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Semi-Wild Population of Kulans in the Bukhara Breeding Centre and Their Co-Habitation with Przewalski's Horses

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Semi-wild population of kulans in the Bukhara Breeding Centre and their co-habitation with Przewalski's horses[1]

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Abstract

Asiatic wild asses and Przewalski horses initially inhabited steppe, semi-desert and desert areas, but Przewalski horses became extinct in the wild, and kulans are under threat of disappearance. The Bukhara Breeding centre (Uzbekistan) was created in 1976 for conservation and reintroduction of wild ungulate species. In 1977-1978, 5 kulans (2 males and 3 females) from Barsa-Kelmes Island on the Aral lake were introduced to the reserve. The group increased to 25-30 animals in 1995-1998, when 5 Przewalski horses from Moscow and St. Petersburg zoos were introduced to the same territory. We analyzed the home ranges, preferred habitats and social interactions of these closely related species during 1995-1999 by season and group composition. Horses and kulans each formed a reproductive group and a secondary bachelor group. The home range of the secondary group in both species was larger then that of the reproductive group and seemed to be less dependent on watering places. Kulans and Przewalski horses demonstrated different strategies of habitat use. They can share one area without serious conflicts, avoiding competition by the temporal differentiation in the usage of key sites.

Key words: kulans, Przewalski horses, behaviour, home range.

Introduction

Asiatic wild asses (*Equus hemionus* spp.) and Przewalski horses (*Equus przewalski*) once inhabited steppe, semi-desert and deserts of temperate Eurasia. Unlike kulans, horses preferred more mosaic ecosystems, displayed less local migratory activity and smaller home ranges, and were bound to a greater extent to watering places (GRUM-GRIZIMAILO 1892, 1896, GEPTNER et al. 1961). Both species were mainly confined to deserts, since humans disturbed their semi-arid habitats during the 18-19th centuries (ZHIRNOV & LUSCHEKINA 1991, SOKOLOV & ORLOV 1980).

Asiatic wild asses had disappeared from the European part of the USSR, and by the beginning of the 20th century only 40 animals survived in southern Turkmenistan. Since then special conservation and restoration measures have facilitated growth of the populations to 5000–6000 *E. hemionus* Pallas in total in an area of 100,000 km², and about 3000 kulans (in 1998), mainly in Badkhis Nature Reserve (Turkmenistan) (ATUMURADOV, KUZTNETSOV, pers. comm.).

Przewalski horses and Asian wild asses display two basic social systems (BASKIN 1976): type I consists of small non-territorial harem-like groups and bachelor groups and type II consists of territorial males associated with varying group of females (KLINGEL 1967, 1968, 1969, 1975; RUBENSTEIN 1986, BERGER 1988). Until now we do not know the real social structure of

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Przewalski horses. Unique data from Mongolian experiments (BOUMAN 1998) demonstrates a differentiation of home ranges between three harem groups, which may indicate true territoriality. For the kulans we can find all variants of habitat use in populations with different densities, from strict territoriality to large nomadic aggregations of animals of different sex and age (GEPTNER et al. 1961, RASHEK 1966, BANNIKOV 1963, SOLOMATIN 1973). Anyway, different factors, namely semi-captivity, high predator-pressure and food availability, can induce more permanent associations (type I) among Asian wild asses, with one or two males (RUBENSTEIN 1986, GINSBERG 1988, 1989; FEH et al. 1994).

Some kulans originating from a population of the Barsa-Kelmes Island on Aral lake were introduced in 1977 (three animals) and 1978 (two animals) to the Bukhara Breeding Centre, but the fenced territory there is too small for a free development of the group, and artificial management has been carried out since 1991-1992, resulting in pronounced growth of the population. Przewalski horses were brought to the Centre from the Moscow and St. Petersburg zoos in 1989 and 1990. Inititally, animals were kept in small pens. The group was composed of one adult male and four adult females and was set free to the main fenced area in summer 1991 (PERELADOVA et al. 1999).

