Wild camel training and collaring mission for the Great Gobi A Strictly Protected Area in Mongolia

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1. Data Processing and Analysis of collared wild camels
2. Wild camel satellite collaring and monitoring

Contents

1. Introduction

The Great Gobi Strictly Protected Area (SPA) “A” located in the southwestern part of Mongolia bordering with People’s Republic of China is one of the world’s great desert ecosystems. The extremely harsh environment has given rise to a unique ecosystem with particularly well-adapted species, many of which are found nowhere else in the world (Zhirnov and Ilyinsky 1986). The large mammal fauna consists of several rare or globally threatened species, namely the wild Bactrian camel (*Camelus batrianus ferus*), the Gobi bear (*Ursus arctos gobiensis*), the snow leopard (*Uncia uncia*), the argali wild sheep (*Ovis ammon*) and the Asiatic wild ass (*Equus hemionus*; Zhirnov and Ilyinsky 1986; Reading et al. 1999, McCarthy 2000).

Yet human pressures for pastures and water on the edges of the Great Gobi SPA and in its buffer zones have substantially increased since the early 1990s and are believed to have lead to significant habitat degradation in some areas (UNDP Mongolia 2004). Thus in June 2003 a UNDP / GEF founded project "Conservation of the Great Gobi Ecosystem and its Endangered Species" was initiated. The project aims to ensure the long-term conservation of the Great Gobi ecosystem and its umbrella species by building the capacity of the park management authority, improving participation of local communities in the management of the protected area (SPA) and supporting research and environmental monitoring activities through the development of a model conservation program using the wild Bactrian camel as an "umbrella species" (UNDP Mongolia 2004).

The range of the wild Bactrian camel has become severely reduced to only three locations world wide: two in China (Lop Nuur and Taklamakan desert) and one in Mongolia (Great Gobi A SPA). The population is listed by IUCN as critically endangered and there remain an estimated ~600 animals in China (Hare 1997) and between 350 to 1,950 in the Great Gobi A SPA (Reading et al. 1999, Guoying et al. 2002, Mix et al. 2002, Weidong et al. 2002). The large range in the population estimate is due to the large size, remoteness and harsh climate of the Great Gobi A SPA. Past population estimates often lack a detailed description of the survey methods and more recent surveys use different methods or lack the documentation of the search effort (Tulgat and Schaller 1992, Reading et al. 1999, McCarthy 2000, Mix et al. 2002, Dorvchindorj 2005). Thus, there is still quite a debate about population numbers and trends (Mix et al. 2002). The general belief is that the population is stagnating or declining due to (1) low recruitment of calves caused by wolf predation, (2) habitat deterioration and (3) illegal hunting (McCarthy 2000, Tulgat 2002, Midjidorj pers. comm., Enkhbileg pers. comm.).

There are also great knowledge gaps concerning the ecology of the wild camels and data on population dynamics (McCarthy 2000, Magash and Indra 2002), behaviour (Mijiddorj 2002), habitat use (Tserenbaljid 2002), movement patterns (Reading et al. 2005), and veterinary aspects (Blumer et al. 2002) is scarce. Even the genetic status and the purity of the three wild Bactrian camel populations has not yet been fully resolved and preliminary results (e.g. Jie et al. 2002) need to be treated with caution.

The UNDP / GEF funded project "Conservation of the Great Gobi Ecosystem and its Endangered Species" was heavily based on research and training carried out by international and national research teams, namely the Mongolian Conservation Coalition (MCC) represented by: Richard P. Reading, Denver Zoological Foundation; Henry Mix, German Nature Conservation; Evan S. Blumer, The Wilds and the Institute of Biology, Mongolian Academy of Sciences. The MCC team had initiated a wild camel conservation project in 1997 to determine the reasons for camel population decline and to develop a program to address those problems. The team had collared two wild camels with satellite collars for landscape-scale information such as home-range and migration in 2001 and 2002 and produced initial results (Blumer et al. 2002, Adiya et al. 2004). For unclear reasons the first collar stopped working after one year and the second only provided sporadic data (Reading et al. 2005). Further attempts to collar more animals were postponed due to the difficulties in darting camels (Reading et al. 2005; Blumer pers. comm.) and finally the withdrawal of the MCC from the project.

Despite the encountered problems, it was decided by the project staff that collaring of additional wild camels is needed in order to gather data on camel movement pattern, habitat use and to assess the feasibility of establishing “corridors” between the Great Gobi A SPA and adjacent Protected Area in Mongolia and China. In November/December 2005 the authors were hired as short term international experts for initial training of capture and field anaesthesia of wildlife, satellite data management and analysis and the collaring of 3 wild camels in the Great Gobi A SPA.

The contract work basically consisted of two parts:

1. Initial training of a Mongolian wildlife biologist and a Mongolian veterinarian in Europe
2. An expedition to the Great Gobi A to collar 3 wild camels

2. Training in Europe

2.1. Data management and analysis training

Mr Enkhbileg Dulamtseren, Coordinator for the captive breeding program by the Wild Camel Protection Foundation & Mongolian National Commission for Conservation of Endangered Species stayed for initial training in data management and analysis at the Department of Wildlife Ecology and Management, University of Freiburg, Germany from 7-20 November 2005 (Table 1; also see appendix I).

Table 1: Training program Enkhbileg Dulamtseren 6-20 November 2005.

