Chris Walzer, Petra Kaczensky, Enkhbileg Dulamtseren, Adiya Yadamsuren

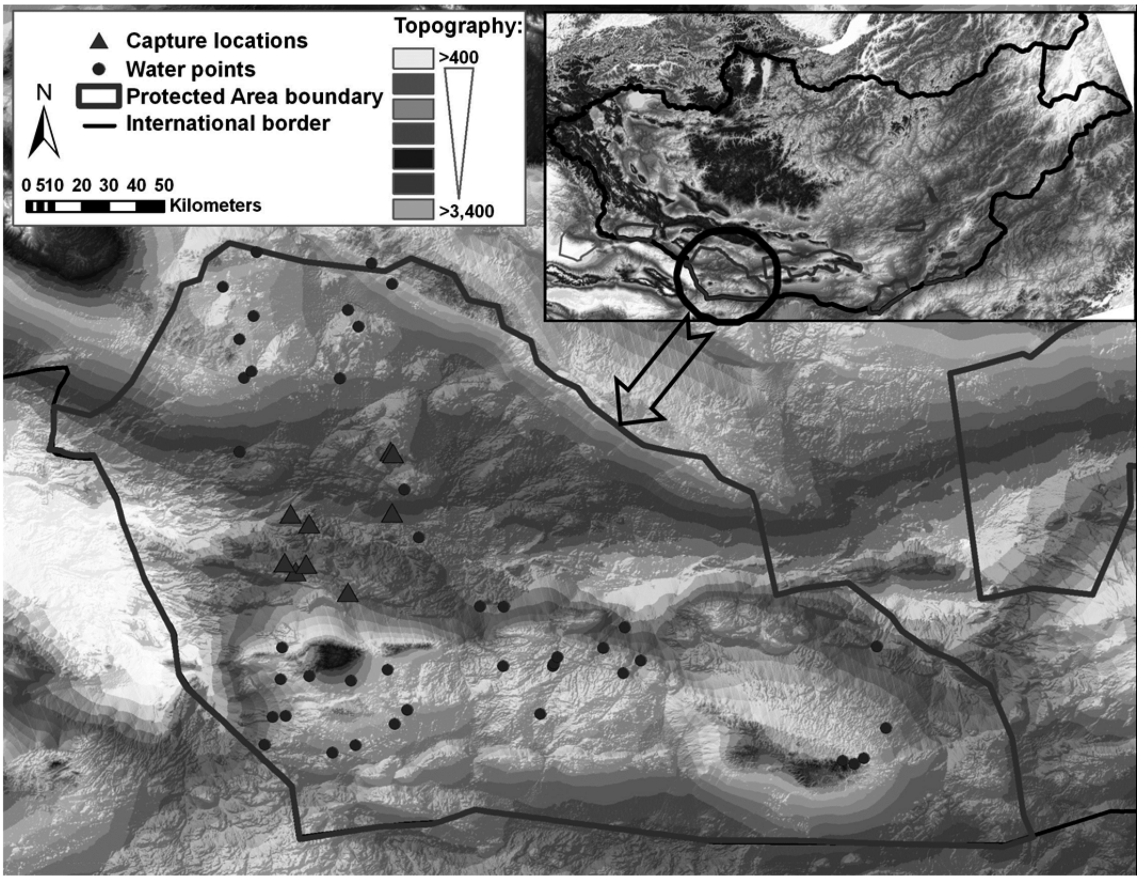
Working in a Freezer: Capturing and Collaring Wild Bactrian Camels

The range of the wild Bactrian camel (*Camelus ferus*) has been reduced to only four locations worldwide. The population is listed as critically endangered. To better understand the movement patterns and habitat needs of wild camels in southern Mongolia several expeditions were undertaken between 2005 and 2007.[1] Using a chase method where camels are darted from a moving jeep, eight camels were chemically captured. In seven of the camels darted, anesthesia and subsequent recovery was smooth and without complication and these animals were outfitted with satellite radio-collars. However, one camel died of undetermined causes during anesthesia. Extremely low ambient temperatures in the winter season and dry, hot and windy summer conditions greatly hampered fieldwork. This article reports on the field trips and the challenging task of providing wild camels with GPS satellite collars.