In the territory of the Bukhara Breeding Centre, asses and horses depend on a southern watering place, especially during summer, and on grazing places concentrated in the middle and south of the Bukhara Breeding Centre. We hypothesized that these conditions would induce a permanent or temporary (summer) type I organization in the population of kulans. Since they are less adapted to desert conditions than kulans, Przewalski horses from zoos are supposed to be much more dependent on watering places, which should constrain their home-range to the southern part of the reserve and limit their expansion to the other areas. Moreover, because of the existence of a bachelor group and development of a possible second stallion group, competition for access to the watering place with the initial stallion group will increase.

As these two species are close relatives, and their possible areas of conservation and restoration overlap to a great extent, it is important to analyze their co-existence and interactions within the same limited area. To our knowledge, no information is available on interactions of these two species in the wild. The purpose of our work was to study the space utilization and the behavioural and ecological interaction of the groups of kulans and Przewalski horses in the Bukhara Breeding Centre, and to offer a plan for expanded introduction for the species in similar habitats.

Materials and methods

Study area and climate

The Bukhara Breeding Centre was created in 1976 for reintroduction and conservation purposes. It is situated in the South of the Kyzyl-kum Desert, Uzbekistan, 40 ºN; 65º E. The reserve has a fenced area of 5126 ha. The reserve stretches over 15 km from south-east to north-west and is 3 km wide.

The main zones of vegetation in the Bukhara Breeding Centre are composed of Graminae (*Phragmites communis, Aeluropus litoralis, Poa bulbosa,* etc.), Chenopodiaceae (*Salsola* spp, *Astragalus* spp, *Halloxylon aphyllum,* etc.) and, mainly in the south, tamarisks (*Tamarix* spp.) which constitute a large part of the autumn, winter and spring diet of horses (for further details see Pereladova *et al*., 1998, 1999). The climate is typically hyper-continental. Rains occur from November to May, with a maximum in March (30 mm) and an annual average rainfall of 143 ± 49 mm. Temperatures vary from 2 - 4 ± 1.5 ºC in winter (December - February) to 28 ± 0.7 ºC in summer (June - August). The annual average temperature is 15.1 ± 10 ºC with the minimum usually occurring in January (-15 ºC) and the maximum occurring in July (44 ºC). Spring (March - May) is warm, 25.1 ± 3 ºC, and autumn is cold, 6.5 ± 1.2 ºC (PERELADOVA et al. 1998).

Study animals and methods

The size of the populations of all ungulate species was known from censuses conducted annually since 1978 (PERELADOVA et al., 1998). Special observations on the development of horse groups had been carried out in 1995–99. The population of kulans grew slowly from 1978 to 1982 (seven animals), then rapidly until 1991(37 animals; fig. 1).

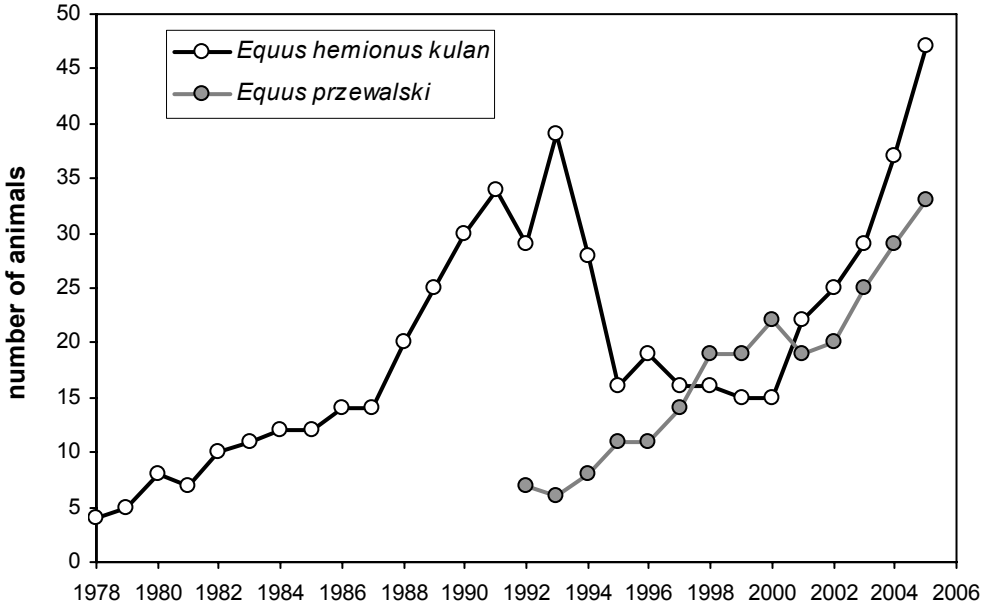

Fig. 1: Development of the population of kulans and Przewalski horses in the Bukhara Breeding centre.

