

Monitoring of agonistic behaviours in free-ranging Przewalski's horses

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1. Introduction

The Przewalski's horse (*Equus ferus przewalskii*) population in and around Takhin Tal continues to grow. By the end of December 2007 114 Przewalski's horses inhabited the park. 28 foals were born from end of March until end of August, of which 15 (54%) were still alive by the end of the year 2007. Eight foals disappeared within the first two weeks following their birth, one after a month. The reason of their death cannot be detected as no carcasses were found. Two dead foals were found, one most likely killed by a wolf, whereas for the other the cause of death remained unclear. Another two foals died in autumn, one due to a broken leg, the other one killed by a wolf according to the rangers.

In 2006 only 12 foals out of 33 (36 %) survived until winter, despite good pasture conditions. Our Mongolian colleagues believed that the reason for the high losses was predation by wolves (Enkhsaikhan, 2001). However, the wolf population is heavily persecuted and wolf densities are believed to be low (Kaczensky et al., accepted 2008; Kaczensky & Walzer, 2001-2005). Furthermore, carcasses are rarely retrieved and without a detailed necropsy the cause of death (Robert et al., 2005) or the distinction between predation and scavenging is impossible to assess.

In summer 2006 group stability of Przewalski's horse harems had decreased due to the loss of several lead stallions. This resulted in new group formations and frequent shifts of animals among groups. The killing of foals by conspecifics, especially stallions is well documented for Przewalski's horses and other equids under captive conditions (Ryder and Massena, 1988). Recent evidence suggests this may not entirely be an artefact of captive conditions. Single observations of stallions killing foals of both sexes were independently made in the semi-reserve Pentezug in Hungary (W. Zimmermann, pers. comm.), in Hustain Nuruu (Bandi, pers. comm.) and Takhin Tal (O. Ganbaatar, pers. comm.). Whether foals are killed on purpose or as a side effect of aggression within the group is unclear. Based on the observations of stallions killing foals we hypothesized that social unrest rather than wolf predation may have caused the high foal losses. In

February 2007 two lead stallions, Pas and Tuulai, died which again resulted in the formation of new groups.

To test the hypothesis whether social unrest is coupled with an increased level of agonistic behaviour which in turn results in higher foal mortality we monitored aggressive behaviour, group stability and foal survival in 8 harem groups from mid July to end of September 2007.

2. Material and Methods

All investigations on takhi groups were carried out in the Small Gobi B Strictly Protected Area, mainly around Takhin Tal. The behavioural observations concentrated on harems with foals and were carried out between 14th of July and 23rd of September 2007.

Four temporal separated observations were recorded for the five harem groups Jiguur, Mondol, Myangan, Selenge and Zandan (named after the lead stallions). One observation period included a day from dawn to dusk and was between 16 and 13.5 hours in duration, depending on day-length. Normally one herd was observed on two consecutive days, starting at midday of the first day and finishing at midday the next day. Thus within two weeks each group was observed once and the cycle was repeated ideally starting again with the first group of the previous cycle. For the following groups some adaptations had to be made:

- (1) The Khuchit harem group was observed twice. Later his group was taken over by the stallion Nomkhon and an additional two observations were made of the group with the new lead stallion.
- (2) The mare Bulga and her foal separated from their previous harem group and were observed for one day in an additional monitoring effort.

(3) The foal in Moogii's group was born in late August and observed for the first time on the 3rd of September. Therefore only two observational cycles of Moogii's harem could be completed within our study period.

(4) No observations could be made of Hubsugul's harem because they stayed at Takhin Us, a half a day drive from the Takhi Camp. Including them into the monitoring would have been too time-consuming.

All observations were carried out continuously by one or two persons, interruptions were noted and excluded from observation time. Upon distance and sight, binoculars or telescopes were used. According to the situation the observer was situated in a Jeep, on the open land or on a view point. The data sheet contained behavioural category, start and end of observation, behaviour, initiator and target of aggression, comments, other disturbances, location, distance, direction and observer.

Behavioural categories (Tab. 1) were separated into A for aggressive behaviour (attacking, biting, chasing, fighting, kicking, play fighting, threatening; Fig. 10 and 11), D for disturbance (alert, fleeing, etc.), F for foal drinking (F1, F2 ...F17), I for interruption (approaching by car), N for normal behaviour (drinking, grazing, moving, resting), O for other interesting behaviour (mating, yearling drinking, etc.) and P for positive interactions (grooming, playing, Fig. 13 and 14).

The condition of each individual horse was determined using the chart and grading table of Rudman and Keiper (1991): 0 (very skinny), 1 (thin), 2 (fair), 3 (good), 4 (fat) to 5 (very fat). Depending on observation distance, the condition could not be estimated in all observation cycles for each group.

Locations are given as GPS coordinates plus distance and direction (degrees deviation from north) to the group.

Dead foals were investigated according to a necropsy protocol (Robert et al. 2005).

All data visualization and analysis was carried out in Excel. Photos were made with a digital camera by Tania Hoesli.