06.1.2005: Arrival in Freiburg

07.11.2005: basics about telemetry (VHF telemetry, satellite telemetry)
08.11.2005: understanding and managing an ARGOS account (accessing the account, data download, data decoding, data storage)
09.11.2005: ArcView basics (how is to organize the GIS on the computer, setting up an ArcView project)
10.11.2005: ArcView for wildlife tracking analysis (Animal movement, Home Range)
11.11.2005: EXCEL database (organisation, basic analysis, pivot tables, calculations, macros)

12-13.11.05 Weekend

14.11.2005: ArcView for the Great Gobi A (visualization of data from the Great Gobi A)
15.11.2005: data download, creation of database and visualization of real time data from the SE Gobi
16.11.2006: SPSS basics
17.11.2005: spatial statistics basics (home ranges, autocorrelation, habitat use analysis)
18.11.2005: monitoring of wildlife populations basics (line transects, DISTANCE sampling)

19.11.2005 Weekend
20.11.2005 Return to Mongolia

We would like to point out that this initial training was mainly aimed to give Mr Enkhbileg the routine to manage an ARGOS account, download and de-code the data, manage the database and visualize the data. In respect to data analysis the training was aimed to provide the mere basics as any training in the field of statistics (SPSS), database use and management (EXCEL), GIS (ArcView) and wildlife monitoring (DISTANCE) would require separate 1-2 week training sessions.

2.2. Veterinary training

Mrs Battsetseg from the Institute of Veterinary Medicine was selected by the project team to be trained in Austria in wildlife capture and anaesthesia methods (Table 2). It was planed that training would be 14 days from 7-20 November 2005. Unfortunately due to errors in visa issue only the initial phase of the training (7-12.11.2005) could be carried out.

Table 2: Training program Mrs Battsetseg 6-13 November 2005.

06.1.2005: Arrival in Vienna – transfer to Tierpark Herberstein

07.11.2005: Field anaesthesia in the park. Darting equipment basics
08.11.2005: Field anaesthesia in the park, practical work with dating equipment, theoretical background on drug selection
09.11.2005: Monitoring anaesthesia, choosing the appropriate drugs, practical work in the park
10.11.2005: Field anaesthesia in the park
11.11.2005: Field anaesthesia in the park
12.11.2005: Field anaesthesia in the park
Transfer to Vienna

13.11.2005 return to Mongolia

The second week of training had been planed at the University of Veterinary Medicine in Vienna – this week was to provide an insight into modern anaesthesia management and would have offered the opportunity to greatly increase basic background knowledge. For reasons of animal welfare and especially human safety issues we strongly recommend that significant additional training be provided before wild animals are chemically captured in the field.

3. Camel collaring in the Great Gobi A SPA

3.1. Time table & route

The field trip for wild camel collaring in Mongolia was conducted between 28 November and 18 December 2005 (Table 3). In total the team covered 2,400 km, 1,920 for domestic travel to and from the Great Gobi A SPA and 480 km within the camel range in the SPA (Fig. 1+2).

Table 3: Travel dates and route of the wild camel expedition in December 2005.

Date	Location	Tasks
27.11.2005	leaving Europe for UB	international travel
28.11.2005	arrival UB	international travel
29.11.2005	UB-Arvaykheer	domestic travel to gobi
30.11.2005	Arvaykheer-Bayantsagaan	domestic travel to gobi
01.12.2005	Bayantsagaan-Bayantooroi	domestic travel to gobi
02.12.2005	Bayantooroi-Camp1	domestic travel to gobi
03.12.2005	Camp1-Camp2	camel search
04.12.2005	Camp2-Camp3	camel search + capture
05.12.2005	Camp3-Camp4	camel search + capture attempt
06.12.2005	Camp4-Camp5+6 (Container)	camel search + capture
07.12.2005	Camp5+6 (Container)	wildlife survey + sample collection
08.12.2005	Camp5+6-Camp7	wildlife survey + sample collection
09.12.2005	Camp7-Camp8 (Zakyn us)	wildlife survey + sample collection
10.12.2005	Camp8-Bayantooroi	autopsy + sample collection
11.12.2005	Byantooroi	meeting with park staff, darting training
12.12.2005	Bayantooroi-Bayantsagaan	domestic travel to UB
13.12.2005	Bayantsagaan-Arvaykheer	domestic travel to UB
14.12.2005	Arvaykheer-UB	domestic travel to UB
15.12.2005	UB	meeting
16.12.2005	UB	meeting with UNDP
17.12.2005	UB	rest day
18.12.2005	UB-Europe	International travel

Fig. 1: Headed for the Great Gobi A SPA.