The peak kulan population was observed in 1993 (39 animals) then the population was artificially regulated and has remained stable at 16-18 animals from 1995 until 2000. Then artificial regulation has been stopped, and number of animals began to increase again. The kulan population comprised a main group of females without newborns, together with sub-adult and adult males; a bachelor group of four males; and a group of females with newborns and young from the previous year. The number of Przewalski horses increased regularly from 1991 onwards, reaching a population of 33 animals in 2005 (fig. 1). The adaptation phases and the variations in size and composition of the groups were analyzed and described in a previous study (PERELADOVA et al. 1999); all the horses are identified (ear tags, skin marks or individual characteristics of the coats) with sex and ages being known. Until 1995, all the animals were in one group. Since 1996, there have been two groups: the group of the dominant stallion with mares and newborns; and a group of 2–3 bachelor males. In 1997, the dominant male of the main group died and was replaced by a bachelor male. In the next years the number of harem groups has reached 5, the bachelor group is permanently present but it has different members each year.

Observations

Different observers carried out observations of the movements, home range uses and interactions between kulans and horses at different times between 1987 and 1993 (PERELADOVA et al. 1999). Between May and July 1994 and May and July 1995, horses and kulans were recorded twice daily (morning and evening). Observations (using binoculars) were made from the three towers 20 m in height located in the south, middle and north of the territory. Other additional observations were made from vehicles, using the roads of the reserve, and on foot when brushes obscured sight into certain areas.

Between November 1995 and May 1998, the positions of horses and asses were recorded at least twice a week. Our records of the locations and structures of the groups were combined with those of other studies on the behaviour and social structure of the two equids, especially of the Przewalski horses, made by following the groups at a distance (from a few to some dozens meters). The positions of horses and kulans in the Bukhara Breeding Centre were determined using 500-m-side-quadrates. A total of 374 positions for kulans (277 for the main group and 107 for the bachelor group) and 335 positions for Przewalski horses (219 for the stallion group and 86 for the bachelor group) were recorded during the study. Home ranges were established according to these positions. For home-range analysis, we divided observations into different periods as follows:

(1) 01.01. - 01.03.1996, period winter 1;
(2) 01.03. - 04.06.1996, period spring 1;
(3) 04.06. - 07.09.1996, period summer 1;
(4) 07.09.1996 - 10.03.1997, period winter 2;
(5) 10.03. - 04.06.1997, period spring 2;
(6) 04.06. - 07.09.1997, period summer 2;
(7) 07.09.1997 – 10.05.1998, period winter 3.

Statistical analysis

We used the MC Paal (Micro Computer Programs for Analysis of Animal Locations) version 1/22, (STUKEW & BLOHOWIAK 1985) to analyse animal locations. Home-range areas were calculated by the Minimum Convex Polygon method (JOURICH & TURNER 1969). Harmonic mean transformations were used for area-occupation by including 100, 95, 90, 85 and 80 % of locations in the analysis.

We used Statview 4/5 software (1992–1996 Abacus concepts) for all statistical tests. We tested independence among number of locations and home-range size with Spearman's Rho coefficient of correlation. We used paired Wilcoxon rank tests for the comparison of home-ranges between groups for each period, and Kruskall–Wallis ANOVA for variation in the home range of a group over time. Home-range overlaps between two groups were calculated with the minimum Convex Polygon maps (JOURICH & TURNER 1969) as [(area shared/area of group 1) + (area shared/area of group 2)]/2.

