the EEP Coordinator.

2.5.4 Births

Calving occurs mostly in April and May. Females give birth to one calf (543 litters, 98,5 %), although in rare cases they can give birth to two calves (7 litters, 1,5 %).

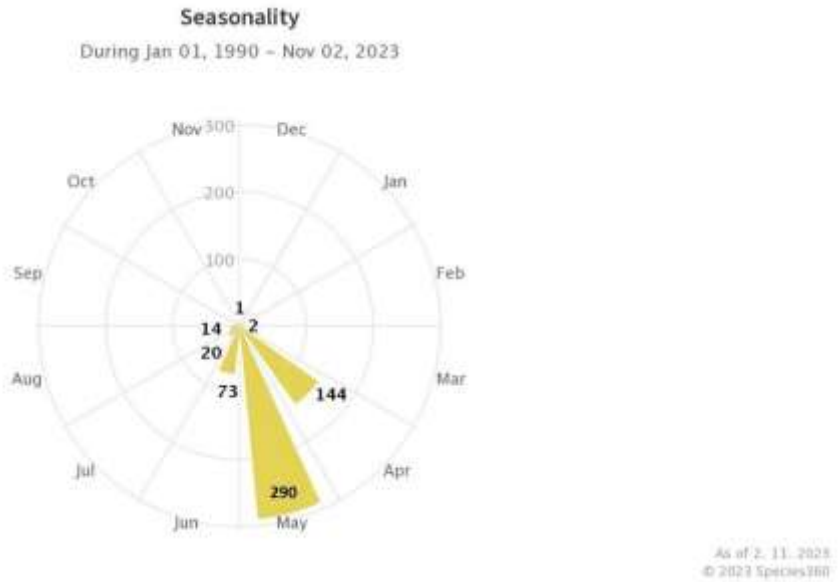


Figure 2.5: Seasonality in calving from January 1, 1990 to November 2, 2023. Source: ZIMS for Studbooks.

Some holding institutions reported that before parturition, the pregnant female separates herself from the herd and searches for a quiet place to give birth. Some reported that they do not observe any atypical behaviour a and that females give birth during the night.

During the births, a breeding stag does not have to be separated from the herd. The holding institutions reported that no aggressive behaviour towards calves has been ever observed.

Picture 2.11. Female giving birth with an assistance in Zoopark Chomutov. Photo: Miroslav Brtnický.

2.5.5 Development and care of calves

After the birth, it was reported that females become more nervous and vigilant towards keepers and some of them can be very protective of their calf. The calf is usually left in a calm and safe space for the first days. Females, in general, show good care of calves. Although it was reported that some females abandon their calf, this only rarely happened in holding institutions. When abandoning their calf, the reasons can be insufficient milk production, milk retention or nervous disorders (Marmazinskaya, 2012).

Picture 2.12. Calf in Zoopark Chomutov. Photo: Helena Hubáčková.

2.5.6 Hand-rearing

Hand-rearing was not described by holding institutions. Regarding the subspecies' size and dangers to human, it is not recommended to hand-rear males. As described in Burmese brow antlered deer, hand-reared female has not been reported to become aggressive towards keepers and may act as 'Judas' deer, leading their conspecifics into indoor facilities when called (Hartley, pers. comm.; cited by Wall and Hartley, 2017).

However, artificial feeding of Bactrian wapiti calves is used in nursery pens in the Zarafshan Reserve. The procedure of picking the calves for artificial nursing and experiences with rearing are described in Marmazinskaya (2012) and a selection of the text is given in the text below:

Choosing the animals for artificial nursing

During the calving period, the condition of the born calves should be monitored. During the initial period of life, they spend most of their time lying hidden among the vegetation of the enclosure. The enclosure keeper, whom the animals know well both by appearance and smell, should quietly without disturbing the animals, go around the enclosure every day and find the calves at the places where they lie down (the presence of unauthorized people in the enclosure during calving and lactation is highly undesirable). On the third or fourth day after birth, the calves jump up from their places and run away when approached by a human. Their physical condition can be determined by the nature of their movements.