THE WILD CAMEL IN THE GOBI

The Great Gobi Strictly Protected Area "A" (GGSPAA), located in the south-western part of Mongolia bordering the People's Republic of China, is one of the world's great desert ecosystems (see graph 9). The extremely harsh environment has given rise to unique, particularly well-adapted species, many of which are found nowhere else in the world (Zhirnov/Ilyinsky 1986). The large mammal fauna consists of several rare or globally threatened species, namely the wild Bactrian camel (*Camelus ferus*; see picture 15), 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/Ilyinsky 1986, Reading 1999, McCarthy 2000). Human pressures for pastures and water on the edges of the GGSPAA and in its buffer zones have substantially increased since the early 1990s and are believed to have led to significant habitat degradation in some areas (UNDP 2004, see also Yadamsuren/Dulamtseren/Reading in this volume). Additionally, the past two years have seen a marked increase in mining activities and there are concerns about the threat of partial degazetting for mineral extraction.

[1] We are especially grateful for the highly motivated and competent field crew – it was their local knowledge, good organization and humor that made these expeditions a success – I. Khatanbaatar, Y. Nyambayar and B. Tseveenpurev for their never ending support at camp and looking out for khulans (the Mongolian Wild Ass) and camels. Thanks for the careful but spirited driving Davaa-Ochir Avirmed, G. Enkhbold and R. Tumen-Ulzii. Without A. Gerelmaa and her wonderful cooking we would all have starved. We would like to thank UNDP staff, namely Ms. Vatucawaqa and Ms. Batkhishig for project facilitation, Mrs. Narentuya and Mr. Enkhbat for organization and support and the Great Gobi Strictly Prodected Area "A" staff in Bayantooroi for their hospitality and motivation.
This contribution is dedicated to the memory of Gobi A ranger Mr. Choijim – a true Gobi man.



Graph 9: Map of Great Gobi Strictly Protected Area "A" (GGSPAA) with water points and wild camel capture sites, one of the world's great desert ecosystems located in the south-western part of Mongolia bordering the People's Republic of China.

The "Conservation of the Great Gobi Ecosystem and its Endangered Species" project was initiated in June 2003 by the United Nations Development Program (UNDP)/Global Environment Facility (GEF). It aimed at ensuring 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 (GGSPAA) 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 2004). The concept of umbrella species is to use species requirements for baseline conservation planning. Conservation activities directed towards the selected umbrella species are deemed to be beneficial to a multitude of sympatric species, i.e. the animals and plants with which this umbrella species shares a specific habitat. Selecting single species as an umbrella, however, has been shown to have severe limitations as ecological factors not relevant to the (often large) umbrella species severely limit other (often smaller) co-occurring species (Roberge/Angelstam 2004).

The range of the wild Bactrian camel has been reduced to only four locations world-wide: three in China (Lop Nuur, the Arshin Mountains and Taklamakan desert) and one in Mongolia (GGSPAA). The population is listed by the International Union for Conservation of Nature (IUCN) as critically endangered and there remains an estimated population of 600 animals in China and between 350 to 1,950 in the GGSPAA. (Hare 1997, Reading et al. 1999, Guoying et al. 2002, Mix et al. 2002, Weidong et al. 2002). The large range in the population estimates is due to the large size, remoteness and harsh climate of the GGSPAA. Past population estimates have often lacked a detailed description of the survey methods and more recent surveys have used different methods or lacked documentation of the search effort (Tulgat/Schaller 1992, Reading et al. 1999, Mix et al. 2002, Dorvchindorj 2005, Reading et al. 2005). These problems are compounded by the inherent issues in estimating population size in low density, clumped populations without the possibility of aerial surveys (Kaczensky/Kramer-Schadt 2010). Thus there is still significant debate concerning population numbers and trends (Mix et al. 2002). The general belief is that the population is stagnating or declining due to low survival rates of calves, caused by wolf predation, habitat deterioration and illegal hunting (Tulgat/Schaller 1992, Mijiddorj 2002). There are also great knowledge gaps concerning the ecology of the wild camels and data on population dynamics (McCarthy 2000, Magash/Indra 2002), behavior (McCarthy 2000), habitat use (Tulgat 2002), movement patterns (Reading et al. 2005) and veterinary aspects (Blumer et al. 2002). Initial studies concerning the genetic status of the Mongolian wild camel population have revealed high levels of mitochondrial differentiation between wild and present-day domestic Bactrian camels (Silbermayr et al. 2010, Ji et al. 2010). Further genetic evidence[2] supports the nomenclature of the wild two-humped camels (Gentry et al. 2004) as an original wild form and a separate species *Camel ferus*.