Results

Kulan home ranges

The home ranges of the secondary group of kulans were large but not different from those of the main group during the four periods tested except in spring 1996 (main group: 18 km^2 vs. 9.75 km^2 for secondary group), however, this difference was not significant (U = - 0.7303, n = 6, p = 0.233) (fig. 2). The seasonal home-range sizes for the main group were similar from spring 1996 to summer 1997 (14.6 ± 2.2 km^2, n = 6; H = 1.179, df. = 2, p = 0.555) although a small decrease was observed during the last winter (3.5 km^2). For the secondary group, the home-range size was the same during the three seasons (20.8 ± 3.8 km^2, n = 4; H = 1.8, df. = 2, p = 0.4) although it was smaller during the first spring in 1996 (9.8 km^2), and increased again next spring/summer period. Overlap between the main and the secondary groups (table 1) was calculated for spring 1996 (65.7 %) and 1997 (68.75 %), summer 1996 (76.55 %) and winter 1996/1997 (68.37 %). Overlap was highly invariable (69.84 % ± 2.337) between seasons (F = 66.542, p = 0.267). Finally, there was no significant correlation between the seasonal home-range sizes of the two groups (r = + 0.3024, n = 4, p = 0.698). The activity centre of the main group of kulans was very large, which points to a higher diversity of home range use compared to the Przewalski horses. Nevertheless, activity was concentrated in the south of the reserve. For the secondary group there were frequently two or more activity centres, one in the south and the other one in the north of the small hill.

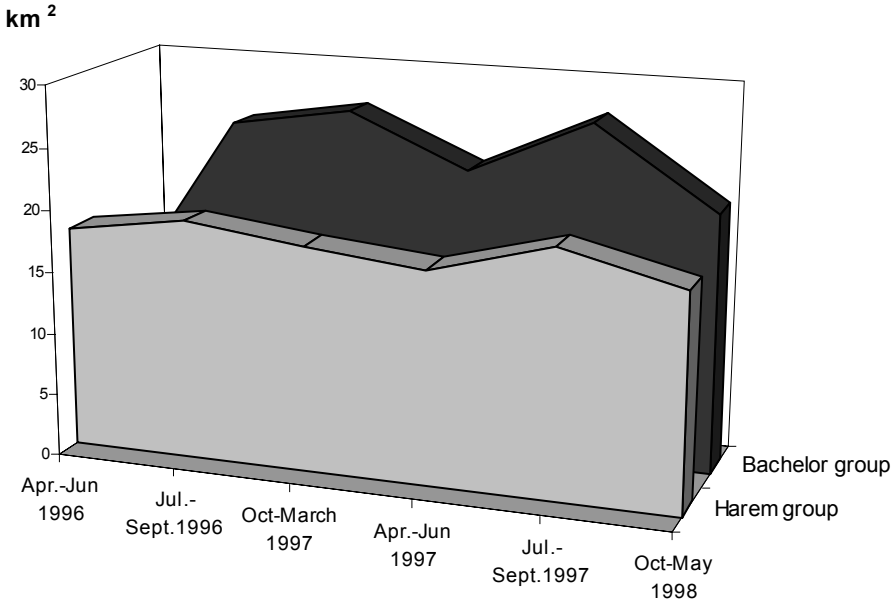

Fig. 2: Home ranges of the main group vs. secondary group of kulans.

Table 1: Home range overlap between the main and the secondary groups of kulans

Period	Overlapping of the main and secondary group of kulans
spring 1996	65.70 %
summer 1996	76.55 %
winter 1996/1997	68.37 %
spring 1997	68.75 %

Coupled analysis (kulans vs. Przewalski horses)

Home range size of the main group of kulans was higher than that of the Przewalski stallion group during all the six periods tested in the course of this study (U = 1.887, n = 6, *p* = 0.0296). The overlap between the two groups (table 2) varied seasonally (F = 18.507, df. = 2, 3; p = 0.0205), with a minimum in winter (6.78 % ± 5.48), intermediate values in summer (19.73 % ± 8.82) and a maximum in spring (60.28 % ± 4.29). There was no significant correlation between the seasonal home-range size of the two groups (r = 0.4363, n = 6, p = 0.387).