If the calf is very weak, the keeper should inform the veterinarian or research assistant. Lactating females should also be observed: if a female separates from the group and is not with the group for some time and does not come to feed, it means that she has left to feed the calf. A good indicator is the udder of the female - if the milk production is low, it is small. In this case, even if the female periodically leaves to feed the calf, this fact should be cause for alarm - since due to a lack of milk the calf may become weak, and if it is not taken away in time for feeding, it will die. Thus, a weak physical condition of the calf and the underdeveloped udder in the female is a reason for taking the calf for artificial feeding. By the beginning of the calving period, everything should be ready for artificial feeding: bottles, teats, milk powder or milk mixture, vitamins, veterinary drugs, bedding for the room.

Rearing enclosure

Calves are kept separately from the rest of the group during artificial milking. They can be kept as a group in one rearing enclosure. A round enclosure or an enclosure with rounded corners and fencing made of fine mesh netting is the most convenient for working with calves. The area of the enclosure should be sufficient for playing and running (diameter of at least 10 m for 3 – 5 calves, with the expectation that they will be kept in this enclosure until the age of one year). The general furnishing and environment of rearing enclosure construction is the same as for the main enclosure. The enclosure must have trees in the shade of which the calves can take shelter from the sun and must be protected from predators. For this purpose, the base of the enclosure should be concrete. Part of the enclosure wall, on the side of the approach of people or the passage of machinery, should be covered with reed mats so that the fawns are not frightened. Feed troughs and drinkers shall be installed in the enclosure.

An indoor room with straw bedding must be built adjacent to this enclosure to hold the calves for the first few days, during the teat training period. After the young calves are accustomed to the teat (at the age of 1-2 weeks), they can be let out of the room into the enclosure - at first for a few hours in the daytime, in warm weather; gradually such walks in the enclosure can be prolonged. Once the calves are stronger and finally accustomed

to people, they can be left in the enclosure permanently. In bad weather (rain, cool nights), which may still occur in late spring and early summer, the calves can be lured indoors with a bottle and teat.

In the first year, it is not recommended to release young animals into the enclosure with the main group of wapitis, because young animals may be subjected to aggression from adult animals. It is better to do this after the calves have reached the age of one year. To minimize stress in the animals and to facilitate the transfer (no need to immobilize them), it is necessary to have a connection between the young and main enclosures - through a gate or possibly a temporary mesh corridor between the two enclosures.

Teat training

The first feeding is very important, as an incorrect approach to it may result in a negative reflex in the calf towards the teat and towards the human. During the first feeding, the lying calf is gently stroked, massaging the anogenital area, supported, gently lifted and placed on its feet. Feeding should be carried out in the standing position of the calf. This is necessary to make it suck the teat which is put in its mouth. A few drops of warm milk from the teat may be dribbled onto the calf's nose. If the pacifier is unsuccessful, the calf should be left alone for an hour and a half. Usually, in the first day, after several attempts, the calf can become accustomed to the teat and develop a food reflex to it. The first feeding should take place in a calm environment. The speed of getting used to the teat depends on the individual characteristics of the animal. Some calves get used to the teat almost immediately, others more slowly. At the first feeding, in order to improve the functioning of the gastrointestinal tract, one raw egg stirred in water should be given. The total amount of the mixture should not exceed 100 - 150 g. Such a mixture is easily digested, promotes the formation of gastrointestinal flora, and helps to transfer the calf to a new type of feeding without complications.

2.5.7 Assisted reproductive techniques

The holding institutions are encouraged to participate in semen cryopreservation and artificial insemination (AI) in an effort to reverse the long-term population decline (see Chapter 2.5.8 Population management).

It would be great to get the cryopreserved samples of germ cells from as many males as possible in order to create a solid sperm bank for Bactrian wapiti. The genetic information of various males (even those that would otherwise not have the opportunity to reproduce) will be preserved and can be used in the event of the sudden death of a breeding male and the impossibility of replacing it.