WILDLIFE CAPTURE

In wildlife research and management to "capture" wildlife is to be understood in the sense of "getting hands on the animal" and subsequently releasing it – not as its "removal". Prior to any wild animal capture the purpose and circumstances of the procedure must be considered to be both practical and essential (Osofsky/Hirsch 2000), as every anesthetic event entails the intrinsic 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). Capture and general anesthesia can only be as safe as the acquired skills and knowledge of the person performing the procedure allows. These skills in combination with an adequate anesthetic protocol will determine the outcome of the anesthetic event. From the onset, it is important to realize that capture operations, conditioned by the use of potent drugs and severe environmental conditions, are inherently dangerous for the people involved (Caulkett/Shury, 2007, Haymerle et al. 2010).

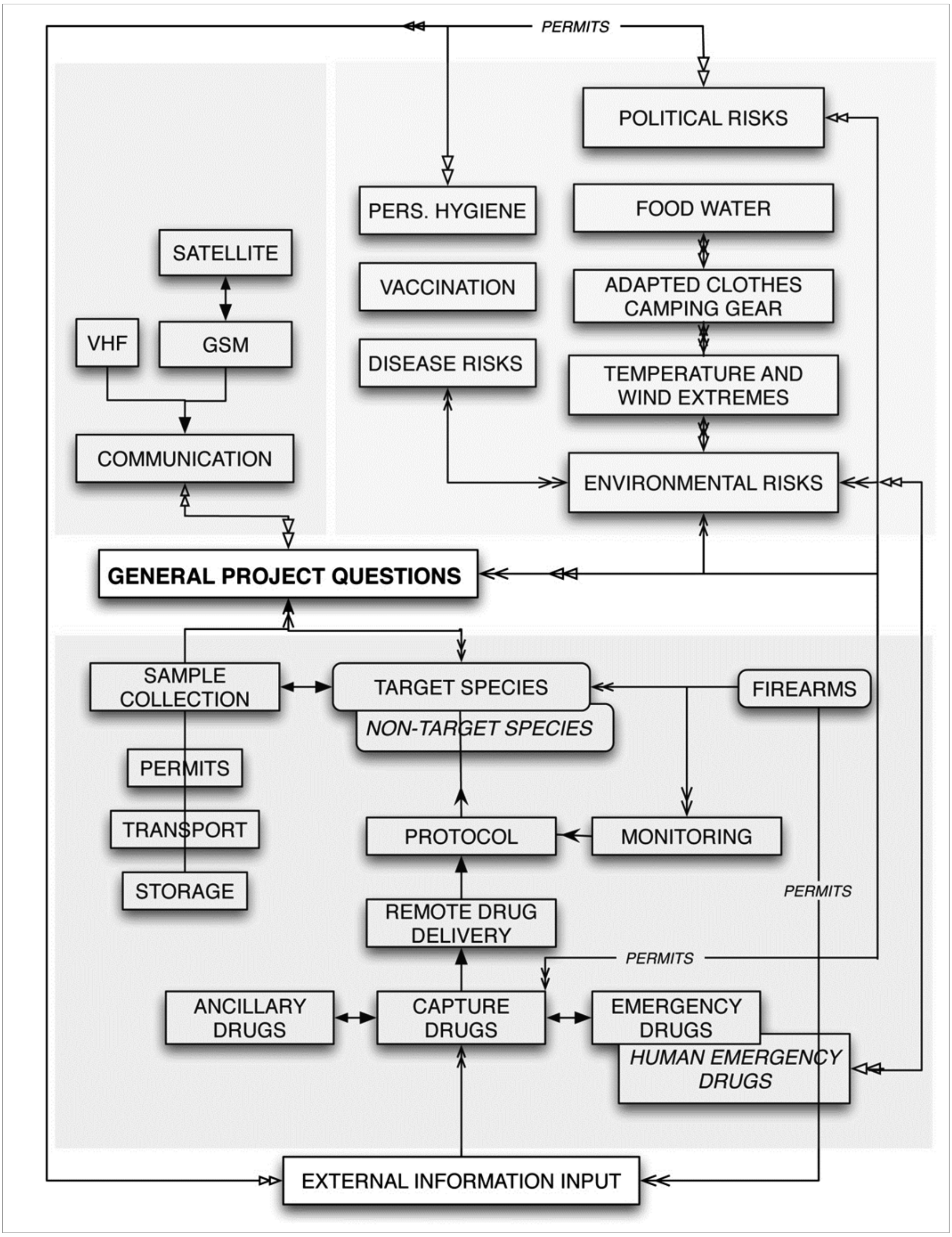
When planning a wildlife capture event it is vital to attempt to identify the various issues and risks involved with the capture event and the field site. The entire procedure can in this author's view be broken down into three main components: a) the actual anesthesia and capture event, b) environmental and socio-political issues and c) communication issues. Graph 10 provides a simplified outline of the individual components. This outline can be used to evaluate risk and to generate a project specific checklist. The process of risk evaluation is best viewed as a continuous and on-going adaptive process. Initial risk assessment will possibly need to be adjusted as field data becomes available. A static approach to risk assessment in the field can lead to significant and potentially dangerous misjudgments. On returning from the field trip it has proven useful to re-evaluate the checklists and adapt them accordingly for future use.