Table 2: Home range overlap between Przewalski harem group and kulan main group

Period	Overlap of the Przewalski harem group and kulan main group
Spring 1996	64.60 %
Summer 1996	10.91 %
Winter 1996/1997	1.29 %
Spring 1997	55.99 %
Summer 1997	28.55 %
Winter 1997-1998	12.26 %

Discussion

The development of Przewalski horse groups followed a similar pattern as the kulans, and when the newborn males survived 1 year, they formed a new bachelor group (PERELADOVA et al. 1999). For both Przewalski horses and kulans, males were excluded from the main groups at 1 or 2 years of age, either by the dominant males during the reproductive period or by their mothers during or just after the next foaling. Consequently, they were pushed outside the home range of the main groups of their species, further to the north-west. For both species, the secondary groups were still using the southern part of the reserve mainly for water and partly for green fodder, when coming for drinking. Consequently, the animals of the secondary groups were forced to increase their home range in order to avoid the main groups while retaining access to watering places. This was confirmed by the poly-modal centers of activity for the secondary groups of both species, one in the south and the other in the north-west. In any case, according to previous fragmentary data (GRUM-GRZIMAILO 1892, 1896), the typical structure of home ranges for wild Przewalski horses consisted of some preferable pastures connected with watering places where horses could be seen mainly at dawn, traditional routes, and areas where they spent most of daytime, combining pasturing, comforting behaviour and rest. Sites for the latter activity were preferred over daytime and were typically situated 5 - 7 km from the main watering places in open steppe, semi-desert or even desert areas, while watering places with preferable vegetation were typically situated in some hilly areas, on the lower slopes of mountains, etc. In our study, the very same type of home-range structure was also registered for the bachelor group of Przewalski horses, composed of animals born in the Centre, which never had any contact with people, or had never been given any additional food. By contrast, during the dry 1996 autumn–winter period, the main group of former zoo animals still came to the south and arrived near the buildings of the Centre where spots of lucerne still grew in some fields, or just chose areas with otherwise preferable vegetation, which were situated mainly around the lakes. Therefore, their registered home-range size was small over this period. Even for the main group, we could see some tendency towards a bi-centred composition of the home range (spring/summer 1997): animals were registered mainly not far from the lake in morning and evening times, while in the daytime they were 3 - 4 km away from the lakes and out of bushes in an open area. This was the period when the former zoo animals had already got adapted to semi-wild life in desert conditions (PERELADOVA et al. 1999). Besides, spring/summer 1997 was the period when territorial displays of the dominant male became regular when in contact with the 3-year-old bachelors. The overlap between home ranges of the stallion and the bachelors was small, because the stallion group of zoo animals had a small home range, which was frequently used in all its parts and thus more easily defended against intrusions by bachelors. Anyway, it was smaller in winter because the home range of the stallion group was reduced to the extreme south, where horses could find additional food, and also because the bachelor group can do longer without water (period of autumn vegetation with grasses and brushes), and they consequently stayed more in the middle and north of the reserve. The sizes of home ranges were larger in spring and summer, as well as the overlap, because of the regular need for water, changes in dynamics of activity, and condition of summer vegetation. Moreover, spring corresponded to the breeding period, and the attractive effect of females on bachelors (pheromones) was not completely excluded.

Kulans are typically more migratory-active and better adapted to desert conditions (GEPTNER 1961). That is why they can regularly do without water, or use water with very high salinity (RASHEK 1966). Moreover, the animals that were brought to the Centre were initially wild. So, it was not surprising that the home ranges of kulans were always larger than those of Przewalski horses, and that kulans only occasionally approached areas in the south where people are present, having their main centers of activity in the middle part of the whole area. The secondary group of kulans had simply moved its home range slightly to the north-west without any apparent need to increase its size significantly compared to the main group. As the home ranges of both the main and secondary groups of kulans were large throughout the year, there were no important seasonal variations, which confirm the fact that they were not as dependent on water