Tab. 1: Categories and behavioural features within these categories.

category	behaviour
A aggressive interaction	attacking biting chasing fighting kicking playfighting threatening
D disturbance by external source	alert fleeing moving running scared
Fx foal x drinking F? unknown foal drinking	drinking (F1, F2 F17) drinking
I interruption of observation	approaching by car moving by car to a better spot
N main behavior of whole group (>50% of adult animals)	drinking grazing moving resting
O other interesting behavior	drinking attempt mating attempt observation condition other group smelling, tasting wallowing yearling drinking hardly visible not visible partly visible
P positive interaction	grooming playing

3. Results

3.1. Comments about the observed harem groups

Four observation cycles could be completed for the harem groups Jiguur (51.6 hours), Mondol (54.8 h), Myangan (54.7 h), Selenge (52.2 h) and Zandan (36.4 h). The harem groups Khuchit (26.8 h), Moogii (22.7 h) and Nomkhon (18.4 h) were observed twice, the mare Bulga and her foal once (12.1 h), (Fig. 1).

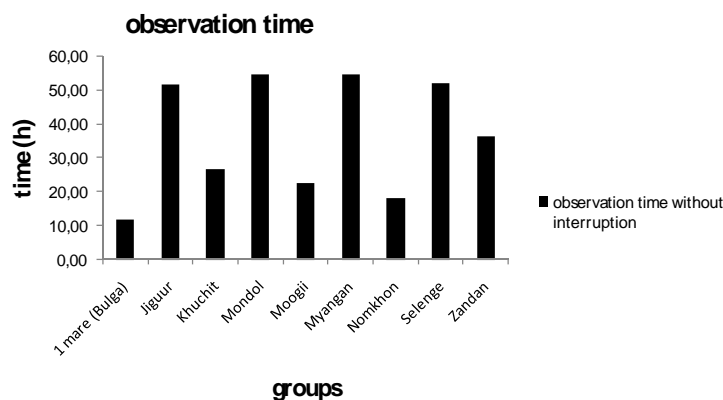


Fig.1: Observation time without interruptions presented for all groups.

The comments for each group include: number of adults and foals, body condition, death and sire of foals, home range and observation condition, interactions with other groups and unusual occurrences in the group. Table 2 and 5 give an overview on group size, individuals, sire of foals plus foals born and lost in all harem groups in the Great Gobi B SPA. Body condition scores from mid July to mid September are shown in Table 3. In general, all horses increased in body condition from July to September.

Tab. 2: Group sizes and foals born and lost in all harem groups of the Great Gobi B Przewalski's horse population.

group	adults	born foals	dead foals
Jiguur	8	4	0
Selenge	3	1	1
Zandan	12	6	2
Mondol	15	4	1
Khuchit/Nomkhon	4/5	1	1
Myangan	6	4	3
1 mare (Bulga)	1	1	1
Moogii	7	2	1
Hubsgul*	13	4	2
Tayan*	7	1	1
total	77	28	13

* not observed groups

Tab. 3: Condition factors of adult and yearling females plus males in all groups from mid July to mid September.

	Jiguur	Selenge	Zandan	Mondol	Khuchit	Myangan	1 mare (Bulga)	Moogii	Nomkhon
Mid July									
ad female+foal	2,00	2,00	2,00	2,00	2,00	2,00	-	g.f.	g.f.
ad female	2,00	2,00	2,00	2,00	2,00	2,00	2,00	g.f.	g.f.
ad male	2,00	2,00	2,33	2,50	2,00	2,00	-	g.f.	g.f.
yearling female	2,00	-	-	1,67	-	-	-	g.f.	g.f.
yearling male	-	-	1,00	1,50	-	-	-	g.f.	g.f.
Begin of August									
ad female+foal	2,50	2,00	m.	2,33	2,00	2,50	g.f.	g.f.	g.f.
ad female	2,00	2,00	m.	2,40	2,00	2,33	g.f.	g.f.	g.f.
ad male	2,50	2,00	m.	2,50	3,00	3,00	g.f.	g.f.	g.f.
yearling female	2,00	-	m.	2,00	-	-	g.f.	g.f.	g.f.
yearling male	-	-	m.	2,00	-	-	g.f.	g.f.	g.f.
End of August									
ad female+foal	m.	m.	2,50	2,67	g.f.	m.	g.f.	m.	2,00
ad female	m.	m.	2,75	2,67	g.f.	m.	g.f.	m.	2,33
ad male	m.	m.	2,33	2,50	g.f.	m.	g.f.	m.	2,00
yearling female	m.	-	-	2,00	g.f.	-	g.f.	-	-
yearling male	-	-	2,00	2,00	g.f.	-	g.f.	-	-
Mid September									
ad female+foal	2,50	2,00	2,75	2,33	g.f.	3,00	g.f.	3,00	3,00
ad female	2,00	2,00	2,75	2,60	g.f.	2,75	g.f.	2,67	2,50
ad male	3,00	3,00	2,33	2,50	g.f.	2,00	g.f.	2,50	3,00
yearling female	2,00	-	-	2,00	g.f.	-	g.f.	-	-
yearling male	-	-	2,00	2,00	g.f.	-	g.f.	-	-

m. = missing

g.f. = no observation due to group formation

3.1.1. Jiguur

The Jiguur harem group consisted of eight adults and four foals. The foals, all of them the offspring of Jiguur, seemed to be in a very good condition. They grew well, groomed each other, played a lot and often stayed quite far away from their mothers. No losses of foals were recorded during the monitoring time.