CAMELS AND THEIR VETERINARIAN – EACH HAVE THEIR OWN PLANS

In order to capture camels for radio collaring we employed a chase method where the camel is darted from a moving jeep. This method has been successfully used to dart grey wolf (*Canis lupus*), Asiatic wild ass (*Equus hemionus*), Przewalski's horse (*Equus f. prezwalskii*) (Walzer 2003, Walzer/Kaczensky 2004, Walzer et al. 2006, Walzer 2007) and a single wild camel (Blumer et al. 2002). Poachers traditionally employ this method with 12-bore shotguns, predominantly hunting for Asiatic wild ass. For remote dart firing we used a modified high pressure CO_2 dart gun (Daninject JM,TM Dan-Inject ApS, 7080 Børkop, Denmark) with a short, 4-cm barrel, as this greatly facilitates movement within the confines of the jeep.

---

[2] For a more detailed discussion about the genetic status of the wild Bactrian camel see the articel by Pamela Burger in this volume.



Graph 10: The three main components of a field capture event and their interactions: communication (in the left upper part), environmental and socio-political risks (in the upper right part), and the actual capture/anesthesia (lower part).

During the winter 2005 expedition[3] (Walzer/Kaczensky, 2005; see also Walzer 2008, a popular description of this expedition) we combined drugs to anesthetize one male and two female

[3] See also a popular description of this winter expedition (Walzer 2008).

camels.[4] More specifically, we used a combination of the potent opioid etorphine 4.4 mg (M99, C-Vet Veterinary Products, Leyland, UK); 10 mg of the opioid agonist-antagonist butorphanol (Torbugesic, Fort Dodge Animal Health, Iowa, USA); 13 mg of the alpha-2 agonist detomidine (Domosedan, Orion Corp. FI-02200 Espoo Finland) and 160 mg tiletamine-zolazepam (Tilest 500; Virbac, 06515 Carros, France). Because the ambient temperatures varied between –15 and –30°C during the day, all drug combinations were supplemented with sterile propylene glycol (Sigma-Aldrich GmbH, 1120, Vienna, Austria) as an anti-freeze. Once an animal was identified, it was chased at a speed of 35 to 40 km/h until the jeep was able to approach within approximately 10 to 15 meters on a parallel track (see picture 16 and 17). It was then easily darted in the rump using standard pressure settings. It is essential to define a chase cut-off time before the chase procedure is initiated. Our experience has shown that a chase time of 15 min. is easily tolerated without a significant increase in body temperature. To ensure accuracy and reliability, only new, 3 ml darts (Dan-Inject ApS, 7080 Børkop, Denmark) were used during the captures. Once an animal was darted, we attempted to maintain visual contact, but did not disturb the animal before it was fully immobilized. Once the animal was recumbent, we approached on foot from behind and secured the head. All animals where collared with a GPS-Argos satellite collar (see picture 18). Anesthesia was reversed in all cases with 200 mg of intravenous naltrexone a full opioid antagonist (Trexonil, ZooPharm, Inc., Fort Collins, CO 80524, USA), and 25 mg intravenous atipamezole, an alpha-2 antagonist (Antisedan, Orion Corp., FI-02200 Espoo, Finland). The rapid reversal (60 seconds) of these anesthetic components enabled us to keep the down-time in lateral recumbency to a minimum, which in the face of the exceptionally cold temperatures is extremely important to reduce the risk of hypothermia in the animal.