Hand in hand with sperm cryopreservation goes AI in females which is done by laparoscopic intra uterine insemination. This procedure is difficult in terms of perfect knowledge of the estrous cycles and animal training, but must be done so that stress does not cause fluctuation during ovulation and the whole AI procedure goes well.

In case of interest in those techniques please contact the EEP Coordinator.

2.5.8 Population management

The EAZA Studbook contains information on a total of 732 animals held in 34 institutions. Those animals were not held only in EAZA institutions and non-EAZA EEP participants, but also from AZA (San Diego Zoo, San Diego Safari Park, Shadow Nursery Inc., Detroit Zoological Society, The Wilds) and EARAZA (Moscow Zoological Park, Rostov on Don Zoo). Historically, some animals were also sold to private holders or private zoos.

The population was managed as European Studbook (ESB) with recommendations for many years. In March 2020, the programme was upgraded to an EAZA Ex situ Programme (EEP) following the recommendation of the Regional Collection Plan (RCP). After becoming an EEP, the studbook was cleared of living AZA animals, as cooperation with AZA was not possible and the likelihood of exchanging any animals was negligible.

According to the studbook, the first two Bactrian wapitis in Europe occured in the 1950s in Riga Zoo coming from the Tashkent Zoo (Nr. 385) and from Leningrad Zoo (Nr. 386) with unknown birth location. The animals from Riga Zoo have succesfully bred several times but did not contribute further to the population and the first two animals (Nr. 2 and Nr.3) brought around 1958 or 1959 to Tierpark Berlin became the first two actual founders of the EAZA population. Four more founders (Nrs. 40, 83, 318 and 319) were brought in 1970s. The population was founded by a total of six founders.

By tracking and creating MULT parents, the known pedigree[6] increased from the original 70,6 % to 98,1 %. Inbreeding coefficient close to the level of full siblings. Without the import of new founders, it is impossible to maintain genetic diversity at the current level. Institutions are also strongly advised to identify mothers and put this information to ZIMS for Husbandry. In case this is not possible, it is advisable to create MULTs. More about this in chapter 2.7.1 Individual identification.

[6] Information from pmx. Filters used: demographic and genetics window: January 1, 1990 to December 31, 2024; institutional filter: EAZA + MISKOLC + CUPAR + WP LEIPZIG

The EAZA population is demographically unstable, small, currently consist of 40 individuals in 10 institutions[7]. It peaked with 112 living individuals in 2006, but has been continuously decreasing since 2015.

The population is managed by yearly breeding and transfer recommendations sent by the EEP Coordinator. The Coordinator should be available throughout the year to deal with any problems holding institutions might have.