Jiguur and his harem lived in a much protected area between the fences around the Takhin Tal Camp. Their home range stretched between the barns east and west of the camp, the river Bij and Five Hills. The individuals of this group were often spread out rather far from each other and thus were grazing over a large area.

Although Jiguur group had little interactions with other groups, Jiguur sometimes had to defend his group against bachelors. In September cows grazed within the range of the Jiguur group.

3.1.2. Selenge

Selenge harem group (Fig. 2) comprised only three adults and one foal. The mare Sonja and her foal (F5) originated from Jiguur`s harem, who was also the sire of the foal. F5 stayed close to its mother during the first observations, later it groomed and lingered around with all adults. Although Sonja`s foal survived throughout the observation period it disappeared in November and the mare Sonja moved back to Jiguur group.

In July and August the group had a very specific home range in Five Hills, mostly around the Bij river flood plain. End of August and September when cowherds grazed close to the river they moved to the mountains northwest of Five Hills during most of the day, spending only some time close to the water. In the beginning the group was very shy, but still curious to our observations.

Selenge carried out some attacks against bachelors.

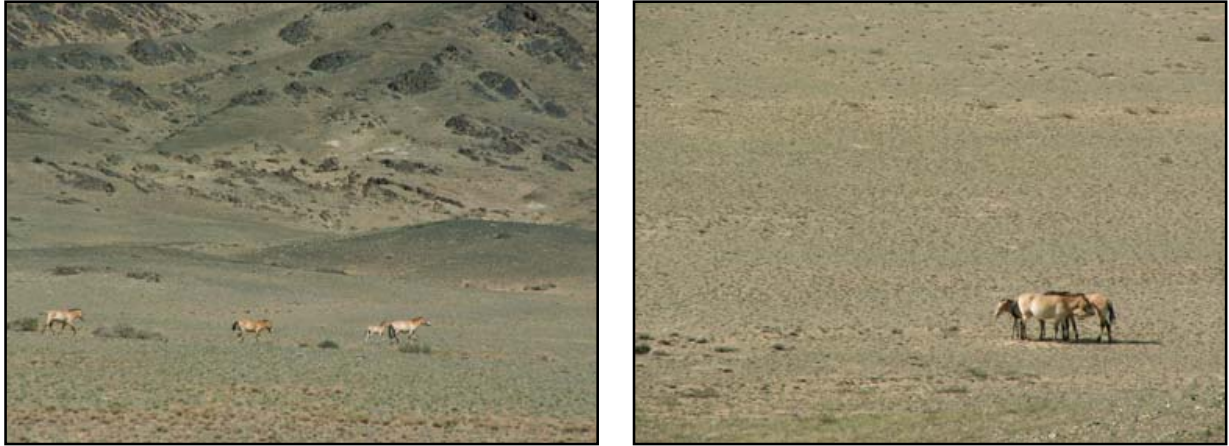


Fig. 2: Sonja and the foal, Yyl and Selenge running back towards the mountains after drinking at Bij River (left) and resting close to the mountains (right).

3.1.3. Mondol

Mondol group (Fig. 3) counted 15 adults and three foals. Mondol was the father of all the foals in his harem. Dorothee's foal had already disappeared before the onset of our observation. In July all the foals looked to be in a good condition, playing with and grooming each other. Telmen's foal got severely injured on the right hind leg at the beginning of August. It was hardly able to put weight on the affected leg, mostly walking on three legs. The leg could have been broken. Although the foal survived until the end of our observation period it became rather skinny and subsequently disappeared in November.

This group was the largest of all, which made observations of all individuals hard if the group was spread out. They moved mainly around the Shirin Us water point and the mountains in the surrounding. In August they used a temporal water point close to the mountains northwest of the TT Camp.

Interactions in the group were numerous, especially between the yearlings. Fewer conflicts could be seen with other takhi groups because Shirin Us was only used by Mondol's herd and one bachelor group. Within the last observation Mondol and Zandan groups were grazing close to each other. Interestingly the one year old stallion Sumber from Mondol group changed to Zandan's harem for a short time, grooming there with another yearling stallion, Taij. First Mondol play fought with Sumber and then Zandan chased him. Sumber then fled about four kilometers away from the group in the evening. The next day he was back in his group.



Fig. 3: Mondol's harem resting in the Shirin Us area (left) and fleeing after some disturbance (right).

3.1.4. Zandan

The Zandan group (Fig. 4 and 5) consisted of 12 adults and 4 foals. Two of the four foals were the offspring of the deceased stallion Tuulai. Another foal of Tuulai and Saran died before the observation period. The foal of Tuulai and Erdene either died during birth or was killed shortly thereafter. The observed foals were in a general good condition. During the first observation foals often stayed quite far from their mothers, whereas in a later turn they stuck very much to their mothers without grooming or playing with each other. But in the last two rounds the foals were again very active; they played, groomed

and run a lot. Also Zandan was grooming with the foals and mares, interestingly also with foals where he was not the biological father.