A short anecdote might illustrate the extreme working conditions for a veterinarian in the Gobi, which are, in fact, the conditions of a freezer (see picture 19): the normally simple procedure of taking a blood sample from the jugular vein is a significant challenge at close to minus 40° C in the environment, as the body-temperature blood instantly freezes rock solid in the large gauge intravenous needle. These working conditions necessitate careful planning and a thoughtful use of available body heat to keep medications and samples in a liquid state.

During the summer 2007 expedition, six camels were captured using the method described above (Kaczensky et al. 2007). In five of six camels darted, anesthesia and subsequent recovery was uneventful. However, the first animal, an old bull of about 15 years, died during the capture.[5] This bull was easily darted as he ran much more slowly than the other animals in his group. It took 40 min. after darting to locate the bull, which was in acute respiratory distress when approached. Intravenous naltrexone (250 mg) was immediately administered and the animal's respiratory rate and effort improved. However, cardiac arrest occurred after 10 min. and the animal could not be resuscitated. The cause of death remains unknown. Due to the lack of water and approaching sunset we could not perform a complete necropsy. The animal appeared extremely bloated and was noted to have regurgitated. We cannot exclude that it aspirated gastro-intestinal contents, leading to its death. Furthermore, we suspect that this animal possibly had a pre-existing medical condition that was also responsible for its very slow pace.

CONCLUSIONS

Based on previously published reports (Blumer et al. 2002) and subsequent to our experience, we recommend the following combination of drugs for the field anesthesia of adult wild camels: 4.4 mg ethorphine, i.m., 10 mg Butorphanol, i.m. and 15 mg detomidine-HCl, i.m. Butorphanol

[4] Excerpts from this publication have been published previously in various proceedings of the American Association of Zoo Veterinatians (AAZV) and the European Association for Zoo and Wildlife Veterinarians (EAZWV) meetings.

[5] While Bactrian camels have been reported to reach some 35 to 40 years in captivity, a 15-year-old wild male has to be considered very old.

is a mu-opioid receptor antagonist and through its action potentially alleviates the marked respiratory depression induced by the ethorphine at the mu-receptor and potentates the sedative effect at the kappa and sigma receptors. Induction to sternal recumbency is accelerated by the addition of 160 mg, i.m. of tiletamine-zolazepam. Etorphine was reversed with intravenous naltrexone (200 mg) and atipamezole (25mg). Naltrexone has a longer half-life than the standard antagonist-agonist diprenorphine (Revivon, C-Vet Veterinary Products, Leyland, UK) thus eliminating renarcotization, which could leave recovering camels vulnerable to hypothermia, predation or injury. The depth of anesthesia was in all cases largely sufficient to place GPS-Argos collars on the animals and to collect the necessary biological samples.

Losing an animal during field anesthesia is always a painful experience. With this individual we felt that the long recovery time (and a possible pre-existing medical condition) contributed to the animal's death. Immobilizing an animal that exhibits abnormal behavior should generally be avoided. The difficulty in actually locating an animal in the steppe landscape must not be underestimated and utmost care and concentration is needed not to lose sight of a darted animal. Decreasing the ethorphine by 1mg and omitting the tiletamine-zolazepam results in standing – sternal sedation, which makes it easier to locate the animal in the steppe. However, this reduced dosage leads to a prolonged chasing phase in which the animal can cover a greater distance and potentially injure itself.

In our view, the risk and cost involved in capturing and anesthetizing these animals is outweighed by the need to base future wild camel management plans firmly on sound scientific data. Our preliminary results have shown that the animals range widely throughout the protected area. However, the satellite data is still insufficient to infer clear habitat preferences and subsequent management priorities. For an effective conservation strategy that secures the survival of these unique animals it is essential to have exact knowledge about the habitat requirements. A further collaring expedition is planned in the early fall of 2011, and this should help in providing the additional data. Some management issues are urgent and require immediate action. It is our hope that the management plan for this critically endangered species will remain a working document in order to integrate scientific field-based knowledge as it becomes available.