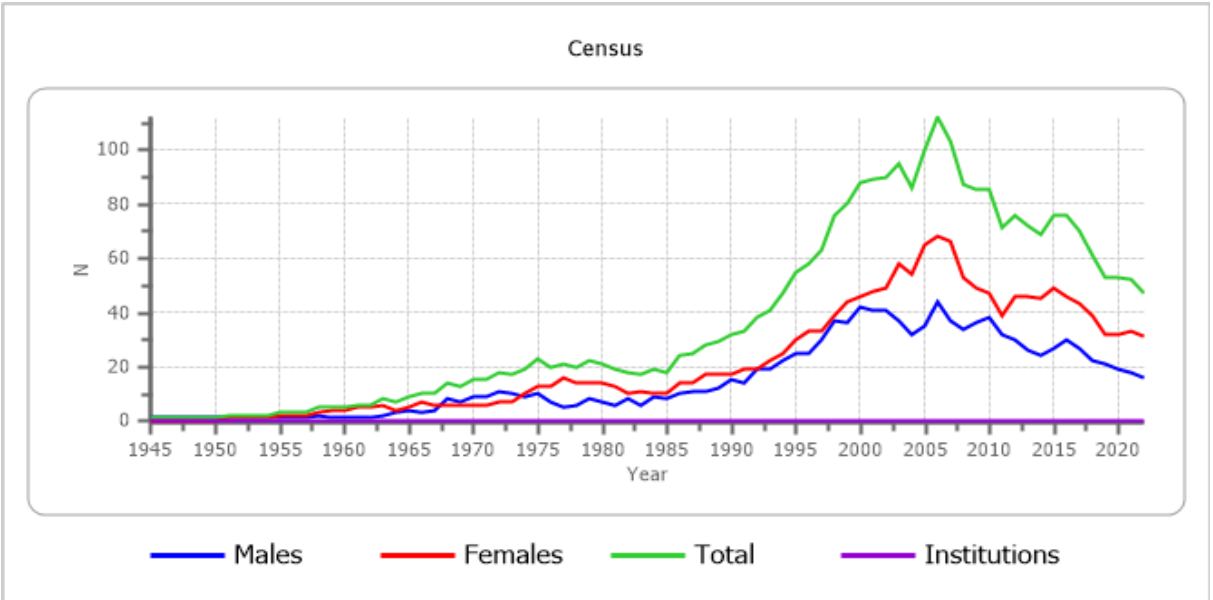


Figure 2.7. Population size throughout the years (EAZA+AZA+EARAZA).

2.6 Behavioural enrichment

Enrichment can be provided by enclosure furnishing described in chapter 2.1.3 Furnishing and maintenance. The stags should have a rubbing post for velvet sheding. Small ponds or mud will be used by stags during rut. Females need safe spaces for births. An uneven terrain with logs can provide enrichment for calves when playing.

Providing branches for browsing is also a good food enrichment.

Habituation of various routine management practices is possible. For easier maintenance in the enclosure the group should be used to its keepers.

The Bactrian wapiti, like any other deer, can become nervous and stressed very quickly. Training the animals by using positive reinforcement can reduce the level of stress while necessary handling, transport or veterinary examination but none of holding institutions reported doing training with the animals.

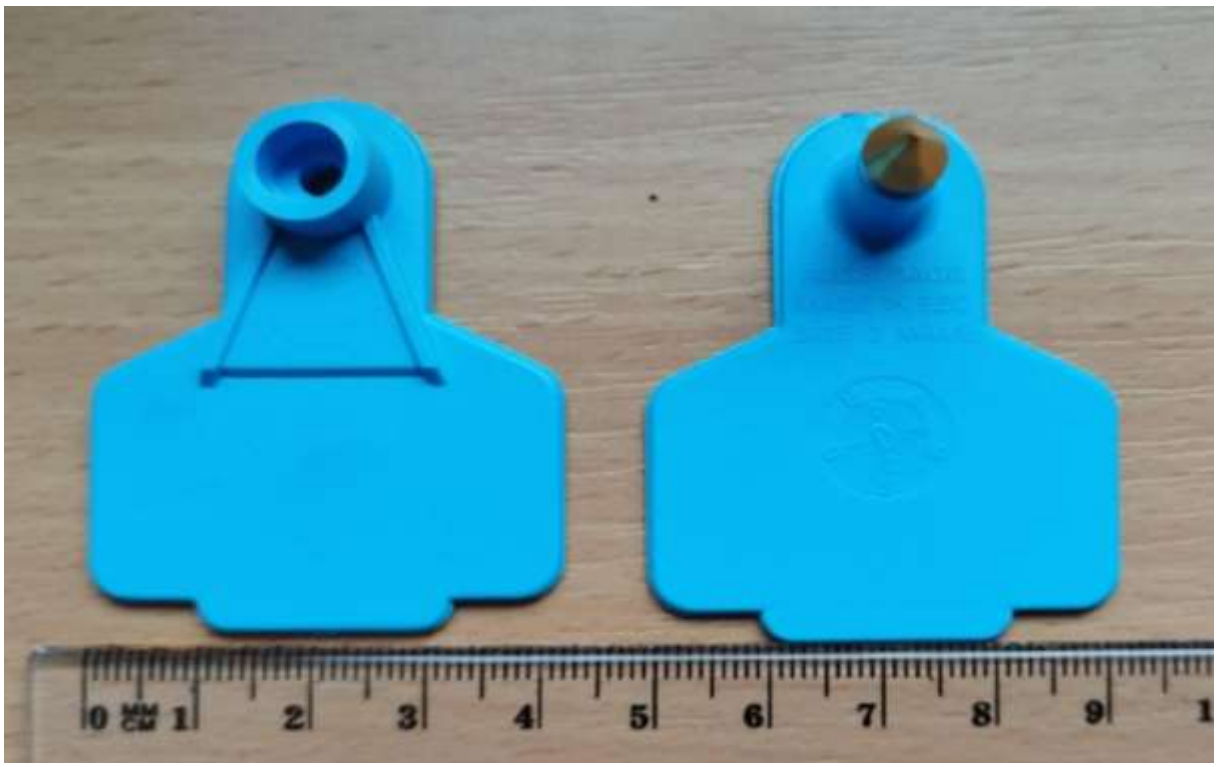
[7] As of the date December 31, 2024.