In July the herd moved mainly in the area southwest of Five Hills in a sandy hilly area and around the Bij River, where continuous observations due to the landscape and their fast travelling speed were difficult. Additionally their long flight distance (700 m) in the beginning made it difficult to observe this group. Later they were found just behind the TT camp or in the mountains northwest of the camp and they drank from the river between the Ranger camp and Bij. In the first and second observation round they got more and more used to us, so that in the end they even walked curiously towards us; sometimes as close as 20 meters.

Zandan had once to chase away 3 bachelors, who mixed into his group and started to fight with the young stallions. Otherwise the group seemed quite excluded from any interactions with other groups (see above Mondol: Taij and Sumber). Their home range changed from a rather large area in July to a small district in August and September.



Fig. 4: One of the mares and two foals (left), Zandan watching us (right).



Fig. 5: Zandan's group walking curiously towards us up to a distance of 20 meters (left), Tania observing nearby Zandan harem (right).

3.1.5 Khuchit/ Nomhkon

Khuchit group was made up of 4 adults and 1 foal. Uugan's foal originated from the deceased old lead stallion Pas (= Khowch). However, we never documented any aggressive behaviour against the foal from the new harem stallions. Usually the foal stuck to its mother, being in a good condition.

In July the main range of Khuchit's group included the area between the mountain TK and the Guntamag water point close to the military camp. In August they were found next to River Bij southwest of Five Hills.

The group had a very long flight distance (1000 m) after the capture of Uugan to remove her old radiocollar. Khuchit was quite slow as a lead stallion, often trotting behind his mares. Still in July he protected his mares well against some bachelors around the water point. Interestingly the lead stallion Nomkhon of these bachelors had been the former lead stallion of the Khuchit group before May 2007.

Begin of September the Khuchit group was again taken over by the stallion Nomkhon (Fig. 6), who also brought the mare Bulga with him. Khuchit himself got only little injuries and joined a bachelor group of five stallions.

The new group of stallion Nomkhon and the four mares used the big area between the mountains KT and Chimbaz, and the river Bij far south. They appeared to be a very nervous group, running a lot after the slightest disturbance and showing a flight distance of 2000 meters. Observations were therefore a difficult task. The mare Nuden was missing during the last observation and was later found to have joined Myangan's group.



Fig. 6: Nomkhon and the mares fleeing from us.

3.1.6. Myangan

The harem group of Myangan (Fig. 6 and 7) consisted of 6 adults and 2 foals. The mares Borkhul and Udam had already lost their foal before the onset of our observations. One of the two remaining foals, Zuram's foal seemed weak with some older wounds on shoulder and mouth whereas Ner's foal seemed very strong. However, Ner's foal was found dead due to unclear circumstances end of August. In total three out of four foals died, two being the offspring of the dead former harem stallion Tayan, one of Myangan himself. Still, we never observed any aggressions of Myangan towards the unrelated foals.

The very active group was moving in the area between the mountains TK, KT, Five Hills and the water point in Guntamag close to the military camp, the Bij River and a temporary water source behind KT. They seemed to be very restless, changing often their behaviour between grazing, moving and resting. Usually Myangan followed his mares, which seemed to decide what to do. In the beginning the group was frightened of us or easily alerted, although the reason was not always clear. They run because of our car, but a little later walked up to 50 meters towards us.

Inter-aggressive behaviour could only be observed once when Myangan had a short fight with Jiguur in the mountains northwest of 5 hills.



Fig. 6: Myangan's harem resting with the foal stretching out close to them (left), Myangan running after some disturbance (right).



Fig.7: F15, Zuram's foal, drinking from its mother (left), Myangan harem curiously watching us.

3.1.7. Bulga

Begin of August Bulga, a mare originating from Moogii's group, was observed alone with her foal. She kept on walking alone between TK and the military water point. The foal's father was the deceased stallion Pas (Khowch). For two days we observed Bulga, which was very frightened and watchful, moving most of the time. Her foal seemed to be fine but was found dead two weeks later. Because a wolf showed up at the hill site with the dead corpse and the foal showed extensive bite marks, we assume it was killed by a wolf (see 3.4.1). Later Bulga was found to have joined Nomkhon southwest of 5 hills.

3.1.8. Moogii

Moogii group consisted of seven adults and one foal, born in the beginning of September. The tiny foal still stuck close to its mother most of the time. Not the lead stallion Moogii, but rather the deceased stallion Pas was the father of the foal.

Until 20th of September the group always stayed close to the Guntamag water point. On the 21st they left this area very fast and a little nervous towards the Bij River southwest of Five Hills. No conflicts with any other groups could be documented.

Since the birth of the foal the group appeared to be more watchful and alerted, fleeing easily.