REFERENCES

Blumer, ES/Namshir, Z/Tuya, T/Mijiddorj, B/Reading, RP/Mix, H (2002): "Veterinary Aspects of Wild Bactrian Camel (*Camelus bactrianus ferus*) Conservation in Mongolia", in: Reading,RP/Enkhbileg, D/Galbaatar T (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 115–122

Caulkett N/Shury, T (2007): "Human Safety During Wildlife Capture", in: West, G/Heard, D/Caulkett, N (eds.): *Zoo Animal & Wildlife Immobilization and Anesthesia.* Ames, Iowa, USA, Blackwell Publishing Professional, pp.123–128

Dorvchindorj, R (2005): "*Group Size and Group Composition of Wild Bactrian Camels in the Great Gobi A SPA."* Masters thesis at the National University of Mongolia

Gentry, A/Clutton-Brock, J/Groves, CP (2004): "The Naming of Wild Animal Species and their Domestic Derivates", in: *Journal of Archaeological Science* 31, pp. 645–651

Guoying, Y/Weidong, L/Hongxu, L/Li, L/Zhigang, Z/Lei, Y (2002): "Distribution and Number of the Wild Bactrian Camels in the World", in: Reading, RP/Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 13–24

Hare, J (1997): "The Wild Bactrian Camel (*Camelus bactrianus ferus*) in China: The Need for Urgent Action", in: *Oryx* 31, pp. 45–48

Haymerle, A/Fahlman, Å/Walzer, C (2010): "Human Exposure to Immobilising Agents: Results of an Online Survey", in: *Veterinary Record* 167, pp. 327–332

Ji, R/Cui, P/Ding, F/Geng, J/Gao, H/Zhang, H/Yu, J/Hu, S/Meng, H (2010): "Monophyletic Origin of Domestic Bactrian Camel (*Camelus bactrianus*) and its Evolutionary Relationship with the Extant Wild Camel (*Camelus bactrianus ferus*)", in: *Animal Genetics* 40, pp. 377–382

Kaczensky, P/Adiya, Y/Walzer, C (2007): "Asiatic Wild Ass and Wild Camel Collaring Mission in the Great Gobi A Strictly Protected Area in Mongolia (Report June 2007)" http://homepage.mac.com/

cwalzer/.cv/cwalzer/Sites/.Public/Khulan%20Reports/2007_06_09_khulan%20and%20camel%20collaring.pdf-zip.zip, consulted 14 March, 2011

---/Kramer-Schadt, S (2010): "Why We Measure What We Measure: Understanding Asiatic Wild Ass (*Equus hemionus*) Population Size Estimates in the Great Gobi B Strictly Protected Area, Mongolia", in: *Proceedings International Jubilee Conference of the Royal Norwegian Society of Sciences and Letters – Sustainable Conservation, Bridging the Gap Between Disciplines;* March 15–18, 2010; Trondheim, Norway, pp. 11

Kreeger, JT/Arnemo, JM/Raath JP (2002): *Handbook of Wildlife Chemical Immobilization* (international edition). Fort Collins, Colorado, USA: Wildlife Pharmaceuticals

Magash, A/Indra P (2002): "Population Biology & Reproduction of Wild Bactrian Camels (*Camelus bactrianus ferus*) in Mongolia", in: Reading, RP/Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus)*. Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 73–77

McCarthy, M (2000): *"Ecology and Conservation of Snow Leopards, Gobi Brown Bears and Wild Bactrian Camels in Mongolia"*. PhD thesis, University of Massachusetts, Amherst, USA.

Mijiddorj, B (2002): "A Short Introduction to the Captive Breeding Program for Wild Camels in Zahuin Gobi, Mongolia", in: Reading, RP/Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 123–128

Mix, H/Reading, RP/Blumer, ES/Lhagvasuren, B (2002): "Status and Distribution of the Wild Bactrian Camels in Mongolia", in: Reading, RP/Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 39–48

Osofsky, SA/Hirsch, KJ (2000): "Chemical Restraint of Endangered Mammals for Conservation Purposes: A Practical Primer", in: *Oryx* 34, pp. 27–33

Reading, RP/Mix, H/Lhagvasuren, B/Blumer, ES (1999): "Status of Wild Bactrian Camels and Other Large Ungulates in South-western Mongolia", in: *Oryx* 33, pp. 247–255