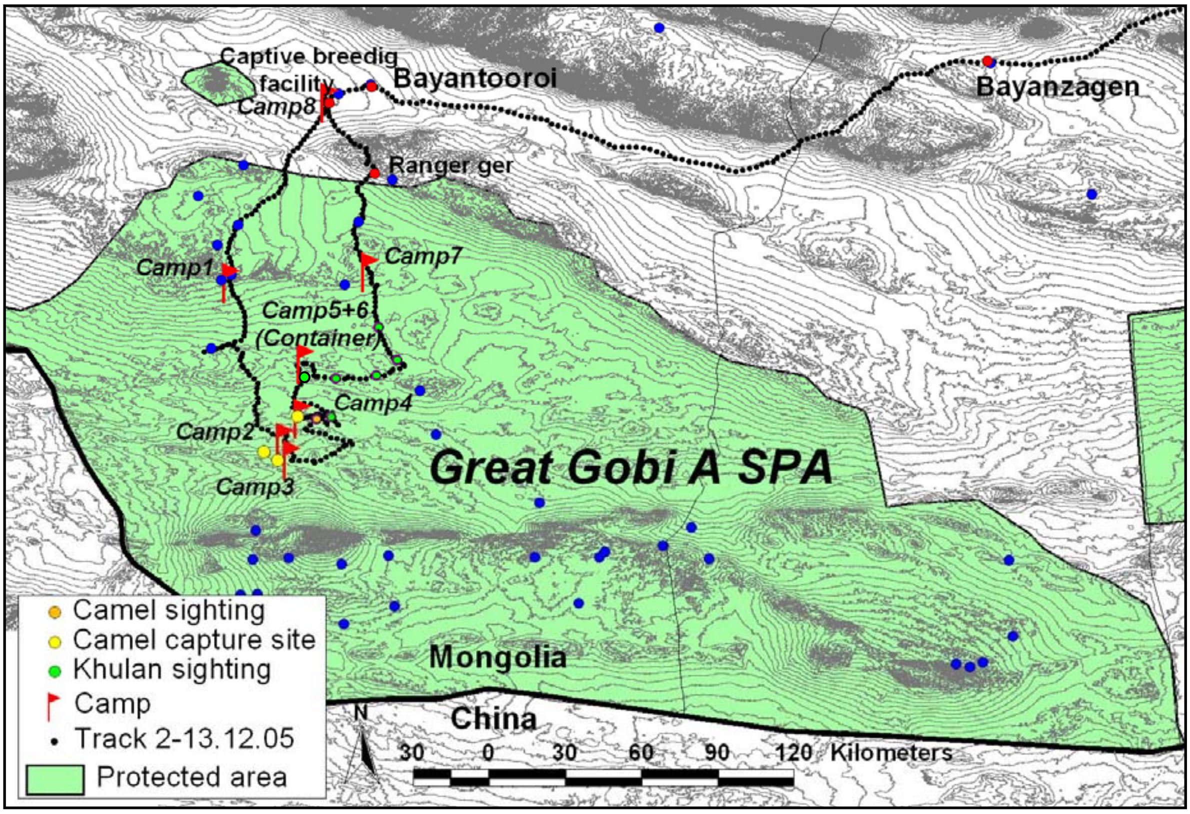

Fig. 2: Route in the Great Gobi A SPA.

3.2. The field team

The field team consisted of 11 participants (Fig. 3):

National:

- Enkhbileg Dulamtseren; Coordinator, Wild Camel Protection Foundation & Mongolian National Commission for Conservation of Endangered Species, camelproject@magicnet.mn
- Adiya Yadamsuren; Camel Researcher, Institute of Biology Mongolian Academy of Sciences, adiya@yahoo.com
- Dorvchindorj Ganbold; Researcher, Great Gobi A Strictly Protected Area greatgobispa@yahoo.com
- Khatanbaatar Igoriin; Researcher, Laboratory of Parasitology, Institute of Veterinary Medicine, kha_igo@yahoo.com
- Tumaa; Driver and Ranger, Great Gobi A Strictly Protected Area
- Boltoo; Driver and Ranger, Great Gobi A Strictly Protected Area
- Choijin; Ranger, Great Gobi A Strictly Protected Area
- Tsogerdene; Ranger, Great Gobi A Strictly Protected Area

● Gerelmaa; Cook and Camp Assistant, Great Gobi A Strictly Protected Area

International:

● Chris Walzer; Zoo and Wildlife Veterinarian, Research Institute of Wildlife Ecology, University of Veterinary Medicine, Vienna, Austria, chwalzer@eunet.at
● Petra Kaczensky; Wildlife Biologist, Department of Wildlife Ecology and Management, University of Freiburg, Germany, petra.kaczensky@wildlife.uni-freiburg.de

Fig. 3: The camel collaring team (from left back to right front: Boltoo, Tumaa, Tsogerdene, Dorvchindorj, Khatanbaatar, Enkhbileg, Gerelmaa, Choijin, Petra Kaczensky, Adiya, Chris Walzer).

A team headed by Mr Adiya had explored the camel range for a period of 10 days prior to the collaring mission. This strategy proved to be highly effective as it allowed us to locate wild camels within a very short timeframe.

In addition, the two rangers Choijin and Tsogerdene were sent into the wild camel range on camelback several days ahead of the collaring team (Fig. 4). It was planned to use the domestic camels as attractants for their wild counterparts in case the capture method using the jeep for darting would not work.

Darting camels from a blind at water points was not an option in December because water at oasis is frozen and camels can cover their water requirements by eating snow – which at the time of the expedition covered large portions of the camel range in the Great Gobi A SPA.

Fig. 4: Ranges Choijin and Tsogerdene heading into the gobi on camel back.