3.2. Inter- and Intra- Aggression of Takhi groups

Aggression in (intra) was calculated both as duration and frequency of aggressive interactions per hour and adult (Fig. 8), between (inter) the groups as duration and frequency of aggressive interactions per hour (Fig. 9). The solitary mare Bulga was not taken into account for these comparisons because she was only observed once when no aggressive interactions with any other groups occurred.

Intra-aggressive interactions occurred most often in Myangan's group, followed by Jiguur's, Mondol's (Fig. 10) and Zandan's harem (Fig. 11) and less frequently in the small harems of Khuchit, Moogii, Nomkhon and Selenge (Fig. 8). The time spent with aggressive behaviour differed from the frequency of aggressions in most groups. For example Khuchit's group spent a long time on a few aggressive interactions whereas in Myangan's group only very short aggressive interactions occurred (Fig. 8).

The smaller groups like Khuchit and Selenge suffered more from aggressive interactions with other groups than the bigger groups where intra-aggression was dominant (Fig. 9).

Foals were only involved into aggressive behaviour within groups (Tab. 4), mainly in Jiguur's group as well as in Myangan's and Selenge's harem, for the most part just accidentally being present but never seriously being attacked themselves.

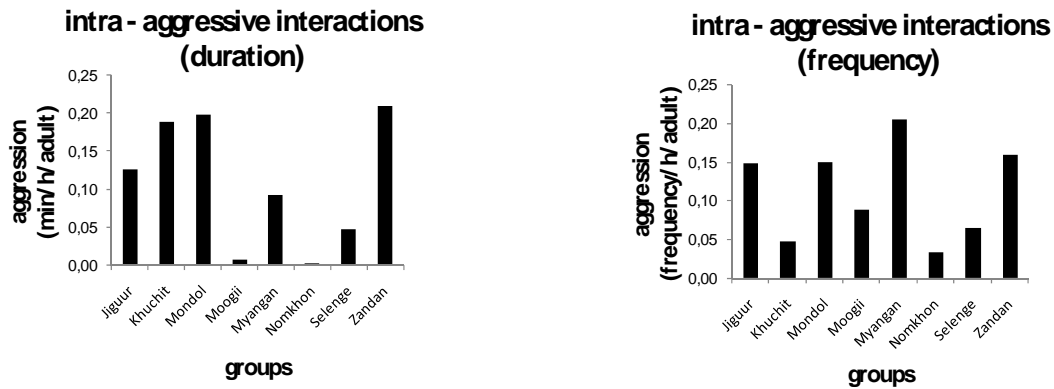


Fig. 8: Averaged duration (min) and averaged frequency of intra-aggressive behaviour per adult and hour in the eight harem groups.

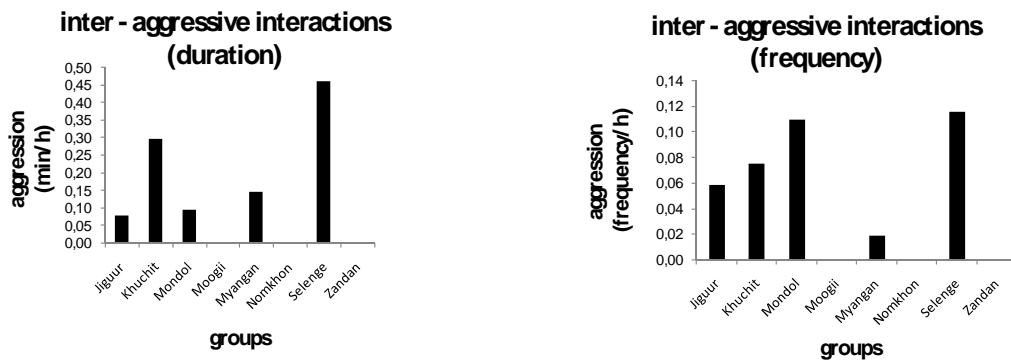


Fig. 9: Averaged duration (min) and averaged frequency of inter-aggressive behaviour hour in the eight harem groups.

Tab. 4: Averaged frequency of foals involved into aggressive interactions per hour and according to adults in the group.

groups	frequency of foals involved into aggressive behaviour per hour and according to adults in the group
Jiguur	0,046
Khuchit	0,000
Mondol	0,004
Moogii	0,000
Myangan	0,021
Nomkhon	0,000
Selenge	0,019
Zandan	0,007



Fig. 10: Intra-aggressive behaviour of the bachelors in Mondol's group: kicking (left), biting (middle) and fighting (right).



Fig. 11: The lead stallion Zandan fighting with the two year old stallions of his group.

3.3. Positive Interactions

Positive interactions like grooming and playing also occurred more often in the larger groups (Fig. 12). Grooming occurred within all different combinations of lead stallions, mares, bachelors and foals (Fig. 13 and 14). Playing usually took place between the foals, sometimes also between or with one year olds or adults. The time spent with grooming and playing corresponded with the frequency of positive interactions.