and fresh grass as Przewalski horses. The level of overlap between the groups' home ranges was different for each species and between main and secondary groups of either species. There was territoriality between groups of kulans in nature, but it was not strict in all different seasons (BANNIKOV 1963, BASKIN 1976, RASHEK 1966). In any case, the home ranges of the main reproductive groups were more constant and stable. Subdominant animals composed the bachelor groups (and other types of secondary groups). They were pushed out of the main groups for different reasons. They had to stay in less favourable biotopes and are more mobile. All groups needed to have access to watering places, and this need was more vital for the main group, which includes newborns and lactating mares in summer. Such a dependency on water and feeding places was at the heart of conflicts with farmers in Turkmenistan when the kulans from the Badkhis reserve left the reserve in spring and summer and spread to the surrounding agricultural lands. Consequently, numerous kulans were killed, and by 2000, their number had dramatically decreased. During the breeding season (late spring) the dominant male was more aggressive towards bachelors because the females were in oestrus, the home range of the secondary group of kulans was therefore at its maximum, with a high level of overlap but nonetheless with free possibilities to avoid each other using the same areas at different times. As it was already discussed, the home ranges of both Przewalski horse groups were strongly overlapping in the area around the watering places, especially in summer. But a strict temporal differentiation was registered in the usage of watering places, so that bachelors were rather rarely registered at a distance small enough to allow visual contact with the main group until October 1997. The home range of the main group increased from the period of releasing the group free on the main area (summer 1991) till April - June 1996. In summer 1996, three mares had newborn foals so they were more confined to watering places and better food resources. Size of the home range decreased; later on it increased again until September 1997.

Male horses reach their statute of dominance when they are 5 years old and can replace older dominant males in horses groups (BASKIN 1976, BOYD & HOUPT 1994, DUNCAN 1992). The new dominant male which was 4 years old (present results) had to defend his new position as a stallion. The home range became very limited (including only the main preferable biotopes) in order to be more easily controlled. Simultaneously territorial demonstrations of the new dominant male were registered.

There was a question about the overlap between kulan and Przewalski horse home ranges. When the horses were set free on the main area, they had a very small home range, which stretched to the very limits of the southern part of the home range of the main group of kulans, but the animals divided the area using it at different time periods, and were never registered at less than distant 2500 m from each other (PERELADOVA et al. 1999). Further, the home range of horses increased and kulans practically stopped using the south-eastern part of the Centre. They continued to use overlapping parts of their home ranges in turn (time-differentiation of area usage) and it was probable that horses disturbed kulans. Therefore, for kulans the southern part of their home range served mainly for providing access to drinking water. In spring, Kulans and horses shared 60 % of their home range, which means that they were probably competing for fresh grass during this period, while the overlap decreases in summer and is even smaller in winter (6.8 %) because of the retreat of horses to the extreme south-eastern part of the reserve and the kulans' decrease in need for water resources during this period. Moreover, the females of kulans are pregnant in spring and needs for food are higher because they require more energy input.

Consequently, the two species do not compete in natural conditions, but for a successful reintroduction project, a large area of fresh grass in spring and free access to water resources for horses is necessary. From October 1997 to March 1998 the home ranges of the main groups of both species were smallest among all of those analyzed over time because of a comparatively dry winter and the necessity to have access to water resources. Still, overlap was very small (4 %), because not only temporal differentiation of area usage was registered, but also true territorial behaviour of the new Przewalski horses dominant stallion.

In conclusion, it has been shown that kulans and Przewalski horses demonstrated differences in area usage strategy even while the groups showed a similar development within the limits of the same fenced area. They can inhabit one area without serious conflicts, avoiding competition by the way of using temporal differentiation of the usage of key points, such as limited water resources. A possible reintroduction method could well consist of releasing a mixed group of horses and asses in suitable habitats, within their historical area and without agricultural lands and domestic horses in the surroundings. Still, for reintroduction programs of the Przewalski horses in semi desert-environments, it is important to take into consideration that Przewalski horses must be well adapted to these environments as was the case in our study area (Bukhara Breeding Centre). Kulans are more adapted to desert conditions than horses and could seriously compete with them should water and food resources be limited, at least if the kulan population is well developed in size and social structure, and if groups of not initially-adapted horses are set free within the same area.

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