3.3. Wild camel capture and anaesthesia

As planed we were able to capture and collar three (1,2) wild camels on this trip. We employed a chase method where the camel is darted from a moving jeep. We have successfully used this method previously to dart gray wolf (*Canis lupus*) and Asiatic wild ass (*Equus hemionus*) (Walzer and Kaczensky 2004). Furthermore it has been used to collar a single wild camel (Blumer et al., 2002) and is traditionally employed by khulan poachers with 12 gauge shotguns.

When using the local UAZ jeeps it is important to remove the window from the passenger side and to provide seatbelts for the driver and shooter (Fig. 5). For remote dart application we used a modified high pressure CO_2 dart gun (Daninject JM™, Wildlife Pharmaceuticals, Fort Collins, CO 80524, USA). If using the Daninject JM model, a short 4 cm barrel can be used instead of the standard barrel as this greatly facilitates movement in the jeep.

Fig. 5: Jeep prepared for darting wolves in Takhin Tal in March 2003. The same set-up was used for darting wild camels in the Great Gobi A SPA. Note the removed window and the seat belt for the shooter.

Once an animal is identified, it is chased till the jeep is able to approach within approximately 10-15 meters on a parallel track. It is then easily darted in the rump musculature using standard pressure settings (Fig. 6-8). It is essential to define a chase cut off time before the procedure is started. Our experience has shown that a cut off time of 15 minutes is adequate. When working in the wild we prefer to use new 3 ml darts discharged by expanding compressed air (Daninject, Wildlife Pharmaceuticals, Fort Collins, CO 80524, USA). Old darts are not used, as these are never as accurate. In wild camels a dart needle length of 40 mm is sufficient to safely due to the absence of significant layers of fat in the rump region (by comparision a wild horse would need 55 mm long needles). The use of wire barbs or collars on the needle to securely retain the dart in the animal is used in order to enable complete drug expulsion. Once an animal is successfully darted one should attempt to keep it in sight. However, it is very important at this stage not disturb the animal any further by chasing it or approaching before the drugs have taken full effect. Once the animal has become recumbent, an approach on foot from behind and immediate fixation of the head is recommended.

Fig. 6: Once an animal is identified, it is chased till the jeep is able to approach within approximately 10-15 meters on a parallel track.

Fig. 7: Singled out female camel #2.

Photos: Petra Kaczensky

Fig. 8: The selected camel is then easily darted in the rump musculature using standard pressure settings.

Capture 1

On the 04.12.2005 at 12:05 we were able to capture a male camel of 8-9 years of age (ID 62097; Fig. 9). The chase time was only 5 minutes. Five minutes after darting the animal became immobile. At 9 minutes after darting the animal was laterally recumbent. Anaesthesia provided very good muscle relaxation (a general problem in camelids with etorphine in many cases) and monitoring data revealed good oxygenation (SpO_2 values increased from 64 – 66 – 71 – 89 – 100%). Respiration rate was on average 15 / minute. Internal body temperature remained in the normal range throughout the procedure (38.0 ^{o}C). At 35 minutes, anaesthesia was reversed. Reversal was smooth and complete and the animal left the site of capture 2 minutes after application.

Fig. 9: Capture 1 – bull wild camel. Note the puls oxymeter for anaesthesia monitoring.

Capture 2

On the 04.12.2005 at 13:35 we were able to capture a female camel of 6 years of age (ID 62098). The chase time was only 4 minutes. The initial dart was inadvertently placed just cranial of the large rump muscles which compromised drug absorption. The animal became recumbent at 20 minutes and could be approached on foot (Fig. 10). The initial dart had only partially discharged (approx. 70%). At 33 minutes an additional 2 mg ethorphine were applied intramuscularly (IM). Due to the protracted drug absorption muscle relaxation was not good in this case. At 40 minutes an additional 10 mg detomidine were applied intravenously (IV) to relax the neck muscles and facilitate collar placement. Monitoring data revealed adequate oxygenation (SpO_2 values increased from 65 – 78 – 85%). Respiration rate was on average 15 / minute. Internal body temperature remained in the normal range throughout the procedure (38.6 ^{o}C). At 60 minutes, anaesthesia was reversed. Reversal was smooth and complete and the animal left the site of capture 3 minutes after application.

Fig. 10: Capture 2 – female wild camel. Due to only partial discharge and suboptimal placement of the initial dart the animal became recumbent at 20 minutes and could be approached on food for second darting.

Capture 3

On the 05.12.2005 a female camel was chased for 4 minutes and darted. However, the dart did not discharge correctly and no effect could be observed. The animal was followed and observed for a period of 35 minutes to ensure that the drugs had no effect.

Capture 4

On the 06.12.2005 at 11:35 we were able to capture a female camel of 6 years of age (ID 62099). The chase time was a slightly prolonged 9 minutes as the initial dart missed the animal forcing the shooter to reload. The second dart was placed successfully in the rump muscles. Five minutes after application the animal markedly slowed. At 6 minutes the animal was lost from view and only found at 12 minutes in lateral recumbency. Muscle relaxation was good. Monitoring data revealed adequate oxygenation (SpO_2 values increased from 72 - 79 – 82 – 86 - 80%). Respiration rate was on average 15 / minute. Internal body temperature remained in the normal range throughout the procedure (38.6 ^oC). At 50 minutes, anaesthesia was reversed. Reversal was smooth and complete and the animal left the site of capture 3 minutes after application (Fig. 11).

Photo: Chris Walzer

Fig. 11: Capture 3 – female wild camel. Animals with collar minutes after anaesthesia was reversed.