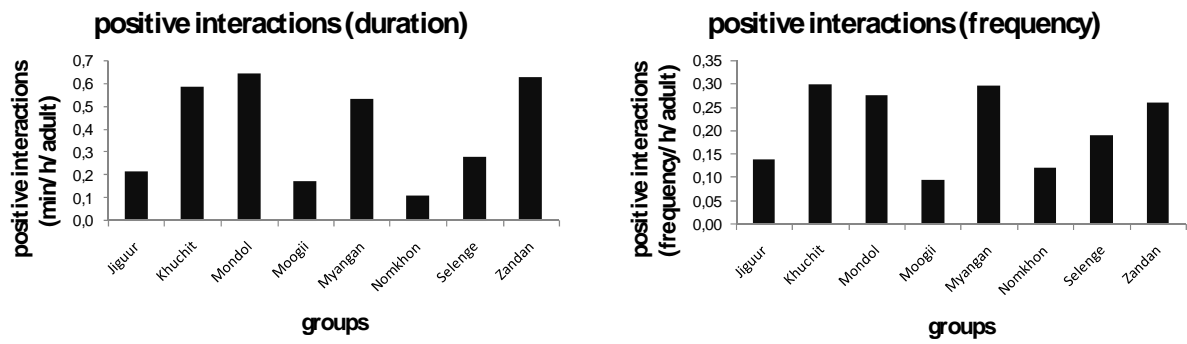


Fig. 12: Averaged duration (min) and averaged frequency of positive interactions per adult and hour in the eight groups.



Fig. 13: Grooming of several individuals in Mondol’s harem.

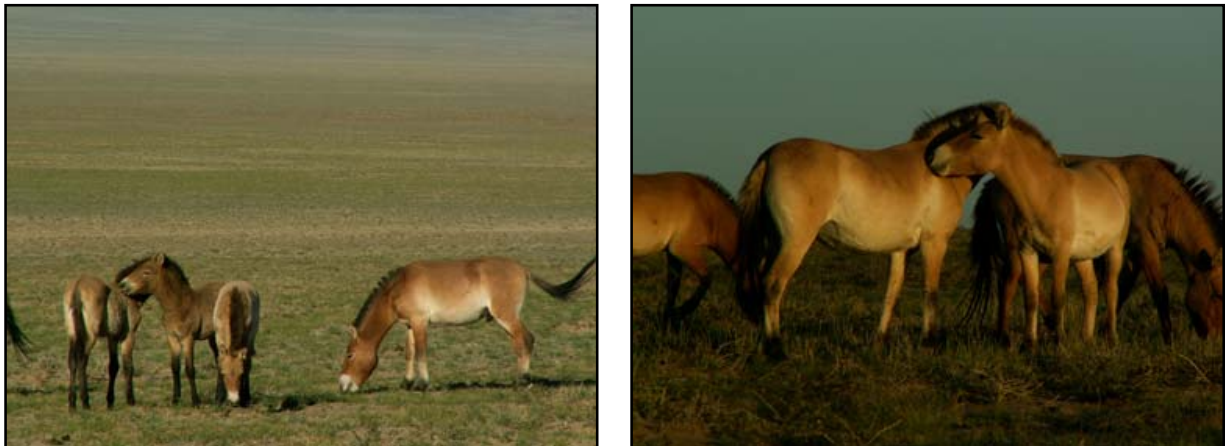


Fig. 14: Two foals grooming (left) and two adult horses grooming (right) in Zandan's group

3.4. Dead foals

3.4.1. Bulga's foal (F16)

Sex: female

Date: 12.8.2007

Site: mountains between KT and TK (WP)

Description: discovered at 8:30, dissection at 23:00. The dead foal was discovered with the mother still standing traumatized next to it. While we observed the situation in a distance of 1,000 meters with the telescope a wolf appeared trying to eat or get the foal. The wolf left after a few minutes, probably because of our human smell due to a strong backwind. When we approached the foal two hours later, the first vultures had arrived by which the mother was scared away. The foal was quite well preserved, so that we were able to examine the cause of death. It had bite marks on the neck and head (Fig. 15 and 16), and the oesophagus was bitten through. In addition, there was a big open wound on the abdomen with some organs coming out (Fig. 16). Around the location of the dead foal we found tracks that looked to be from a hunting scene. Following these signs we concluded that F16 had been killed by a wolf.

Possible time of death: around 8 in the morning on the 12th of August

Organs taken: lungs, heart, liver, stomach, intestines, kidney, ovary, uterus, skin



Fig. 15: Bite marks on the neck of F16 (left) and separated oesophagus (right).



Fig. 16: Bite marks on the head of the dead foal (left) and open abdomen wound (right).

3.4.2. Ner's foal (F14)

Sex: female

Date: 29.8.2007

Site: WP 219; 2000 m west of 5 hills, 50 m distance to the water point

Description: discovered at 15:30, dissection at 17:00. Already half eaten, only little of the head was left to recognize the foal. Four vultures and several smaller birds were feeding on the carcass when we arrived. One leg was found in 6 meters distance of the body. The two marks on the neck are similar to those of the wounds on the head of F16, still the oesophagus is complete (Fig. 17). On the very dry ground some tracks were visible, but were not really recognizable.