2.7 Handling

2.7.1 Individual identification

It is recommended to identify individuals with permanent markers, such as transponders. Transponders should be implanted intramuscularly on the left side of the neck.

It is strongly recommended to use additional identification in hinds in order to identify the mothers of the calves. Ear tags and ear notching can be used for that. Simple coloured ear tags work fine.



Picture 2.12. Ear tags used in Zoopark Chomutov. Photo: Aneta Konvalinková.

As CITES II species, the animals need to be identified permanently for export or import outside the EU region.

2.7.2 General handling

The Bactrian wapitis are by nature rather cautious and skittish. Some holding institutions reported they are able to clean the outside enclosure without needing to close the animals indoors. This should be assessed on the basis of the group and individual behaviour. When working, the keeper should be calm and avoid sudden movements. The animals will get used to the routine. While cleaning indoors, the animals need to be moved outside.

As written, it is recommended to not enter the outside enclosure during rut and to be very cautious while cleaning indoors.

2.7.3 Catching/Restraining

A separation stall may be used for restraining simply by waiting for the animal to come inside and closing the door. As said above in chapter 2.2 Inside enclosure, it is better to have two or more shelters or one shelter divided into two parts (boxes) for better handling or in case separation is needed.

While handling or catching, keepers have to take account of the species' escape behaviour if they are under stress.

Young calves up to 3 months old can be caught by hand. Calves of 4 or 5 months old can be also caught by hand, however it is at the discretion of the curator or responsible keeper to decide whether the reason for catching is worth the risk (Brtnický, 2023, pers. comm.). During the treatment, the use of a towel to cover the eyes is recommended.

Older calves and adult animals are dangerous and any procedures regarding veterinary examination, sampling, vaccination, etc. should be carried out under anesthesia. Darting with an immobilization drug is widely used.

2.7.4 Transportation

Transports of the animals may only take place on the recommendation of the EEP Coordinator.

As said earlier, the species is by nature skittish and gets nervous quickly. Transport may cause high stress in the individual, so only animals in good health and shape can be transported. No institution answered in the questionnaire if they remember death after or directly related to transport.

For transport, institutions are encouraged to choose a transport company which has previous experience with transports of deer species.

While planning transport of stags, it should be taken special care with regard to the antler cycle. Stags cannot be transported when their antlers are covered with velvet. The best time for transport is when the antlers are hard, nor can stags be transported during rut. Considering all this, the best time for stag transport is from October (after rut) to February/March (before they cast their antlers or slightly after that).

Hinds cannot be transported during advanced pregnancy.

It is recommended to transport animals only older than 1 year.