Science-based conservation efforts in general and wide-ranging species conservation specifically, often require capture and subsequent handling of the subject animal. Safe and animal-welfare appropriate wildlife capture and anaesthesia is a complex operation necessitating a multitude of skills that require appropriate veterinary training (Osofsky & Hirsch 2000). Every anaesthetic event bears the inherent risk of significant injury and potentially death. Though this risk is for the most part very small it must be ascertained that the procedure is necessary and that the potential gains outweigh the risks (Kreeger et al. 2002).

Based on the previous wild camel capture work (Blumer et al. 2002) and subsequent to our experience on this trip we recommend the following combination for the safe capture of adult wild camels:

The primary agent of choice for wild camel immobilization and anaesthesia is the potent opiate ethorphine. The opiates interact in the central nervous system (CNS) with stereo-specific and satuarble receptors (Kreeger et al. 2002). Various receptors have been identified. These are classified as kappa, delta, sigma and mu receptors.). Ethorphine is an analogue of thebaine and is in humans 500 times more potent then morphine. A major advantage in the use of the opiates, are the specific opiate antagonists that allow for the complete reversal of the anaesthetic effects.

The opiate ethorphine (M99, C-Vet Veterinary Products, Lancs, UK), is initially combined with the antagonist-agonist opioid buthorphanol (Torbugesic, Fort Dodge Animal Health, Iowa, USA). Butorphanol is a mu-opioid receptor antagonist and through its action alleviates the marked respiratory depression induced by the ethorphine at the mu-receptor and potentiates the sedative effect at the kappa and sigma receptors. Furthermore this combination significantly limits the ethorphine specific pacing which reduces the distance a camel travels after darting. This is particularly important in the open steppe habitat where animals darted without the addition of butorphanol can cover several kilometres before becoming recumbent.

The combination is further enhanced through the addition of the sedative $alpha_2$ agonist detomidine-HCl (Domosedan, Orion Corp. Farmos Finland). Detomidine acts on the $alpha_2$-adrenergic receptors where it inhibits the release of norephinephrine. It is combined in this case with tiletamine-zolazepam a phencyclidine and benzodiazepine derivative.

Ethorphine is reversed with the opioid antagonist naltrexone (Trexonil, Wildlife Laboratories Inc., Fort Collins, Colorado, USA) which has a longer half-life than the standard antagonist-agonist diprenorphine (Revivon, C-Vet Veterinary Products, Lancs, UK) and eliminates in- and post-transport renarcotization. Renarcotization is an effect that occurs when using opioids. Several hours after antagonist application the animals once again comes under the influence of the opioid agonist (Kreeger et al., 2002). Especially in camels captured in the wild this effect could be fatal as it potentially makes an individual more prone to predation and injury.

Table 4: Recomended drug combination for the chemical capture of a wild camel

Generic name	Dosage per adult wild camel (IM)
Etorphine	4,4 mg
Butorphanol	10 mg
Tiletamine – Zolazepam	160 mg
Detomidine	13 mg

Table 5: Recomended drug combination for anaesthesia reversal in the chemical capture of a wild camel

Generic name	Dosage per adult wild camel (IV)
Naltrexone	200 mg
Atipamezole	25 mg

Using potent capture drugs bears the inherent risk of human injury. Though prevention is the mainstay in avoiding capture drug related accidents it is important to establish a protocol to deal with eventual problems. Accidental capture drug injection is always to be considered an emergency that will require calm, prompt and organized action. Be aware that the legal implications of administrating medical treatment to accident victims by persons that are not qualified vary from country to country (Morkel, 1993).

As a bare minimum in the field the following precautions should be adhered to: use capture drugs only with a second, trained person present; respect the potency of the drugs and do not take chances and under estimate a dangerous situation; never work with opioid drugs without having the human antidote in the emergency kit; limit personnel present when working with the drugs (Fig. 12). See Morkel (1993) for an excellent review on dealing with drug related accidents in the field.

Fig. 12: Training and precautions are necessary so that safety for the capture team and animal is secured. Chris Walzer with bull camel #1 minutes after anaesthesia reversal.

3.4. Wild camel collaring

3.4.1. Satellite collars

Given the large range that can be expected to be covered by wild camels, the harsh climate and the remoteness of the Great Gobi A region it was decided to use satellite telemetry to monitor wild camels. Ground bound telemetry has proven to be ineffective and small, fixed winged aircrafts are not available in Mongolia.

Based on the project aims and timetable, the collars needed to have the following specifications:

- remote data uplink option (satellite link)
- specification of satellite system used
- collars need to last for 12-24 months
- collars need to collect 2-4 GPS locations per day
- the collars needs to be able to transfer all data by satellite link, but for back-up it should also store this information in the collar
- to allow collar retrieval and for animal welfare reasons, collars need to have a drop-off option (pre-programmable drop-off time)
- collar weight should not exceed 800-900 grams
- collars need to be able to function in a temperature range of -40 to +40 ^{o}C
- all software and other equipment necessary for collar deployment and data processing needs to be listed
- delivery date should be no later than mid May

Given our good experiences with collars from the company Telonics (Mesa, Arizona, USA) during the past 3 years in the Great Gobi B Strictly Protected Area and the SE gobi on wild ass, wild horses and wolves we suggested to use the same system on wild camels. Telonics collars have proven reliable and the company is good to work with, providing technical support whenever needed. In addition, the prices are reasonable and compared to other companies Telonics offers the best equipment and service for the lowest price. In addition, Telonics was the only company that was able to produce the requested collars within the very short time span required.