Possible time of death: night between 28.8./29.8 (full moon, cloudy and partly raining)

Organs taken: as most parts of the foal were already eaten, we only were able to take one eye and a piece of skin for a later necropsy.



Fig.17: The leftovers of Ner's foal (left) and the wound on the neck in detail (right).

4. Discussion

4.1. Agonistic behaviours

Aggression within or among the Przewalski's groups does not seem to be a key factor explaining foal mortalities in Takhin Tal. During our observations obvious attacks on foals were rare. In most cases, foals happened to be involved into aggressive interactions by accident but were never seriously injured. Most often foals were drawn into aggressive behaviour in Jiguur's harem. Nevertheless, this group did not lose any of its four foals.

Still social unrest may indirectly contribute to the loss of foals. The harem of Myangan for example was observed to be easily alerted, running a lot, shifting the grazing areas many times during summer. Compared to other groups they changed a lot between grazing, moving and resting, which might result in less time for social interactions in the group and more stress for the foals. This group lost one foal during the observation period and two others previous to our observations and only one survived until the end of the year.

Interestingly the severely injured foal F12 of Telmen in Mondol's group managed to survive at least until the end of the observation period, though it finally disappeared in November. We suppose that a bigger harem group like Mondol offers a better protection against wolves and predators, whereas smaller herds and lone mares are more exposed to such dangers.

Several foals had a different sire than the lead stallion. In one such case a mare (Bulga) and her foal left the harem just after the foal's birth, which could be interpreted as trying to avoid the killing of her foal by the unrelated stallion. However, also the opposite happened. The mare Sonja and her foal left the harem of the foals' sire (Jiguur) and joined the group of an unrelated stallion (Selenge group). We did not document any aggressions of Selenge towards the foal. However, after the observation period the foal disappeared and Sonja switched back to Jiguur group. What caused these group

changes remains unclear. In another group the lead stallion Zandan was observed grooming the two unrelated foals in his group. Apparently an unrelated lead stallion can be a risk for the life of foals, but does not necessarily have to be.

4.2. Disturbances

A strong influence of the domestic herds on the Takhis can be observed with begin of September, where most of the nomads come back from the mountains to their autumn camps. For instance Moogii and the mares fed in the area around Gashurn Us for the first two months. But a few days after the appearing of three different herder families and their livestock, Moogii left Gashurn Us and moved to Five Hills. At this time the Bij River close to Five Hills became the main drinking source for most of the Takhi groups and several domestic animals. Selenge group who grazed around Bij River near to Telmet in July and August seemed to retreat to the mountains and only came to the river briefly to drink. It seemed that due to crowded water points a new dynamic in the movement pattern of the wild horses started. Yet no conclusions about the impact of these circumstances can be made, we just noticed that there is apparently some pressure regarding pasture use and a certain disturbance potential for the Takhis.

According to the weather, landscape and the behaviour of the P-horses the groups were observed from the Jeep, the open field or from a viewpoint. The harems showed very different reactions to our presence resulting in quite diverse flight distances. Whereas most groups became accustomed to us during the second observation circle, Khuchit, Nomkhon and Moogii stayed very vary. One reason for the fear of the harem of Khuchit/Nomkhon might have been the chasing and subsequent darting of the mare Uugan to remove her broken satellite collar at the beginning of July (Kaczensky & Walzer, 2007). The group takeover by Nomkhon may have made them even more cautious and sensitive to disturbances. The foal of Uugan might have suffered

somewhat from the frequent running due to the slightest disturbance. At least it seemed a little skinnier than before.

4.3. Conclusions

No final conclusions can be drawn from this pilot project as we were only able to survey the groups during a very limited time period. Several foals had already disappeared and others vanished without us being able to observe the circumstances. Thus further investigations should be carried out throughout the whole reproduction period. Less time intensive and more systematic methods, like monitoring of groups positions with high temporal resolution to document the timing and frequency of interactions among groups would be desirable. Additional studies on the interactions and impact of domestic herds and the P-horse population also would be of a high value for a sustainable management of both takhis and domestic animals (Kaczensky et al, 2007).

6. Acknowledgments

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8. Appendix

Przewalski's horse groups in Takhin Tal in 2007.