Regarding road transport, it is recommended to transport the animal in a trailer, although transport in crates is possible. When transporting more than one animal from one institution to another, the character of the animals should be taken into account. Some animals can be transported together in a trailer (e.g. two females which know each other or have been separated together from the group for some time), some of them should be better separated in their own crates or with an opaque partition. The size of the crate needs to be carefully chosen so the animal can comfortably stand in it. For air transport, an IATA approved crate is necessary.

Loading the animals is the hardest part of the transport and again, the individual's character needs to be taken into account. Some animals can be pushed into a trailer without much problems but most of them need to be sedated and carried into the trailer or crate. Crate training can be considered as an option to reduce stress but no institution has ever reported trying this. Tranquilizers can be used to reduce stress during transport.

2.7.5 Safety

The Bactrian wapiti is a big social deer species and adult animals, especially adult stags are considered dangerous according to the EAZA Standards for the Accommodation and Care of Animals in Zoos and Aquaria and to the DEFRA Secretary of State's Standards of Modern Zoo Practice. Therefore, special safety principles should be taken while handling this subspecies.

2.8 Veterinary care

2.8.1 Disease prevention

Body condition should be visually monitored regularly. Faeces for sampling should also be collected regularly and when a problem occurs. The recommended time scope for general parasitological and bacterial veterinary tests is 2 – 3 months.

2.8.2 Parasitic invasions

One of the biggest veterinary problems in this subspecies are reoccurring gastrointestinal parasitic infections. These invasions in many cases cause deaths, mostly in young calves or weakened individuals. It is not clear why the animals are susceptible to parasitic diseases to such a large extent. More about this topic including recommended treatment should be explored (see chapter 2.9 Recommended research).

Among the endoparasites commonly found in Bactrian wapiti are the following:

- *Giardia intestinalis*
- *Eimeria* sp.
- *Trichuris* sp.
- *Strongyloides* sp.
- *Escherichia coli*
- *Clostridia* sp.

All of those parasites inhabit intestines and cause indigestion, diarrhoea, inappetence and weight loss.

Among the most often used active substances for the treatment of parasitic diseases are ivermectin, albendazolum and fenbendazole.

Ivermectin is a broad-spectrum antiparasitic drug and is sufficient against parasites (e.g. *Paramphistomum cervi*, Nematoda including *Trichuris* sp., most of the ectoparasites) (Myšíková, 2011).

Albendazolum is a broad-spectrum anthelmintic and antiprotozoal agent of the benzimidazole type. It can be used for treatment of Cestoda, pulmonary and gastrointestinal Nematoda including *Strongyloides* sp. and *Trichuris* sp.

ALDIVERM® 100 mg/ml with the active substance albendazolum 100 mg is oral suspension mostly used in Zoopark Chomutov for treatment when *Trichuris* sp. *or Giardia* sp. occurs. The product is dosed for 5 consecutive days. (Brtnický, 2023, pers. comm.). Whipworm (*Trichuris sp*.) is an endoparasite inhabiting the gastrointestinal tract of many deer species in various environments as well as in many mammal species, including human. The disease is transmitted by oro-faecal route. The eggs are found in faeces of the infected animal and contaminate the environment. The animal becomes infected by ingesting the infested ground or grass. The larvae inhabit caecum and colon and cause diarrhoea and associated anorexia, dehydration and anemia (Jones, 2021). ALDIVERM® 100 mg/ml is, in cattle, effective against following gastrointestinal helminths: *Haemonchus contortus, Ostertagia ostertagi* (including larvae), *Trichostrongylus axei, Trichostrongylus columbriformis, Nematodirus spathiger, Cooperia punctata, Cooperia oncophora, Bunostomum phlebotomum, Oesophagostomum radiatum*. The product is also effective against: *Dictyocaulus viviparus, Moniezia spp, Fasciola hepatica* (adults).

Fenbendazole is also a broad-spectrum benzimidazole anthelmintic and can be used for the treatment of gastrointestinal and pulmonary Nematodes, Eucestoda, Strongylidae, *Giardia* sp., etc.

Significant problems with ectoparasites were not reported.