Therefore we ordered 3 TGW-3580 collars from Telonics with the following specifications (Fig. 13):

- CR-2a pre-programmed drop-off with release date 1 May 2007
- 1 GPS location every 7 hours
- ARGOS transmission 6 hours every 2. day beginning at 0900 UTC

- ARGOS repetition rate 200 sec
- ARGOS ID numbers: 62097, 62098, 62099
- VHF duty cycle 12 hours on / 12 hours of. The 12-hour transmission time begins at 0000 UTC
- VHF frequencies: 151.050, 151.150, 151.250
- Collar adjustment size 33 to 39 inches with central point 36 inches
- Collar width 2 ½ inches
- Reference coordinates: Long: 98.000 Lat: 43.500

***Fig. 13: a.Wild camel collar** TGW-3580 from Telonics, b.GPS Antenna (square) and ARGOS antenna (rod), c.CR-2a drop-off.*

Collars were ready for pick up from Telonics begin of October. International shipment into Mongolia was not possible due to small amounts of black-powder in the CR-2a drop-offs. Since 9/11 explosives cannot shipped to most countries. Unfortunately collar pick up by the Mongolian side was greatly delayed and did not happen before mid November, thus leaving almost no time for testing in Mongolia.

3.4.2. Collar testing

Collars were tested according to the Telonics protocol by Mr Enkhbileg and the initiation process did not produce any error messages. On 22.11.05 all three collars were deployed for testing. On 26.11.05 we received the first data from the collar 62067. Upon arrival in UB there was no new data, but also no time to wait for the other collars to come on air. After leaving UB on 29.11.05 there were no further access to the internet and thus no chance to check the ARGOS account for any further data.

Originally the importance of adequate testing was discussed in August 2003 with project staff and UNDP. Testing was scheduled 3 weeks prior of the collaring mission and included the placement of all 3 collars on domestic camels in the vicinity of Ulaanbaatar. Unfortunately this aspect of the planning phase was not possible due to the significant delays in collar procurement and transport.

3.4.3. Collaring of camels

On 4.12.05 we collared two and on 6.12.05 one more camel (Table 6). Although neck circumferences were quite variable, collar adjustment was possible without problems. Collars fitted snugly and the GPS antenna was correctly positioned on the highest point of the neck. Upon wakeup, camels did not seem to be bothered by the new collars (Fig. 14).

Table 6: Camels collared in December 2005 in the Great Gobi B SPA.

Capture date	Camel #	Sex	Age (years)	ARGOS ID	VHF	XCO	YCO	Collar cut (cm)	Drop-off date
04.12.2005	1	male	8-9	62097	151.051	43.60008	96.41918	5	01.05.2007
04.12.2005	2	female	6 (pregnant)	62098	151.151	43.63052	96.37228	15	01.05.2007
06.12.2005	3	female	6	62099	151.251	43.75426	96.48960	39	01.05.2007

Fig. 14: Collared camel #2.

3.4.4. Camel GPS data collection

For reasons yet to be determined, so far none of the collars has transmitted any data to the ARGOS satellite system. ARGOS France confirmed that the account was properly established and is working correctly. We have also contacted Telonics and an evaluation of the situation is pending.

4. Conclusions

The capture and anaesthesia of wild Bactrian camels, with the subsequent placement of radio-telemetry equipment and the collection of biomedical samples provides a substantial contribution to the knowledge and conservation of this endangered species.
Careful selection of the adequate material, a dedicated team and detailed knowledge on the whereabouts of the wild camels are required to allow for a successful wild camel capture mission (Fig. 15). In order for procedures to be safe for both the camels and humans involved, a significant amount of veterinary knowledge and training is required. Capture and general anaesthesia can only be as safe as the acquired skills and knowledge of the person performing the procedure allow. These in combination with an adequate anaesthetic protocol determine the outcome. The described protocols provide a rapid and safe anaesthesia for this species. The use of the specific opioid antagonists provides a smooth and rapid reversal of the anaesthetic effects.

Fig. 15: Spotting for wild camels in the Great Gobi A SPA in December 2005.

5. Recommendations

Based on our own experience working in the Gobi region these past years, and having encountered similar problems and situations in our own research projects we would like to provide several recommendations and suggestions to UNDP and project staff that could be incorporated into the future research plan.

5.1. Collaring

In order to adequately evaluate wild camel habitat-use in the Gobi A SPA additional collars will need to be applied. Sound individual based statistical analysis of habitat use will only be possible with a minimum of 7 deployed collars (*Compositional analysis*; Aebischer et al. 1993). We strongly recommend that in 2006 at least an additional 4 collars be deployed on wild camels in the Gobi A. The present data collection frequency can be reviewed and possibly adjusted in new collars. One suggestion would be to increase the number of positions gathered per 24 hours from presently 3 to 6.

If collaring is to be carried out in 2006 then we urgently recommend that this is planned well in advance – position acquisition and data transmission of the respective collars must be adequately tested on the ground in Mongolia prior to deployment on a wild camel. (Also see 3.4.2 for a discussion of this subject).