Individuals	Fx	sex	age	birth	death	death cause	father of foal
Jiguur-group							
Jiguur		stallion	15	12.06.92			
Sogoo		mare	14	01.12.92			
Sogoos foal	F3	stallion	0	31.05.07			Jiguur
Gurguul		mare	12	07.05.95			
Gurguuls foal	F2	stallion	0	26.04.07			Jiguur
Od		mare	13	23.04.94			
Ods foal	F1	mare	0	22.04.07			Jiguur
Itgel		mare	11	12.06.96			
Itgels foal	F4	stallion	0	09.05.07			Jiguur
Taikhar		stallion	3	12.05.04			
Agsam		stallion	2	24.06.05			
Naran		mare	2	01.09.05			
Maizii		mare	1	24.04.06			
Selenge-group							
Selenge		stallion	7	28.08.00			
Yyl		mare	13	17.04.94			
Sonja		mare	7	13.06.00			
Sonjas foal	F5	stallion	0	31.05.07	22.11.07	disappeared	Jiguur
Zandan-group							
Zandan		stallion	9	28.05.98			
Misheel		mare	10	28.05.97			
Misheels foal	F6	stallion	0	03.06.07			Zandan
Maral		mare	7	23.05.00			
Maral foal	F7	stallion	0	07.07.07			Tuulai
Kherlen		mare	7	26.05.00			
Kherlen's foal	F8	mare	0	begin july			Zandan
Orkhon		mare	7	15.07.00			
Orkhon foal	F9	mare	0	02.07.07			Tuulai
Oroo		mare	5	24.05.02			
Erdene		mare	9	19.02.98			
Erdene's foal				10.07.07	10.07.07	disappeared	Tuulai
Zorgol		mare	7	20.05.00			
Saran		mare	4	09.04.03			
Saran's foal		?	0	26.05.07	29.05.07	disappeared	Tuulai
Bars		stallion	2	09.05.05			
Burd		stallion	2	25.05.05			
Taij		stallion	1	09.05.06			
Mondol-group							
Mondol		stallion	10	10.05.97			
Tsgaadai		mare	11	06.06.96			
Imj		mare	13	02.08.94			
Dorothee		mare	8	06.06.99			
Dorothee's foal		mare	0	10.05.07	20.05.07	disappeared	Mondol
Khokhoo		mare	10	19.11.96			
Khokhoos foal	F10	stallion	0	20.06.07			Mondol
Soir		mare	10	31.03.97			
Soirs foal	F11	mare	0	03.06.07			Mondol
Telmen		mare	5	15.05.02			
Telmens foals	F12	stallion	0	20.06.07	15.11.07	back leg broken	Mondol
Sormuus		mare	3	13.06.04			
Buman		mare	2	29.04.05			
Azaa		stallion	2	21.05.05			
Khatan		mare	1	21.05.06			
Bokhoo		mare	1	03.06.06			
Sumber		stallion	1	24.06.06			
Tumen		mare	1	30.06.06			
Matar		stallion	1	02.07.06			

Khuchit's group

Khuchit		stallion	8	16.06.99			
Uugan		mare	15	02.09.92			
Nuden		mare	3	20.05.04			
Holog		mare	2	30.06.05			
Uugans foal	F13	mare	0				Khowch

Myangan's group

Zuram		stallion	7	01.05.00			
Zuram		mare	5	02.06.02			
Zuram's foal	F15	mare	0	12.07.07			Myangan
Ners		mare	5	10.06.02			
Ners foal	F14	mare	0	08.06.07	29.08.07	unclear, found	Tayan
Udam		mare	5	15.05.02			
Udam's foal		mare	0	03.06.07	06.07.07	disappeared	Myangan
Borkhul		mare	3	28.04.04			
Borkhul's foal		stallion	0	04.05.07	12.05.07	disappeared	Tayan
Huvhar		mare	3	06.06.04			

1 mare

Bulga		mare	12	07.05.95			
Bulga's foal	F16	mare	0	20.07.07	12.08.2007	wolf predation likely	Pas (Khowch)

Nomkhon's group

Nomkhon		stallion	5	07.05.02			
Bulga		mare	12	07.05.95			
Uugan		mare	15	02.09.92			
Nuden		mare	3	20.05.04			
Holog		mare	2	30.06.05			
Uugans foal	F13	mare	0				Pas (Khowch)

Moogii's group

Moogii		stallion	8				
Tschandaga		mare	16				
Tschandaga's foal	F17	stallion?	0	30.08.07			Pas (Khowch)
Toot		mare	20	25.07.07	25.07.2007	disappeared	Pas (Khowch)
?		stallion	?				
?		mare	?				
?		mare	?				
?		mare	?				

Hubsugul's group

Altai		mare	1	16.04.06			
Audi		mare	1	09.04.06			
Beltes		mare	10	15.04.97			
Hubsugul		stallion	10	21.05.97			
Mandhai		mare	5	13.05.02			
Mandhai foal		mare	0	27.03.07	27.03.07	disappeared	Hubsugul
Nergui		mare	5	26.04.02			
Nergui's foal		mare	0	12.05.07	12.05.07	disappeared	Hubsugul
Shandas		mare	8	11.06.99			
Shandas foal		stallion	0	25.06.07			Hubsugul
Shandast		stallion	1	01.09.06			
Suvd		mare	1	30.05.06			
Tolbo		mare	5	30.06.02			
Tolbos foal		mare	0	25.06.07			Hubsugul
Ynzagahan		mare	1	25.08.06			
Zolboo		mare	5	19.10.02			
Zur		mare	8	06.06.99			

Tayan's group

Buman		mare	2	29.04.05			
Doroo		stallion	3	27.05.04			
Harz		mare	3	02.05.04			
Kheren		mare	5	28.07.02			
Kheren's foal		mare	0	03.06.07	10.06.2007	disappeared	Tayan
Mongon		mare	8	06.05.99			
Tayan		stallion	10	24.04.97			
Zogii		mare	7	15.05.00			