2.8.3. Infectious diseases

The Bactrian wapiti is susceptible to common major infectious diseases of other deer species managed in zoos. These include:

- Clostridia diseases
- Yersiniosis
- Brucellosis
- Tuberculosis
- Paratuberculosis (Johne's disease)

Those diseases should be tested before every transport.

2.8.4 Vaccination

To prevent bacterial infections caused by Clostridia sp., calves can be vaccinated. Product Covexin®10 is used in Zoopark Chomutov (Brtnický, 2023, pers. comm.). Covexin®10 is a multiclostridial vaccine for cattle and sheep to be used from 2 weeks of age to prevent mortality, lesions and clinical signs of disease caused by *Clostridium perfringens* type A (haemorrhagic enteritis), *C. perfringens* type B (lamb dysentery), *C. perfringens* type C (necrotic enteritis), *C. perfringens* type D (pulpy kidney*), C. chauvoei* (black quarter), *C. novyi* type B, *C. septicum* (malignant oedema), *C. tetani* (tetanus), *C. sordellii* (sudden death syndrome) and *C. haemolyticum* (C. novyi type D). The vaccinated calf has to be older than 2 weeks and is to be given two injections of 2 ml each, at an interval of 6 weeks (MSD Animal Health).

Vaccination against paratuberculosis (Johne's disease) can be also carried out. In Scottish Deer Centre Gudair® vaccine is used (Simon Louden, 2023, pers. comm.). The vaccine can be used in cervids and small ruminants (such as sheep and goats).

2.8.5 Trauma

Trauma can occur as in any other species but are not that common. The Bactrian wapiti has no specifics regarding treatment.

2.9 Recommended research

After reading this document, it can be seen that there are still gaps in the knowledge of husbandry and, especially, veterinary care of this interesting deer subspecies. The holding institutions are, in general, not indifferent to Bactrian wapiti population and can help close these gaps by providing more information and data or by carrying out research.

There are two recommended research topics that should be explored more deeply.

The first and "number one priority" is finding out more about gastrointestinal parasitosis and its link to high mortality . This is crucial for this *ex situ* programm. Information is lacking

about reasons why this is happening, how to treat the animals, if inbreeding is one of the factors, how the diet plan affects those invasions etc. Any research on this topic would be helpful. Institutions are welcomed to contribute with any help (conducting research on their own or with assistance from universities). The EEP Coordinator will of course assist to an appropriate extent.

The second research should be focused on methods of sperm cryopreservation and artificial insemination. Because the population is decreasing at a rapid pace, preserving some genetic material would be helpful for future use. Cryopreservation is already used in several deer species and its methodology is available. Further cooperation with EAZA Biobank is recommended.

Additional specific research can be conducted into the physiology and behaviour of the animals. Interesting topics can be the creation of the ethogram, the monitoring of sex and stress hormones and enrichment research.

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Appendix I

Diet plans from selected holding institutions

Zoopark Chomutov, p.o.
Přemyslova 259, 43001 Chomutov, Česká republika; www.zoopark.cz
tel.: +420 474 629 917; +420 474 624 412; e-mail: zoopark@zoopark.cz
Registrace: obchodní rejstřík vedený u Krajského soudu v Ústí nad Labem, oddíl PR, vložka 627
IČ: 00379719, DIČ: CZ00379719, bankovní spojení: KB Chomutov, č.ú.: 1843944/0100

DIET PLAN

Bactrian wapiti
(*Cervus hanglu bactrianus*)

One animal / per day

Pellets (for elks)	1,1 kg	Divide the amount into two feedings
Pellets (for deer)	0,2 kg	
Oat	0,5 kg	
Hay	Ad libitum	
Browse	Oak, willow, hazelnut, fruit trees	Once a day
Graze		
Root vegetables		
Herbs		
Mineral supplements		

DIET SHEET

BACTRIAN DEER (*Cervus hanglu bactrianus*) number of individuals: 3 (1.2.0)