---/Blumer, ES/, Mix, H/Adiya, Y (2005): "Wild Bactrian Camel Conservation", in Stubbe, A/Kaczensky, P/ Wesche, K/Samija, R/Stubbe,M (eds.): *Exploration into the Biological Resources of Mongolia,* Halle (Saale), Martin-Luther-Universität Halle Wittenberg, pp. 91–100

Roberge, J-M/Angelstam, P (2004): "Usefulness of the Umbrella Species Concept as a Conservation Tool", in: *Conservation Biology* 18, pp. 76–85

Silbermayr, K/Orozco-terWengel, P/Charruau, P/Enkhbileg, D/Walzer, C/Vogl, C/Schwarzenberger, F/Kaczensky, P/ Burger, PA (2010): "High Mitochondrial Differentiation Levels Between Wild and Domestic Bactrian Camels: A basis for Rapid Detection of Maternal Hybridization", in: *Animal Genetics* 41/3, pp. 315–318

Tserenbaljid, G (2002): "Vegetation and Flora in the Pastures Used by Wild Bactrian Camels", in: Reading, RP/ Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 95–108

Tulgat, R (2002): "Causes of Changes in the Population Size and Distribution of Wild Bactrian Camels in the 20th Century", in: Reading, RP/Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 49–62

---/Schaller, GB (1992): "Status and Distribution of Wild Bactrian Camels *Camelus bactrianus ferus*" in: *Biol. Conservation* 62, pp. 11–19

UNDP (2004). "Current Projects – Sustainable Resource Management – Conservation of the Great Gobi Ecosystem and its Endangered Species" (MON/02/g35) http://www.undp.mn/new/snrm-cgbe.html, consulted 14 April, 2008

Walzer, Chris (2003): "Equidae", in: Fowler, ME/Miller, RE (eds.): *Zoo and Wild Animal Medicine, Current Therapy*. Philadelphia: WB Saunders, pp. 578–586

--- (2007): "Non Domestic Equids", in: West, G/Heard, D/Caulkett, N (eds.): *Zoo Animal & Wildlife Immobilization and Anesthesia.* Ames, Iowa, USA: Blackwell Publishing Professional, pp. 523–531

--- (2008): "A Camel in the Snow", in: Lucy H. Spelman/Mashima, Ted Y. (eds.): *The Rhino With Glue-On Shoes And Other Surprising True Stories of Zoo Vets and their Patients*, New York: Bantam Dell Publishing Group, Random House.

---/Kaczensky P (2005). "Wild Camel Training and Collaring Mission for the Great Gobi – A Strictly Protected Area in Mongolia". Final Report for UNDP for the Short-term International Expert Contracts. http://homepage.mac.com/cwalzer/.cv/cwalzer/Sites/.Public/Wild%20camel/Wild%20Camel%20UNDP_Report 12_2005.pdf-zip.zip., consulted 14 March, 2011

---/Kaczensky, P (2004): "Capture and Field Anaesthesia of a Fast Runner – The Mongolian Wild Ass (*Equuus hemionus*)", in: *Proceedings Annual Conference European Association Zoo Wildlife Veterinarians*, Ebeltoft, Denmark, pp. 199

---/Kaczensky, P/Ganbataar, O/Lengger, J/Enkhsaikhan, N/Lkhagvasuren, B (2006): "Capture and Anaesthesia of Wild Mongolian Equids – the Przewalski's horse *(E. ferrus przewalskii)* and the Khulan *(E. hemionus)*", in: *Mongolian Journal of Biological Sciences* 4, pp. 19–28

Weidong, L/Guoying, Y/Lei, Y (2002): "The Distribution and Habitat of Wild Bactrian Camels in the Southern Lop Nur Region, Xinjiang, China", in: Reading, RP/Enkhbileg, D/Galbaatar T. (eds): *Ecology and Conservation of the Wild Bactrian Camel (Camelus bactrianus ferus).* Series in Conservation Biology, Mongolian Conservation Coalition, Ulaanbaatar, Mongolia. pp. 85–94

Zhirnov, LV/Ilyinsky, VO (1986): *The Great Gobi National Park – A Refuge for Rare Animals in the Central Asian Deserts*, Centre for International Projects, GKNT, Moscow, Russia, pp. 128