5.2. Livestock-wildlife interface

Of particular concern is the extensive livestock-wildlife interface around the Gobi A. Providing general information on this type of interface is beyond the scope of this report, and the reader wishing a more comprehensive view is referred to several other texts that provide useful data (e.g. IUCN Species Survival Commission report on Conservation and Development Interventions at the Wildlife/Livestock Interface 2005 and Boyd C, et al. 1999).

The role of disease in protected areas and the land-use matrix within which they are embedded must be recognized and addressed within the context of protected area and landscape-level planning and management (IUCN World Parks Congress 2003). The remaining wild camels in the Great Gobi A SPA are surrounded by 6 soums with an estimated population of 10,000 domestic camels and other domestic livestock (Dorvchindorj pers. Comm.). Movement of animals and potential pathogens across this interface was observed on numerous occasions during our trip. Basically one can identify three major groups:

- Domestic camels moving into the wild population
- Wild camels moved into domestic herds with unclear future management plans
- Domestic camels moving into the captive wild camel herd at Zakhin Us and subsequent movement of this group out of the enclosure (Fig. 16)

Disease issues are generally becoming an important issue in conflicts between national parks authorities and surrounding - frequently poor - interface communities. When high-impact diseases such as Anthrax, Tuberculosis and Brucellosis - to name just a few - occur, the implications can be devastating financially to the surrounding communities and disastrous to small remnant wildlife populations such as the wild camel in the Great Gobi A. In the case of disease outbreaks politics, national and international regulations dictate that interventions by public health and the agriculturally oriented state veterinary services take priority. In many cases this will impact negatively on the wildlife resource (Kock 2005).

To reduce the potential of conflict, the risks and impacts of disease, in particular at the interface between wildlife and livestock but also at the interface with humans, will need to be investigated. In order to assess the specific livestock - wildlife interface and to conform to IUCN guidelines a detailed risk analysis concerning the possibility of pathogen transfer from the buffer zone to the wild population is needed. It is essential that such an analysis include a detailed analysis of the relevant diagnostic possibilities and limitations in respect to the specific pathogens. Additionally the herd at Zakhyn Us must assume a model character and strictly limit the possibilities of pathogen transfer to wild populations. The captive breeding facility can further support this initiative by acting as an information resource.

A detailed disease risk assessment will also benefit the interface-communities, as it will contribute to improving livestock and by extension human health. These actions benefit community development and biodiversity conservation alike (Kock 2005).

Fig. 16: Domestic and wild camel in the captive breeding facility in Zakhyn us.

5.3. Sample collection and Necropsy Protocol

During our trip we performed a necropsy on a female wild camel (captured 1983) at the Zakhyn Us captive breeding facility (necropsy report pending; Fig. 17). This death provided a useful training opportunity.

Disease is one of many factors potentially affecting the viability of wild populations. In a balanced ecosystem, most populations survive with low levels of disease or with periodic epidemics. However, as wildlife populations become denser from habitat restriction, the risks of a catastrophic epidemic within wildlife populations increase. As described above transmission of diseases between wild and domestic animals also becomes more likely. To accurately determine the disease risks to a population (in this case a captive population), the causes of morbidity and mortalities must be determined.

Many wildlife disease epidemics affecting valuable wildlife resources or livestock have previously gone undetected, as appropriate samples were not collected for diagnostic testing. If field personnel are trained in necropsy procedures and sample collection, they can obtain and store appropriate tissue samples for subsequent histo-pathological investigation. When appropriate samples and accurate written and photographic records are taken, the cause of an epidemic can be determined in most cases (Munson 2005).

In an initial phase we strongly recommend that complete tissue and blood samples be obtained from any carcass at the Zakhyn Us facility and those found in the SPA. It is essential to collect complete sample sets in all cases. Selected sample sets, taken because a particular disease is suspected will in the most cases be inadequate to test for other diseases that might be causing the epidemic. Furthermore, selective sampling severely limits the information that could be procured from a wild animal necropsy that could aid in future population or ecosystem management (Munson 2005). Similar to the situation in the Great Gobi B SPA we recommend that Great Gobi A SPA staff be trained in sample collection and storage. A recent publication provides a review of the information gathered in the Gobi B SPA from Przewalski's horses (Robert et al. 2005). See appendix II for a simplified wild/domestic camel necropsy protocol.

Fig. 17: Wild camel necropsy at Zakhyn us.

5.4. Hybridization

Similar to the potential of disease transmission the small remnant population of wild camels in the Great Gobi A SPA is at risk due to hybridization with domestic camels. The wild population is embedded – with permeable boarders - in a large population of domestic camels. During our trip several hybrids could be observed. The surrounding soums are reported to hold 50 – 60 hybrid camels (Enkhbileg, pers. Comm.).
We strongly recommend that the project together with the various stakeholders develop a concise written policy on the identification and management of hybrid camels. This policy would have to have a legal basis in order to be implemented. This policy should discuss amongst other aspects:

- Steps to be taken when a hybrid or domestic camel is encountered in the park
- Limiting breeding possibilities for hybrid camels held with livestock in the buffer zone

(e.g. castration, hormonal implants)
- Limiting the movement of hybrid and domestic camels in the park

Furthermore we strongly support the proposed plan of a hybrid camel inventory. However, we would like to stress that this can only be a useful management tool if a prior management policy is developed.
We suggest that all hybrid camels be marked with ear tags in combination with transponder chips. Furthermore, holders are requested to notify the SPA if the status of an animal changes (e.g. escape to the wild).