DAILY DIET									
FOOD COMPONENTS	**QUANTITY**								
Hay	ad libitum								
Salt lick	ad libitum								
MORNING									
FOOD COMPONENTS	**QUANTITY /individual**	**QUANTITY /group**	**Mo**	**Tu**	**We**	**Th**	**Fr**	**Sa**	**Su**
Crushed grain	0,5 kg	1,5 kg	daily						
Pellet	0,9 kg	2,7 kg	daily						
AFTERNOON									
FOOD COMPONENTS	**QUANTITY /individual**	**QUANTITY /group**	**Mo**	**Tu**	**We**	**Th**	**Fr**	**Sa**	**Su**
Vegetables	2 kg	6 kg	daily						
Fresh grass	4 kg	12 kg	regurarly in summer (no vegetables that day)						
Alfalfa pellet	0,2 kg	0,6 kg						x	
Fresh branches			regurarly						

Notes:

- Pellet: Bábolna Bonafarm Browser.
- Crushed grain: wheat, triticale, corn, barley, oats.
- Fresh water should be available at all times.

Futtermittelmanagement Tierpark Berlin
Feeding at Tierpark Berlin, Germany

Bucharahirsch *Bactrian deer*
(*Cervus elaphus bactrianus*)

Revierbereich: Hirsche & Kamele
Department

	ganzjährig *all year*	**Bemerkung** *remarks*
Pellets *pellets*	Weibchen 1 kg Huftierpellets *Females 1 kgg ungulate pellets* Männchen 1,5 kg Huftierpellets *Males 1,5 kg ungulate pellets*	**bei Grünfuttergabe nur die Hälfte!** *with green fodder only half!*
Heu *hay*	ad libitum Wiesenheu *meadow hay*	
Gras *grass*	ad libitum	
Laub & Äste *leaves & branches*	regelmäßig *regularly*	
Lockfutter *specials*	100 g Knusperwaffel *100 g crispbread*	Lockfutter, Einsatz nach Bedarf *Use as required*
Zusätze *additives*	Salzleckstein *Salt lick*	

Futtermenge pro Tier und Tag
amount per animal and day

Futtermittelmanagement/nutritionist für Zoo- und Tierpark Berlin, Dr. Matschei 24. September 2021
E-Mail: c.matschei@zoo-berlin.de
phone: +49-30-25401-226 oder +49-30-51531-109

Stand: September 2023

11 Bucharahirsche

- Gemeinschaftsfütterung
- Gruppe:
- Kraftfutter:
  - 1 Schaufel Melasseschnitzel (wird eingeweicht)
  - 1,5 Schaufeln Quetschhafer + 1,5 Schaufeln Grazer
  - Menge wird aufgeteilt auf 2 Fütterungen
- *Winter:* Heu ad libitum
  Sommer: 1 Karre Gras -> nicht täglich, abhängig wie das Gras schmeckt
- 150 g Futterkalk
- 2x täglich ~100 g Bierhefe
- 100ml Leinöl/d

Feeding diet of the Bukhara deer at the Tashkent Zoo

Name of food	Quantity kg / 1 head per day	Note
Oats	0.4	
Bran	0.2	
Corn	0.2	
Barley	0.4	
Compound feed	0.3	winter
Potato	1.0	
Carrot	1.0	
Hay	2.0	winter
Brooms (pcs.)	5	winter
Branches	3.0	summer
Grass	6.0	summer
Salt (lick)	to your heart's content	
Vitamin and mineral premix	0.04	
TOTAL feed:	**8.34**	Winter
	11.64	Summer

Average energy value of the diet, kcal – 7877.00

Average nutrient content in the diet (%)

Crude protein	Crude fat	Crude fiber	Raw ash	Calcium, mg	Phosphorus, mg	Sodium, mg
13.61	2.96	7.30	3.46	202.93	102.52	32.46

Note :

1. Young animals at the age of 6 months. 50% of the diet of an adult animal is introduced.

2. Young animals at the age of 12 months. The diet of an adult animal is introduced.