5.5. Genetics

We strongly recommend that all possible steps be entertained to rapidly resolve the outstanding questions regarding the genetic status of the wild camel. This presently lacking information, constitutes one of the foundations on which future wild camel management must be based. Based on recommendations from the Institute of Genetics at the University of Veterinary Medicine in Vienna and relevant international literature we suggest that an evaluation of nuclear and mitochondrial DNA is necessary to obtain conclusive answers.

5.6. Information exchange and distribution

We recommend that the project investigate possibilities to enhance and strengthen information exchange and distribution in a timely manner between the various stakeholders. In our view Great Gobi A SPA staff are somewhat isolated in respect to project information. This fact can lead to an unnecessary duplication of efforts in the field and waste of the already sparse resources. We believe that national and international information and data exchange would be greatly improved by installing an e-mail connection at the park headquarters (e.g. via satellite telephone). We are running a similar system in the Great Gobi B SPA that has immensely improved communication and coordination. When the phone is only used for e-mails and emergency calls, the monthly costs are in the magnitude of 150 US$.

Additionally, on a more general note, we suggest that efforts are made to provide all the researchers involved in this project with access to the international literature. This access is one essential step in facilitating that the scientific output of this project will eventually be internationally recognized. In our opinion, international recognition of the project output is vital in order to proceed beyond the stated project goals after 2007. Finally, we strongly recommend that the Chinese counterparts be informed of the collaring activities this December.

5.7. Data evaluation

We recognize that a large quantity and diversity of data has been collected within the framework of this project. Furthermore, additional data is also available. We strongly recommend that future training not only focus on data collection but also on data evaluation, as these two factors are mutually dependent. In order to make the data collected compatible with international standards additional training and capacity building is urgently required. We would be saddened if the excellent (and in many cases extremely strenuous) fieldwork and data collection measures did not receive the recognition of the international conservation community as a result of lacking international peer-reviewed publications. To achieve this goal in a timely manner and profit most from national and international expert knowledge, we suggest the following:

- put together the collected data in one well-organized database
- visualize and tabulate all available data
- make detailed descriptions on how data was obtained (methods and effort)
- make a plan with detailed descriptions of the analysis methods
- present the data, methods and analysis plans on 1-3 small workshop (e.g. habitat analysis, monitoring, population dynamics) with all the scientists involved in the project and invite international experts for in-depth consultancy
- evaluate the present methods and develop new improved data collection schemes where necessary
- identify knowledge and analysis gaps in the team and plan on subsequent training
- prepare publications in international journals, if needed with the help of international experts

5.8. Equipment

Whereas we recognize that the available equipment (this is especially true in respect to communications and vehicles) in the Great Gobi A SPA has greatly improved since our last visit in 2003 we would like to point out the following:

- At the present the Great Gobi A SPA staff does not have access to the available Geographic Information System (GIS). Today, GIS constitutes one of the most important tools in protected area management. We strongly recommend that adequate training, soft- and hardware be made available to the park staff.

- In order to monitor ambient conditions and document possible climate changes we suggest the installation of several automatic weather stations throughout the Great Gobi A SPA. In the Great Gobi B SPA temperature we have been using HOBO© temperature, rain and wind speed / wind direction data loggers (http://www.hoskin.ca/).
- Ground telemetry equipment was only partially ordered and as a result no training was possible. For additional data collection and collar retrieval the suggested receiver (The R-1000 by Communication Specialist) should be purchased and a short training organized in 2006.
- If sex ratios in wild camels are to be determined then field staff needs good spotting scopes (20-40x) and tripods. Spotting scopes are obviously essential in many other aspects of researchers/rangers work.
- Similarly, several good binoculars would greatly enhance viewing capabilities.
- A laptop computer for fieldwork appears essential. At the present field staff in the Gobi SPA have no possibility to download transect tracks from their GPS units in the field. It should be noted that accurate documentation of transect "effort" is a prerequisite for scientifically sound transect evaluation.
- On this trip the minimum temperatures we encountered were in the order of – 30°C. Camping equipment provided to our Mongolian colleagues and park staff was barely adequate. If temperatures had dropped a further 10°C the trip would have had to be aborted or at least shortened. We strongly support that all national researchers and staff be provided with adequate field equipment for winter trips. In our opinion not providing and subsequently checking that every participant has adequate equipment is negligent and an accident waiting to happen. Furthermore, this can make the position of well-equipped international staff difficult.

5. 9. Saxaul as firewood

We were greatly impressed by the motivation and skills of the Great Gobi A SPA staff and rangers in swiftly dealing with illegal activities threatening the environment. On the way to the Great Gobi A SPA illegal saxaul pickers were encountered and persecuted and on the way back to UB poachers were stopped and turned over to the local environmental inspector. However, it is more than inadequate that saxaul is still used in inefficient stoves within the gers at the park headquarters in Bayantooroi. Better stoves are widely available as is alternative fuel including: animal dung, animal dung briquettes (dung mixed with coal) or coal. In the respect of efficient fuel management, the park headquarter really need to have model character.

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Fig. 18: Captive wild camel in Zakhyn us.

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